CEOSE

Committee on Equal Opportunities in Science and Engineering

2000 Biennial Report to the United States Congress

COMMITTEE ON EQUAL OPPORTUNITIES IN SCIENCE AND ENGINEERING

The Committee on Equal Opportunities in Science and Engineering (CEOSE) 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 representatives from the Advisory Committees of each NSF Directorate, as well as several at-large members.

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 a SMET advancement and dissemination paradigm that is inclusive of all citizens, regardless of gender, ethnicity, or disability status.

CEOSE was established by Congress in 1980 (42 U.S.C. §1885c). For the convenience of the reader, this law and its charges are excerpted below:

SEC. 36. (a) There is established within the Foundation a Committee on Equal Opportunities in Science and Engineering (hereinafter referred to as the ''Committee''). The Committee shall provide advice to the Foundation concerning (1) the implementation of the provisions of sections 1885 to 1885d of this title and (2) other policies and activities of the Foundation to encourage full participation of women, minorities, and other groups currently underrepresented in scientific, engineering, and professional fields.

(b) Each member of the Committee shall be appointed by the Director with the concurrence of the National Science Board. The Chairperson of the National Science Board Committee on Minorities and Women shall be an ex officio member of the Committee. Members of the Committee shall be appointed to serve for a three-year term, and may be reappointed to serve one additional term of three years.

(c) There shall be a subcommittee of the Committee which shall be known as the Subcommittee on Women in Science and Engineering. The Subcommittee on Women in Science and Engineering shall have responsibility for all Committee matters relating to (1) the participation in and opportunities for the education, training, and research of women in science and engineering and (2) the impact of science and engineering on women. The Subcommittee shall be composed of all the women members of the Committee and such other members of the Committee as the Committee may designate.

(d) There shall be a subcommittee of the Committee that shall be known as the Subcommittee on Minorities in Science and Engineering. The Subcommittee on Minorities in Science and Engineering shall have responsibility for all Committee matters relating to (1) the participation in and opportunities for education, training, and research for minorities in science and engineering and (2) the impact of science and engineering on minorities. The Subcommittee shall be composed of all minority members of the Committee and such other members of the Committee as the Committee may designate.

(e) The Committee may organize such additional standing or ad hoc subcommittees as the Committee finds appropriate.

(f) Every two years, the Committee shall prepare and transmit to the Director a report on its activities during the previous two years and proposed activities for the next two years. The Director shall transmit to Congress the report, unaltered, together with such comments as the Director deems appropriate.

The enclosed report is hereby presented in compliance with (f) above.

Committee on Equal Opportunities in Science and Engineering (CEOSE)

Biennial Report to the United States Congress

"…If in your employment practices you ignore 85 percent of the newly available talent in this country, how are you going to be a great company? How are you going to compete against companies that recruit from the country's entire pool of talent? And so, if for no other reason than self-interest, we ought to do more to maintain a diverse workforce."

Norm Augustine,
Chairman and Chief Executive Officer,
Lockheed Martin

"In the 21st century, the education and skills of the workforce will end up being the dominant competitive weapon."

Lester Thurow
Professor of Economics and Management
Massachusetts Institute of Technology

"If we are to maintain a strong science and technology workforce that will make the new discoveries, drive a strong economy, ensure our national defense, provide a clean environment, improve our health and teach our children, we must increase the participation of minorities in science and technology."

Arthur Bienenstock,
Associate Director for Science,
Office of Science & Technology Policy, IWG Co-Chair

Table of Contents

1. Introduction: Why Invest in a Diverse Workforce?

As the National Science Foundation (NSF) celebrates its 50th anniversary in the year 2000, it is interesting to reflect upon the fact that the U.S. economy has enjoyed an unprecedented period of growth due in large part to a technological revolution that has spawned greater productivity and a host of new industries and jobs. However, in this climate it is possible to lose sight of the precarious nature of this prosperity and forget that the so-called "new economy" is critically dependent on—and thus vulnerable to any deficiencies in—the talents and knowledge of the available technical workforce.

Recent reports by the National Science and Technology Council {1} and the Commission for the Advancement of Women and Minorities in Science, Engineering and Technology (the "Morella Commission") {2} have eloquently identified the perils inherent in a society characterized by ethnic, gender, and socioeconomic disparity. While progress has been made over the past 20 years, the risk remains. As we enter the 21st century, U.S. jobs are growing fastest in areas that require knowledge and skills stemming from a strong grasp of science, engineering, and technology (see Figure 1-1) {3}.

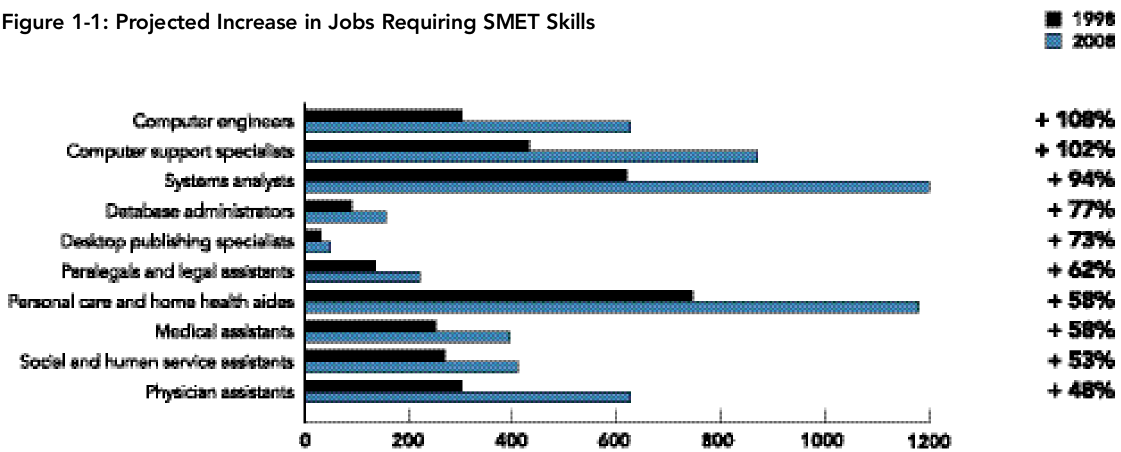
In some areas—particularly computer and information technology—business leaders warn of a critical shortage of skilled U.S. workers, which threatens our ability to compete in the global marketplace. The business community is not alone in its need to develop and maintain a highly skilled domestic science, mathematics, engineering, and technology (SMET) workforce. Both academe and the federal government have a vested interest in finding ways to deepen the pool of science and technology educators and researchers.

At the same time, SMET workers remain overwhelmingly white, male, and without disabilities, and the available pool of talented women, minorities, and persons with disabilities remains significantly underutilized. Figure 1-2 shows the racial/ethnic distribution of the U.S. population in 1997 compared to the representation of these groups in the general workforce and the Science Education and Technology (SET) workforce {4}{5}{6}.

Persons with disabilities make up approximately 20% of the population, 14% of the overall U.S. workforce, and 6% of the U.S. SMET workforce {2}. As it turns out, if individuals from these underrepresented groups were represented in the U.S. SMET workforce in parity with their percentages in the total workforce population, the shortage would largely be filled.

More than ever, the nation must cultivate the scientific and technical talents of all its citizens, not just those from groups that have traditionally worked in SMET fields. According to Census Bureau projections {18}, non-Hispanic white males will decline as a fraction of the working-age (18–64) population from 37% in 1995 to 26% in 2050. Over the same period, the fraction of African Americans in the workforce will increase from 12% to 14%, that of Hispanic Americans will increase from 10% to 24%, and that of Asians will increase from 4% to 9% (see Figure 1-3). The end result is that currently underrepresented groups will increase from about a quarter of the workforce to nearly half (48%).

Figure 1-1: Projected Increase in Jobs Requiring SMET Skills



Source: Bureau of Labor Statistics, 1999, within *Land of Plenty*, Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, September 2000 {3}.

The current and projected need for more SMET workers, coupled with the fact that women, minorities, and persons with disabilities comprise an increasing proportion of the labor pool, demand policies, programs, and *resources* that support greater participation by these groups in SMET education and careers.

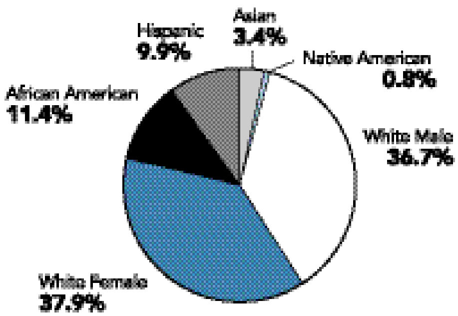
Studies have shown that appropriate investment in preparing a diverse workforce yields substantial economic benefits to the nation {7}{8}. A recent survey conducted by the American Management Association of more than 1,000 of its members found that heterogeneity—a mixture of genders, ethnic backgrounds, and ages—in senior management teams consistently correlated with superior corporate performance in such areas as annual sales, growth revenues, market share, shareholder value, net operating profit, worker productivity, and total assets {9}. In short, a culturally diverse workforce creates a competitive advantage.

If, on the other hand, the United States continues in its failure to prepare citizens from all population groups to participate in the new, technology-driven economy, our nation will risk losing its economic and intellectual pre-eminence. Significant evidence for this conclusion already exists. One California research group has estimated that the workforce shortage costs Silicon Valley high-tech companies approximately $3-4 billion annually {8}. Paradoxically, underrepresented minorities, who comprise nearly half of California's college-age population, make up less than 8% of the employees at these companies. Overall, women, minorities, and persons with disabilities together constitute a little more than two-thirds of today's U.S. workforce {2} {10}. Ironically, just when the U.S. economy requires more SMET workers, the largest pool of potential workers continues to be isolated from SMET careers. The imminent national need thus cries out for strategies designed to establish parity in the domestic SMET workforce.

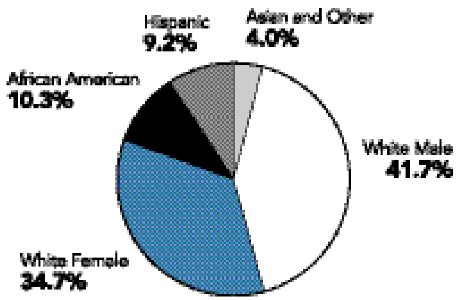
NSF has recognized the serious nature of this predicament and taken steps to facilitate progress. In its response to the 1993 Government Performance and Results Act (GPRA) {11}, the Foundation articulated in its 2000-2005 GPRA Strategic Plan a performance goal of producing "a diverse, globally oriented workforce of scientists and engineers" {12}. This goal has been further reinforced in the 2000-2005 NSF Strategic Plan, which includes an outcome goal calling for "a diverse, internationally competitive, and globally engaged workforce of scientists, engineers, and well-prepared citizens" {13}.

Figure 1-2: Racial/Ethnic Distribution of U.S. Population and its Workforce, 1997

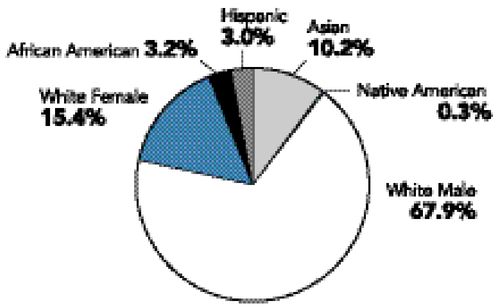
1997 U.S. Population



1997 U.S. Workforce*



1997 U.S. SET Workforce



** The Asian and other category in this graph covers both Asians and American Indians*

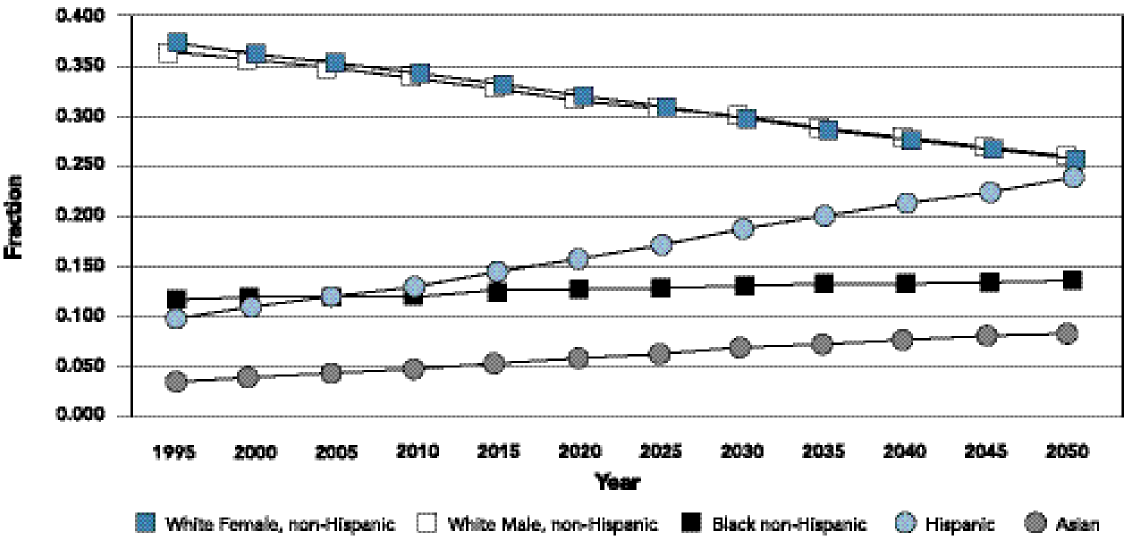
Source: Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, September 2000 {4}{5}{6}.

In preparation for the *2000 Biennial Report to Congress*, the NSF Committee on Equal Opportunities in Science and Engineering (CEOSE) has spent the past two years examining the barriers that exist for women, underrepresented minorities, and persons with disabilities at different stages of the SMET pipeline. CEOSE has conducted a comprehensive review of existing workforce and educational data, past reports, and current trends. We have also heard testimony from experts in the science and technology policy arena, educators, corporate executives, government officials, and non-profit sector leaders. The outcome is this report, which includes a carefully selected set of action-oriented recommendations and accountability measures.

Sections 2-4 of the report provide data describing the underrepresentation of women, minorities, and persons with disabilities in the various stages of the SMET pipeline, beginning with the pre-college grade levels and continuing through higher education to graduate programs. Sections 5-7 consider professional life in industry, academe, and the federal government; NSF is addressed specifically in Chapter 7. We discuss the barriers that impede women, underrepresented minorities, and persons with disabilities from becoming successful scientists, mathematicians, engineers, and technologists, and lay the groundwork for the recommendations for each pipeline stage. Section 8 concludes the report, provides recommendations, and suggests a mechanism of accountability by which the goals of the report may best be realized.

CEOSE strongly believes that if NSF is willing to make the investment in time and resources called for by these recommendations, the Foundation can achieve the goals articulated in its Strategic Plan and could serve as a catalyst to eliminate our SMET national workforce problems.

Figure 1-3: Population Projection for Ethnic and Gender Groups, Ages 18-64, 1995-2050



Source: Bureau of Labor Statistics, 1999, within *Land of Plenty*, Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, September 2000 {18}.

2. K-12: An Inadequate Reservoir Of Future Scientists

As the new millennium began, many K-12 measures of mathematics and science achievement were indicating substantial progress. For example, graduating high school seniors in 2000 posted the highest average SAT mathematics score (514 points) in 30 years {14}. In addition, the percentage of 17-year-old students scoring at or above 300 on the science portion of the National Assessment of Educational Progress (NAEP) increased steadily between 1982 and 1996 {15}. (A score of 300 or better on NAEP assessments indicates high performance in a subject area.)

However, the overall picture of K-12 education in math and science is not nearly as optimistic as these recent results seem to indicate. Findings from the Third International Mathematics and Science Study (TIMSS) revealed that U.S. 8th and 12th graders, as a whole, still perform at about the international average in both mathematics and science {16} {17}.

Further testament to the shortcomings of American science and mathematics education is offered by the 2000 United States Department of Labor solicitation for grant applications under the "H-1B Technical Skill Training Grant Program." Through this program, funds will be available for programs to prepare U.S. workers to hold high-tech jobs presently being filled by foreign workers under the provisions of H-1B. This effort provides evidence that the United States can no longer maintain the unmatched technical prowess achieved in the 20th century by its own citizens. The economic security of the country is at risk due to the failure of the public educational system to confer sufficient science and mathematics skills. Although standardized test scores in mathematics and science have risen in some segments of the population, the reservoir of American K-12 students who have the background to pursue baccalaureate degrees in the sciences or technology is small, even when compared to their counterparts in the poorest developing nations.

Efforts to increase the flow of skilled U.S. workers must begin with the reform of K-12 education, which has failed to adequately prepare students—especially women, underrepresented minorities, and persons with disabilities—in science, mathematics, or technology. High-quality education is a particularly relevant issue with regard to minority children, who today constitute a majority of the nation's 50 largest school systems, and whose educational opportunities are the most dismal. Currently, minorities make up 33% of the nation's school age population; by 2035 this percentage will grow to half of all school-aged children (see Figure 2-1) {19}.

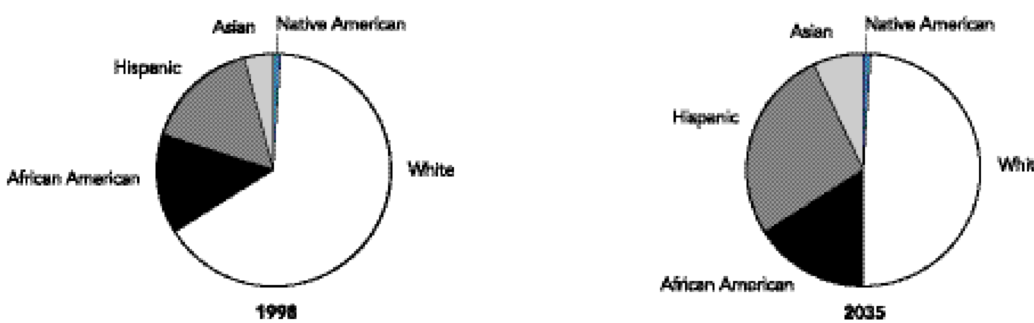
2.1 Women and Men Differ on Attitudes Towards Mathematics

Overall, male students still outperform female students on key benchmark measures such as the NAEP or TIMSS. Female high school students are now taking and completing upper level high school mathematics and science courses at the same rate as males. However, females still tend to hold more negative attitudes about mathematics than do their male peers.

NAEP Results

For 9-year-olds, male and female performance results on NAEP mathematics and science assessments is nearly identical, with mean scale scores varying no more than 1 or 2 points in favor of males throughout the 1990s (see Table 2-1) {15}. For 13- and 17-year-olds, gender differences remain small for both mathematics and

Figure 2-1: Distribution of, and Projections for, 5-to-19-year-olds in the U.S. by Racial/Ethnic Group: 1998 and 2035



Source: U.S. Department of Commerce, 1996; 1998; 1999; 2035 projections: data within *Land of Plenty*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000 {19}.

science. However, males still outscore females, and performance differences among 17-year-olds in science failed to narrow during the 1990s. In 1990, and again in 1999, 17-year-old males outscored 17-year-old females in science by around 10 points.

Table 2-1: Main NAEP Trends in Mathematics and Science Assessments

	Mathematics			Science		
Age 9	**1990**	**1994**	**1999**	**1990**	**1994**	**1999**
Male	214	221	233	230	232	231
Female	213	219	231	227	230	228
White	220	228	239	238	240	240
African American	189	193	211	196	201	199
Hispanic	198	202	213	206	201	206
Age 13						
Male	263	268	277	259	259	259
Female	262	269	275	252	254	253
White	270	278	283	264	267	266
African American	238	238	251	226	224	227
Hispanic	244	247	259	232	232	227
Age 17						
Male	297	301	310	296	300	300
Female	291	298	307	285	292	291
White	301	306	315	301	306	306
African American	268	276	283	253	257	254
Hispanic	276	284	293	262	261	276

Source: U.S. Department of Education, National Center for Education Statistics (NCES), *NAEP 1999 Trends in Academic Progress: Three Decades of Student Performance*, 2000. Washington, D.C. {15}.

TIMSS Results

With regard to TIMSS, male U.S. 8th graders outperformed female U.S. 8th graders in both mathematics and science, but like the NAEP outcomes, differences are small. Females score, on average, 497 in mathematics and 528 in science, in comparison to males, who average 502 and 540 respectively. Neither gender difference in mean scores is statistically significant. Nonetheless, with regard to mathematics performance male U.S. 8th graders are about “average” from an international perspective. Their TIMSS performance is lower than 19 nations and better than the average level of achievement of their peers in 8 nations. In comparison, female U.S. 8th graders’ TIMSS performance is lower than 22 nations and better than the average level of achievement of their peers in 7 nations. A somewhat similar picture exists with regard to science performance {17}.

Course Enrollments

Data from the 1998 NAEP High School Transcript Study reveal that females completed advanced level high school mathematics and science courses at the same rate as males {21}. The percentage of females and males completing the two most rigorous levels of mathematics coursework—pre-calculus through calculus—stood at 27% (see Table 2-2). The percentage of females and males completing both Chemistry 1 and Physics 1 stands at 18% and 20%, respectively. The percentage of females and males completing Chemistry II or Physics II stands at 7% and 8%, respectively.

Table 2-2: Course Taking Trends: Percentage of Male, Female, White, African American, and Hispanic American High School Graduates Completing Highest Levels of Mathematics and Science Courses

Course	Male	Female	White	African American	Hispanic American
Precalculus	15%	15%	17%	9%	11%
Calculus	12%	12%	13%	7%	7%
Chemistry I Or Physics I	30%	38%	34%	36%	29%
Chemistry I And Physics I	20%	18%	20%	13%	13%
Chemistry II Or Physics II	8%	7%	7%	5%	6%

Source: U.S. Department of Education, National Center for Education Statistics (NCES), *NAEP High School Transcript Study*, 1998. Washington, D.C. {21}.

Attitudes and Career Intentions

Increases in test performance and college enrollments have neither affected how female students feel about mathematics nor altered their interests in science, mathematics, engineering, and technology (SMET) careers. According to NAEP survey data, at the 12th grade level the percentage of females saying “I like mathematics” and “I am good at mathematics” declined from 1990 to 1996. In 1990, 53% of females and 63% of males agreed that they were good at mathematics; however, in 1996, both percentages declined. In 1996, less than half (47%) of the females agreed that they were good at mathematics, and only 48% agreed that they liked mathematics {15} {16}.

The lack of interest in mathematics among girls seems to influence their career intentions as high school seniors. Among SAT-takers in 2000, females were less likely to express an interest in SMET careers than were males (see Table 2-3) {14}. A mere 18% of the 2000 SAT-takers who expressed an interest in an engineering major were female. A similar percentage of females (22%) expressed an interest in majoring in computer or information science. However, the majority (65%) of those who expressed an interest in a biological sciences major were female.

Girls' rejection of mathematics and science interests may be driven by teachers, parents, and peers, when they subtly steer girls away from the kind of informal technical pastimes (working on cars, fixing bicycles, changing hardware on the computer) and science activities (science fairs, science clubs) that too often are still thought of as the province of boys. Data show that girls are less likely than boys to be involved in science and mathematics activities outside of school, from using meters and playing with electromagnets to fixing machines and reading about technology {2}. Additionally, media and real-life images of women in scientific and technical careers are still rare (as are female role models and mentors in general), sending an unspoken message to girls that an SMET career is not for them.

Table 2-3: Percentage of College Bound Males and Females Expressing an Interest in an SMET College Major

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, October 30, 2000, (see http://www.collegeboard.org/press).

2.2 Underrepresented Minorities Still Fall Behind

Since the early 1970s, the test-score gap between white students and underrepresented minorities on the NAEP has narrowed. Still, white students continue to outperform both African American and Hispanic American students on the NAEP, as well as other key benchmark measures such as TIMSS and college entrance examinations. Underrepresented high school graduates are now taking and completing more upper level high school mathematics and science courses, but

K-12 Teaching Partnerships with Graduate Students

NSF's Graduate Teaching Fellows in K-12 Education (GK-12) program provides fellowships to enable graduate students and advanced undergraduates in SMET fields to assist teachers in elementary and secondary schools.

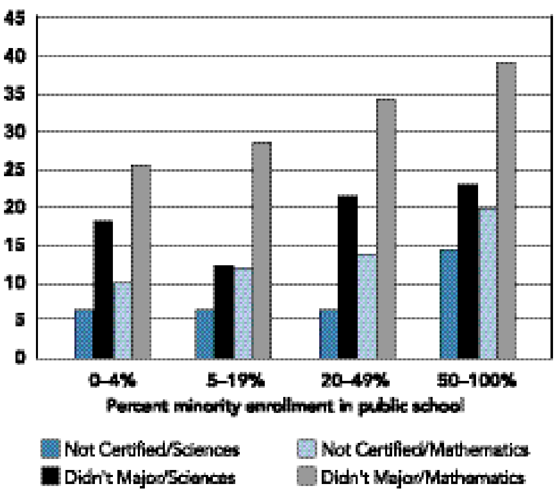
GK-12 Fellows instruct teachers and students, familiarize students with the skills necessary in SMET disciplines, and serve as role models for students. Examples of GK-12 projects include:

- **University of Arizona**. Fellows and their faculty mentors are gaining experience in inquiry-based teaching. Recruitment and selection processes are ensuring the participation of diverse groups, especially Hispanic minorities, which comprise about half the student population in Tucson.
- **University of Kansas**. Fellows work alongside teachers to develop course content and apply technology where possible. Each Fellow attends a one-week pre-assignment training workshop and a university-level course covering best practices in K-12 teaching, multicultural education, and cognitive skill development.
- **Johns Hopkins School of Medicine**. Ph.D. candidates are matched with teachers in local schools and receive formal training in classroom teaching. As student teachers in science and biotechnology, they serve as resources for urban high school teachers and share knowledge about classroom uses of technology.

the percentage doing so still lags noticeably behind rates for white students. This disparity in upper level math and science course enrollment results in underrepresented high school graduates going off to college less prepared than white peers (see *Who Is Prepared for College* sidebar at right). This latter condition relates directly to the fact that minority students progress through high school with more risk factors than do white students. For example, African American high school students are twice as likely to carry multiple risk factors such as being from a single parent household, having an older sibling who dropped out of high school, or repeating a grade {22}.

In addition, many African American and Hispanic American students attend schools in the inner city (32% and 25%, respectively). Significantly, students in these groups also tend to be enrolled in predominantly minority schools, which means that the majority of African American and Hispanic American students are isolated in schools that typically suffer from a grievous lack of resources. Although less data are available to document the access that Native American students have to educational resources, these students also attend impoverished schools.

Figure 2-2: Percentage of Public Secondary Students Taught Mathematics or Science by Teachers Without Certification/Major in Content Area



Source: U. S. Department of Education, National Center for Education Statistics. The Condition of Education 1998, NCES 98-013. Cited in 1998 Biennial Report to the United States Congress, NSF Committee on Equal Opportunities in Science and Engineering, 1998 Biennial Report to the United States Congress.

Who Is Prepared for College

The data below show the percentage of 1992 high school graduates qualified for admission to a 4-year post-secondary institution. The College Qualification Index is based on high school grade point average, senior class rank, the National Educational Longitudinal Study's aptitude test, SAT or ACT scores, and high school curricular rigor.

Race/ Ethnicity	Percent Marginally Qualified or Unqualified	Percent Highly Qualified	Percent Very Highly Qualified
Total	35.5	18.2	13.8
White	31.9	20.3	15.2
African American	53.1	9.9	6.3
Hispanic	47.0	10.8	7.9

Source: U.S. Department of Education, National Center for Education Statistics (NCES), *The Condition of Education 2000*. Washington, D.C. {24}.

The educational context in which learning occurs is another important determinant of student achievement. Data on variations in the educational resources to which different groups of students have access show that there are great disparities between the contexts in which minority and non-minority students learn. For example, minority students are more heavily concentrated in schools where it is more likely that they will be taught mathematics and science by less qualified teachers. A key indicator of teacher quality—especially for mathematics and science teachers—is whether or not the teacher has majored or has certification in mathematics or science. Figure 2-2 {23} shows that students in high minority enrollment schools are much more likely to be taught mathematics and science by a teacher who has neither a major nor certification in the content area being taught.

Overall, data on the distribution of resources in schools—including expenditures, qualified teachers, high quality curriculum, and computer equipment—show that inner city, high poverty, and high minority

Table 2-4: Race/Ethnicity and TIMSS Mathematics, Science Achievement: 1999 Mean Scores

	White	Nations Scoring Better	African American	Nations Scoring Better	Hispanic	Nations Scoring Better
Mathematics	525	12	444	30	457	28
Science	547	5	438	31	462	26

International Mean Math: 561 International Mean Science: 513

Source: U.S. Department of Education, National Center for Education Statistics, *Pursuing Excellence: Comparisons of International Eigth-Grade Mathematics and Science Achievement from a U.S. Perspective, 2000.* Washington, D.C. {17}.

enrollment schools consistently receive fewer resources than do schools that serve high percentages of white students. High minority enrollment secondary schools also offer less extensive and less demanding science and mathematics programs, giving minority students fewer opportunities to take the courses necessary to help them pursue science and mathematics majors in college. Further, underrepresented minority students are disproportionately placed in lower-track courses, and thus have less access to higher level courses even when they are in schools that offer these courses.

The lack of educational resources experienced by underrepresented minority students affects both their achievement and participation in mathematics and science; and achievement and participation data indicate that it scarcely matters whether underrepresented students of color have an interest in SMET careers. Because of the inadequate education received, low achievement levels often preclude their successfully attempting a career in an SMET field.

NAEP Results

Regardless of grade, white students outperformed both African American and Hispanic American students on the 1999 NAEP mathematics and science assessments (see Table 2-1 on page 6). Gaps were narrowest at age 9 and 13, widest at age 17. Gaps also were wider in science than in mathematics. Typically, white students outperform African American and Hispanic American students in mathematics by 15-30 scale score points. Whites outperform African Americans and Hispanic Americans in science by 25-50 scale score points.

TIMSS Results

With regard to TIMSS, white U.S. 8th graders outperform African American and Hispanic American 8th graders in both mathematics and science, and the differences in performance are extremely large and statistically significant (see Table 2-4) {17}. White 8th graders score, on average, 525 in mathematics and 547 in science. In comparison, African American 8th graders score, on average, 444 in mathematics and 438 in science, while Hispanic American 8th graders score 457 in mathematics and 462 in science. For whites, TIMSS mathematics performance is about "average" from an international perspective—with 12 nations scoring better. Their science performance is topped by five nations in the world. However, African Americans and Hispanic Americans score significantly lower than the international averages in both mathematics and science {17}.

College Entrance Examinations

The college entrance exam scores for historically underrepresented minority students still lag far behind the scores of white students, and those differences did not change much between 1988 and 1998 (see Table 2-5) {25}. In 1988, on the SAT math component, African American and white mean scores were nearly 100 points apart (418 and 514 points, respectively). Ten years later, the gap stood at 102 points (426 and 528 points). Score gaps for various Hispanic American students were less severe. Mexican American and white mean math scores were over 50 points apart (460 and 528 points, respectively). Similar score differences also exist on the ACT. Data from the 2000 ACT, however, reveal several promising trends. For example, African American students who took the ACT and graduated with mostly college preparatory courses recorded their highest subscale score in science reasoning {26}. Score differences between white and underrepresented minority students, however, have not had a negative impact on the aspirations of underrepresented minority students planning to seek advanced degrees. According to data from the College Board, nearly 60% of both African American and Hispanic American students aspire to advanced degrees (M.A. or Ph.D.), while 52% of white SAT-takers expressed similar aspirations {25}.

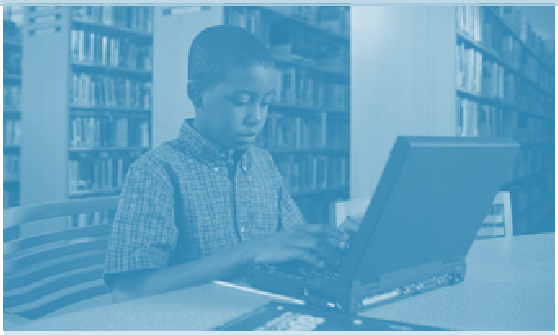


Table 2-5: 10-Year Change in Average SAT Math Scores

	1988	1998	Difference
White	514	528	14
African American	418	426	8
Hispanic	463	466	3
Mexican American	460	460	0
Puerto Rican	434	447	13
Total	501	512	11

Source: The College Board, "*College-Bound Students Set Records in Racial and Ethnic Diversity, Precollege Credit, and Grades*," The College Board News, 1998, (see http://www.collegeboard.org/press) {25}.

Course Enrollments

The enrollments of African American and Hispanic American high school students in the highest levels of mathematics and science courses increased significantly between 1982 and 1994 (see Table 2-6) {27}. In 1982, 26% of African American high school students enrolled in Algebra II. In 1994, their enrollments stood at 44%. Similar increases occurred for Hispanic American students, who saw their enrollments climb from 23% in 1982 to 51% in 1994. Still, in 1994, white students had higher enrollments rates than either African American or Hispanic American students, and the percentage of white students completing the two most rigorous levels of mathematics coursework—precalculus through calculus—stood at 30%, compared to 16% for African American students and 18% for Hispanic American students. White students also outpaced African American and Hispanic American enrollments in chemistry and physics, with nearly two-thirds of them completing various levels of these two courses, compared to half the African American and Hispanic American high schoolers.

Table 2-6: Race/Ethnic Differences in Students Taking Algebra 2 and Chemistry, 1982 to 1994

	Percent taking Algebra II		Percent taking Chemistry	
	1982	1994	1982	1994
White	41%	62%	35%	59%
African American	26%	44%	23%	44%
Hispanic	23%	51%	17%	47%

Source: Rolf K. Blank and Doreen Langesen. *State Indicators of Science and Mathematics Education 1999*, Washington, DC: Council of Chief State School Officers, 1999 {27}.

Minority Participation in Advanced Placement (AP) Exams Rises

The data below illustrate that the number of African American and Hispanic American high school students taking Advanced Placement (AP) Examinations and qualifying for college credit and/or advanced courses at college increased substantially between 1988 and 1998. Still, African American high school students represent just 4% of all AP-exam takers and 5% of graduating seniors qualifying for college credit and/or advanced courses at college. Hispanic American students represent 9% of all AP-exam takers and 8% of graduating seniors qualifying for college credit and/or advanced courses at college. Each of these numbers reveals that while minority youngsters have made great strides in AP-exam participation they are still underrepresented when compared to their total representation in the U.S. high school population. Together, African American and Hispanic American high school youngsters make up more than 30% of the U.S. high school population.

	Number Taking AP Exams		
	1988	1998	Increase
White	215,110	403,553	88%
African American	10,448	27,054	159%
Hispanic	13,322	53,627	303%
Total	288,372	618,257	114%

	Number Graduating AP Seniors		
	1988	1998	Increase
White	113,632	216,406	62%
African American	6,691	15,085	125%
Hispanic	7,665	25,240	229%
Total	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) {25}.

Limited Availability of Data about Persons with Disabilities

In contrast to women and minorities, the availability of data on persons with disabilities in science, mathematics, engineering, and technology is seriously limited. The paucity of data is due primarily to the following factors:

1. Different data sets and studies utilize varying definitions of "disability." Although the passage of the Americans with Disabilities Act (ADA) has clarified somewhat the definition of disability, the term is used to describe a wide range of physical and mental conditions.
2. For school-aged children, a good indicator of disability status is the existence and nature of the child's Individual Education Program (IEP) that is prepared as part of the special education process.
3. Information for adults found in the records of educational institutions and employers is typically self-reported. Such self-reported responses reflect individual decisions to indicate a disability. They are likely to be subjective and may well be dependent upon the context of the report. For example, a person with a disability may be concerned that reporting the disability to an employer may result in workplace discrimination.
4. Institutional records often do not include comprehensive information on disability status. Concerns about confidentiality necessitate self-reporting and limit dissemination.
5. Measures of disability status used in surveys and special studies vary considerably, at least in part because of varying goals of study designers and users. For example, the informational needs of those who study workplace equity are quite different from those who provide medical services to individuals with severe disabilities and the needs of both of these groups are different from those of educational specialists.

NSF collects data on the disability status of scientists and engineers, using a common definition of disability patterned after one developed by the Census Bureau. This measure is based on asking individuals, "What is the USUAL degree of difficulty you have with [specific tasks involving seeing, hearing, walking, and lifting]. Respondents are given five choices for each response, ranging from "none" to "unable to do." Having a disability is defined for these surveys as having at least moderate difficulty in performing one or more of these tasks. While this definition was designed to provide a relatively objective measure of disability, it is important to note that not all disabilities are captured by this measure. For example, learning disabilities and behavioral disorders are not included.

NSF does not collect data on individuals at the K-12 or undergraduate levels. The National Center for Educational Statistics does collect data for those educational levels, but in many instances does not include measures of disability status. One important survey in which this information is reported is the National Post-Secondary Student Aid Study (NPSAS), which asks students, "Do you have any disabilities such as hearing, speech, or mobility impairment, or vision problems that can't be corrected with glasses?" If the student answers in the affirmative, he or she is asked about the specific disability {31}.

Although it is difficult to compare information reported from different sources, some general conclusions on the participation of persons with disabilities in science and engineering can be drawn from the growing body of available data.

NSF Sponsored Programs Addressing SMET Challenges

Support for Teacher Preparation

The Collaboratives for Excellence in Teacher Preparation (CETP) program of NSF supports cooperative, multi-year projects to increase the quality and number of well-prepared science and mathematics teachers, especially among historically underrepresented groups. Collaboratives are comprised of SMET faculty, education faculty, and pre-school teachers.

Collaboratives design curricula that integrate mathematics, the sciences, and engineering; use advanced technologies; identify applications in engineering and technology; and utilize new methods of student assessment.

Among more than 110,000 undergraduate and post-baccalaureate students in CETP institutions who are preparing to become teachers, close to one-half are members of minority populations – in contrast to 13% minority representation in the current teaching workforce.

CETP projects include college recruitment of high school students with interest and ability in mathematics, university recruitment on two-year college campuses with large minority enrollments, and scholarship awards to outstanding prospective teachers.

Access and Motivation for Students, Teachers, and Scientists with Disabilities

Since 1991, NSF's Program for Persons with Disabilities (PPD) has supported 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. PPD grants fall into three categories:

- **Demonstration projects**. Innovative intervention strategies include workshops, camps, and mentoring programs that promote access to instructional materials and technologies and offer interpersonal support.
- **Research and development**. A typical project is the development of computer-based audio systems that use voice synthesizers to allow individuals with visual and learning disabilities to read technical publications.
- **Information dissemination**. These projects promote awareness of what individuals with disabilities can achieve with appropriate understanding and support.

According to reports from grant recipients, more than 70% of high school students who participate in PPD activities go on to higher education and the majority continue to study SMET.

It is worth noting here that while many minority students are now graduating from high school better prepared than 5 or 10 years ago, many challenges remain. Recent reports from both the College Board and ACT reveal that minority students still earn lower grades than do their white peers, which unfortunately is associated with lower performance on both the SAT and ACT. In 2000, African American ACT-takers reported that their lowest high school grades were in mathematics and science courses {26}. And Advanced Placement Examination data from the College Board show that while minority student participation is rising, and doing so dramatically, African American and Hispanic American students are still underrepresented among AP-exam takers. African American high school students represent just 4 percent of all AP-exam takers and Hispanic Americans 9 percent of all AP-exam takers (see sidebar, *Minority Participation in AP Exams Rises*).

2.3 Academic Achievement of Students with Disabilities

Between 1989 and 1998, the number of school-aged children (6–21) reporting with disabilities climbed 29%, while public elementary and secondary school enrollment grew by 17%. U.S. schools now serve more 5.4 million children with disabilities. More than half (52%) of these children had specific learning disabilities, and one-fifth (20%) had speech or language impairments. Academic achievement outcome data on students with disabilities is limited, but available data suggest that students with disabilities do not perform well in science and mathematics compared to their peers who do not have disabilities {28}. In addition, college-bound students with disabilities lag far behind their peers without disabilities on the SAT.

NAEP Results

Regardless of the NAEP assessment or grade in which students were tested, students with Individual Education Programs (IEP) performed lower than students without disabilities (see Table 2-7) {28}. Differences in mean scale scores, in both mathematics and science, tend to be smaller among 4th graders and larger among 8th and 12th graders. Typically, in the secondary grades students without disabilities outperform students with disabilities by 40 to 50 scale score points.

When NAEP mathematics and science results are further disaggregated by gender and race/ethnicity, data show that male students with IEPs consistently outperform female students with IEPs, and white students with IEPs outperform non-white students with IEPs. Overall, male and female mathematics and science score differences are small, ranging from 5–10 scale score points; however, score differences between white and non-white students are generally as large as 20-30 scale score points.

Table 2-7: Main NAEP Scores for Students with and without an Individual Education Program (IEP) in Schools Permitting Testing Accommodations

Mathematics	With IEP	Without IEP
Grade 4	206	225
Grade 8	234	275
Grade 12	257	303
Science		
Grade 4	130	152
Grade 8	115	152
Grade 12	111	151

Source: U.S. Department of Education, Office of Educational Research and Improvement. *21st Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act* 1999. Washington, D.C. {28}.

SAT Results

Approximately 7% of college-bound high school seniors taking the SAT in 2000 reported a disabling condition {14}. In 1994, SAT-takers with disabling conditions stood at 4% {29}. In 2000, the average SAT mathematics score for students with disabilities was 485 points, compared with 514 points for other students. And students taking the SAT under nonstandard testing conditions, or special accommodations, scored slightly lower at 474 points.

High School Completion Rates

In 1997, approximately 25% of the high school students with disabilities aged 17 and older graduated with a standard high school diploma {28}. Graduation rates differ greatly among the various disabilities conditions. More than a third of the students with speech and language impairments receive a diploma, compared to 8% of the students with autism. Graduation rates for students with disabilities can be misleading, however, because graduation requirements for many students with disabilities frequently are based on standards and requirements that are "watered" down. In fact, many states allow students with disabilities to graduate with fewer than 15 Carnegie "credit" units. Typically, students without disabilities exited high school in 1998 with 25 Carnegie "credit" units {30}. Moreover, while more than one-third of these graduates enroll in college, the number of high school graduates with disabilities doing the same stands at 16.5% {30}.

Assistance for Urban Schools

NSF's Urban Systemic Initiative (USI) program fosters partnerships between urban school districts and two- and four-year colleges and universities that conduct educational research. Projects are designed to:

- Increase student achievement and enrollment.
- Improve implementation of standards-based, inquiry-centered K-12 curricula.
- Improve the competency and diversity of science and mathematics teachers in school districts that serve the largest number of school-aged children living in poverty.

The program incorporates Comprehensive Partnerships for Mathematics and Science Achievement. USI initiatives have resulted in significant increases in minority enrollment in higher level science and mathematics courses. For example, in Memphis, the number of students graduating with three years of college preparatory mathematics and three years of science increased from 41% to 66%. In Los Angeles, USI high schools showed an increase in the percentage of students who were eligible to attend the University of California and California State University, while at other high schools, the percentage of eligible students declined.

3. Undergraduate Education: Looking Beyond The Traditional Pool

For the United States to remain competitive in a global technological market, it must take serious steps to create a diverse and well-trained workforce. Faced with lessened general interest in engineering and science careers {2} {16}, coupled with an increase in demand for engineers and scientists, companies worldwide are looking beyond the traditional pool of talent (largely Caucasian men) and targeting the growing workforce population of women and minorities.

3.1 Women Underrepresented in Some Sciences

Although the numbers of women in some SMET fields have been rising, women remain underrepresented in engineering and physics. The U.S. enrollment of women students in engineering curricula grew from less than 2% of engineering enrollments in the 1960s to only a little less than 20% in 1998 (see Table 3-1) {32}. In 1999, women received 19.8% of the bachelor's degrees in engineering (Table 3-2) {33}. (Although the percentage of bachelors degrees in engineering earned by women increased from 15.4% in 1990 to 19.8% in 1999, this meant an increase in actual numbers of only about 2,230 {33}). Physics is another field where women are underrepresented. For example, in 1997 women received 19.2% of the physics bachelor's degrees (Table 3-3) {34}.

Table 3-1: Total Undergraduate Enrollment of Women in Engineering, 1990-98

Year	Total	Number of Women	Percent of Total
1990	380,287	61,816	16.3
1991	379,977	63,536	16.7
1992	382,525	66,065	17.3
1993	375,944	66,532	17.7
1994	367,298	66,655	18.1
1995	363,315	67,286	18.5
1996	356,177	67,618	19.0
1997	365,358	70,765	19.4
1998	366,991	72,393	19.7

Source: Commission on Professionals in Science & Technology (Washington, D.C.), data derived from Engineering Workforce Commission, *Engineering and Technology Enrollments*, Fall 1990 through 1998 {32}.

Table 3-2: Total Undergraduate Degrees Earned by Women in Engineering, 1990-99

Year	Total	Number of Women	Percent of Total
1990	65,967	10,130	15.4
1991	63,986	10,016	15.7
1992	63,653	9,972	15.7
1993	65,001	10,453	16.1
1994	64,946	10,800	16.6
1995	64,749	11,303	17.5
1996	65,267	11,737	18.0
1997	65,091	12,160	18.7
1998	63,271	11,797	18.6
1999	62,500	12,360	19.8

Source: Commission on Professionals in Science and Technology, data derived from Engineering Workforce Commission, Engineering and Technology Degrees, 1990 through 1999 {33}.

Table 3-3: Total Undergraduate Degrees Earned by Women in Physics, 1990-97

Year	Total	Number of Women	Percent of Total
1990	4,193	679	16.2
1991	4,245	670	15.8
1992	4,107	672	16.4
1993	4,080	677	16.6
1994	4,005	710	17.7
1995	3,836	675	17.6
1996	3,703	684	18.5
1997	3,393	652	19.2

Source: National Science Foundation, Division of Science Resources Studies, Susan T. Hill, *Science and Engineering Degrees: 1990-97*, 2000 (NSF 00-310) {34}.

Women drop out of engineering at higher rates than men do. The persistence rates in science, math, and engineering majors varies between 39–61% and 30–46%, for men and women, respectively, depending upon the type of institution {35}. Research indicates that women's educational experiences differ considerably from men's, even when they attain the same grades in engineering courses; and the women who leave engineering have higher grades than men who do so. Women who leave engineering do not leave because of poor academic performance, though they do display a higher degree of academic dissatisfaction.

3.2 Minority Enrollment in Freshman Engineering Declines

Minorities are enrolled at an even lower rate than females (Table 3-4) {32}. For example, in 1998 16% of all engineering undergraduates were from underrepresented minority groups and 20% were women. Recent trends in first-time undergraduate enrollment in engineering are even more alarming. From a peak enrollment of 15,181 African American, Latino and American Indian freshmen in 1992-93, minority freshmen in engineering enrollment declined 8.2%, dropping to 13,929 in 1997-98 {32}. This percentage decline far exceeded the drop in engineering enrollment overall (2.4%) during the same period. For the past several years, the retention rate of minority students in engineering has averaged 35%. In 1996-97, underrepresented minorities constituted one of every ten new engineers {36}.

By individual science and engineering field in 1996, the proportion of baccalaureates earned by Hispanics ranged from a high of 6.9% in psychology to a low of 3.1% in the agricultural sciences {37}. Hispanic women earned a higher proportion of bachelor's degrees in comparison to their male counterparts. They earned 2,730 (4%) of master's degrees in science and engineering. Baccalaureate degrees awarded to minorities and women in engineering are shown in Table 3-5 on page 16 {33}.

In 1996, African Americans earned 7.4% of baccalaureates awarded in science and engineering, but there are differences among the individual disciplines,

Undergraduate Women Speak Out

"In Calculus III and Advanced Calculus, there were only two women in the class. There just have to be more capable women out there than that. One was a friend of mine. She just didn't think she could handle it—and that comes from your self-image. I was advised not to take it by my physics advisor, but I was confident enough to know I could do it. And the women with me in the earlier class were very smart—they knew how to handle it. But, like me, they were advised not to try it."

Female science major

"It's set up that women have to be more male in engineering to get along. I notice that women in other majors don't seem to like that they have to change themselves like I did in order to fit in. To make it in engineering, I had to learn to be more male, but to me, that's a real turn-off. I think it makes you rougher, because eventually, you've learned to take more stuff. You may be more strong than when you first came in. But it always bothered me that I had to change."

Female engineering major

Table 3-4: Undergraduate Enrollment of Underrepresented Minorities in Engineering as a Percent of all Undergraduate Enrollment, 1990-98

		All Underrepresented Minorities		African Americans		Hispanic Americans		Native Americans	
Year	Total	No.	%	No.	%	No.	%	No.	%
1990	380,287	46,770	12.3	23,562	6.2	21,601	5.7	1,607	0.4
1991	379,977	48,692	12.8	24,563	6.5	22,441	5.9	1,688	0.4
1992	382,525	51,517	13.5	25,722	6.7	23,863	6.2	1,932	0.5
1993	375,944	52,437	14.0	25,920	6.9	24,586	6.5	1,931	0.6
1994	367,298	52,238	14.2	24,994	6.8	25,216	6.9	2,028	0.6
1995	363,315	53,670	14.8	25,569	6.9	25,998	7.2	2,103	0.6
1996	356,177	53,801	15.1	24,922	7.0	26,483	7.4	2,396	0.7
1997	365,358	57,811	15.8	24,809	6.8	30,580	8.4	2,422	0.7
1998	366,991	56,919	15.5	25,699	7.0	28,802	7.8	2,418	0.7

Source: Commission on Professionals in Science and Technology, data derived from Engineering Workforce Commission, *Engineering and Technology Degrees*, Fall 1990 through 1998 {32}.

Table 3-5: Baccalaureate Degrees in Engineering by Gender, Minority Group, and Citizenship, 1990-1999[1]

		Women		African Americans		Hispanic Americans		Asians		Native Americans		Foreign Nationals	
Year	Total	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1990	65,967	10,130	15.4	2,173	3.3	2,473	3.7	5,989	9.1	112	0.2	5,121	7.8
1991	63,986	10,016	15.7	2,304	3.6	2,663	4.2	6,305	9.9	146	0.2	4,540	7.1
1992	63,653	9,972	15.7	2,374	3.7	2,708	4.3	6,479	10.2	163	0.3	4,389	6.9
1993	65,001	10,453	16.1	2,637	4.1	2,845	4.4	6,764	10.4	175	0.3	4,604	7.1
1994	64,946	10,800	16.6	2,769	4.3	3,045	4.7	6,881	10.6	207	0.3	4,908	7.6
1995	64,749	11,303	17.5	2,897	4.5	3,409	5.3	7,056	10.9	230	0.4	4,893	7.6
1996	65,267	11,737	18.0	3,120	4.8	3,557	5.4	7,333	11.2	263	0.4	5,042	7.7
1997	65,091	12,160	18.7	3,203	4.9	4,005	6.2	7,625	11.7	265	0.4	5,017	7.7
1998	63,271	11,797	18.6	3,144	5.0	3,939	6.2	7,131	11.3	351	0.6	5,083	8.0
1999	62,500	12,360	19.8	3,171	5.1	4,073	6.5	7,226	11.6	328	0.5	5,052	8.1
Total	**644,431**	**110,728**	**17.2**	**27,792**	**4.3**	**32,717**	**5.1**	**68,789**	**10.7**	**2,240**	**0.3**	**48,649**	**7.5**

[1]This table contains degrees granted in engineering at the baccalaureate level broken out by gender, race/ethnicity, and citizenship Degree data on minorities are for U.S. citizens and permanent residents only. Total engineering degrees are shown for comparison purposes.

Source: Commission on Professionals in Science & Technology, data derived from Engineering Workforce Commission, *Engineering and Technology Degrees*, 1990 through 1999 {33}.

ranging from 5.7% in the physical sciences to 6.1% in engineering, 6.3% in the biological sciences, and 7.8% in mathematics and nearly 11% in computer science {38}. African American women earn a higher proportion (64%) of bachelor's degrees in comparison to their male counterparts than do women of other races. In science and engineering fields, they earned nearly 60% of the bachelor's degrees awarded to African Americans. However, of the 17,355 bachelor's degrees in science and engineering earned by African American women, nearly 65% were in the social and behavioral sciences.

A major barrier for minority students is unmet financial need, which places them continually at risk if something unexpected happens. In addition, many universities still use only SAT scores to determine "merit." Since standardized test performance is highly correlated with family income, minority students are more likely to be excluded from educational opportunities simply because of low test scores. The current backlash against affirmative action policies has exacerbated institutional factors that impede student retention. These include the domination of certain aspects of university culture by white males, low expectations of and unsupportive attitudes towards minorities and women, gender and ethnic isolation, a lack of mentors, and an absence of peer support {35}.

3.2 Persons with Disabilities Likely to Major in SMET

The difference in science and engineering degree completion rates by disability status is related to differences in high school completion rates, college preparation level and enrollment rates, and college persistence and attainment rates. Persons with disabilities are less likely than those without disabilities to graduate from high school, enroll in four-year colleges, and graduate from college. The good news is that individuals with disabilities who are attending college are as likely to major in science and engineering as their peers without disabilities.

Representation in Postsecondary Education

A 1996 study of undergraduate institutions {40} found that approximately 6% of students reported having a disability (Figure 3-1) {40}. This self-reported figure is significantly below the 1994-95 Census Bureau estimates that about 20% of the population had some form of disability, and about 10% had a severe disability. A wide range of disabilities was reported among the undergraduate population, including visual, hearing, speech, orthopedic (mobility), and learning disabilities, as well as other disabilities or impairments. Students with learning disabilities comprised the largest group, and are also the fastest-growing segment of the population with disabilities. The range of disabilities reported indicates that a wide array of needs, accommodations, and technologies will be necessary to address the requirements of this diverse population {41}. Compared with students without disabilities, those with disabilities were more likely to be male, older, and white, non-Hispanic. Students with disabilities are, however, as likely to study science and engineering as students without disabilities (27.2% verses 28.5%), as shown in Table 3-6 {40}.

Table 3-6: Percentage Distribution of 1995-96 Undergraduates, by Disability Status According to Major Field of Study

Major field of study	Total	Does not have a disability	Has a disability
SMET total	28.3	28.5	27.2
Computer/ information science	3.4	3.3	3.9
Mathematics	0.6	0.6	0.2
Physical sciences	1	1	0.6
Life sciences	5.7	5.7	3.4
Social/behavioral sciences	9.5	9.7	9.4
Engineering	8.1	8.2	9.7
Humanities	14.6	14.5	17.6
Education	8.5	8.7	8.3
Business/management	19.7	19.8	17.4
Health	12.7	12.8	11.4
Vocational/technical	2.7	2.6	3.8
Other technical/professional	13.5	13.3	14.2

Source: National Science Foundation, *Women, Minorities and Persons with Disabilities in Science and Engineering: 2000*, (NSF 00-327).

Preparation Level and Institutions Attended

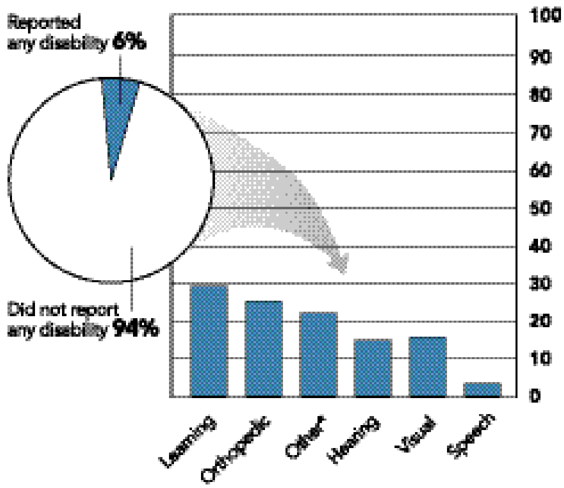
The National Education Longitudinal Study of 1994 {31} found that students with disabilities are less academically prepared for college than those without disabilities. Students with disabilities were, for instance, more likely to have taken remedial courses, less likely to have taken advanced placement courses, and have lower grade point averages and SAT scores than those without disabilities. The 1994 study found that among 1988 eighth graders who went on to complete high school, students with disabilities were less likely than those without disabilities to have enrolled in postsecondary education by 1994 (see Table 3-7 on page 18) {31}. A 1998 study of college freshmen found that students with disabilities were more likely than those without disabilities to have earned Cs and Ds in high school; less likely to have met the recommended years of high school study in mathematics, biological sciences, and physical sciences; and more likely to have spent more time between high school graduation and entry into college {44}.

Challenging Stereotypes

"When I had my accident, leaving me with a severe disability, my Division of Vocational Rehabilitation Counselor told my parents not to expect too much of me. That 'people with such severe disabilities' are not generally able to succeed academically or in the workforce."

College freshman with quadriplegia.
Note: This student went on to earn a Ph.D. and become employed

Figure 3-1: Percentage of 1995-96 Undergraduates Who Reported a Disability, and Among Those with Disabilities, the Percentage Reporting Each Disability Type: 1996



* Any other health-related disability or impairment.

Source: National Science Foundation, *Women, Minorities and Persons with Disabilities in Science and Engineering: 2000*, (NSF 00-327) {40}.

Table 3-7: Among 1988 8th Graders Who Completed High School the Percentage who Enrolled in Postsecondary Education by 1994, and Percentage Distribution According to Type of Institution, by Disability Status and Type: 1994

Disability status and type	Total	4-year institutions	Public 2-year institutions	Other institutions[1]
Total	70.4	59.4	34.4	6.2
Does not have a disability	71.7	61.5	33.3	5.3
Has a disability	62.8	42.0	44.9	13.1
Visual impairment	70.4	48.4	44.2	7.4
Hearing impairment or deaf	60.2	39.8	47.0	13.2
Speech impairment	58.5	49.0	47.6	3.5
Orthopedic impairment	73.9	71.4	23.6	5.1
Learning disability	57.5	28.2	53.9	17.9
Other disability or impairment[2]	65.9	44.3	42.8	13.0

Sources: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988, Third Follow-up survey, 1996 (NELS: 88/94); Data Analysis System within *Students with Disabilities in Postsecondary Education: A Profile of Preparation, Participation, and Outcomes*, Laura Horn and Jennifer Berktold, (NCES 1999-187) U.S. Department of Education, Washington, D.C. 1999 {31}.

1 Private for profit-institutions, public less-than-2-year institutions; or private, not-for-profit less-than-4-year institutions.
2 Any other disability, including health problems, emotional problems, mental retardation, or other physical disabilities.

The difference in preparation level is reflected in the institutions attended by students with disabilities. Compared with their counterparts who reported no disabilities, students with disabilities were less likely to be enrolled in public 4-year institutions, about as likely to be enrolled in private, not-for-profit 4-year institutions, and more likely to be enrolled in sub-baccalaureate institutions such as public 2-year colleges. There were no apparent differences, however, between undergraduates with and without disabilities with respect to their general fields of study.

Undergraduate Persistence and Attainment

Not only are students with disabilities less likely to be enrolled in bachelor's degree programs, they are also less likely to have completed a bachelor's degree program within five years. Indeed, 53% of students with disabilities who were enrolled in the 1989–90 academic year were still enrolled or had attained a degree by 1994, compared with 64% of those without disabilities (Table 3-8) {40}. Conversely, a higher proportion of those with disabilities (47%) than of those without (36%) had left college without earning a degree. Among those who completed their programs in 1995 and 1996 earning science or engineering bachelor's degrees, 23% of persons with disabilities, compared with 13% of those without disabilities, had previously earned associate's degrees. Research has shown, however, that a majority

Table 3-8: Percentage Distribution of 1989-90 Beginning Postsecondary Students According to Postsecondary Persistence Status and Highest Undergraduate Degree Attained, by Disability Status: 1994

Persistence status and highest degree	Total	Does not have a disability	Has a disability
Attained degree or enrolled	63.2	64.1	52.9
Attained degree or certificate	50.0	50.7	41.1
Enrolled in 1994	13.3	13.4	11.8
Not enrolled/no degree or certificate	36.8	36.0	47.2
Highest undergraduate degree attained by 1994			
None	50.1	49.3	58.9
Certificate	12.9	12.5	18.8
Associate's	11.2	11.6	6.0
Bachelor's	25.8	26.6	16.3

Source: National Science Foundation, *Women, Minorities and Persons with Disabilities in Science and Engineering: 2000*, (NSF 00-327) {40}.

of students who enroll in the 2-year sector with the intention of later transferring to a 4-year institution do not transfer. Therefore, students with disabilities may be reducing their chances of earning a bachelor's degree by attending two-year institutions in higher proportions.

Research-Based Learning in HBCUs

The Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) assists HBCUs in implementing action plans to address minority underrepresentation in SMET. Projects prepare college students for graduate study by emphasizing research-based teaching and learning.

Awards have been used to support a variety of initiatives, such as the establishment of summer programs for college freshmen, funding of undergraduate research projects, enhancement of course technology, assistance for students and faculty who wish to attend conferences and internships, and curricular reform.

Universities are encouraged to develop and maintain a diverse faculty committed to education reforms. Project faculty, working in collaboration with other academic institutions, professional organizations, business, and industry, provide students with mentor-supervised research to complement their academic programs. In 1998 alone, HBCU-UP initiatives enrolled nearly 20,000 minority students in SMET disciplines and awarded over 2,500 baccalaureate degrees.

Collaborating institutions include participants in related NSF-supported programs, such as LSAMP, AGEP, and CREST.

Institutional Alliances Supporting Minority Participation

The Louis Stokes Alliances for Minority Participation (LSAMP) program encourages minority students to complete SMET baccalaureate degrees. Long term, LSAMP expects to impact, significantly, the number of students who earn PhDs and attain faculty positions.

LSAMP is the major endeavor funded by NSF to remedy the underrepresentation of minorities at the college level. Approximately 20,000 participants receive baccalaureate degrees in SMET fields each year.

Rather than support individuals or single institutions, LSAMP creates partnerships among academic institutions, government agencies and laboratories, industry, and professional organizations. LSAMP activities help minority students fulfill their potential in college and sustain their interest in SMET fields and graduate study through hands-on research experiences. A residential summer bridge program enrolls graduating high school seniors in college preparatory courses and, in addition, teaches them study skills and time management. LSAMP also provides mentors and role models and supports drop-in centers on college campuses for program participants.

4. Graduate Education: A Declining Share For SMET

Although overall graduate enrollments increased by 6% from 1992 to 1997, the number of graduate students in SMET degree programs declined by 5% over the same period {34} {44}. Failure to increase the numbers enrolling and completing graduate degrees in SMET programs threatens our ability to generate new knowledge and transmit that knowledge to new generations of students. This trend is all the more alarming when focusing on the corresponding figures for women, minorities, and people with disabilities, who continue to be underrepresented in graduate SMET programs. For example, women constituted only about 40% of the students in graduate SMET programs in 1999—still short of parity. And the situation is even more disturbing for minorities in engineering, where first-year graduate enrollment dropped 21.8% for African Americans and 19.3% for Hispanic Americans between 1996 and 1997 {32}. The decline in overall graduate enrollment in SMET disciplines calls for renewed efforts to recruit and retain underrepresented groups in these programs.

4.1 Number of Women in SMET Graduate Programs Increasing

In 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 1999, they accounted for 40% of enrollment (Tables 4-1) {44}. However, their representation in graduate SMET programs other than the social and behavioral sciences still fell far short of parity in 1999. Women represented only 20% of full-time graduate enrollment in engineering and 30% of enrollment in mathematics and the computer sciences.

The percent of SMET graduate degrees earned by women between 1966 and 1997 reflects a trend similar to that observed for enrollment (Figure 4-1) {34}. During this time period, women's share of SMET degrees increased from 12% to 39%, while their share of all graduate degrees rose from 31 to 55%. As was the case for enrollment, there are considerable differences in women's achievement by field. In 1997, women attained 58% of graduate degrees in the social and behavioral sciences, but only 17% of the engineering graduate degrees.

4.2 Few Minorities Complete SMET Graduate Studies

U.S. graduate programs in science, engineering, and mathematics are the envy of the world and have contributed greatly to the country's technological innovation and economic growth. The current decline in overall graduate enrollment rates in SMET, however, combined with the extremely small numbers of minorities completing graduate degrees in SMET fields, pose a significant challenge to our nation's continued economic vitality, national security, and quality of life. While the percentage of underrepresented minorities

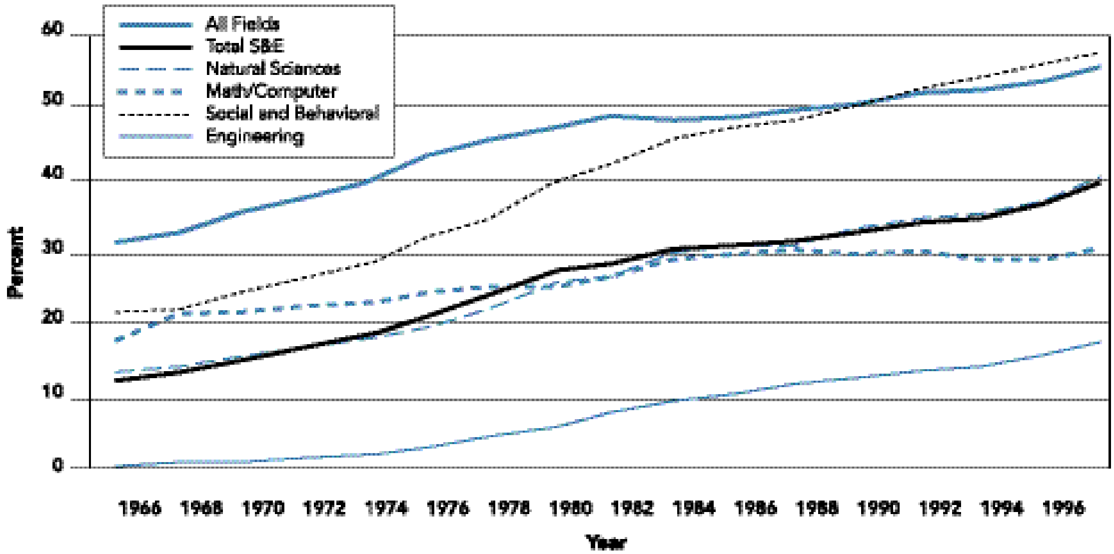
Table 4-1: Full-Time Graduate Enrollment of Women in SMET, 1976/1999

	1976		1999	
	Total	Women	Total	Women
Total SMET Enrollment	204,861	48,692 (24%)	283,915	114,890 (40%)
Field				
Natural Sciences (all)[1]	79,684	17,894 (22%)	93,610	39,666 (42%)
Physical Sciences	22,252	3,047 (14%)	26,640	7,564 (28%)
Earth, Atmospheric, Oceanic	10,091	1,634 (16%)	10,492	4,312 (41%)
Agricultural Sciences	9,436	1,491 (16%)	9,210	3,807 (41%)
Biological Sciences	37,905	11,722 (31%)	47,268	23,983 (51%)
Math/Computer Sciences	15,700	3,218 (20%)	34,500	10,513 (30%)
Social and Behavioral Sciences (all)[2]	72,595	25,555 (35%)	87,973	51,217 (58%)
Psychology	25,643	11,052 (43%)	34,715	24,630 (71%)
Social Sciences	46,952	14,503 (31%)	53,258	26,587 (50%)
Engineering	36,882	2,025 (5%)	67,832	13,494 (20%)

Source: Data from U.S. Department of Education/NCES, *Survey of Opening Fall Enrollment*, and National Science Foundation, Division of Science Resources Studies, Joan Burrelli, *Graduate Students and Postdoctorates in Science and Engineering: Fall 1999* [Early Release Tables], 2000 (http://nsf.gov/sbe/srs/srs01402/start.htm; http://nsf.gov/sbe/srs/srs01402/tables/5.xls; http://nsf.gov/sbe/srs/srs01402/tables/7.xls) {44}.

1 Natural Sciences includes Physical Sciences, Earth, Atmospheric and Oceanic Sciences, Agricultural Sciences, and Biological Sciences
2 Social and Behavioral Sciences includes Psychology and Social Sciences

Figure 4-1 Percent of Graduate Degrees Awarded to Women, By Field: 1966-96



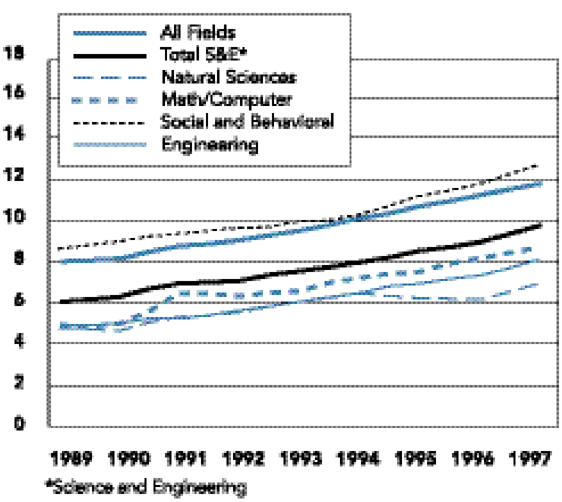
Source: National Science Foundation, Division of Science Resources Studies, Susan T. Hill, *Science and Engineering Degrees: 1966-96*, 2000 (NSF 00-310). {34}

enrolling in and completing graduate degrees in SMET has risen in the past decade, the numbers are not yet equivalent to their representation in the U.S. population.

In 1998, underrepresented minorities constituted 12% of full-time citizen or permanent resident graduate student enrollment while constituting 24% of the total U.S. resident population {46}. Although this means that graduate enrollment of underrepresented minorities (African Americans, Hispanic Americans, and Native Americans) is considerably below parity, it is encouraging to note that underrepresented minorities have made strides towards equity in the last few years. In 1992, only 9% of the full-time enrollment of citizens and permanent residents in graduate school were underrepresented minorities.

The participation rate of underrepresented minorities varies considerably by field. For example, in 1997, underrepresented minorities constituted 12.9% of the social sciences, but only 7.1% of the natural sciences. The time trends reflecting the graduate degree attainment of underrepresented minorities reflect a pattern similar to the trends with respect to enrollment (Figure 4-2) {47}. There has been an increase in the proportion of graduate degrees earned by underrepresented minorities in Science and Engineering (S&E) disciplines (from 6.1% in 1989 to

Figure 4-2: Percent of Graduate Degrees Awarded to Underrepresented Minorities, by Field (U.S. Citizens and Resident Aliens Only): 1989-97



Source: National Science Foundation, Division of Science Resources Studies, Susan T. Hill, *Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1989-97*, 2000 (NSF 00-311) {47}.

Table 4-2: Full-Time Graduate Enrollment of U.S. Citizens and Permanent Residents in SMET, by Race/Ethnicity: 1992-98

	1992		1998	
	Total	Underrepresented Minorities (%)	Total	Underrepresented Minorities (%)
Total SMET Enrollment	197,473	17,346 (8.8%)	192,407	22,351 (11.6%)
Field				
Natural Sciences[1]	66,216	4,467 (6.7%)	68,052	5,951 (8.7%)
Math/Computer Sciences	17,791	1,243 (7.0%)	16,131	1,416 (8.8%)
Social and Behavioral Sciences[2]	73.568	8,798 (12.0%)	74,807	11,616(15.5%)
Engineering	39,898	2,838 (7.1%)	33,417	3,368 (10.1%)

1 - Natural Sciences includes Physical Sciences, Earth, Atmospheric and Oceanic Sciences, Agricultural Sciences, and Biological Sciences
2 - Social and Behavioral Sciences includes Psychology and Social Sciences

Source: National Science Foundation, Division of Science Resources Studies, *Graduate Students and Postdoctorates in Science and Engineering: Fall 1999*, November 2000 (NSF 01-302) {45}.

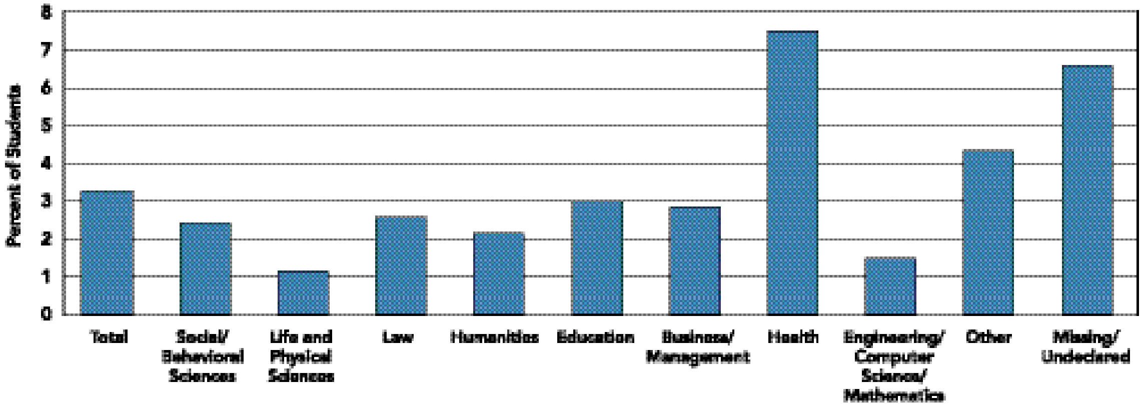
9.9% in 1997). Representation of underrepresented minorities is higher in the social and behavioral sciences (13% in 1997) than in other SMET disciplines. As is true for women, the SMET disciplines other than the social and behavioral sciences lag behind the non-science and engineering fields.

4.3 Persons with Disabilities Likely to Enter Graduate School

Training of future scientists and educators who live with disabilities is hampered by the difficulty of determining the extent to which they currently participate in the SMET enterprise and their career progression compared to individuals without disabilities. We do know, however, that college graduates with disabilities are as likely as those without disabilities to enroll in graduate school within a year after graduating from college {41}.

Information from the National Postsecondary Student Aid Study reveals that about 3% of graduate students studying in all fields reported a disability, but in 1996 this percentage was lower in the life and physical sciences, engineering, computer sciences, and mathematics than in the social and behavioral sciences and in the non-

Figure 4-3: Percent of Graduate Students with Disabilities, by Field: 1996



Source: National Science Foundation, Division of Science Resources Studies, *Women, Minorities, and Persons With Disabilities in Science and Engineering: 2000*, using data from U.S. Department of Education, National Center for Education Statistics, 1995–96 National Postsecondary Student Aid Study, data analysis system {48}.

Improving Graduate Level Opportunities for Minorities

University Cooperation to Support Minority Education

The Centers of Research Excellence in Science and Technology (CREST), formerly known as Minority Research Centers of Excellence, upgrade the research capabilities of the most productive minority institutions, increasing the number of minorities with PhDs in SMET fields.

Centers serve as hubs for conducting competitive research in such fields as materials science and computing and serve as models for the integration of education and research.

CREST has supported the Center for Systems Research at Tennessee State University, a member of the team that first observed planets circling another star system. Another CREST initiative supported research at the University of Puerto Rico, the nation's leading Hispanic institution, which confers 20 percent of all baccalaureate and doctoral degrees in science, mathematics, and engineering that are awarded to Hispanics.

CREST also promotes cooperation among faculty at different institutions and establishes alliances among minority students and business, government laboratories, and other universities.

Minority Support from Recruitment to the Workplace

The Alliances for Graduate Education and the Professoriate (AGEP) seek significant increases in the number of minority students pursuing doctoral degrees and faculty positions in science, mathematics, and engineering.

Regional and statewide Alliances link federal and private institutions. Efforts focus on recruitment, mentorship, and retention of minority students in SMET doctoral programs.

AGEP also supports research to identify major factors that may help minority students transition from undergraduate to graduate study, from course work to dissertation research, and from academe to the workplace.

Universities receiving AGEP awards conferred close to 20 percent of the PhDs awarded to minority students in science, mathematics, and engineering in 1998 and 1999.

Students with Disabilities Excels at PhD Level

Kurt Hoffman, a Ph.D. student in Animal Behavior at the University of California at Davis, was born with no arms. He completed his undergraduate studies at Bucknell University, where he participated in research in animal behavior. He so impressed his mentors at Bucknell that they recommended him for the top animal behavior program in the country at UC-Davis, where he chose to work with primates. Behavioral research requires a good deal of observation and recording, so Kurt developed a system to use a computer keyboard with his toes and a modified foot. He insisted on receiving no physical help from others other than a chair to be placed in the room where he carried out his research.

Kurt was the beneficiary of a campus graduate opportunity fellowship and an NSF Research Training Grant in Interdisciplinary Approaches to Animal Behavior. He finished his Ph.D. in less than the normal time and, according to his advisor, he turned in a thesis that was more polished than any first draft this professor had seen. When Kurt finished his Ph.D. he had three employment options: a full-time academic teaching job, a full-time academic research job, and a postdoctoral position. Kurt chose the postdoctoral offer and, when finished, will be in a prime position to continue his academic career at a research university.

Multidisciplinary Approach to Graduate Research

NSF's Integrative Graduate Education and Research Traineeships (IGERT) program provides support for Institutions of Higher Education to experiment with new paradigms in graduate education. Students and faculty have developed programs enabling each to experience and work in collaborative environments wherein multidisciplinary research and education are emphasized. Moreover, institutions are afforded the opportunity to explore mechanisms that facilitate multidisciplinary research and education.

IGERT is a Foundation-wide activity in that financial and personnel support is garnered from every Directorate and the Office of Polar Programs.

Features of the program include:

1. Problem-based research and education as opposed to disciplinary focused projects.
2. Graduate student education in the traineeship mode is emphasized over new pure knowledge production.
3. Recruitment, retention, and graduation of individuals from underrepresented groups is of prime significance.
4. Personal and professional skill development for multiple careers is significant.
5. Other activities include internships and promotion of global awareness.

To date there are 57 sites located across the country in 31 states and the District of Columbia. On average, each site supports 12 trainees per year for a 2-year period. After the 2 years of support a new cohort is recruited. Last year NSF had a 9.8% representation of minorities in the entire program. Efforts to improve this number are being made. Each year a significant part of the PI meeting is devoted to elaborating best practices in recruitment and retention of individuals from underrepresented groups and to acquainting PIs with sources for recruiting. Approximately one-third of the trainees are women.

SMET fields. (See Figure 4.3) {48}. No data are available for master's degrees granted to persons with disabilities. The percent of SMET doctorate recipients reporting disabilities stayed at approximately 1.3% between 1993 and 1997 {40}.

As with other underrepresented groups, individuals with disabilities may be reluctant to enter graduate studies or are not encouraged to do so by their undergraduate or high school mentors. There are now a number of government agencies—federal, state, and local—that have targeted resources to assist people with various types of disabilities. With targeted outreach programs, the community of persons with disabilities could be afforded more graduate educational opportunities and embark on subsequent professional paths. The remarkable advancement in technologies to remove barriers to access and achievement is another promising sign for greater participation of people with disabilities in the SMET enterprise. Assistive technologies, such as voice recognition systems, automated Braille printout, and "all-terrain" wheelchairs, will make possible and enrich the contributions of a wider pool of future scientists.

5. The Nondoctoral Technical Workforce: Shortage Of Skills Is Dampening Job Growth

"Science, math, engineering and technology workforce issues are not about the end of the pipeline but about the full spectrum of workers who use technology as well as create it, and upon whom we all depend for our health and our quality of life."

Shirley Malcom, Director,
Education & Human Resources,
AAAS, Member, President's Committee of Advisors on Science and Technology, (PCAST)

During 1998-2008, U.S. employment in SMET fields is expected to increase at almost four times the rate for all occupations (Table 5-1) {49} {50}. While the economy as a whole is expected to provide approximately 14% more jobs over this decade, employment opportunities in SMET are expected to increase by about 51%, or about 1.9 million jobs. Substantial increases are expected in almost all industries over the next decade. For example, jobs for computer engineers and scientists are expected to increase from about 900,000 to over 1.8 million, while employment for computer systems analysts is expected to grow from a little over 600,000 to almost 1.2 million jobs.

Table 5-1: Projected Employment and Labor Force Growth, by Gender and Race/Ethnicity: 1998-2008

Total employment	14%
SMET employment	51%
Total civilian labor force	12%
Within civilian labor force:	
Men	10%
Women	15%
White, non-Hispanic	7%
Black	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: pp 19-32; Braddock, D., Occupational employment projections to 2008, *Monthly Labor Review*, November 1999: pp 51-77 {49}{50}.

This job growth is being dampened by the shortage of skilled U.S. workers. Past studies and reports have amply described the depth of the problems resulting from the underutilization of women, most ethnic minorities, and persons with disabilities {2}. With the exception of Asian Americans, minorities continue to comprise a much smaller proportion of the SMET workforce than they do in the total U.S. population.

Given the projected growing demand for SMET professionals, several factors need to be considered in some depth:

- Rates of entry into the SMET workforce from current college graduates are not expected to satisfy the existing or future demand.
- There are not enough well-prepared students at the secondary school level (see Chapter 2).
- The achievement gap of underrepresented minority students is large and the closure rate of this gap too slow.
- High-quality science and mathematics teachers are not available in sufficient numbers to meet current and future demands (see Chapter 2).

These issues are interdependent and must be addressed as a high priority if significant inroads are to be made in this area.

5.1 A Higher Percentage of Women Employed Part-Time

As in science and engineering as a whole, women and men in the non-Ph.D. SMET workforce differ in their occupations. Women constitute the majority in some science and engineering occupations; for example, in 1996, more than two-thirds of all non-Ph.D. psychologists (69%) and more than half of non-Ph.D. sociologists (57%) were women. Men, on the other hand, constituted 91% of non-Ph.D. engineers, 75% of non-Ph.D. physical scientists, and 73% of non-Ph.D. computer scientists {29}.

Among those in the labor force (that is, those who were employed or seeking employment), the unemployment rates of female and male non-Ph.D. scientists and engineers differed: 2.3% of women and 1.6% of men were unemployed in 1996 {29}. This difference reflects variations in the age distributions of men and women as well as differing family responsibilities.

Similarly, a higher percentage of female than of male non-Ph.D. scientists and engineers are employed part-time. Of those who were employed, 17% of women and 8% of men worked part-time in 1996 {29}. As with unemployment, variations in age distribution of men and women, as well as varying family responsibilities, are factors in part-time employment choices.

Among non-Ph.D. scientists and engineers, 61% of women and 68% of men had a bachelor's degree as their highest degree in 1996. Employed women scientists and engineers with bachelor's or master's degrees were more likely than men to have their highest degrees in mathematics and computer sciences (21% vs. 15%), in life sciences (12% vs. 6%), and in social and related sciences (22% vs. 7%). Men, on the other hand, were more likely than women to have their highest degree in engineering (48% vs. 18%) {29}.

Among all employed non-Ph.D. scientists and engineers, women were less likely than men to be employed in business or industry—54% and 73%, respectively—and more likely to be employed in educational institutions—22% vs. 9% of men. However, these variations by sector primarily stem from differences in occupation. Women are less likely than men to be engineers or physical scientists, who tend to work in business or industry. Within occupations, the percentages of men and women employed in industry were similar. For example, among physical scientists, 65% of women and 67% of men were employed in private for-profit business or industry in 1996.

Among non-Ph.D. scientists and engineers, women generally earn less than men do, but these salary gaps are due primarily to differences in length of experience (as measured by years since highest degree), occupation, and highest degree attained. Female scientists and engineers have less experience, on average, than men and are less likely than men to be in computer science or in engineering—occupations that command higher salaries. The 1997 median salary for female scientists and engineers with a bachelor's degree was $45,000; for men it was $55,000. Within occupations and within experience categories, the median salaries of men and women were more alike. For example, in 1997, among physical scientists with a bachelor's degree and less than 5 years of experience, the median salary for women was $26,000; for men it was $27,800. (In addition to experience, occupation, and highest degree obtained, there are additional factors that influence the differences between the salaries of men and women in SMET professions. {51})

5.2 Many Minorities New to SMET Field

In 1997, African Americans (14%), Hispanic Americans (14%), and Native Americans (0.8%) together formed about 29% of the U.S. population, and 7% of the total SMET workforce. African Americans and Hispanic Americans each comprised about 3%, and Native Americans less than 0.5% {40}.

These population groups also differed in terms of educational background and work experience. For example, African American scientists and engineers have on average a lower level of education than do scientists and engineers of other racial or ethnic groups. African American scientists and engineers are more likely than their white, Hispanic American, or Asian counterparts to have a bachelor's as the terminal degree. Furthermore, about 36% of white scientists and engineers employed in 1997 had received their degrees within the previous 10 years, compared with between 47–52% of Asian American, African American, and Hispanic American scientists and engineers {40}.

The overwhelming percentage of the nondoctoral workforce (i.e., those who have received bachelor’s and master’s degrees) is employed in the private for-profit sector {40}. Thus, it is not surprising that there are growing concerns among U.S. business leaders about the disproportionately small numbers of underrepresented minorities in the SMET pipeline.

5.3 Incidence of Persons with Disabilities Rises with Age

The underrepresentation of persons with disabilities also extends beyond academic programs and into the workforce. Indeed, while individuals with disabilities constitute 20% of the U.S. population, they made up only 6% of the SMET workforce in 1997, representing little change since 1993 {53}. Individuals with disabilities in the SMET workforce are, on average, older than those without disabilities. This is due in large part to the fact that the incidence of disability rises with age. More than half of the scientists and engineers with disabilities acquired a disability at age 30 or older, while only 8% of scientists and engineers with disabilities had them since birth, and one-third had them since the age of 20 {53}.

In contrast, the occupations of individuals with and without disabilities do not differ greatly. In 1997, 10% of both populations worked in life sciences while 8% worked in the physical sciences. Similar participation results hold for those with and without disabilities in the engineering (42% vs. 41%), social science (11% vs. 10%), and computer science (25% vs. 28%) professions.

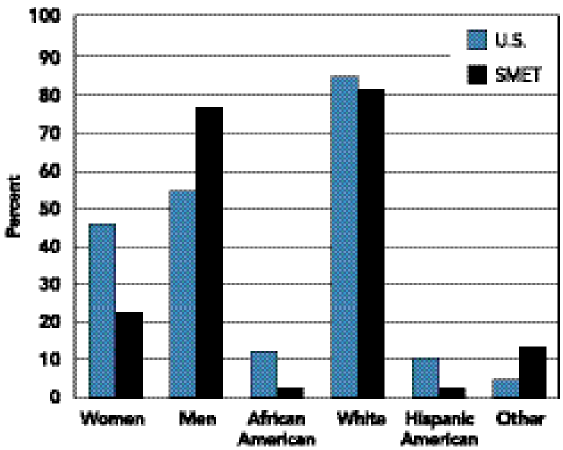
The labor force participation rates, however, are quite different for scientists and engineers with and without disabilities. In 1997, nearly one-third of scientists and engineers with disabilities were out of the labor force, compared with 11% of those without disabilities. Although the older mean age of individuals with disabilities accounts for some of this difference, not all of the large disparity can be attributed to age difference alone. Within age categories, for example, individuals with disabilities were still more likely than those without disabilities to be out of the labor force. Among those ages 35 to 44, 8% of those with disabilities were out of the labor force, compared with 4% of those without disabilities. Among employed scientists and engineers, individuals with disabilities were also more likely to be working part-time: 11% vs. 8% in 1997 {40}.

While individuals with disabilities are less likely than those without disabilities to be employed in for-profit businesses (53% vs. 60%), the type of work performed within the business setting varies little with disability status. For instance, 44% of scientists and engineers with disabilities, and 46% of those without disabilities, were engaged primarily or secondarily in management. Median salaries of scientists and engineers with disabilities also varied little from their counterparts without disabilities, $56,000 and $55,000, respectively, and this similarity held across age groups {40}.

6. Doctoral Workforce: Traditional And Not-So-Traditional Career Paths

Women, African Americans, and Hispanic Americans are consistently underrepresented in the U.S. doctorally-trained SMET workforce, as seen in the composition of the SMET doctoral workforce compared to that of the overall workforce (see Figure 6-1) {54} {55}. The underrepresentation is most notable for underrepresented race/ethnic minorities than for women. These patterns vary somewhat by field, being most accentuated in mathematics, computer sciences, engineering, and the physical sciences, and least accentuated in the social sciences. These patterns reflect decisions and opportunities with regard to doctoral training over the past three decades and will change only as the proportion of SMET doctorate recipients who are women and underrepresented minorities changes (See Chapter 4 for a discussion of these trends). This chapter focuses on the distribution and salary of doctoral trained individuals across labor force sectors on a group-by-group basis.

Figure 6-1: Distribution of the U.S. Civilian and SMET Doctorally-Trained Labor Force by Gender and Race/Ethnicity, 1997



(Note: For the U.S. labor force, persons of Hispanic origin may be of any race and so are not mutually exclusive of the other racial categories).

Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States: 1998*, National Science Foundation/SRS, Survey of Doctorate Recipients, 1997 {54}{55}.

6.1 Women a Small Percentage of SMET Faculty

As seen in Figure 6-2 {55}, doctorally-trained women are less likely to have full-time employment than are their male counterparts. (22.8% of the SMET labor force are women, while 29.5% of the not-full-time-employed are women.) Although the difference in full-time employment varies somewhat by field, this generalization holds within all of the broad fields.

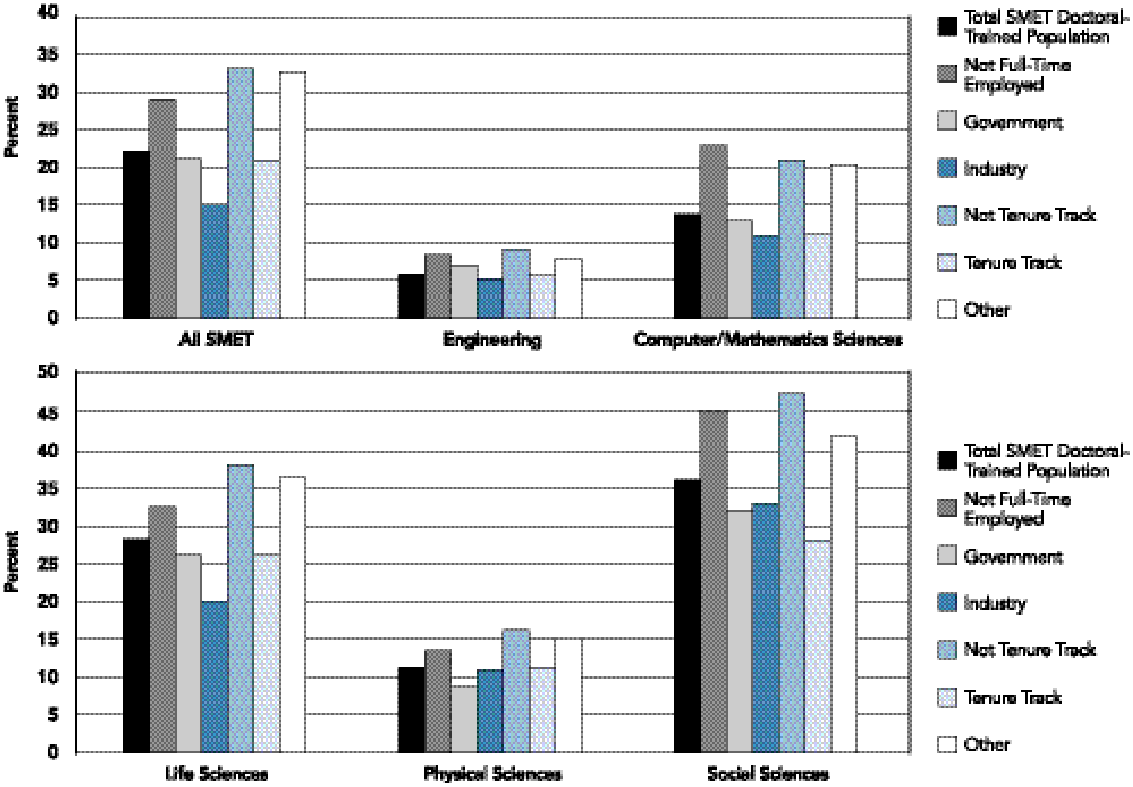
The composition of tenure-track faculty at U.S. universities and colleges corresponds fairly closely to the composition of the SMET doctorally-trained population: 20.5% of tenure-track faculty is female compared to 22.8% of the doctoral population. Likewise, the composition of SMET doctoral personnel working for the government reflects the composition of the doctoral population: 21.2% vs. 22.8%. Doctorally-trained women, however, are underrepresented in industry (15.4%) and overrepresented (32.9%) among "non-faculty"—those working at colleges and universities in non-tenure-track teaching, research associate, or postdoctoral positions. Indeed, approximately 1 in every 3 of those employed full-time in a "non-faculty" position was a woman, as were those in the "other positions" (i.e., full-time employment in educational institutions other than four-year colleges and universities and in the non-profit sector).

Disproportionate employment of women in the non-faculty and "other" sectors suggests that women have less access to career paths that foster research independence and are heavily concentrated instead in positions that lack permanence and often the ability to follow an independent research agenda. With a few exceptions, these patterns hold when the SMET fields are disaggregated.

Among tenure-track faculty, women are consistently more likely to be found in the junior than senior ranks. In the natural sciences and engineering, for example, in 1995 women made up only 12% of the senior faculty (associate and full professors) at U.S. universities and four-year colleges; among the top 90 U.S. research universities, less than 10% of senior faculty in these disciplines were women {56}.

The plight of female faculty, especially in senior positions, drew widespread attention in 1999 when the Massachusetts Institute of Technology (MIT) released a report admitting widespread practices that adversely impacted the research careers of women within the university. At the time that MIT began its investigation (initiated by female faculty) there were only 14 tenured women among a total tenured faculty of 280. Senior female faculty complained of subtle differences between

Figure 6-2: Percentage Representation of Women Within Labor Force Sectors and Selected Degree Fields, 1997



Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

the circumstances of men and women, that lab space, university research awards, teaching loads, and departmental support favored senior male faculty. For instance, in one MIT department senior male faculty had roughly 95 square meters more lab space than their female peers {56}.

Differences in salaries between men and women only reinforce the skewed picture of the doctorally-trained workforce. (Figure 6-3, 6-5 and 6-7) shows the median salaries of SMET workers with doctorates employed full-time in 1997 by gender, disability status, and race/ethnicity. In 1997, the median salary for SMET doctorates employed full-time was $67,000 for men, compared to $50,500 for women. (Figure 6-3) {55}. The gap is largest in the life, physical, and social sciences and smallest in computer and mathematical sciences and engineering.

To summarize, the evidence indicates that women in the SMET full-time workforce disproportionately make up the non-tenure-track academic and "other" workforce and on average receive lower salaries than men. Women are also more likely than their male counterparts to be in the non-full-time workforce. Of SMET doctorate recipients employed part-time in 1997, women accounted for almost 30%. A variety of factors contribute to doctorally-trained women being overrepresented in these frequently less rewarding careers. These include a lack of family-friendly policies in traditional academic and industry workplaces and an absence of programs designed to provide the non-faculty workforce opportunities to develop independent research agendas. In addition, as noted in Chapter 5, gender differences can be explained, in part, by differences in the age distribution of men and women in the SMET workforce.

6.2 Minorities Take a Different Academic Path

The traditional career path for doctoral recipients has been a tenure-track position in academe. Considering underrepresented minorities as a group, Figure 6-4 shows that, in 1997, underrepresented minorities were more likely to find full-time tenure-track positions than to be employed in non-tenure track positions within academia and in “other” positions. Underrepresented minorities are less likely to be outside the full-time workforce and to be in the industrial sector than are other members of the doctoral population. The traditional career path for doctorate recipients has been a tenure-track position in academe. Figure 6-4 {55} shows that, in 1997, underrepresented minorities were relatively likely to find full-time tenure-track positions when compared to race/ethnic groups that are not considered underrepresented (whites and Asian Americans). Underrepresented minorities are also relatively likely to be employed in non-tenure track positions within academia and in “other” positions. Underrepresented minorities are less likely to be outside the full-time workforce and to be in the industrial sector than are other members of the doctoral population.

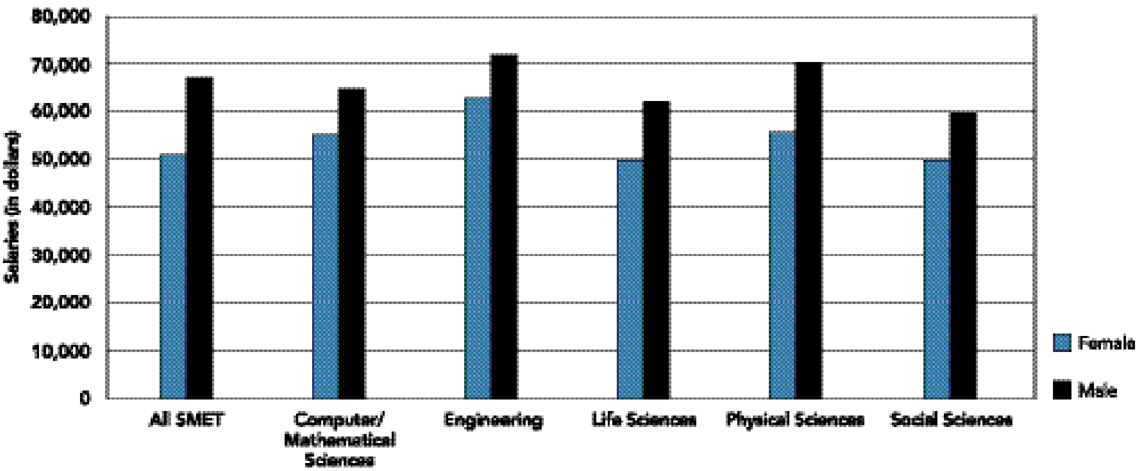
The high rate of employment in traditional career positions among underrepresented minorities holds within broad degree fields. It is likely that at least some of the reason for the success of underrepresented minorities on this measure is attributable to extraneous factors such as the relatively young age of the doctorally-trained underrepresented minority population. It is also quite possible that the difference

One Woman’s Impressive Contribution

Gail K. Naughton, President and COO of Advanced Tissue Sciences, is a co-founder of this company and co-inventor of its core technology. At age two, a toddler named Dominic suffered serious burns from spilling boiling coffee on his neck and chest. Dominic would typically require twice daily painful dressing changes, up to two weeks of hospitalization, and terrible scarring.

Dominic was the first patient to receive TransCyte™, a tissue engineered burn treatment which Gail Naughton co-invented. Within minutes of TransCyte application, Dominic was pain-free, and he was able to go home with parents the same day. The Dominics of the world would not be receiving the benefits of tissue engineering if not for Dr. Naughton. How many other life-changing technologies are not being developed due to the underutilization of the talents of scientists and engineers such as Gail Naughton, who are women, minorities, and persons with disabilities?

Figure 6-3: Median Salaries (in dollars), Full-Time Employed SMET Doctorates, by Field and Gender, 1997



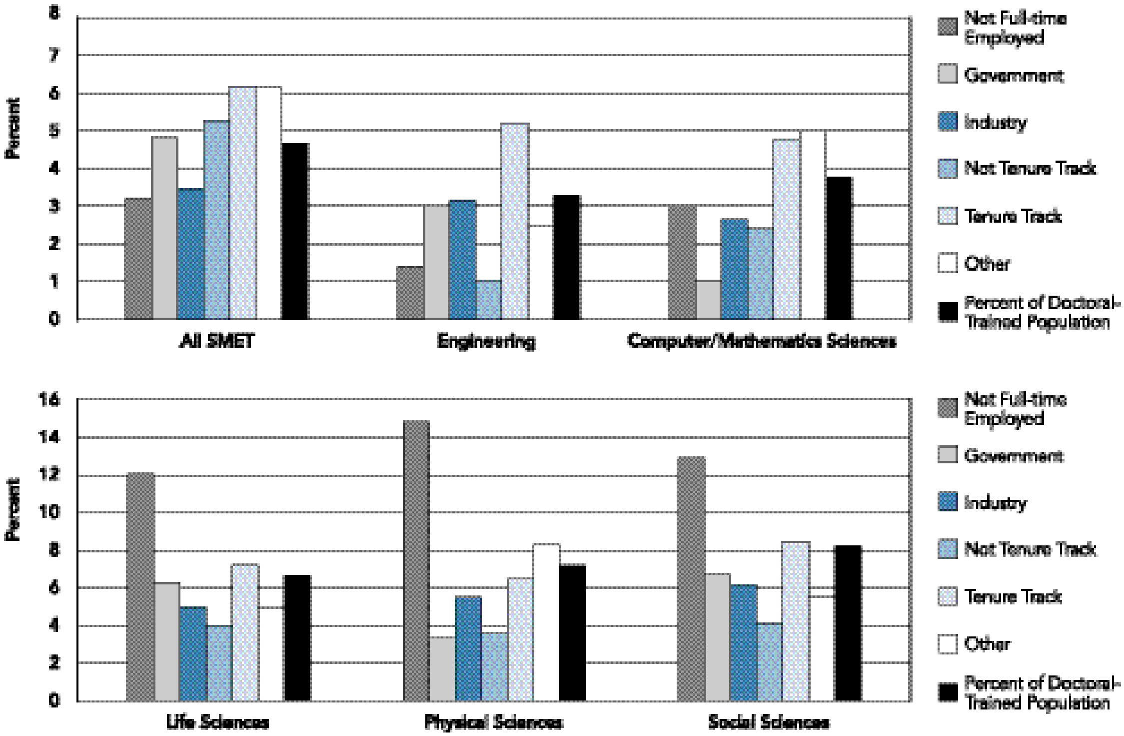
Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

reflects successful affirmative action policies within academia. Or it may reflect a strong desire on the part of these individuals to enter academic positions where they can act as role models for young people. Still given their extremely low representation in the overall Ph.D. - trained population—fewer than 1 in 33 of U.S. tenure-track faculty are African American and fewer than 1 in 40 Hispanic Americans—students remain extremely unlikely to be taught by an underrepresented minority.

While employment patterns for underrepresented minority members have mimicked to some extent those for whites, salary patterns suggest very different labor market rewards across race/ethnic groups among the doctoral population (see Figure 6-5) {55}. For all SMET fields in 1997, the median annual salary for whites was $9,000 more than for Hispanic Americans and $7,000 more than for African Americans. Native Americans earned substantially less than all other underrepresented minorities, while Asian Americans earned median salaries closely resembling those of whites, except in the social sciences and life sciences where the differences were $7,000 and $10,000 less, respectively. The gap between whites and underrepresented minorities was narrowest in engineering, followed closely by mathematics and computer sciences, and widest in the physical and social sciences. A portion of the salary gap can be explained by differences in job experience due to age, as minorities in the SMET workforce are typically younger than their white counterparts. {55}

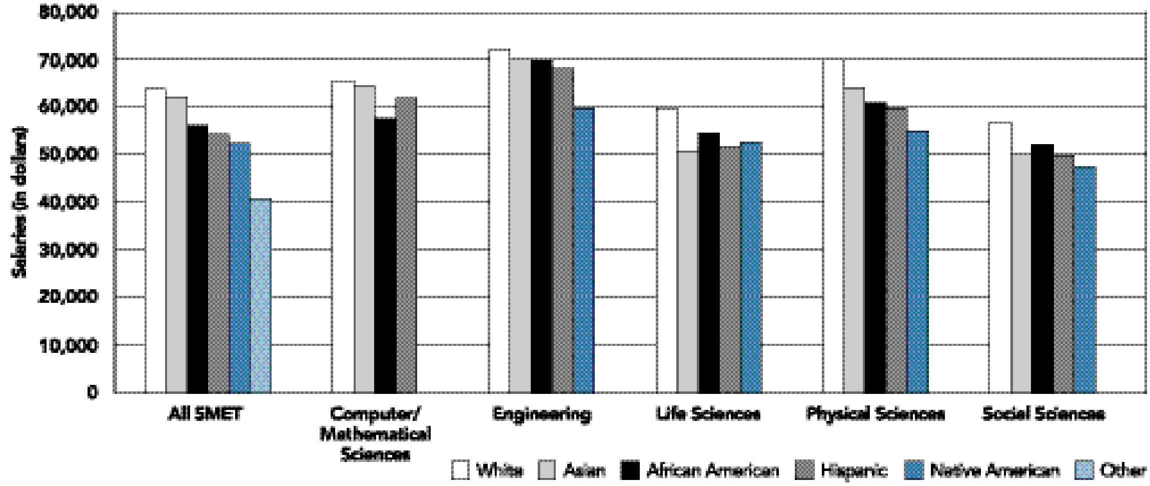
The low number of Hispanic Americans and African Americans in the SMET workforce can be changed only by increasing the flow from these populations into the doctorally-trained workforce. Policies to achieve that include ensuring the widespread availability and enhancement of SMET educational opportunities in grades K-12 to equip all students with the skills and interests required to pursue doctoral training.

Figure 6-4: Percent Within Each Sector



Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

Figure 6-5: Median Salaries (in dollars), Full-Time Employed SMET Doctorates, by Race Ethnicity, 1997



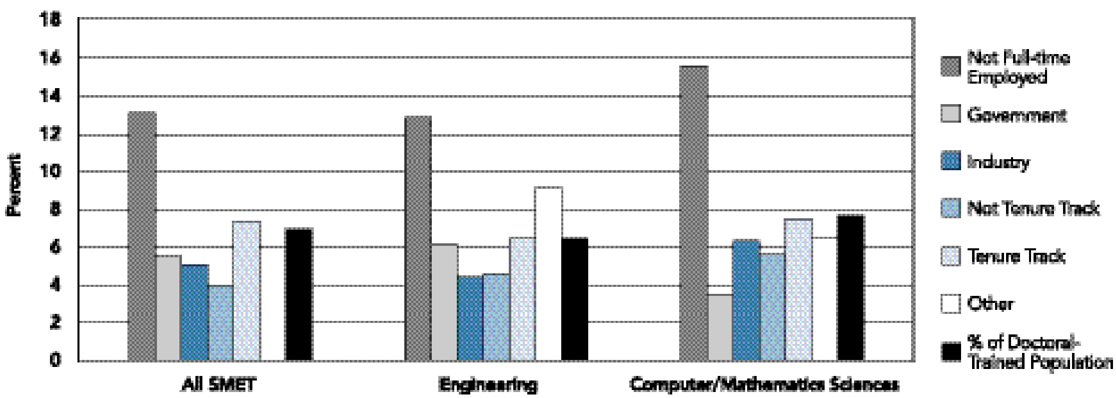
Note: Other category is suppressed due to small sample size.

Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

6.3 Full-Time Employment Less Likely for Persons with Disabilities

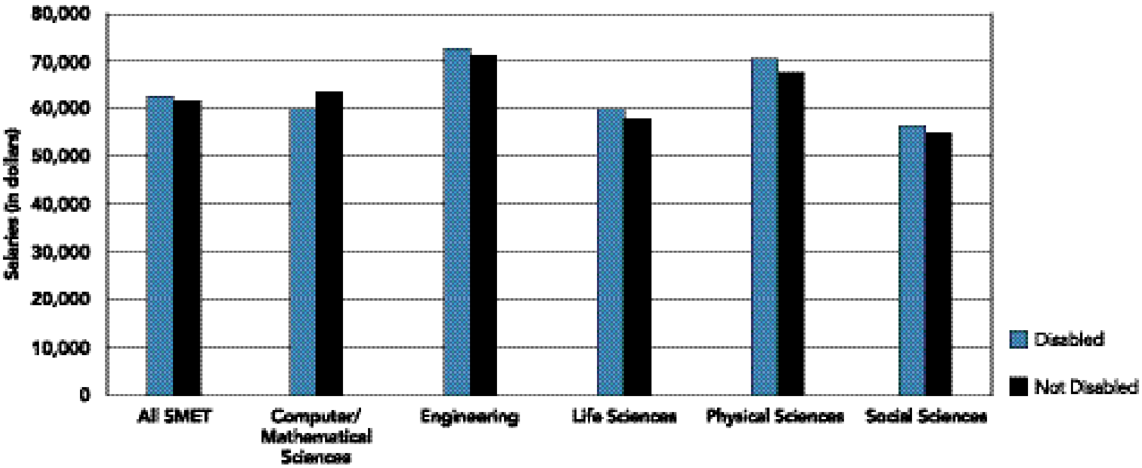
The limitations on available data on persons with disabilities allows only a limited view of their labor force experiences. (See sidebar on page 11) Figure 6-6 {55} shows the share of SMET doctoral recipients for different labor force sectors by disability status and educational field in 1997. Persons with disabilities are less likely to be employed full-time than are individuals without disabilities. Despite this, persons with disabilities are relatively on par in tenure-track academic positions, comprising 7.3% of SMET doctorates and 7.5% of full-time workers in tenure-track positions. Those with disabilities are modestly underrepresented in industry and government, where their share of employment for all SMET fields ranged from 5.4–5.7%.

Figure 6-6: Persons with Disabilities Within Employment Sectors and Selected Degree Fields, 1997



Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

Figure 6-7: Median Salaries (in dollars), Full-Time Employed SMET Doctorates, by Disability Status, 1997



Source: National Science Foundation/SRS, *Survey of Doctorate Recipients, 1997* {55}.

Underrepresentation in government is noticeably more pronounced in mathematics and computer sciences and in the physical sciences.

In terms of median salary (see Figure 6-7) {55}, those with and those without disabilities earn much the same; only in mathematics and computer sciences did those with disabilities earn less (a difference of $4,000) than those without disabilities. One explanation for the slightly higher salaries among most SMET workers with disabilities is that the incidence of disability tends to increase with age, and thus many of those who self-report a disability may occupy more senior and higher-paid positions (see discussion of workforce participation rates among those with disabilities in section 5.3).{55}

What is most striking, however, is the number of persons with disabilities not employed full-time. In 1997, almost one-third of doctorally-trained individuals with disabilities were either out of the labor force, unemployed, or working part-time; more than one in eight of the "not-full-time" population consisted of persons with disabilities. This overrepresentation suggests that persons with disabilities may have difficulty in securing full-time employment. (There does not seem to be evidence among doctoral recipients that persons with disabilities trained in SMET fields leave SMET occupations at a significantly greater rate than those without disabilities. Persons with disabilities are not disproportionately leaving SMET, but are simply not choosing or receiving full-time employment).

Two avenues can improve the SMET workforce participation rates of persons with disabilities. First are continued efforts to educate institutions with regard to the contribution those with disabilities make in SMET. Funding incentives should be established to provide supplemental support to assist those with severe disabilities participating in the workforce. Second, advances in assistive technology should be incorporated into strategies to facilitate more individuals with disabilities in entering in the SMET workforce. These could include promotion of and training programs in both workplace-based equipment, such as voice recognition systems, automated Braille printout, and robotic devices, and in the new information technologies that allow research to be carried out virtually or through remote access.

7. Issues Internal To NSF

"*As we strive to improve opportunities in science, engineering, and technology for all citizens, we face challenges of inclusion and challenges of opportunity that are in many ways more complex and more subtle, and therefore more difficult to address... That is why we need a new strategy, a new direction, for human resource development in science and engineering.*"

Rita Colwell, Director,
National Science Foundation

As the federal agency charged with advancing science and engineering across the United States, it is incumbent upon NSF to provide equal opportunities both internally through staffing and administrative practices and externally in its grants programs and review criteria. One of NSF's primary goals is to foster the entire nation's scientific activity and discovery by expanding the preparation of and thus the science career choices available to all citizens, not just a select few. CEOSE believes that the regular presence of members of underrepresented groups as program directors, Advisory Committee members, and review panelists will not only help educate society as a whole, but also enable NSF to identify best practices that are appropriate to a diverse community. Similarly, the ways in which NSF designs programs and awards grants are critical to this mission. Diversity within all programs and in all practices is essential to broadening the participation of underrepresented groups.

In this chapter, we examine the demographics of senior NSF staff, Advisory Committees, and review panels in order to gauge whether directorates and divisions are actively seeking to include members of underrepresented groups. We also examine the number of awards compared to the number of proposals submitted at the directorate and divisional levels. While the proposal success rate is not the only measure of NSF progress in this area, it is certainly one measure of the direct impact of NSF support on the communities served. Finally, we review current practices to embed diversity and broaden participation in all NSF programs and discuss the effects of these efforts in terms of outputs and outcomes, as defined by the Government Performance and Results Act (GPRA) (see sidebar to right).

7.1 Staffing for Diversity at NSF

The diversity among professional staff makes a broad statement about NSF's attention to diversity. Indeed, objectives of NSF's fiscal year 2000-2005 Strategic Plan include increasing the quality, number, and percentage

Government Performance and Results Act (GPRA): History and Terminology

In 1993, Congress determined that waste and inefficiency in Federal programs was hampering government performance. In response, Congress passed the Government Performance and Results Act (GPRA), which holds Federal agencies accountable for meeting agency-defined goals. The legislation mandates a variety of measures, to streamline the workings of the Federal Government and improve public satisfaction with Federal programs.

As a result of GPRA, agencies such as NSF are required to submit a strategic plan to the Office of Management and Budget, and Congress, every three years. The strategic plan addresses agency missions and goals for a given fiscal year and five years into the future. The agencies are required to submit annual performance plans that outline the year's goals and determine if those goals are realized. If necessary, actions for meeting or modifying the original goals will be addressed.

The following terms are often used to describe GPRA goals:

Performance Goal: A measurable objective, such as increasing minority participation in SMET fields.

Input: The resources available to an agency for implementing a program. Inputs can include employees, funding, equipment, facilities, etc.

Output: The goods or services produced by a program. The mentorship that is provided to minority SMET undergraduates as part of the NSF Division of Human Resource Development, *Historically Black Colleges and Universities Undergraduate Program* would be considered an output.

Outcome: Program results; how well a program performed in relation to its stated performance goals.

Impact: The direct or indirect effects of a program. Agencies often measure impact by comparing program results to a hypothesized outcome resulting from the program's absence. For example, if SMET baccalaureates awarded to minorities increase over the several years that the *Historically Black Colleges and Universities Undergraduate Program* is active, it can be asked if there would be an increase without the program?

References:
Government Performance and Results Act of 1993{57}; Primer on GPRA Performance Management, Office of Management and Budget, Revised Feb. 25, 1995 (Web Document){58}; and GPRA Strategic Plan FY 2001-2006, National Science Foundation, September 30, 2000 {59}.

Table 7-1: Total Number of Staff and Percentage of Women, Underrepresented Minorities, and Persons with Disabilities Among NSF Staff with Decision-Making Responsibilities, 1999

NSF Directorate	Total Staff	Percentage of Women	Percentage of Underrepresented Minorities	Percentage of Persons with Disabilities
BIO – Directorate for Biological Sciences	59	49%	7%	2%
CISE – Directorate for Computer and Information Science and Engineering	39	21%	3%	NA*
EHR – Directorate for Education and Human Resources	91	53%	27%	1%
ENG – Directorate for Engineering	66	24%	8%	NA*
GEO – Directorate for Geosciences	64	30%	2%	NA*
MPS – Directorate for Mathematical & Physical Sciences	84	18%	12%	NA*
SBE – Directorate for Social, Behavioral and Economic Sciences	92	49%	8%	1%
OD – Office of the Director	49	35%	8%	2%
Total	547	36%	10%	<1%

Source: National Science Foundation, Internal Data {64}.
* Numbers are not available (NA)

of U.S. degree recipients from underrepresented groups and expanding their participation in NSF research and education programs {13}. The Foundation's recruiting strategies include efforts to attract applicants from groups underrepresented in science and engineering, such as participation in job fairs targeted to underrepresented groups, targeting vacancy announcements to institutions and publications primarily serving underrepresented groups, and direct networking {12}. This section discusses diversity among all decision-making staff at NSF for FY 1999.

Women

In some disciplines in the Biological Sciences (BIO) and Social, Behavioral and Economic Sciences (SBE) directorates, the participation of female researchers has grown considerably in the last two decades. As shown in Table 7-1 {64}, for BIO, SBE, and Education and Human Resources (EHR), the proportion of women in decision-making staff positions (i.e., assistant director, program director, program officer, or senior executive) is about half (49% for BIO and SBE, and 53% for EHR). For other directorates, the number of women is closer to one-fifth (18% in Mathematical and Physical Sciences [MPS], 21% in Computer and Information Science and Engineering [CISE]) and 24% in Engineering [ENG]. Not surprisingly, the ranking of the directorates with respect to female representation in decision-making positions generally reflects similar statistics for female representation within the doctoral population discussed in Chapter 6.

Overall, women hold approximately 36% of the decision-making staff positions at NSF (i.e., assistant director, program director, program officer, or senior executive). This compares favorably with the percentage of women in the U.S. doctorally-trained SMET population (24% in 1999).

Minority Groups

As indicated in Table 7-1, the percentage of underrepresented minorities in decision-making staff positions (i.e., assistant director, division director, or program director) is considerably lower than that of women. They range from a high of 27% in EHR to lows of 2% and 3% for Geosciences (GEO) and CISE, respectively. Overall, the percentage of underrepresented minorities among decision-making staff at NSF in 1999 was 10%. The corresponding percentage for underrepresented minorities in the doctorally-trained SMET population in 1999 was 5%.

Persons with Disabilities

Little data are available for staffing with respect to persons with disabilities. Table 7-1 shows figures of 1-2% for several directorates. However, it should be cautioned that disability data are based on self-reports of

Table 7-2: FY 2000 Advisory Committee Demographics, by Directorate

NSF Directorate	Number of Advisory Committee Members	Percentage of Women	Percentage of Underrepresented Minorities
BIO – Directorate for Biological Sciences	15	40%	13%
CISE – Directorate for Computer and Information Science and Engineering	14	14%	7%
EHR – Directorate for Education and Human Resources	17	41%	41%
ENG – Directorate for Engineering	33	21%	21%
GEO – Directorate for Geosciences	31	35%	0%
MPS – Directorate for Mathematical & Physical Sciences	17	18%	12%
SBE – Directorate for Social, Behavioral and Economic Sciences	29	48%	17%
OD – Office of the Director	48	44%	13%
National Science Board	41	34%	10%
Total	245	35%	14%

Source: National Science Foundation, Internal Data.

severe disabilities, as defined by the U.S. Office of Personnel Management, and therefore may underreport these figures in actuality.

7.2 Reviewers And Advisors

Much of NSF's work is performed by scientists and engineers who act as reviewers for and advisors to NSF. Unfortunately, the available demographic information about these individuals is quite limited, either because NSF has not made a concerted effort at tracking the information and/or because requested information has not been provided.

The only reliable demographic information about panelists that is available is their gender. Among the 95% of panelists reporting this information in FY 1999, 26% were women.

Only 3 divisions within NSF reported having any Special Emphasis/Advisory Panel members with disabilities: 2 of 84 members of Civil and Mechanical Structures panels, 1 of 276 members of Design, Manufacturing, and Industrial Innovation panels, and 2 of 31 members of Human Resource Development (HRD) panels. However, these low figures may constitute a significant underestimation of the actual disability rate, because of the reporting problems discussed above.

Each year Directorate Advisory Committees—composed of experts in academia, industry, and government—review Committee of Visitors 5 (COV) reports, external evaluations, and directorate annual reports with the combined purposes of providing advice for strategic planning and systemic programming and judging program and directorate effectiveness. Across NSF directorates in FY 2000, 35% of Advisory Committee members were women (See Table 7-2). {64} Their representation in individual directorates ranged from 14% for CISE to 48% for SBE. With regard to race/ethnicity, 14% of all Advisory Committee members were underrepresented minorities, with a range in individual directorates from 0% for GEO up to to 41% for EHR. Fewer than 1% of all individuals on NSF Advisory Boards reported having a severe disability.

7.3 Current Program and Review Practices with Respect to Diversity

NSF's practices to ensure diverse representation in its programs have changed in the past few years. New review criteria, data collection systems, and programs have enabled the Foundation to address more directly issues of equal opportunity in science and engineering. In this section, we discuss these changes as they relate to diversity.

Merit Review Criteria

NSF's merit-based review process (see sidebar on page 40) includes evaluation of proposed grants on "broadening opportunities and enabling the participation of all citizens – women and men, underrepresented minorities, and persons with disabilities…."

In FY 1999, 95% of funds were allocated to projects

A Diverse, Globally Oriented Workforce

Since FY 1999, NSF's first full year of implementation for GPRA, the agency has shown progress towards meeting its goals. One of the desired GPRA Strategic Outcomes is "A diverse, globally-oriented workforce of scientists and engineers." Committee of Visitors and Advisory Committee reports have rated NSF as generally successful in meeting these goals, although they emphasize that additional progress will be necessary.

In 1999, progress was demonstrated in the awarding of Graduate Research Fellowships to 900 graduate students, of whom 49% were women and 8% minorities. In addition, in that same year Collaborative Teacher Preparation programs enrolled nearly 74,000 undergraduates and post-baccalaureate students, 58% of whom were women and 30% from underrepresented minority groups.

For FY 2000, the Division of Human Resource Development's Annual Report highlights additional successes for underrepresented minorities. The Alliances for Graduate Education and the Professorate (AGEP) program reports increases in the participation of underrepresented groups at the doctoral level. For example, the University of California at Irvine reported an increase of over 50% in first-year Ph.D. minority graduate enrollment in SMET fields. The University of Michigan enrolled 21 AGEP Fellows in SMET fields during the 1998-1999 academic year, representing a 34% increase in minorities entering these doctoral programs. Furthermore, the university saw a 50% increase in minority Ph.D. graduates in SMET fields from 1998 to 1999.

The NSF FY 2001 GPRA Performance Plan (February 2000) declares a new performance goal: to increase the total number of hires to SMET positions from underrepresented groups over 1997 (in FY 1997, there was a baseline of 54 hires, 22% female and 19% from underrepresented groups). These strategies include a focus on encouraging new applicants and proposals among women and minorities, attending to diversity as one of the elements of merit review criteria, developing and increasing funding for specialized programs to promote diversity, and embedding diversity in all NSF programs. The plan also stipulates that trend data will be kept on the actual numbers of new hires as well as the aggregate numbers of underrepresented groups.

Source: FY 1999 National Science Foundation GPRA Performance Report {60};, 2001 National Science Foundation GPRA Performance Plan (February 2000){61}; ,and FY 2000 National Science Foundation Division of Human Resource Development's Annual Report {62}.

subjected to merit review, compared to 89% in FY 1997 and 90 percent in FY 1998. In addition in FY 1999, 33 of 36 Committees of Visitors (COV) reports and 3 of 8 Advisory Committee (AC) reports rated NSF as successful in achieving a GPRA goal of using established merit review criteria. While these ratings are encouraging, they generally do not provide separate information about how well reviewers are doing on the specific element of integrating diversity into NSF Programs, Projects, and Activities. In the future, CEOSE encourages NSF's COVs and Advisory Committees to provide specific ratings of how well reviewers do in using the specific merit review element of integrating diversity into NSF Programs, Projects, and Activities in order that progress in this area can be directly tracked.

An example of the importance of the COV reports as a catalyst for change is provided by the Directorate for Engineering. Staff are addressing COV concerns that both principal investigators and reviewers pay too little attention to Criterion 2 when developing and reviewing proposals. The directorate has asked reviewers to consider more closely the embedding of diversity into NSF programs, projects, and activities.

Greater understanding and application of the diversity and other merit-review requirements are expected as program announcements make these requirements more explicit and as more guidance is provided to reviewers in using the criteria to evaluate proposals.

FastLane

FastLane is a proposal submission and data collection system designed to make NSF a paperless environment. The online system comprises a collection of modules intended to help all directorates streamline interactions with the research community. The relevant GPRA performance goal for FY 1999 was that 25% of full proposal submissions would be received and processed electronically: in fact, nearly twice as many (44%) were submitted electronically. The FY 2001 performance goal for FastLane is that 95% of full proposals will be received electronically.{59} While FastLane has the capability to collect data regarding women, minorities, and persons with disabilities, priorities have been placed on expanding its overall use, and these data have not been monitored to date. As FastLane matures, CEOSE encourages NSF to institute procedures that will permit

Table 7-3: NSF Funding Success Rates for Women and Minorities, FY1998 to FY2000

		Funding Success Rates		
Directorate	Year	All PIs	Female PIs	Minority PI
BIO	2000	29%	33%	32%
	1999	29%	29%	37%
	1998	29%	28%	36%
CISE	2000	31%	36%	30%
	1999	33%	34%	35%
	1998	35%	33%	26%
HER	2000	35%	35%	37%
	1999	29%	32%	25%
	1998	34%	44%	31%
ENG	2000	25%	32%	22%
	1999	27%	27%	26%
	1998	25%	30%	21%
GEO	2000	39%	41%	35%
	1999	38%	35%	24%
	1998	37%	32%	28%
MPS	2000	39%	39%	42%
	1999	37%	37%	33%
	1998	35%	33%	30%
SBE	2000	38%	33%	32%
	1999	30%	30%	29%
	1998	41%	37%	35%

Source: National Science Foundation, Internal Data {64}.

collecting more accurate data about the application rate, success rate, and grant size of groups based on gender, race/ethnicity, and disability status.

Transitions from Focused Programs to Embedded Diversity

Perhaps NSF's most dramatic shift with respect to providing equal opportunity in science and engineering has been a shift from providing programs specifically targeted to women, minorities, or persons with disabilities to embedding diversity in all of its programs.

In 1980, legislation charged NSF with addressing issues of equal opportunity, reflecting the underrepresentation of women, minorities, and persons with disabilities in the sciences. This was pursued largely through developing programs explicitly for women, minorities, or persons with disabilities. Recently, however, NSF has taken steps to ensure that all its programs serve underrepresented groups. New announcements of opportunities and proposal solicitations include statements asking proposers to take steps to improve the participation of underrepresented groups in their activities.

Much of the activity to embed diversity has taken place in the Divisions of Human Resource Development (HRD) and Division of Undergraduate Education (DUE) in EHR. Strategies for increasing the participation of women include research on pre-college and undergraduate barriers and enablers, demonstration projects at the pre-college and undergraduate levels, and direct support of graduate students and faculty. For minorities, these divisions are focusing on institutional capacity building in research and education, alliances of undergraduate and graduate institutions in partnership with industry and national laboratories, and direct support of students and faculty. Finally, with respect to persons with disabilities, HRD is conducting research on pre-college and undergraduate barriers and enablers, demonstration projects at the pre-college and undergraduate levels, direct support of facilitation aids, and research on assistive technologies. DUE also supports a few demonstration projects.

7.4 Proposals and Awards

In view of NSF's FY 2001 GPRA goal to increase the involvement of women, underrepresented minorities, and persons with disabilities, the distribution of research grants for FY 1998, 1999, and 2000 is a relevant indicator of expanding opportunities for underrepresented groups. (Involvement refers to persons named as principal investigators (PIs) or co-PIs on the proposal, but it should be noted that their gender and race/ethnicity do not necessarily represent the populations being served. In some cases, project PIs may distribute funding to other researchers or may lead projects in areas designated as underserved or with concentrations of underrepresented minorities.)

In FY 1998, 5,785 competitive research grants were awarded. Of these, 990 (17%) were awarded to women and 210 (4%) were awarded to underrepresented minorities (researchers who are both women and underrepresented minorities are duplicated in these figures). In FY 1999, 6,015 competitive research grants were awarded, with 1,030 (17%) awarded to women and 239 (4%) to underrepresented minorities. In FY 2000, 6,505 grants were awarded; of these, 1,173 (18%) were awarded to women and 286 (4%) to minorities.

Funding rates of proposals are also an important indicator of opportunities for women and underrepresented minorities. For FY 1999 the overall funding rate was 32%, and during the recent 3-year period, the funding rates for minorities and for women have not changed dramatically. The FY 1999 Report on the NSF Merit Review System also found that:

- The funding rates for proposals from minority PIs were below the NSF average in FY 1999, and have been for 7 of the past 8 years. The number of proposals received yearly from minority PIs has decreased by 5% since FY 1992.
- Since FY 1992, the funding rates for proposals received from female PIs and male PIs have been similar. The number of proposals received from female PIs increased by 19% during that 7 year period.

The following observations can be made regarding funding success rates within NSF directorates during the period FY 1998 to FY 2000 that are contained in Table 7-3 {64}:

- In FY 2000, women PIs had success rates that were equal to or higher than those of their male colleagues in all directorates except SBE. This stands in marked contrast to FY 1998, when five of the seven directorates reported women having lower success rates than men.
- In FY 2000, the minority success rate was higher than the total success rate in 3 of the 7 directorates in comparison with FY 1998, when only 1 of the directorates (BIO) reported minority members with above average success rates.
- The overall finding rate in 2000 ranged from 25% to 39% across directorates, with an even narrower range among women (32% to 41%) and a slightly larger range among minorities (22% to 42%).

New NSF GPRA performance goals for FY 2001 include:

NSF will begin to implement the mechanisms and approaches put forth in FY 2000 for increasing the number of women and underrepresented minorities in the proposal application pool.

NSF will begin to implement the approaches identified in FY 2000 for retaining women and underrepresented minorities in the proposal applicant pool.

- These strategies include a focus on obtaining new proposals from women and minorities, attending to diversity as one of the elements of merit review criteria, developing and increasing funding for specialized programs to promote diversity, and embedding diversity into all NSF programs.

- The FY 1999 performance goal for the use of merit review was that at least 90% of NSF funds be allocated to projects that are reviewed by external peers and selected through a merit-based competitive process.

Source: FY 1999 National Science Foundation GPRA Performance Report{60};, 2001 National Science Foundation GPRA Performance Plan (February 2000){61}; ,and FY 2000 National Science Foundation Division of Human Resource Development's Annual Report {62}.

NSF Grant Proposal Process

"We must embrace the concept of preparing our citizens to take advantage of opportunities. If we allow anyone to be left behind, we create a formula for our nation to be left behind. We are talking here about opportunities not only for individuals – we are talking also about ways to create expanded opportunities for the United States to participate, prosper and contribute."

Joseph Bordogna, Deputy Director,
National Science Foundation

The current grant proposal guidelines provide the following instructions to potential grantees and reviewers:

Proposals received by the NSF Proposal Processing Unit are assigned to the appropriate NSF program for acknowledgment and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by 3 to 10 other persons outside NSF who are experts in the particular fields represented by the proposal. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Program Officers may obtain comments from assembled review panels or from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards.

Review Criteria

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 (NSB 97-72). The criteria are designed to be useful and relevant across NSF's many different programs, however, NSF will employ special criteria as required to highlight the specific objectives of certain programs and activities.

The merit review criteria are listed below. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will be asked to address only those that are relevant to the proposal and for which he or she is qualified to make judgments.

Criterion 1: What is the intellectual merit of the proposed activity?

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Criterion 2: What are the broader impacts of the proposed activity?

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

PIs should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to the above-described NSF merit review criteria. NSF staff will give these elements careful consideration in making funding decisions.

Integration of Research and Education

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- are essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

Reference: NSF Grant Proposal Guide (NSF 00-2) {63}.

8. Summary & Recommendations: NSF Should Be The Catalyst For Pursuing Full Participation

8.1 Summary

As SMET enrollments and degrees granted are decreasing in the United States as well as abroad, the employment of engineers and computer scientists is growing {43}. For example, during the past four years, actual engineering employment increased from 1,717,000 to 2,051,000 jobs, a growth of almost 20% {43}. For the SMET labor market as a whole, the U.S. Bureau of Labor Statistics predicts an increase in SMET jobs of 51% between 1998 and 2008—a growth rate three times faster than that for all occupations {43}.

Demographic trends indicate that by the year 2010, 68% of the new entrants into the U.S. labor force will be women and minorities {65}. For the United States to remain competitive in a global technological society, it must take serious steps to encourage these groups to enter SMET fields. National trends such as resistance to the backlash against affirmative action have created obstacles from within our own society to continued U.S. competitiveness. It is time for the nation to re-examine and reaffirm its policies of equal opportunity and access for all.

Now, more than ever, the nation needs to cultivate the scientific and technical talents of all its citizens. In a time when the U.S. economy is increasingly dependent on trained SMET workers, it is imperative that traditionally underrepresented human resources be engaged to contribute to such efforts. It is therefore incumbent upon NSF to fulfill its mandated role as the focal point of the nation's scientific discovery and education efforts. It must be the catalyst for pursuing the vision of a nation in which every segment of the population is empowered and enabled to participate fully in the SMET enterprise. CEOSE will continue to advise and guide NSF to by promoting a SMET advancement and dissemination paradigm that is inclusive of all citizens, regardless of gender, ethnicity, or disability status.

8.2 Recommendations

CEOSE's recommendations to NSF are as follows:

Pre-College Issues:

CEOSE recommends that NSF encourage and participate in the adoption and implementation at the state level of comprehensive school standards concerning mathematics and science curricula, mathematics and science teacher qualifications, physical infrastructure, technological assets, built environments, and assistive technologies.

CEOSE recommends that NSF 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 that serve the largest populations of minority students.

CEOSE recommends that, as science as a profession has poorly defined itself in the minds of American youth, NSF should participate actively in promoting and selling SMET, for example by defining and highlighting occupations, developing economic data on availability of positions and professional tracks, and developing salary structure information and comparisons.

CEOSE recommends that NSF fund aggressive, focused intervention efforts targeting women, underrepresented minorities, and students with disabilities at the high school level, at the transition into postsecondary education, and at the transition from community college into four-year degree programs.

CEOSE recommends that NSF collaborate extensively with the Department of Education and other federal agencies in further developing national math and science educational enrichment programs.

Higher Education Issues:

CEOSE recommends that NSF increase funding for intervention programs for women, minorities, and students with disabilities at the undergraduate and graduate levels.

CEOSE recommends that NSF increase funding to build the institutional infrastructure to support underrepresented groups, including both the policy and procedural framework for relevant programs and technological advances that would broaden access for those with disabilities.

CEOSE recommends that NSF continue programs to enhance collaborations between major research institutions and institutions serving minorities.

CEOSE recommends that NSF establish clear lines of responsibility and define effective accountability mechanisms for each program from K-12 through graduate education in the "diversity continuum" (i.e., USI, LSAMP, GK-12, AGEP, ADVANCE, AGEP, GK-12, LSAMP, USI). CEOSE recommends that each program in this portfolio be evaluated periodically against the criteria under which it was established and that any program not meeting the stated objectives in a reasonably projected time frame be overhauled or eliminated.

CEOSE recommends that NSF assess the impact of discontinuing the Minority Graduate Fellowship Program and pursue new strategies to provide support to minorities at the graduate level.

CEOSE recommends that NSF fund research on barriers to minority graduate degree attainment and design programs to address the identified barriers.

Workforce Issues:

CEOSE recommends that NSF strongly consider the "center" model for its upcoming *Workforce Initiative*. NSF has a long history of excellent programmatic activities using this model, and the attributes which characterize centers—clear statements of objectives, embedded assessment and evaluation, and finite duration—are all worthwhile qualities to replicate in the Workforce Initiative.

CEOSE recommends that NSF institute an award to recognize exemplary achievement of SMET workplace diversity by employers in business, government, and academia. This award could be patterned after the existing Presidential Awards for Excellence in Science, Mathematics, and the Engineering Mentoring program.

Internal NSF Issues:

CEOSE recommends that NSF continue to seek an equitable distribution of underrepresented minorities, women, and persons with disabilities at all staff levels throughout the Foundation.

CEOSE recommends that NSF collect demographic data on review panelists and Committees of Visitors in an effort to maintain the diversity of review panels and ad hoc reviewers.

CEOSE recommends that NSF consider targeting some research funding to provide eligibility to non-tenured-track principal investigators to achieve a higher level of female and minority participation.

CEOSE recommends that NSF require written comments on both Criteria 1 and Criteria 2 on proposal submissions (electronic form), and that any proposals that fail to address both criteria be considered unacceptable.

CEOSE recommends the implementation of an annual NSF-wide quantitative assessment of the effectiveness of the implementation of Criteria 2.

CEOSE recommends that NSF should continue the policy of *embedding diversity* at all levels and in all programs throughout the Foundation, and that it delineate strategies for implementing this policy and establish measures of accountability.

CEOSE believes strongly that if NSF is willing to invest the time and resources called for by these recommendations, the Foundation will indeed serve as the catalyst required to support the achievement of a domestic SMET workforce that achieves parity while meeting the nation's strategic needs.

Looking Ahead

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. CEOSE believes NSF should 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.

References

{1} *Ensuring a Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century*, National Science and Technology Council, April, 2000.

{2} *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{3} Bureau of Labor Statistics, 1999, in *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{4} U.S. Census Bureau, *Statistical Abstract of the United States: 1998, within Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{5} Bureau of Labor Statistics, retrieved from Historical Labor Force tables at http://stats.bls.gov/emplab1.htm, in *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{6} National Science Foundation, Science Resource Studies, SESTAT 1997, in *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{7} G. Vernez, R. Kropp, and C. Rydell, "Closing the Education Gap: Benefits and Costs," (MR-1036-EDU), Rand Corporation Report, 1999.

{8} G. Campbell, "Support Them and They Will Come," *Issues in Science and Technology*, Winter, 1999.

{9} *Senior Management Teams: Profiles and Performance, Survey Summary of Key Findings*, American Management Association, 1998.

{10} *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1998*, National Science Foundation, February, 1999.

{11} Government Performance and Results Act, 1993.

{12} *National Science Foundation GPRA Strategic Plan: FY 2000-2005*, National Science Foundation, February, 2000.

{13} *NSF Strategic Plan: FY 2000-2005,* National Science Foundation, January, 2000.

{14} "SAT Math Scores for 2000 Hit 30-Year High," *The College Board News*, October 30, 2000.

{15} *NAEP 1999 Trends in Academic Progress: Three Decades of Student Performance*, U.S. Department of Education, National Center for Education Statistics, Office of Educational Research and Improvement, 2000.

{16} *Pursuing Excellence: A Study of U.S. 12th Grade Mathematics and Science Achievement in International Context*, (NCES 98-049), U.S. Department of Education, National Center for Education Statistics, 1998.

{17} National Center for Education Statistics, *Pursuing Excellence: Comparisons of International Eigth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1996*, U.S. Depertment of Education, Washington, D.C.

{18} J. Day, *Population Projections of the United States by Age, Sex, Race, and Hispanic Origin: 1995 to 2050*, U.S. Census Bureau, 1996.

{19} U.S. Department of Commerce, 1999; 2035 projections: U.S. Department of Commerce, 1996; within *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{20} U.S. Department of Commerce, 1996, within *Land of Plenty*, Commission for the Advancement of Women and Minorities in Science, Engineering and Technology, July, 2000.

{21} *NAEP High School Transcript Study*, U.S. Department of Education, National Center for Education Statistics (NCES), Office of Educational Research and Improvement, 1998.

{22} *Confronting the Odds: Students at Risk and the Pipeline to Higher Education*, U.S. Department of Education, National Center for Education Statistics, 1996.

{23} *1998 Biennial Report to the United States Congress*, NSF Committee on Equal Opportunities in Science and Engineering.

{24} *The Condition of Education 2000*, National Center for Education Statistics (NCES), U.S. Department of Education, Office of Educational Research and Improvement, 2000.

{25} "College-Bound Students Set Records in Racial and Ethnic Diversity, Precollege Credit, and Grades" *The College Board News*, September 1, 1998.

{26} "Selections from the 2000 National Score Report," American College Testing (ACT), 2000.

{27} Rolf K. Blank and Doreen Langesen, *State Indicators of Science and Mathematics Education 1999*. Council of Chief State School Officers, Washington, D.C., 1999.

{28} *21st Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act*, U.S. Department of Education, Office of Educational Research and Improvement, 1999.

{29} *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1996*, National Science Foundation, February, 1997.

{30} *Digest of Educational Statistics*, U.S. Department of Education, National Center for Education Statistics. 1999.

{31} National Postsecondary Student Aid Study, 1995-1996 (NPSAS:96), U.S. Department of Education, National Center for Educational Statistics, 1996.

{32} Commission on Professionals in Science and Technology, data derived from Engineering Workforce Commission, Engineering and Technology Enrollments Fall 1990 through 1998.

{33} Commission on Professionals in Science and Technology, data derived from Engineering Workforce Commission, Engineering and Technology Degrees 1990 through 1999.

{34} Susan T. Hill, *Science and Engineering Degrees: 1966-97*, National Science Foundation, Division of Science Resources Studies, 2000 (NSF 00-310).

{35} C. Strenta, et al., *Choosing and Leaving Science in Highly Selective Institutions: General Factors and the Questions of Gender*, Alfred P. Sloan Foundation, New York, 1993.

{36} Commission on Professionals in Science and Technology, data derived from Engineering Workforce Commission, *Engineering and Technology Degrees 1990 through 1999*.

{37} *Limited Progress: The Status of Hispanic Americans in Science and Engineering*, Commission on Professionals in Science and Technology, prepared by Eleanor L. Babco for the AAAS Alliances for Graduate Education and the Professorate (AGEP), March 2000.

{38} *Uphill Climb: The Status of African Americans in Science and Technology*, Commission on Professionals in Science and Technology, prepared by Eleanor L. Babco for the AAAS Alliances for Graduate Education and the Professorate (AGEP), September, 1999.

{39} G. Campbell, "Engineering and Affirmative Action: Crisis in the Making," NACME Research Letter, Special Edition, National Action Council for Minorities in Engineering, Inc., New York, 1997.

{40} *Women, Minorities, and Persons With Disabilities in Science and Engineering: 2000*, National Science Foundation, Division of Science Resources Studies, 2000 (NSF 00-327).

{41} "A Case Study of Persons with Disabilities Majoring in Science, Engineering, Mathematics, and Technology," SRI International, Menlo Park, CA, 1997.

{42} *National Education Longitudinal Study (NELS: 88/94), Methodology Report, Third Follow-Up*. National Center for Education Statistics, U.S. Department of Education, 1996 (NCES 96-174)

{43} *Science and Engineering Indicators*, National Science Foundation, 1998.

{44} Data from U.S. Department of Education/NCES, *Survey of Opening Fall Enrollment.*

{45} *Graduate Students and Postdoctorates in Science and Engineering: Fall 1998 [Supplemental Tables]* National Science Foundation, Division of Science Resources Studies, 2000. http://nsf.gov/sbe/srs/srs01302/htmstart.htm

{46} U. S. Bureau of the Census, *Graduate Students and Postdoctorates in Science and Engineering: Fall 1998 Supplemental Tables*, National Science Foundation, Division of Science Resources Studies, November 2000 (NSF 01-302).

{47} Susan T. Hill, *Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1989-97*, National Science Foundation, Division of Science Resources Studies, 2000 (NSF 00-311).

{48} *Women, Minorities, and Persons With Disabilities in Science and Engineering: 2000,* National Science Foundation, Division of Science Resources Studies, using data from U.S. Department of Education, National Center for Education Statistics, 1995–96 National Postsecondary Student Aid Study, data analysis system.

{49} H. N. Fullerton, Jr., "Labor force projections to 2008: steady growth and changing composition," *Monthly Labor Review*, Bureau of Labor Statistics, November, 1999: Vol. 122, No. 11.

{50} D. Braddock, "Occupational Employment Projections to 2008," *Monthly Labor Review*, Bureau of Labor Statistics, November, 1999: Vol. 122, No. 11.

{51} "How Large is the Gap in Salaries of Male and Female Engineers?" National Science Foundation, 1999 (NSF 99-352).

{52} National Science Foundation/Science Resources Studies, Tabulated data from Department of Education, National Center for Education Statistics, *Integrated Postsecondary Education Data System Completions Survey, and Survey of Earned Doctorates*, 2000.

{53} National Science Foundation, Division of Science Resources Studies, SESTAT (Scientists and Engineers Statistical Data System) 1997.

{54} *Statistical Abstract of the United States: 1998* U.S. Bureau of the Census.

{55} *Survey of Doctorate Recipients, 1997,* National Science Foundation/SRS.

{56} A. Lawler, "Tenured Women Battle to Make it Less Lonely at the Top," Science, vol. 286, November 12, 1999: pp. 1272-1278.

{57} Government Performance and Results Act of 1993.

{58} Primer on GPRA Performance Management, Office of Management and Budget, Revised Feb. 25, 1995 (Web Document).

{59} GPRA Strategic Plan FY 2001-2006, National Science Foundation, September 30, 2000.

{60} FY 1999 National Science Foundation GPRA Performance Report.

{61} 2001 National Science Foundation GPRA Performance Plan (February 2000).

{62} FY 2000 National Science Foundation Division of Human Resource Development's Annual Report.

{63} NSF Grant Proposal Guide (NSF 00-2).

{64} National Science Foundation Internal Data.

{65} *Changing America: the New Face of Science and Engineering*, Final Report of the Task Force on Women, Minorities, and the Handicapped in Science and Technology, National Science Foundation, 1989.

Membership List

National Science Foundation • Committee on Equal Opportunities in Science and Engineering (CEOSE)

Chair
Dr. Gary S. May
Professor
School of Electrical &
Computational Engineering
Georgia Institute of Technology

Vice-Chair
Dr. Suzanne G. Brainard
Executive Director
Center for Women in Science
and Engineering
University of Washington

Dr. Kenneth E. Barner
Associate Professor
Department of Electrical
and Computer Engineering
University of Delaware

Mr. C. Michael Gooden
President
Integrated Systems Analysts, Inc.

Dr. Paul N. Hale, Jr.
Associate Dean for
External Programs
Louisiana Tech University

Dr. Bruce A. Jackson
Adjunct Assistant Professor
of Biochemistry
Boston University School
of Medicine

Dr. Ken Pepion
Executive Director
Native American Program
Harvard University

Dr. Claibourne Smith
Vice President, Technological
& Professional Development
Experimental Station
DuPont Company

Dr. Paula E. Stephan
Associate Dean & Professor
of Economics
The Andrew Young School
of Policy Studies
Georgia State University

Dr. Beverly Wright
Director, Deep South Center
for Environmental Justice
Xavier University of Louisiana

Former Members
Dr. Arturo Bronson
Director, Materials Center
for Synthesis & Processing
University of Texas, El Paso

Dr. Lesia L. Crumpton
Associate Professor
Department of Engineering
Mississippi State University

Dr. Benjamin Hart
Professor
Department of Anatomy,
Physiology & Cell Biology
School of Veterinary Medicine
University of California, Davis

Dr. Emi Ito
Professor
Department of Geology
& Geophysics
University of Minnesota

Dr. Joe L. Martinez, Jr.
Director, Division of Life Sciences
University of Texas, San Antonio

Executive Liaison
Mr. John F. Wilkinson
Staff Associate for Workforce
Development
National Science Foundation

Executive Secretary
Dr. Bernice T. Anderson
Program Director
Division of Research,
Evaluation, and Communication
Directorate for Education
& Human Resources
National Science Foundation

Acknowledgements:

CEOSE would like to thank the following individuals and their organizations for their help in assembling this report.

Bernice Anderson, *Grant Black*, *Joseph Burrelli*, *Suzanne Harris*, *Joseph Hawkins*, *Jennifer Hoehn*, *Michelle Mc Murray*, *Laurie Plishker*, *Arthur Schening*, *Carolyn Shettle* and *Aimee Stern*. Organizations providing support included *NSF*, *Temple University's Institute for Survey Research*, *Potomac Communications Group* and *Westat*.

Office of the Director
National Science Foundation
Room 1205 North
4201 Wilson Blvd.
Arlington, VA 22230

PRESORTED STANDARD
POSTAGE & FEES PAID
National Science Foundation
Permit No. G-69

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.*