Committee on Equal Opportunities in Science and Engineering

1998 Biennial Report to Congress

Committee on Equal Opportunities in Science and Engineering*

1998 Biennial Report to The United States Congress

* An Advisory Committee to the National Science Foundation

EXECUTIVE SUMMARY

In order to maintain its global leadership, America must ensure our citizens can meet the demands of a more scientifically- and technologically-centered world. The National Science Foundation (NSF) has a key role in creating and maintaining the science, mathematics, engineering, and technology (SMET) capacity in this nation. The Committee on Equal Opportunities in Science and Engineering (CEOSE) has been charged by Congress with advising NSF in assuring that all individuals are empowered and enabled to participate fully in the science, mathematics, engineering, and technology (SMET) enterprise.

America's increasingly diverse society is challenging the adequacy of the current SMET education, research, and workforce support structure. Data indicate that differing rates of access to, and participation in, quality education and other opportunities in mathematics and science impede women, minorities, and persons with disabilities in the attainment of SMET degrees, workforce entry, and research participation.

The full report of CEOSE focuses on three primary areas of SMET programming at NSF: student-related issues from K-12 through higher education; educator-related issues including teacher preparation and the support of doctoral faculty; and fostering the national science and engineering workforce more broadly. The report also examines a number of the successful strategies employed by NSF as well as some of the emerging challenges that NSF faces in addressing the needs of an increasingly diverse constituency, and suggests expansion of specific internal and external practices that will further support our nation's readiness in SMET.

Among the key recommendations to NSF in this report are:

NSF Enablement of the Science and Engineering Enterprise

- Address emergent issues of access and the capacity to employ new technologies among underrepresented communities and persons with disabilities.

- Increase support for programs that foster partnerships among minority serving institutions (MSIs) and research institutions.

- Develop further the infrastructures (i.e., human capital and resource) of MSIs.

- Continue work in, and expand dissemination of, advanced curriculum and pedagogical development in conjunction with expanded programming in systemic reform initiatives.

- Continue activities that prepare teachers with the technological foundation needed to enhance our educational system within the K-12 sector.

- Increase support for programs that enable the development and the success of women, underrepresented minorities and persons with disabilities in faculty positions.

- Expand and support the development of a national data infrastructure concerning persons with disabilities in SMET to inform public policy and programming.

Internal NSF Issues

- Enforce policies and implement management mechanisms concerning cost-sharing that reduce barriers to MSI's ability to compete for NSF awards.

- Achieve better representation of underrepresented minorities, women and persons with disabilities at the scientific and engineering staff levels throughout the Foundation at levels at least proportionate to their representation among doctorate holders in respective SMET fields.

- Continue diffusion of responsibility for workforce preparation throughout all divisions.

- Expand the number of individuals from underrepresented groups in the review process. In addition, ensure and monitor the implementation of "Criterion 2" in programming and internal operations, as set forth in NSF's Government Performance and Results Act (GPRA) strategic and performance plans.

- Initiate activities that educate NSF staff regarding the benefits/advantages of having educators and researchers from diverse populations.

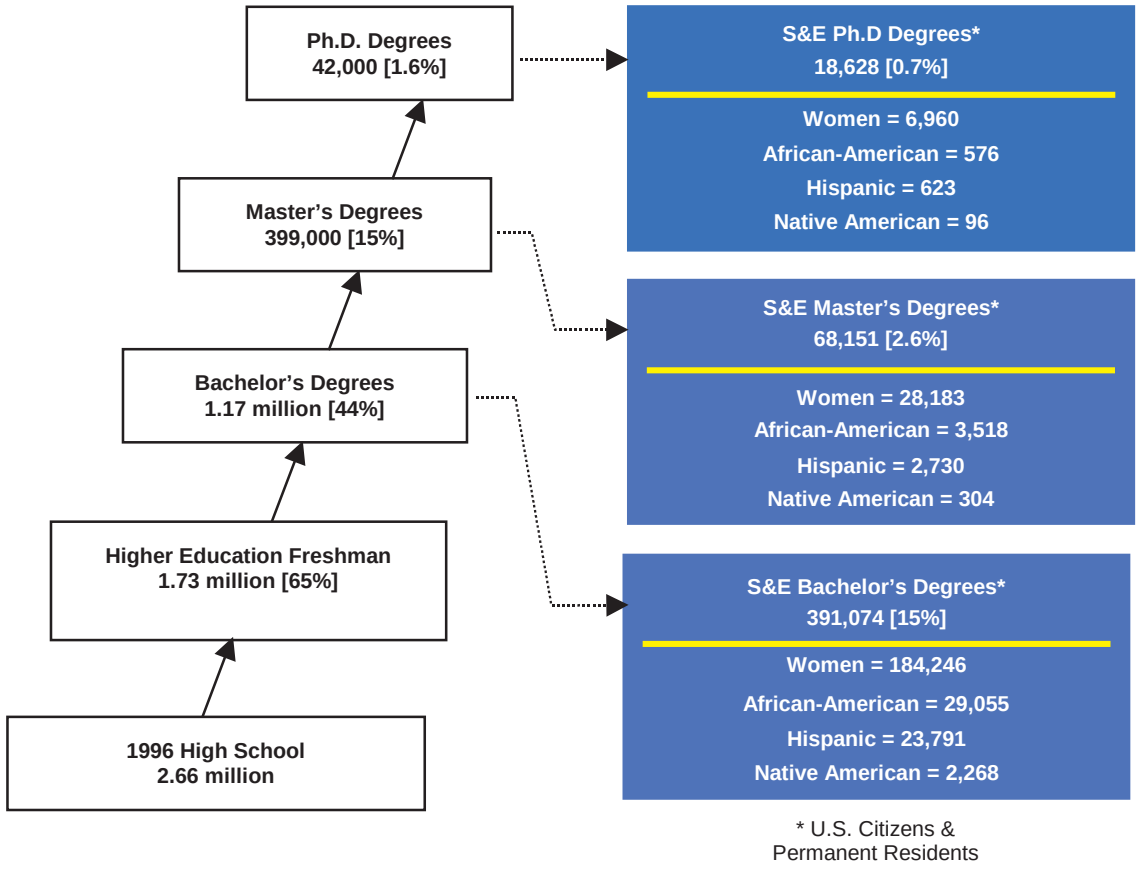
CEOSE CHARGE

The National Science Foundation (NSF) has been charged with the task of addressing issues of equal opportunity in science and engineering as part of its mission of fostering a diverse science and engineering workforce representative of the American populace (42 U.S.C. § 1885C). The United States Congress has charged the Committee on Equal Opportunities in Science and Engineering (CEOSE) with advising NSF in its efforts to ensure the fulfillment of its mission. CEOSE has undertaken its role by promoting the inclusion of all citizens, regardless of gender, ethnicity, or persons with physical disabilities in the nation's science, engineering and technological workforce. Implicit in this approach is the vision of 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.

INTRODUCTION

America's awareness of the need for student achievement in mathematics and science has never been keener. The criticality of mathematics and science education at all levels has been underscored by the Congressional National Science Policy Report, *Unlocking Our Future: Toward a New Science Policy*, produced by the House Science Committee under the direction of Congressman Vernon Ehlers [1]. The integration of technological advancement in all levels of civic life requires that the students of today possess scientific, mathematical, and technological literacy for tomorrow. America's economic, social, and political success will reflect our ability to achieve this through our formal and informal educational systems. The poor showing of American twelfth-graders in mathematics and science relative to other nations on the

Third International Mathematics and Science Study (TIMSS) assessment [2], however, is cause for concern. Just how efficient is the current educational system in producing technologically adept citizens for the workforce? The National Science Board has recently issued its report, "Preparing Our Children: Mathematics and Science Education in the National Interest" [3], which addresses key issues critical to mathematics and science achievement in the United States, including standards-based instructional content; teacher education; and K-12/higher education linkages, especially college admissions issues.



Source: National Science Foundation, Division of Human Resource Development and Division of Science Resource Studies.

Figure 1 - The 1996 graduate productivity of the educational system with projected percentages based on the number of high school graduates.

A snapshot of the success of the system in preparing science and engineering professionals is shown in Figure 1, which reports data from 1996. As can be seen in Figure 1, of 2.66 million high school graduates in 1996, only 15% are projected to attain science and engineering (S&E) bachelor's degrees. And all things being equal, of the 2.66 million high school graduates, only 18,600 (or 0.7%) will receive S&E Ph.D. degrees, of which 7,000 will go to women and 1,300 to underrepresented minorities who are U. S. citizens or permanent residents. Clearly, the percentages of S&E

graduates who progress through the educational system must be significantly increased given our heightened reliance on a technological workforce to maintain our leadership in a world economy. How is this to be accomplished?

At all levels of the educational continuum, educators with the proper knowledge and tools must transfer their expertise and enthusiasm to students to build a strong technical foundation so that graduates of the nation's educational system can ultimately replenish and enhance the technological workforce. Before this can happen, however, existing impediments to the effective functioning of the educational system must be eliminated.

This report of CEOSE highlights key areas of concern relating to students, educators and the workforce. The report also describes representative NSF programs that address these areas and also discusses NSF-specific issues regarding its responsibilities in achieving maximum human resource development and equal opportunity for students, educators and technological professionals. The report concludes with a series of recommendations to guide the Foundation in fulfilling its challenging mission. In addition, as CEOSE continues its ongoing work, it looks forward to working collaboratively with the recently established Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development (P.L. 105-255).

STUDENT RELATED ISSUES

The quality of our future technological achievements depends heavily on the education in science, mathematics, engineering and technology (SMET) that students currently enrolled in K-12 receive. In light of this fact, three situations currently converge to threaten the future of the nation's economy: 1) the growing reliance of America's industry on a globally-competitive scientific and technologically capable workforce; 2) the lower participation of racial/ethnic minorities, women, and persons with disabilities in science, mathematics, and engineering fields; and 3) the rapid increase of certain minority groups in the United States population.

In the last decade, minority populations in the United States have grown at a much faster rate than the non-minority population. At the same time, the proportion of women in the workforce has also risen dramatically. That minorities and women, who make up the large majority of the population, are underrepresented in science, mathematics and engineering professions does not bode well for the country's future economic prosperity. Policymakers, researchers and educators correctly identified the roots of this underrepresentation in the preparation that women and minorities receive in K-12.[1] A host of studies and reports documented the achievement gap between non-minority males and underrepresented groups -- minorities (with the exception of certain Asian American groups), women and persons with disabilities. Several national efforts emerged to address this disparity in achievement and participation; among these are a number of programs undertaken by the National Science Foundation that focus

[1] The Committee recognizes that factors related to socioeconomic status may also contribute to underrepresentation of some racial/ethnic minority groups among SMET degree holders.

on increasing higher level coursetaking, enrollment in science, mathematics and engineering majors at the undergraduate level, and graduation from baccalaureate, master's and Ph.D. programs in science, mathematics and engineering fields.

Recent data show that the achievement/participation gap seems to be closing, although a gap still persists (Figure 2). For example, the percentage of high school graduates who earned credits in chemistry increased by 94, 96, 195 and 58 percent for women, African-Americans, Hispanics and Native Americans, respectively from 1982 to 1994. The latest science assessment conducted by the National Assessment of Educational Progress (NAEP) in 1996 shows a continuation of the trend towards the narrowing of the achievement gap between males and females, although the gap remains. For minorities, the differences in mathematics and science achievement on NAEP assessments, while much more pronounced than differences by gender, have narrowed during the past ten years. Indications suggest, therefore, that while efforts to respond to the disparities in achievement and participation rates of underrepresented groups have had some effect, much still remains to be done. The situation is exacerbated by the rapid growth of the minority school-age population (i.e., 5-17 year-olds), of which underrepresented minorities will constitute 42% by the year 2030 [5]. This shift in the composition of the K-12 enrollment (Figure 3) means

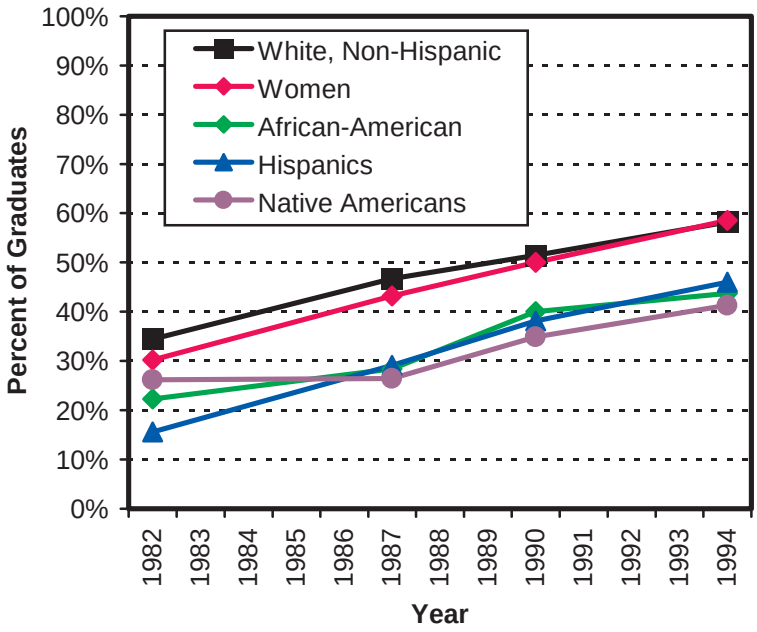


Figure 2 - Percentage of High School Graduates Earning Credits in Chemistry. [4]

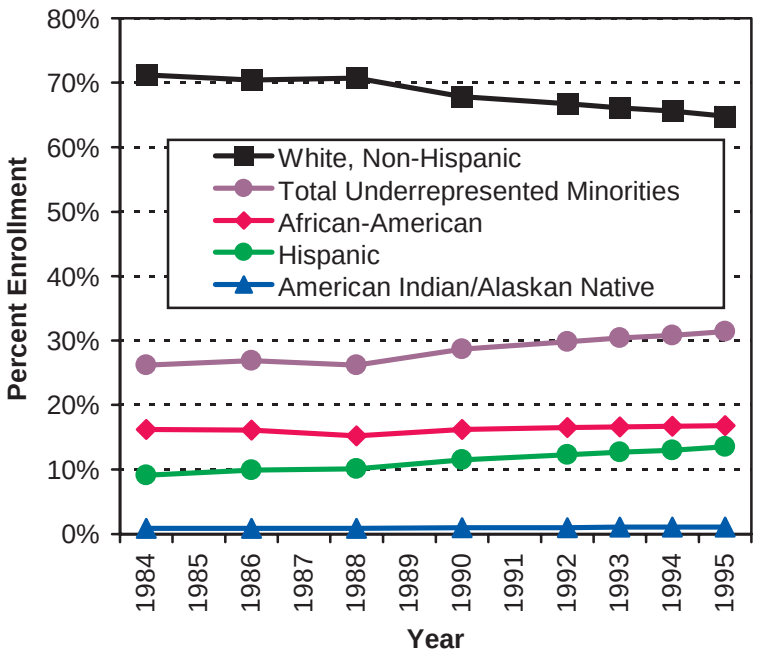


Figure 3 - Percent Distribution in Public Elementary and Secondary Enrollment by Race/Ethnicity. [4]

that racial/ethnic groups such as African Americans, Hispanics and American Indians that have had the lowest achievement and participation rates in science, mathematics and engineering will comprise an ever-increasing proportion of the school-age population. Initiatives to assist these groups to reach parity in science, mathematics and engineering achievement and participation are of the utmost importance to the future economic well-being of the nation.

At the postsecondary level, women now earn over half of the baccalaureates in the social sciences and almost half of the natural science degrees, but a much lower percentage (35%) of mathematics and computer science degrees and 17% of engineering degrees. The undergraduate enrollment of underrepresented minorities increased slightly during the decade, but by 1995 only about 7% of African American and 6% of Hispanic youth earned baccalaureate degrees in science and engineering fields (Figure 4). While women are less fully represented at the graduate level, minorities are critically underrepresented, accounting for only 10% and 7% of master's and doctoral degrees, respectively, in science and engineering in 1996 among U.S. citizens/permanent residents (Figure 1).

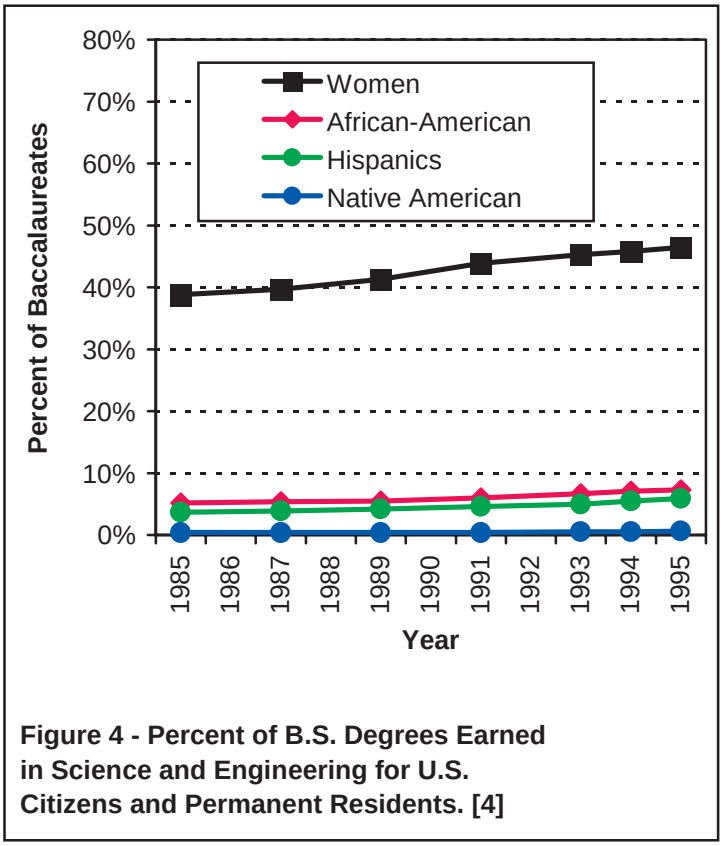


Figure 4 - Percent of B.S. Degrees Earned in Science and Engineering for U.S. Citizens and Permanent Residents. [4]

The picture for students with disabilities is much less clear. There is a general lack of quality data to track the involvement and outcomes in SMET education of these students. They are, for example, underrepresented in state and national assessment efforts. And despite many clear examples of the assets that individuals with disabilities can bring to the SMET workforce, there are too few coordinated efforts to document student outcome data, collect national workforce data, identify successful educational strategies, and support school-to-work efforts for persons with disabilities. NSF's Program for Persons with Disabilities has attempted to address many of these concerns, but there remains a gap in our national databases, the coordination of our efforts to address identified needs, and the responsive allocation of institutional resources.

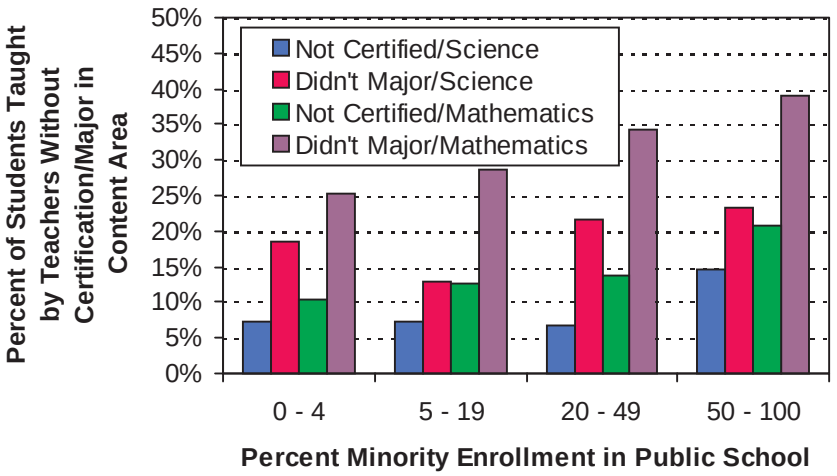
EDUCATOR RELATED ISSUES

The health of the educational continuum depends dramatically upon the characteristics of educators. The preparation of teachers to enhance their

technological expertise and experience, as well as their knowledge of students' learning styles and backgrounds, will affect the ability of teachers to enable student learning. In addition, the educational setting, whether in the K-12 or higher education sector, can inspire students to learn and succeed in their aspirations. Underrepresented minority and women faculty serving as mentors or role models can encourage students to fulfill their aspirations, as well as attest to the attainability of success.

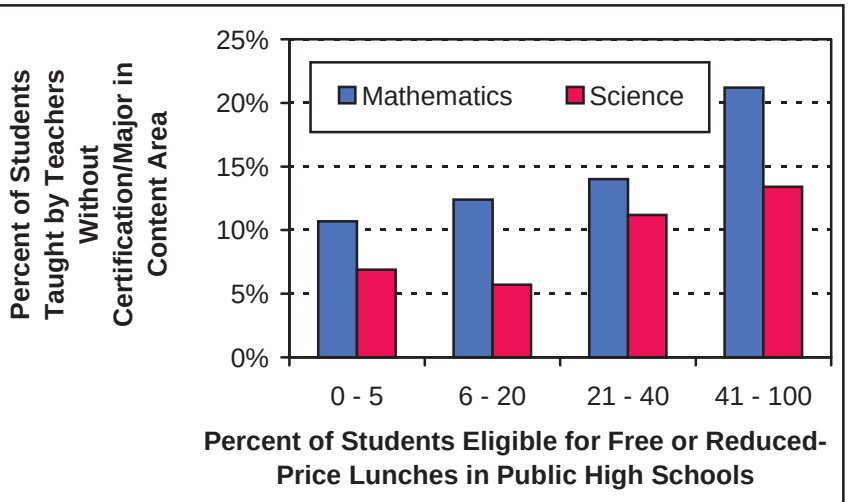
Teacher Quality

The educational context in which learning occurs is an important determinant of student achievement. Data on variations in the educational contexts to which different groups of students have access show that there are disparities between the contexts in which minority and non-minority students learn. For example, minority students are more heavily concentrated in high poverty urban schools, where it is more likely that they will be taught mathematics and science by less qualified teachers (Figure 5) or by even a teacher who does not have either a major or certification in the content area being taught. The preparation of teachers is one of the most important determinants of the quality of education a student receives. 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.



Source: National Center for Educational Statistics, ref 6.

Figure 5 - Percentage of Public Secondary Students Taught Mathematics or Science by Teachers Without Certification/Major in Content Area by Percentage of Minority Composition of School.



Source: National Center for Educational Statistics, ref 6.

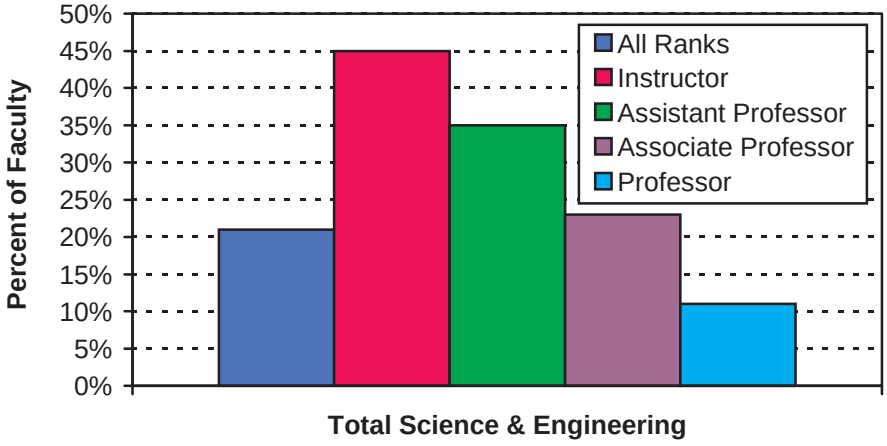
Figure 6 - Percentage of Public Secondary Students Taught Mathematics or Science by Teachers Without Certification/Major in Content Area by Percentage of Students Eligible for Free or Reduced-Price Lunch.

Figure 5 shows that students in high minority enrollment schools are much more likely to be taught mathematics and science by a teacher who does not have either a major or certification in the content area being taught. Similarly, as can be seen in Figure 6, students in schools with the highest poverty levels (as indicated by percentage of students eligible for free or reduced-price lunch) are much more likely to be taught by a less qualified teacher.

Efforts to ensure high quality mathematics and science education for minority students face the formidable barriers of the current national shortage of qualified mathematics and science teachers, as well as a projected explosion in the school-age population (i.e., the cohort of 5-17 year-olds) from 49.8 million in 1995 to 71.2 million by 2050 [5]. This increase in students has led the U.S. Department of Education to project a need for 2 million new teachers in the next ten years. If present trends in teacher supply persist, this will mean an even greater shortage of qualified mathematics and science teachers in the coming years. And if present trends in the distribution of qualified mathematics and science teachers hold, a higher percentage of minority students will be taught mathematics and science by unqualified teachers.

Demographics of Doctoral Faculty

The percent of full-time women doctoral faculty in tenured science and engineering positions amounted to 11% of full professors and 23% of the associate professors, with higher percentages in the untenured instructor and assistant professor positions (Figure 7). Even when considering all ranks, women faculty amounted to 21% of total faculty, a much lower representation than the percent of women in the labor force (i.e., 51%). For African-Americans, Hispanics, Native Americans/Alaskan Natives and persons with disabilities, the percentages are significantly less (Figure 8). The available data on persons with disabilities are inadequate, but the percentage of persons with disabilities in the total science and engineering faculty pool is 6%, about one-third of the 21% of the labor force, identifying themselves as having disabilities.

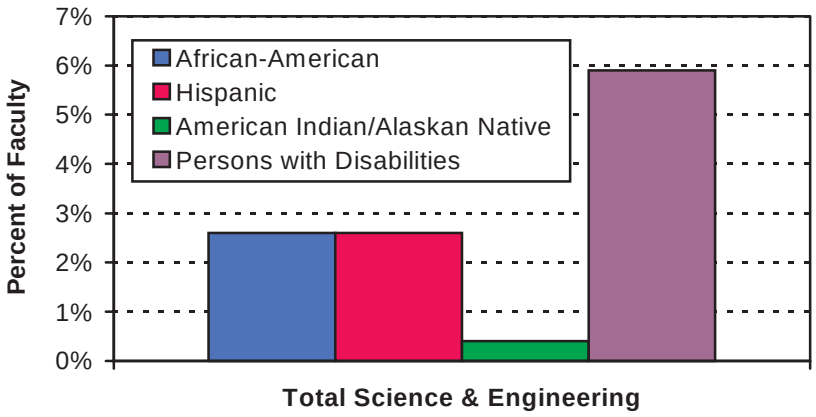


Source: National Science Foundation, Division of Science Resouces Studies.

Figure 7 - Full-Time Science and Engineering Women Faculty, by Rank for 1995.

Quite apart from issues of equity and fairness, the underrepresentation of women, minorities and the disabled among SMET faculty means that higher education does not benefit from their contributions to education, research, and the new knowledge

derived therefrom. It means that all American colle graduates in SMET disciplines, whether or not they are members of underrepresented groups, miss out on perspectives that would better prepare them to work in racially and ethnically diverse environments in our nation and around the world. As society and student populations become even more diverse, the lack of women, minority and faculty with disabilities in SMET disciplines becomes an even greater issue.



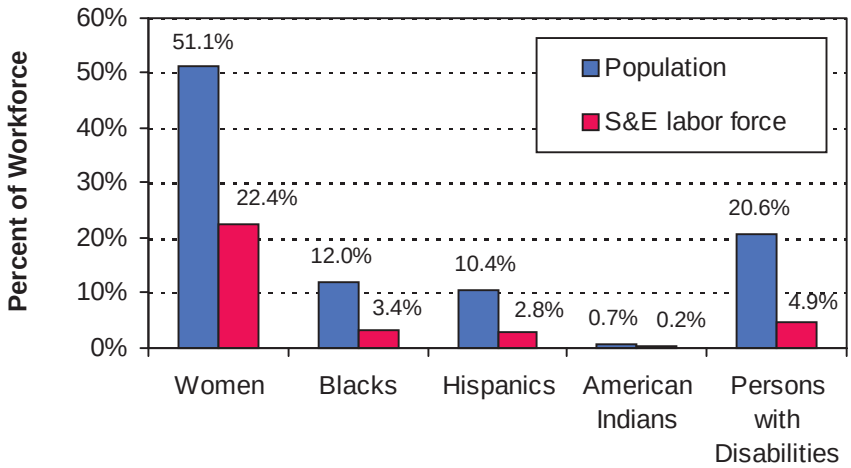
Source: National Science Foundation, Division of Science Resources Studies.

Figure 8 - Percentage of Faculty Who Are Underrepresented Minorities and Persons With Disabilities for 1995.

THE NATION'S SCIENCE AND ENGINEERING WORKFORCE

The ultimate goal of the educational continuum is to provide all students with the means to pursue a career based on their talents and aspirations. With the heightened focus on technological literacy in the workplace, the educational system must prepare all students to meet these new demands. Clearly, the success of such a system of education will become evident when women, underrepresented minorities and persons with disabilities attain parity in the science and engineering workforce.

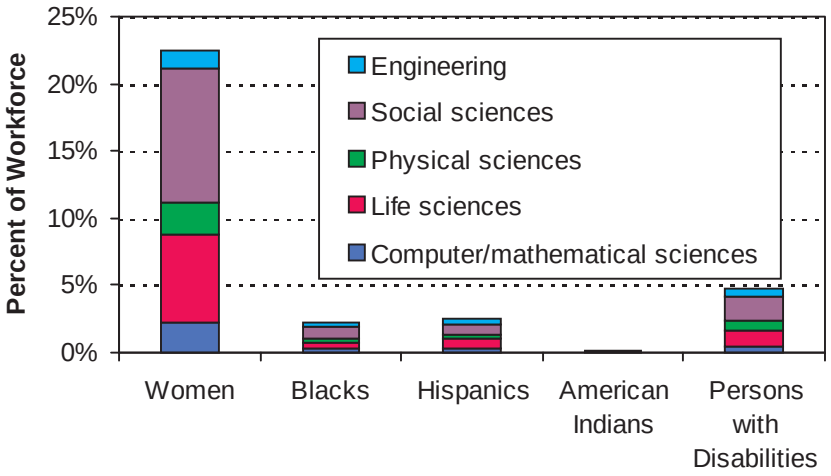
A comparison of the U. S. resident population with the percent of scientists and engineers in the labor force (by gender, race/ethnicity and disability status) indicates that parity has not been achieved (Figure 9). As can be seen from Figure 10, of doctoral scientists and engineers in the labor force, the largest percentage of women, underrepresented



Source: National Science Foundation, Division of Science Resources Studies.

Figure 9 - Percentage of Science and Engineering Labor Force and Percentage of Scientists and Engineers in the Labor Force Within the U.S. Resident Population, by Sex, Race/Ethnicity, and Disability Status: 1995.

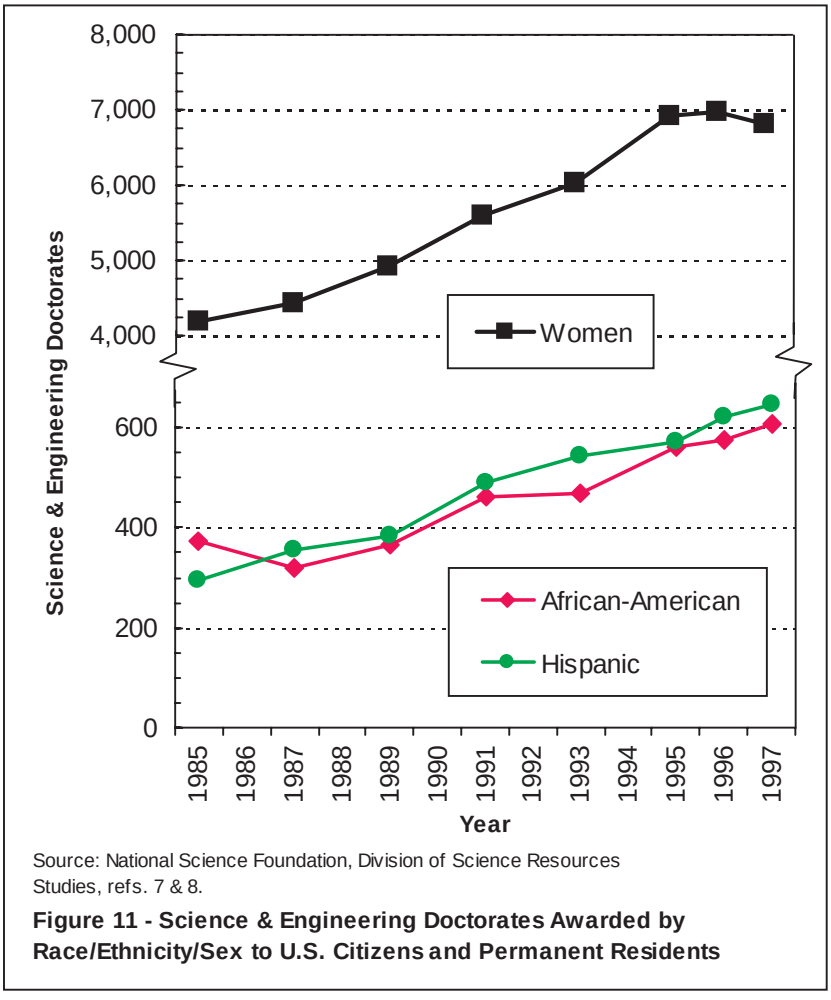
minorities and persons with disabilities occurs in the social sciences, followed by the life sciences, with engineering and the physical sciences having lower percentages of representation.



Source: National Science Foundation, Division of Science Resources

Figure 10 - Percentage of Doctoral Scientists and Engineers in the U.S. Labor Force, by Occupation, Sex, Race/Ethnicity, and Disability Status: 1995.

From 1985 to 1996, the number of doctorates awarded to women increased at a faster rate (271 doctorates/year) than that of African-Americans (22 doctorates/year) or Hispanics (30 doctorates/year), as shown in Figure 11. The number of doctorates awarded to American Indians has remained very small (e.g., 41 in 1985 to 96 in 1996). [7] In 1997, the number of S&E doctorates awarded to women decreased from 6,960 to 6,814. [8] Although we must await the reporting of 1998 and 1999 to determine whether the change will continue or prevail in other underrepresented groups, the number of doctorates for African-American and Hispanics continue to increase in 1997. Clearly, the issues discussed here become more critical, if the declining trend in the number of doctorates transfuses into all underrepresented groups.



Source: National Science Foundation, Division of Science Resources Studies, refs. 7 & 8.

Figure 11 - Science & Engineering Doctorates Awarded by Race/Ethnicity/Sex to U.S. Citizens and Permanent Residents

In order for this nation to maintain its global leadership, all levels of society must respond to the potential crisis of a future workforce ill equipped to meet the demands of a scientifically-

and technologically-centered democracy. NSF has demonstrated a strong commitment to meeting this rapidly escalating need. Across all of its directorates and especially within the Directorate for Education and Human Resources, NSF is constructing model approaches and making investments to enhance scientific, mathematical, and technological literacy for all students. It is not within the budget or capacity of NSF to address the full scope of a potential crisis on its own. The Foundation's efforts must be joined and supported by policy and programming support from all government agencies, as well as corporate and private sectors.

EXAMPLES OF CURRENT NSF PROGRAMS ADDRESSING CEOSE ISSUES

The Foundation's Government Performance and Results Act (GPRA) Strategic Plan FY 1997-FY 2003 incorporated diversity in its long-term strategic goals, annual performance goals and performance measures. Goal 3 of the GPRA Strategic Plan specifically calls for "a diverse, globally-oriented workforce of scientists and engineers" to help ensure that the United States maintains leadership at the forefront of innovation and technological progress. Part of the action plan of Goal 3 focuses on increasing the participation of underrepresented groups and persons with disabilities in all NSF programs. Furthermore, NSF states in its GPRA plan that it seeks to infuse diversity throughout all its programs and operations. CEOSE strongly supports this strategic course. As NSF pursues this direction, several specific examples exist of NSF programs that are effective toward the broader goal of increasing the representation of women, minorities and persons with disabilities in the science and engineering enterprise.

FOCUSED PROGRAMS

Programs for Persons with Disabilities (PPD)

The Program for Persons with Disabilities (PPD) is committed to bringing about needed change in academic and professional climates, increasing the awareness and recognition of the needs and capabilities of students with disabilities, promoting the accessibility and appropriateness of instructional materials, media, and educational technologies, and increasing the availability of student enrichment resources including mentoring activities. In short, efforts are dedicated to changing the factors wherein neglect, paucity, and indirection historically have stifled the early interest in science and mathematics shown by students with disabilities and impede the advancement of these individuals as they prepare themselves for careers in SMET fields.

Centers of Research Excellence in Science and Technology (CREST)

The primary objective of the CREST program has been to increase the diversity in science and engineering by supporting productive minority institutions to enhance their research infrastructure, to encourage and stimulate students intellectually and financially, and to increase the respective institution's effectiveness in research and education. Each Center is evaluated by its ability to achieve three goals to: 1) address challenging and far-reaching interdisciplinary research; 2) create new knowledge and transfer knowledge with technology to industry, government agencies and laboratories, and academic institutions through partnerships and collaborations; and 3) produce

minority graduates at all levels, with special emphasis on Ph.D. degrees, who have multi-disciplinary capabilities in science and engineering.

Indicators assess the success of achieving the centers' goals such as the patterns of research productivity through refereed publications and external research funding, as well as graduation rates for underrepresented minority doctoral students and their respective career success. Centers also serve as models for integration of education and research. An example of a program impact is Hampton University, with a center since 1991, which established a doctoral program in high energy physics in 1993 and is expected to graduate its first two high energy physics doctorates in 1998-99.

Louis Stokes Alliances for Minority Participation (LSAMP)

The Louis Stokes Alliances for Minority Participation (LSAMP) is a multi-disciplinary, comprehensive undergraduate program with the following goals: 1) to increase substantially the quantity and quality of students, including minority students and others, receiving baccalaureate degrees in science, mathematics, engineering and technology; 2) to increase the quality, quantity and diversity of students receiving SMET degrees; and 3) to increase the number of students entering graduate schools for the doctorate in SMET disciplines. While not a focused program per se, the LSAMP focuses on individuals from groups who are underserved by our current educational system, those from the lower socioeconomic sector, and those who have low participation in the SMET enterprise and are in educational settings that do not encourage full development of their academic potential to succeed. In 1998, LSAMP projects graduated more than 18,000 students with baccalaureate science and engineering degrees.

Minority Graduate Education (MGE) Program

The Minority Graduate Education (MGE) program, established in FY 1998, intends to increase significantly the number of students receiving doctoral degrees in the physical and life sciences, mathematics, and engineering, with special emphasis on populations that are underrepresented in these fields. In addition, since lack of mentors in the professoriate constitutes a significant barrier to producing minority science, mathematics and engineering (SME) graduates, NSF is particularly interested in increasing the number of minorities who will enter the professoriate in these disciplines. Specific objectives of the MGE program are: (1) to develop and implement innovative models for recruiting, mentoring, and retaining minority students in SME doctoral programs and (2) to develop effective strategies for identifying and supporting underrepresented minorities who want to pursue academic careers.

To specifically address the need to grow a diverse professoriate, NSF has recently undertaken the strategic alignment of several of its programs designed to increase the representation of faculty of color and to maximize the agency's investment in efforts to increase, strengthen and diversify the science, technology and engineering enterprise. The four programs that span the educational continuum include the above mentioned CREST, LSAMP and MGE, as well as the Historically Black Colleges and Universities (HBCU) initiative. CEOSE supports such innovative strategic approaches to help address the doctoral faculty issue.

Professional Opportunities for Women in Research and Education Program

The Professional Opportunities for Women in Research and Education (POWRE) program supports activities promoting the development of scholarly and institutional leaders in research and education. POWRE is a cross-cutting program designed to increase the prominence of women in science and engineering and to enhance their professional advancement by providing them with funding opportunities that are ordinarily not available through regular research and educational grant programs. CEOSE encourages the exploration of innovative approaches to the recruitment, retention and advancement of women in SMET, including those that address the elimination of overt and subtle barriers to their participation and advancement in these fields.

Focused programs, such as PPD, CREST, LSAMP, MGE, and POWRE, provide opportunities for minorities, women, and persons with disabilities. Recently, however, many of NSF's focused programs (e.g., Minority Graduate Fellowships) have come under scrutiny; under the aegis of "race blind" policies, some focused programs have been severely curtailed or eliminated. As a result, NSF may be limited in its ability to provide, at a national level, programs that will hasten the development of a skilled cadre of minority educators and leaders.

NON-FOCUSED PROGRAMS

Major NSF Research Centers

One of the key investment strategies of NSF's GPRA Strategic Plan is to expose students to cutting-edge research with the potential for application. The goals of the major NSF research centers are conducive to achieving the full participation of women, underrepresented minorities and persons with disabilities by partnering in research with MSI's, by involving K-12 teachers, as well as attracting underrepresented groups to participate in the centers. The research centers include the Engineering Research Centers (ERCs), Science and Technology Centers (STCs), and Materials Research Science and Engineering Centers (MRSECs). Most centers have already linked with MSI's and K-12 schools for outreach purposes, but an expanded involvement is needed.

In high performance computing, the Partnerships for Advanced Computational Infrastructure (PACI) Program focuses on taking advantage of newly emerging opportunities in high performance computing and communications. The program provides the flexibility to adapt to rapidly evolving circumstances and to meet the need for high-end computation to enable continued leadership in computational science and engineering. The PACI program has the added responsibility of becoming the national resource for educating the nation in the inclusion and access of all throughout the educational continuum, especially when the lack of infrastructure capabilities disconnect MSI's or persons with disabilities. CEOSE views such connective capabilities as critical to helping reduce the disparity between information-rich and information-poor communities.

Integrative Graduate Education and Research Training (IGERT) Program

The Integrative Graduate Education and Research Training (IGERT) Program is based on a multidisciplinary research theme providing a framework for the integration of research and educational activities. The training program emphasizes critical and emerging areas of science and engineering, provides students with hands-on experience in state-of-the-art research instrumentation and methodologies, develops trainee communication and teamwork skills, offers training experiences relevant to both academic and non-academic careers, and facilitates the development of a diverse workforce. For the facilitation of a diverse workforce, the program included as one of the guidelines the participation of women, underrepresented minorities and persons with disabilities in the review and award process.

Programs are now guided by the inclusion of diversity as part of the GPRA Performance Plan, toward the goal of increasing the participation of all students aspiring to join the technological workforce. All new program announcements and proposed solicitations include a statement indicating that proposers must address improving the participation of underrepresented groups in S&E in their research and education activities.

NSF SPECIFIC ISSUES

NSF can act to increase the participation and success of grant applicants and principal investigators (PIs) who are women, minority or disabled. The inclusion of diversity as part of NSF's GPRA goal to create a diverse, globally oriented workforce of scientists and engineers can increase the participation of all those aspiring to join the scientific, engineering and technological workforce. The involvement of students in cutting-edge research will encourage our nation's youth to choose science and engineering careers, thus helping to ensure that the United States maintains its global scientific and technological leadership role. Consistent with the goal of increasing the diversity of doctoral graduates, it is imperative that we have role models and mentors in the professoriate who are themselves members of groups underrepresented in the academy. In order to flourish in their careers, professors of underrepresented groups must succeed in obtaining support for their research and educational activities. NSF can play a critical role in ensuring that underrepresented PIs have equal access to mechanisms for obtaining this support. CEOSE commends the new NSF requirement, as called for in its GPRA performance plan, that all new program announcements and solicitations must include a statement indicating how proposers will address improving the participation of underrepresented groups in S&E in their research and education activities. CEOSE recommends that NSF take appropriate steps to ensure that all applicants as well as NSF staff adhere to this requirement.

For the Foundation to achieve equal participation and success among all PIs, the opinions of all scientists and engineers should be included in a fair appraisal of NSF proposals by NSF staff and reviewers. In 1997, NSF scientists and engineers (S&E's) serving in positions such as program directors and division directors by and large reflected the S&E labor force in the private sector, but fell short of parity with the national workforce population. For example, program directors and division directors consisted of 31% women, compared to 22% in the S&E labor force and 51% women in the national workforce. In the same year, the 560 S&Es at the Foundation were

comprised of 0.7% Native Americans, 6.3% African-Americans, and 2.5% Hispanics, compared to 0.7% Native American, 12% African-American and 12% Hispanic in the national workforce.

Review panels, as well as ad hoc reviews, should incorporate underrepresented groups to provide a fair appraisal of NSF proposals, especially those concerning the education of all students. Currently, the success rate among proposers from underrepresented groups does not differ significantly from that of all proposers. For example, in 1997 the success rate among all proposers was 32.7%, and the corresponding figures for proposers who are women, minority or disabled were 36.0 %, 31.4%, and 33.1%, respectively. However, these figures are somewhat misleading because the success rate of women, minorities and persons with disabilities is measured against the total number of proposers from underrepresented groups. A more probing analysis reveals a large disparity in the participation rates for PIs from underrepresented groups as compared with the total population in the SMET professoriate**.** In 1997, for example, NSF made a total of 9,864 competitive awards. Of these, the numbers of awards made to women, minorities, and persons with disabilities were only 1,936 (19.6%), 412 (4.2%) and 102 (1.03%), respectively.

In addition, NSF should diligently enforce the use of Criterion 2[2] in programming and internal operations (such as proposal review). This will help create broadened participation, such as consideration of gender, ethnicity, disability, and geography, and contribute to the infusion of a diversity of perspectives into the S&E enterprise.

Finally, the ability of institutions to compete fairly must be considered in view of the scarce resources and lack of infrastructure of many minority serving institutions. With federal budget restrictions, proposal submissions are evaluated for intellectual merit and for the institutional capacity (e.g., cost sharing and infrastructural capabilities). Although the institutional capacity criterion enables agencies to leverage the nation's research funds, the reduced institutional capacity of a minority serving institution should not prevent MSIs from receiving funding for proposals of high intellectual merit. With the increasing sophistication of research and educational endeavors requiring significant institutional resources, infrastructure capabilities of minority serving institutions must be enhanced so that they can be competitive for federal funding.

RECOMMENDATIONS

We are encouraged by the level of educational support implicit and explicit in the foci set forth by the NSF leadership. To further ensure that many of the goals concerning diversity are obtained, we offer the following recommendations.

NSF Enablement of the S&E Enterprise

- As technology becomes more ubiquitous to educational processes, it will become more critical for NSF to attend to issues of access and capacity among

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[2] Proposals are subjected to two merit review criteria of which criterion 2 considers "…How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?"

underrepresented communities, including persons with disabilities. Initiatives, such as FastLane, require careful planning to ensure that they do not have a disparate impact on these target populations. NSF is in a unique position to provide leadership and understanding of the social and ethical consequences brought to the fore by the use of emerging technologies. We recommend that NSF assert its leadership position to develop quality standards and practices to be used by organizations external and internal to the Foundation that will assure equitable access to information technology by all individuals and institutions.

- NSF should enhance the collaborations developed among major research centers at research institutions and minority institutions and design activities in a way that both partners in such collaboration benefit mutually from the unique contributions that each party brings to the partnership.

- The Committee recommends an increase in the creation and implementation of program initiatives to develop further the faculty and equipment infrastructure capabilities of minority serving institutions (MSIs).

- NSF's work should continue in curriculum and pedagogical development, in data collection and analysis, as well as convener of educational stakeholders, and as partner to policy development.

- With the nation's increasing dependence on technology, activities must be continued to educate teachers so they will have the proper competencies to teach scientific and mathematical concepts within the K-12 sector.

- Programs supporting women, underrepresented minority groups and persons with disabilities in faculty positions should be increased to achieve parity within our universities as well as to provide mentors and role models for underrepresented groups and persons with disabilities.

- NSF should expand and support the development of a national data infrastructure concerning persons with disabilities in SMET so as to better inform public policy and programming.

Internal NSF Issues

- Enforce policies and implement management mechanisms concerning cost-sharing that reduce barriers to MSI's ability to compete for NSF awards.

- NSF should seek to achieve better representation of underrepresented minorities, women and persons with disabilities at the scientific and engineering staff levels throughout the Foundation. As noted previously in the 1996 CEOSE report, effective programs require representation of opinions and ideas from a diverse representation in NSF staff.

- The current programmatic trends in service to education should be continued. We recognize the strength of the formal and informal educational programs that currently exist. We applaud the diffusion of responsibility for educating the workforce of the future throughout all divisions of NSF.

- NSF should expand the diversity of review panels and ad hoc reviewers to include underrepresented groups across all areas of the Foundation and enforce the use of Criterion 2 in programming and internal operations (such as proposal review); take strong steps to integrate it with GPRA goals (Goals 3 and 4); and ensure the actualization of GPRA.

- The Committee recommends the initiation of activities that contribute to the positive education of NSF staff regarding benefits/advantages of having educators and researchers from diverse populations.

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