Broadening Participation in STEM

Committee on Equal Opportunities in Science and Engineering

2013 - 2014 Biennial Report to Congress

MISSION

The Committee on Equal Opportunities in Science and Engineering (CEOSE) advises the National Science Foundation (NSF) on policies and programs to encourage full participation by women, underrepresented minorities, and persons with disabilities within all levels of America's science, technology, engineering, and mathematics (STEM) enterprise.

BACKGROUND

The Committee on Equal Opportunities in Science and Engineering was established by the United States Congress through the Science and Engineering Equal Opportunities Act of 1980 to address the problems of growth and diversity in America's STEM workforce. The legislation specifically provides that:

There is established within the National Science 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 and 1885d of this title and (2) other policies and activities of the Foundation to encourage full participation of women, minorities, and persons with disabilities in scientific, engineering, and professional fields [42 U.S.C.§1885(c)].

Every two years, the Committee shall prepare and transmit to the Director (of the Foundation) 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 [42U.S.C. §1885(e)].

CEOSE is composed of 15 individuals from diverse STEM disciplines, drawn from diverse institutions in higher education, industry, government, and the non-profit sectors. Its membership also reflects the racial/ethnic and gender diversity of the country's citizenry and includes persons with disabilities. Members of the Committee typically serve a three-year term. A full committee meeting is held three times a year (usually winter, spring, and fall) to review and evaluate policies and program opportunities focused on the state of the participation and advancement of women, underrepresented minorities, and persons with disabilities in education, training, and science and engineering research. On the basis of its findings, the Committee makes recommendations to the Foundation for improving the levels of participation of underrepresented groups in STEM professions. Committee members also interact with other federal agencies, such as the Department of Defense, National Institutes of Health, Department of Energy, Department of Homeland Security, National Institute of Standards and Technology, Environmental Protection Agency, United States Department of Agricultural, U.S. Department of Interior – U.S. Geological Survey, the National Aeronautics and Space Administration, Smithsonian Institution, the National Oceanic and Atmospheric Administration, and The White House Initiative on Historically Black Colleges and Universities in forging multi-agency collaborations to broaden participation by underrepresented groups in the Nation's STEM workforce.

CEOSE

Committee on Equal Opportunities in Science and Engineering

2013-2014 Biennial Report to Congress

Broadening Participation in America's STEM Workforce

CEOSE 15-01

March, 2015

ACKNOWLEDGMENTS

Members of the Committee on Equal Opportunities in Science and Engineering (CEOSE) are indebted to the following National Science Foundation officials for their technical consultation, collection of critical data, and review assistance and comments that enabled the completion of this Biennial Report to Congress: **Dr. France A. Córdova**, Director (OD); **Dr. Wanda E. Ward**, CEOSE Executive Liaison and Office Head (OD/IIA); **Dr. Cora Marrett**, Former Acting Director and Former Deputy Director (OD); **Dr. Fay L. Cook**, Assistant Director (SBE); **Dr. Fleming Crim**, Assistant Director (MPS); **Dr. Joan Ferrini-Mundy**, Assistant Director (EHR); **Dr. Pramod P. Khargonekar**, Assistant Director (ENG); **Dr. James F. Kurose**, Assistant Director (CISE); **Dr. James L. Olds**, Assistant Director (BIO); **Dr. Roger Wakimoto**, Assistant Director (GEO); **Dr. Farnam Jahanian**, Former Assistant Director (CISE); **Dr. John C. Wingfield**, Former Assistant Director (BIO); **Dr. Joanne Tornow**, Former Assistant Director (SBE); **Dr. Joan S. Burrelli**, Science Resource Analyst (OD/IIA); **Mr. John Gawalt**, NCSES Division Director; **Mr. Shawn Murray**, Management Analyst (HRM); **Ms. Tracy Gorman**, Staff Assistant (OD); the NSF Broadening Participation Working Group (**Dr. Bernice Anderson**, Co- Chair; **Dr. Scott Edwards**, Co-Chair; **Dr. Janice Cuny; Dr. Sylvia James; Dr. Bevlee Watford; Dr. Julie Palais; Dr. Kathleen McCloud; Dr. Sally Dickerson**); **Ms. Claudia J. Postell**, Former Office Head, Office of Diversity and Inclusion (ODI); **Dr. Alan Blatecky**, Former Division Director (CISE/ACI); **Dr. Mary Galvin-Donoghue**, Division Director (MPS/DMR); **Ms. Lynn Preston**, Former Program Officer (ENG/ERC); **Dr. Dragana Brzakovic**, Senior Staff Associate (OD/IIA); **Dr. Soo-Siang Lim**, Program Director (SBE/BCS); **Dr. Randy Phelps**, Staff Associate (OD/IIA); **Dr. Jaquelina Falkenheim**, Senior Science Resources Analyst (SBE/NCSES); **Dr. Alexandria Medina-Borja**, Interim Head, Evaluation & Assessment (OD/OIA); **Dr. Paul Morris**, Staff Associate (OD/IIA); **Dr. Richard Tankersley**, Program Director (EHR/DGE); **Dr. Charles Bouldin**, Program Director (MPS/DMR); **Dr. Sean Jones**, Program Director (MPS/DMR); **Dr. Charles Ying**, Program Director (MPS/DMR); **Dr. Peter Arzberger**, Senior Advisor for Research Cyberinfrastructure (CISE/OAD); **Dr. Mark Weiss**, Former Division Director (SBE/BCS); **Dr. Graham Harrison**, Program Manager (OD/OISE); and **Dr. James Lightbourne**, Former Division Director (EHR/DGE). We also give special thanks for the technical contributions and oversight role of **Dr. Bernice T. Anderson**, CEOSE Executive Secretary and Senior Advisor (OD/IIA), the administrative coordination support of **Ms. Victoria Fung**, Program Analyst (OD/IIA), and **Mr. Steven Buhneing**, IT Specialist (OD/IIA).

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

EXECUTIVE SUMMARY

Despite decades of efforts to improve representation of women, underrepresented minorities, and persons with disabilities in science, technology, engineering, and mathematics (STEM), progress has been insufficient to meet increased needs and challenges. The grand challenge of broadening participation in STEM is to *transform the STEM enterprise at all levels to fully engage the nation's citizens—including women, underrepresented minorities, and persons with disabilities.* In this 2013-14 report, CEOSE offers five essential practical components needed to accomplish the single recommendation of its influential 2011-12 report: that "*NSF implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM, similar in concept and scale to NSF's centers, that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek.*"

Progress and Challenges

Despite some progress, women, minorities, and persons with disabilities remain underrepresented among STEM doctorate recipients as a whole. And within many fields, the numbers of African American, Hispanic, and American Indian STEM doctorate recipients are in the single digits or even zero. While women earn over half of doctoral degrees in some fields such as psychology and medical/other life sciences, they remain underrepresented among the highest ranked faculty members.

Factors influencing participation rates are numerous, complex, and often interrelated, including differences in high school course-taking and K-12 teacher preparation, school district resources, high school graduation rates, college graduation rates, historic and ongoing bias and exclusion, poverty and family income levels, education of parents, differing cultures within STEM fields, and differences in academic and institutional cultures within colleges/universities, among others. Research also indicates that overreliance on standardized test scores in the admissions practices of many STEM graduate programs is a significant factor in under-participation of underrepresented minorities in STEM doctoral programs.

Institutions serving underrepresented groups need to be recognized and supported. Historically Black Colleges and Universities (HBCUs) award roughly one-fifth of all bachelor's degrees to African Americans in STEM fields. High-Hispanic enrollment institutions, functionally equivalent to Hispanic-Serving Institutions (HSIs) with at least 25% Hispanic enrollment, award roughly one-third of the STEM bachelor's degrees to Hispanics, with higher percentages in biological sciences, physical sciences and engineering.

NSF Investment in Broadening Participation

Two of the strategic objectives outlined in NSF's most recent strategic plan "Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014 – 2018" directly address broadening participation in the STEM workforce and in the NSF workforce:

- Goal 1, Strategic Objective 2 (G1/02): Integrate education and research to support development of a diverse STEM workforce with cutting-edge capabilities.
- Goal 3, Strategic Objective 1 (G3/O1): Build an increasingly diverse, engaged, and high-performing workforce by fostering excellence in recruitment, training, leadership, and management of human capital.

NSF funds programs aimed explicitly at broadening participation, as well as programs that are not explicitly focused on broadening participation but emphasize efforts in this area. In FY 2013, NSF spent $607.12 million on focused and emphasis broadening participation programs. The FY 2014 estimate for these programs is $638.1 million and for FY 2015, $663.3 million was requested. A little more than one-fourth (or $167.5 million in FY 2015) of that amount was for focused programs such as Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Louis Stokes Alliances for Minority Participation (LSAMP), Centers of Research Excellence in Science and Technology (CREST), Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP) and Tribal Colleges and Universities Program (TCUP), and the remaining three-fourths ($495.8 million in FY 2015) was for emphasis programs such as the NSF Graduate Research Fellowship Program (GRFP), scholarship programs, Discovery Research K-12 (DRK-12) and Research Experiences for Undergraduates (REU)s. Additionally, the Experimental Program to Stimulate Competitive Research (EPSCoR) promotes geographic diversity (an aspect of diversity not included in CEOSE's purview) and its budget trends were $147.60 million for FY2013, $158.19 million for FY2014 estimates, and $159.69 million for FY2015 request.

These commendable efforts have had positive impacts on the participation of women, African Americans, Hispanics, Native Americans, and persons with disabilities, but, as noted above, the cumulative impact on the representation of these groups has been minimal. Award statistics offer further evidence of underrepresentation. Of all principal investigators in FY 2013, women were less than one-fourth; African Americans, Hispanics, and American Indians combined were less than 6%; and persons with disabilities were only 1%.

Ongoing CEOSE Work

CEOSE presentations, deliberations, and discussions with NSF leadership focused largely on the CEOSE 2011-12 recommendation for a bold new initiative to dramatically broaden participation of women, underrepresented minorities, and persons with disabilities in STEM. The heart of this effort is to better leverage NSF's $7 billion annual investment for building an inclusive STEM enterprise. The general idea has struck a strongly positive chord across the agency and with agency leadership, engendering enthusiastic support and internal recommendations/actions. The reactivation of the NSF broadening participation working group and its actions to date are particularly significant indicators of NSF's positive responses to the 2011-2012 CEOSE report. CEOSE continues to work with the NSF Assistant Directors and Office Heads, the CEOSE Executive Liaison, and the NSF Broadening Participation Working Group to further advance its 2011-12 recommendation for a bold new initiative to significantly broaden participation.

CEOSE's Recommendation for a Bold New Initiative at NSF

In this 2013-14 report, CEOSE further elaborates on a framework of five essential practical components that will be needed for successful implementation of the new initiative: (1) Develop and implement an effective preK-20+ system of STEM pathways that significantly increase participation of underrepresented individuals at every stage of schooling and across all STEM fields; (2) Provide stable and sufficient direct support for individuals who represent the very broadened participation that we ultimately seek; (3) Support the further development of a science of broadening participation grounded in empirical research; (4) Conduct field experiments including assessment of interventions and outcomes to understand and mitigate the barriers to broadening participation; and (5) Recognize the field-specific nature of the broadening participation challenge by embedding and engaging the bold initiative within and across all NSF directorates and divisions.

We hope that the upcoming America Competes Reauthorization, as well as other legislation and appropriations, are informed by the CEOSE recommendation for a bold new broadening participation initiative. We also hope that Congress authorizes and allocates the necessary funding to NSF to effectively launch and carry out the bold new initiative. Indeed, CEOSE believes that NSF must serve as the ongoing catalyst for coordinated, multiple agency, national action. NSF is encouraged to continue to work with other federal agencies and partners to lead our nation in increasing the participation of underrepresented groups in our nation's STEM enterprise. Indeed, the challenge of broadening participation in STEM is not NSF's challenge alone. However, it is NSF's responsibility to provide the intellectual and scientific leadership if we are to develop a truly inclusive STEM enterprise that fully and effectively engages all of our citizens.

ACRONYMS

ADVANCE	Increasing the Participation and Advancement of Women in Academic Science and Engineering program
AGEP	Alliances for Graduate Education and the Professoriate program
AIR	American Institute for Research
ARRA	American Recovery and Reinvestment Act
BIO	Biological Sciences Directorate
BP	Broadening Participation
BPC	Broadening Participation in Computing program
BPC-A	Broadening Participation in Computing Alliance program
CAREER	Faculty Early Career Development program
CEOSE	Committee on Equal Opportunities in Science and Engineering
CE21	Computing Education for the 21st Century program
CISE	Computer and Information Science and Engineering Directorate
CLB	Career-Life Balance Initiative
COMPETES	Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (as in the America COMPETES Act)
CREST	Center for Research Excellence in Science and Technology program
DHS	Department of Homeland Security
DOC/ESA	Department of Commerce, Economics and Statistics Administration
DOD	Department of Defense
DOE	Department of Energy
DOL	Department of Labor
DOI	Department of Interior
ED	Department of Education
EHR	Education and Human Resources Directorate

ACRONYMS (cont'd)

ENG	Engineering Directorate
EPA	Environmental Protection Agency
EPSCoR	Experimental Program to Stimulate Competitive Research
EREV	Engineering Research Experiences for Veterans program
GARDE	General and Age-related Disabilities Engineering program
GEO	Geosciences Directorate
GRFP	Graduate Research Fellowship Program
GSE	Research on Gender in Science and Engineering program
HBCU	Historically Black Colleges and Universities
HBCU-UP	Historically Black Colleges and Universities-Undergraduate Program
HHEI	High Hispanic Enrollment Institution
HRD	Division of Human Resource Development
HSI	Hispanic Serving Institution
I^3	Innovation through Institutional Integration activity
IGERT	Integrative Graduate and Research Traineeship program
IIA	Office of International and Integrative Activities
IPEDS	Integrated Postsecondary Education Data System
LSAMP	Louis Stokes Alliances for Minority Participation program
MPS	Mathematical and Physical Sciences Directorate
MSI	Minority-serving Institution
NASA	National Aeronautics and Space Administration
NCES	National Center for Education Statistics
NCSES	National Center for Science and Engineering Statistics
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration

ACRONYMS (cont'd)

NSB	National Science Board
NSF	National Science Foundation
NSTC	National Science and Technology Council
OCI	Office of Cyberinfrastructure[a]
OD	Office of Director (NSF)
OEDG	Opportunities for Enhancing Diversity in the Geosciences program
OISE	Office of International Science and Engineering (ISE)
OPP	Office of Polar Programs[b]
OSTP	White House Office of Science and Technology Policy
PAARE	Partnership in Astronomy and Astrophysics Research and Education program
PCAST	President's Council of Advisors on Science and Technology
PI	Principal Investigator
PIRE	Partnership for International Research and Education program
PREM	Partnership for Research and Education in Materials program
RDE	Research in Disabilities Education program
REAL	Research on Education and Learning
REESE	Research and Evaluation on Education in Science and Engineering program
SBE	Social, Behavioral, and Economic Sciences Directorate
SBP	Science of Broadening Participation
SED	Survey of Earned Doctorates
S&E	Science and Engineering
SEH	Science, Engineering, and Health
SESTAT	Scientists and Engineers Statistical Data System

[a] As of 2013, OCI became the Advanced Cyberinfrastructure (ACI) division within the CISE Directorate.
[b] As of 2013, OPP became a division within the Geosciences Directorate.

ACRONYMS (cont'd)

SI	Smithsonian Institution
SOARS	Significant Opportunities in Atmospheric Research and Science program
STEM	Science, Technology, Engineering, and Mathematics
TCUP	Tribal Colleges and Universities Program
URM	Underrepresented Minority
USDA	United States Department of Agriculture

1. INTRODUCTION

Despite decades of efforts to improve representation of women, underrepresented minorities, and persons with disabilities in science, technology, engineering, and mathematics (STEM), progress has been insufficient to meet increased needs and challenges. In its 2011-12 report, the Committee on Equal Opportunities in Science and Engineering (CEOSE) recommended a bold new initiative designed to increase and generate more innovative and transformative efforts to broaden participation in STEM. The effort is needed to meet growing demand for human capital and to increase the vitality, creativity and global leadership of the U.S. STEM enterprise.

The 2011-12 CEOSE report recommended that

NSF implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM, similar in concept and scale to NSF's centers, that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek.

CEOSE members noted the need for a holistic approach that is transformative, far reaching, disciplinary and interdisciplinary, emphasizes accountability, and involves partnerships. Such partnerships should include direct support for students and support for research on underrepresentation. Members agreed that NSF can be the catalyst to help higher education take greater responsibility for a diverse STEM workforce, transforming STEM at all levels and educating STEM domestic talent that fully reflects and represents the US population. Indeed, this is the grand challenge of broadening participation in STEM: to *transform the STEM enterprise at all levels to fully engage the nation's citizens—including women, underrepresented minorities, and persons with disabilities.*

In this 2013-14 report, CEOSE reiterates its commitment to the 2011-2012 recommendation, and further elaborates on a framework of five essential practical components that will be needed for successful implementation of the new initiative: (1) Develop and implement an effective preK-20+ system of STEM pathways that significantly increases participation of underrepresented individuals at every stage of schooling and across all STEM fields; (2) Provide stable and sufficient direct support for individuals who represent the very broadened participation that we ultimately seek; (3) Support the further development of a science of broadening participation grounded in empirical research; (4) Conduct field experiments including assessment of interventions and outcomes to understand and mitigate the barriers to broadening participation; and (5) Recognize the field-specific nature of the broadening participation challenge by embedding and engaging the bold initiative within and across all fields and disciplines that NSF supports and across the nation.

NSF is encouraged to continue to work with other federal agencies and other partners to lead our nation in increasing the participation of underrepresented groups in our nation's STEM enterprise given the urgent issues that are highlighted in this report: the changing nature of STEM, increased challenges to U.S. competitiveness, the complexity of domestic security issues, the creative advantage of achieving workforce

diversity, and the drive to realize America's democratic principles by achieving America's promise of equal opportunities.

This report is organized to highlight the current status of underrepresented groups in the scientific enterprise and summarize the accomplishments of NSF in broadening participation with specific attention to the funding of diversity-related programs. The latter part of the report focuses on activities of CEOSE during 2013-2014 that informed the recommendation and advice to NSF and provided guidance to the Committee's plans for 2015-2016.

2. PROGRESS AND CHALLENGES

Challenges remain in overall participation of women, underrepresented minorities, and persons with disabilities in STEM and in participation within STEM fields.[1] Within many fields, the numbers of African American, Hispanic, and American Indian science and engineering (S&E) doctorate recipients are extremely small. For example, in 2012, only six Hispanic women earned doctorates in computer sciences and no American Indians earned doctorates in mathematics. A diverse group of students who earn STEM doctorate degrees is essential for a diverse set of future faculty members who provide diverse ideas in education and research, develop the knowledge base for achieving full participation in STEM fields, and teach and mentor future STEM students. Despite some progress, women, minorities, and persons with disabilities remain underrepresented among STEM doctorate recipients as a whole; and they are even more underrepresented in some STEM fields. Women earn well over half of doctoral degrees in fields such as psychology and medical/other life sciences, but remain underrepresented among the highest ranked faculty members even in these fields.

This section will share the level of participation data for underrepresented groups across the STEM fields.

Low participation fields: engineering, mathematics, computer sciences, and physical sciences[2]

Although gains have been made by most groups in most disciplinary areas, engineering, mathematics, computer sciences, and physical sciences remain the areas in which women, underrepresented minorities, and persons with disabilities are the least represented (Figure 2.1 in Appendix A). In 2012, women earned one-third or less of all doctorates in these fields, and African Americans, Hispanics and American Indians each earned 3% or less.

- Women's percentages of engineering and physical sciences doctorates increased from 2002 to 2012, but their percentages of doctorates in mathematics and in computer sciences decreased.
- For some groups, numbers remain extremely small. No American Indians earned a doctorate in mathematics in 2012 and only 1 earned a doctorate in computer sciences.
- Although the numbers of African Americans, Hispanics, and American Indians earning doctorates in engineering, mathematics, computer sciences, and physical sciences are generally increasing, in many instances, the percentages are decreasing.
- Women of color are making some progress in engineering and physical sciences, where their numbers and percentages of doctorates are for the most part increasing. They are making less progress in mathematics and computer sciences, where their numbers remain extremely small.
- In 2012, roughly 5% of all doctorate recipients had one or more functional limitations (i.e., visual limitations, hearing limitations, walking limitations, lifting limitations, or cognitive limitations), and their representation varied little by field. Among science and engineering fields, only in engineering were persons with one or more functional limitations (4.3%) a substantially lower percentage of doctorate recipients. Changes over time on the disability question asked on the NSF Survey of Earned Doctorates prohibit analysis of trends over time.
- Historically Black Colleges and Universities (HBCUs) are among the top baccalaureate origin institutions of African American doctorate recipients. They award roughly one-fifth of all bachelor's degrees awarded to African Americans in STEM fields, but relatively fewer in computer sciences, engineering, psychology and social sciences.

- High-Hispanic enrollment institutions, functionally equivalent to Hispanic-Serving Institutions (HSIs) with at least 25% Hispanic enrollment, are among the top baccalaureate origin institutions of Hispanic doctorate recipients. They award roughly a third of the STEM bachelor's degrees awarded to Hispanics, and higher percentages in biological sciences, physical sciences and engineering.

Medium participation fields: agricultural sciences, biological sciences, and social sciences[3]

Representation of women, underrepresented minorities, and persons with disabilities in these fields, although low in some cases, is similar to their representation among science and engineering doctorates as a whole, as shown in Figure 2.2 in Appendix A.

- In these fields, women's participation increased from 2002 to 2012 and is now roughly half of all doctorate recipients.
- African Americans and Hispanics earned roughly 3 to 6% and American Indians earned roughly one half of one percent of the doctorates in these fields.
- African Americans, Hispanics, and American Indians earned increasing numbers and percentages of doctorates in these fields, except for African Americans and American Indians in social sciences.
- Women of color experienced gains in numbers and percentages of doctorate recipients in these fields, except for American Indian women who lost ground in social sciences.
- As noted earlier, the representation of persons with disabilities among STEM doctorate recipients differed little by field. Persons with disabilities earned roughly 5% of doctorates in agricultural sciences, biological sciences, and social sciences.

High participation fields: medical/other life sciences and psychology[4]

Representation of women and underrepresented minorities in these fields is far higher than their representation in science and engineering as a whole. Figure 2.3 and Table 2.1 in the Appendix A provide the following data about increased diversity in these fields.

- Women have earned more than half of doctorates in these fields for some time, and their representation continues to increase. By 2012, they earned roughly two-thirds to three-quarters of doctorates in these fields.
- African Americans and Hispanics earned 4-9% of doctorates in these fields in 2012, and increases in numbers and percentages occurred from 2002 to 2012.
- American Indians earned roughly half of one percent of doctorates in these fields and experienced gains in numbers and percentages of doctorates in medical/other life sciences, but not in psychology.
- As noted earlier, the representation of persons with disabilities among STEM doctorate recipients differed little by field. Persons with disabilities earned roughly 5% of doctorates in medical/other life sciences and in psychology.
- In no STEM field are women close to half of full professors. Even in psychology, in which women have earned more than half of all doctorates since the mid-1980s, only 37% of full professors were women in 2010.

Overall, challenges for women, underrepresented minorities, and persons with disabilities remain in all STEM fields. In some fields, numbers remain extremely small and in some fields, especially mathematics and computer sciences, numbers and percentages of doctorates have declined. Even in high participation fields, access to higher ranks in colleges and universities remains a problem (See Figures 2.4 and 2.5 in Appendix A).

Factors influencing participation rates are numerous, complex, and often interrelated, including differences in high school course-taking and K-12 teacher preparation, school district resources, high school graduation rates, college graduation rates, historic and ongoing bias and exclusion, poverty and family income levels, education of parents, student family status, differing cultures within fields, and differing institutional cultures within colleges/universities, among others. Research also indicates that overreliance on standardized test scores in the admissions practices of many STEM graduate programs is a significant factor in under-participation of underrepresented minorities in STEM PhD programs. The later part of the report provides some insights into NSF's effort to address the grand challenge of underrepresentation as well as research presentations about facilitating factors and frameworks for broadening participation.[5]

3. NSF INVESTMENT IN BROADENING PARTICIPATION

Broadening participation is embedded in NSF's strategic goals. Two of the strategic objectives outlined in NSF's most recent strategic plan, "Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014 – 2018," directly address broadening participation in the STEM workforce and in the NSF workforce:

- Goal 1, Strategic Objective 2 (G1/02): Integrate education and research to support development of a diverse STEM workforce with cutting-edge capabilities.
- Goal 3, Strategic Objective 1 (G3/O1): Build an increasingly diverse, engaged, and high-performing workforce by fostering excellence in recruitment, training, leadership, and management of human capital.

NSF addresses broadening participation in a number of ways beyond strategic goals and objectives—including review criteria, funding broadening participation programs that help ensure a diverse group of future STEM researchers, supporting the research of a diverse group of faculty and their students, and striving for a diverse NSF workforce. This section focuses on NSF's longstanding practices that have contributed to diversifying the STEM enterprise. Specifically, the areas discussed are: review criteria, NSF funding of broadening participation, diversity of NSF-funded principal investigators, reviewer diversity, and diversity of NSF staff.

Review Criteria

The two review criteria used in NSF's review process are Intellectual Merit and Broader Impacts. Broadening participation is one of the many factors NSF considers in reviewing the Broader Impacts criterion. The following language is included in all of NSF's solicitations:

> "Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is 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."

NSF Funding of Broadening Participation

NSF funds programs aimed explicitly at broadening participation as well as funding programs that are not explicitly focused on broadening participation but emphasize efforts in this area. *Focused* programs have an explicit broadening participation goal, and the majority of each award's budget goes to broadening participation activities. *Emphasis* programs emphasize broadening participation through components of the program, but lack an explicit broadening participation goal. In FY 2013, NSF spent $607.12 million on focused and emphasis broadening participation programs. The FY 2014 estimate for these programs is $638.1 million and for FY 2015, $663.3 million was requested. A little more than one-fourth (or $167.5 million in FY 2015) of that amount was for *Focused* programs such as Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Louis Stokes Alliances for Minority Participation (LSAMP), Centers of Research Excellence in Science and Technology (CREST), Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP) and Tribal Colleges and Universities Program (TCUP), and

the remaining three-fourths (or $495.8 million in FY 2015) was for *Emphasis* programs such as the NSF Graduate Research Fellowship Program (GRFP), scholarship programs, Discovery Research K-12 (DRK-12) and Research Experiences for Undergraduates (REU). Additionally, the Experimental Program to Stimulate Competitive Research (EPSCoR) promotes geographic diversity (an aspect of diversity not included in CEOSE's purview) and its budget trends were $147.60 million for FY2013, $158.19 million for FY2014 estimates, and $159.69 million for FY2015 request (See Table 3.1 in Appendix A). CEOSE continues to point out that while funding for the Foundation's broadening participation program portfolio is increasing, the greatest increase in funding is for the *Emphasis* category of programs. The *Focused* programs, which have the greatest concentration of activities that address the underrepresentation in STEM of women, minorities, and persons with disabilities, tend to experience little or no growth.

CEOSE has been most interested in the funding and outcomes of the programmatic activities of the *Focused* programs, which are specifically designed to meet the requirements of the Science and Engineering Equal Opportunities Act of 1980. Highlights of notable accomplishments, as funding increased, include:

- The Social and Behavioral Sciences Directorate (SBE) has provided $1 million in both FY13 and FY14 in matching funds to support research that advances the science of broadening participation (SBP). By leveraging these set-aside funds plus funds from the SBE standing programs, SBE has provided over $11 million in support for awards that advance the SBP since 2011. This research advances understanding of the positive and negative factors that impact the participation of underrepresented individuals in STEM. SBP research provides scientific evidence that STEM educators, STEM employers, and policy makers need to make informed decisions and to design effective programs and interventions.
- The Division of Environmental Biology of the Biological Sciences Directorate used the Dimensions of Biodiversity Workforce REU-Broadening Participation supplemental awards in FY14 as mechanisms to broaden participation of underrepresented groups. These activities are also supported through normal core activities. The division funded a broadening participation workshop and supported broadening participation activities of the Society for the Study of Evolution.
- The Ocean Sciences Postdoctoral Research Fellowship program was established in 2012 to provide research opportunities for individual fellows and to broaden participation of underrepresented groups in ocean sciences research. Successful postdoctoral fellows broaden participation through outreach activities targeting students from underrepresented minorities and involving them in the research project. The program supported eight postdoctoral fellows in 2013 and ten in 2014.
- The Ocean Sciences Postdoctoral Research Initiation Grant program was established in 2012 to provide early career investigators with funding needed to develop their research programs and to broaden participation of underrepresented groups in ocean sciences research. Successful investigators broaden participation through outreach activities targeting students from under-represented minorities and involving them in research activities. The program supported six research initiation grants in 2013 and five in 2014.
- In FY13 and FY14, Experimental Program to Stimulate Competitive Research (EPSCoR) supported ten projects to produce novel methods to broaden the participation of underrepresented groups in STEM fields. Examples of these projects include: partnerships in New Hampshire to build access to relevant computing education for underrepresented minority high school students through teacher professional development; testing of a cyber-learning methodology to elevate STEM learning

opportunities and promote success for underrepresented minority and rural middle school students in Nevada; and creating a regional Native American Network graduate program in Idaho with interdisciplinary courses that combine traditional knowledge and western science.

- In FY14, NSF awarded six grants to institutions of higher education through the Career-Life Balance Initiative to develop and disseminate policies on career-life balance. Projects included efforts to develop and disseminate best practices for implementation of Title IX, development and dissemination of best practices and policies for women of color, and support for reintegration into the academic workplace after family leave.
- Recently, the Graduate Research Fellowship Program (GRFP) launched an aggressive outreach effort to HBCUs to increase the number and quality of fellowship applications from those institutions. A pilot was initiated with six LSAMP institutions that have graduate programs and a robust research portfolio. A fellowship coordinator on each campus is responsible for hosting student workshops and planning faculty development activities focused on the preparation of fellowship applications and understanding the GRF competition process. The effort leverages the LSAMP program by targeting its current undergraduate student participants. There has been a marked increase in fellowship applications and awardees to these institutions since the outreach started.
- The HBCU-UP and ADVANCE programs have jointly funded projects to address the unique issues of women faculty at HBCUs. For example, the Opportunities for Underrepresented Scholars (OURS) program at the Chicago School of Professional Psychology has developed and is delivering a graduate certificate program in Academic Leadership. OURS is designed to address the compelling need for women faculty in STEM disciplines at HBCUs to acquire leadership skills for academic roles either within their discipline or within institutional administration. The first cohort of almost twenty women faculty is scheduled to receive the Graduate Certificate this spring and a second cohort has been selected. Already, in its first year of existence, over 25% of these participants have been promoted into significant leadership positions. Cohort 3 participants will begin in May 2015 and include 12 women from Tribal Colleges.

Diversity of NSF-funded Principal Investigators

NSF also funds a diverse group of principal investigators (PIs) through grants. In recent years, the overall number of PIs funded by NSF declined regardless of group. FY09 and FY10 included a number of PIs supported by funds from the American Recovery and Reinvestment Act of 2009, but as those funds ran out, the number of PIs declined and then continued to decline. The percentages who are women, American Indian, African American, Hispanic and persons with disabilities have remained relatively constant over the last five to nine years. There has been some increase in the percentage Asian, and there has been a large increase in the percentage of unknown race, resulting in a decrease in the percentage White. Women remain less than one-fourth; African Americans, Hispanics, and American Indians combined are less than 6%; and persons with disabilities were only 1% of principal investigators in FY 2013. See Table 3.2 in Appendix A for annual data from FY2005 – FY2013.

Reviewer Diversity

To help ensure a diverse set of principal investigators and to reduce bias in the review process, NSF seeks to have a diverse group of NSF reviewers and staff. Reporting of demographic information by reviewers is

voluntary and the majority of reviewers do not provide this information. The available data revealed increased participation of female reviewers in FY2013. See Figure 3.1 in Appendix A.

Diversity of NSF Staff

At NSF, a diverse staff, that is regularly trained in bias mitigation helps ensure a diverse set of principal investigators and a review process free from bias. A diverse staff, especially science and engineering staff, also demonstrates NSF's commitment to diversity.

Over the 10-year period FY04-FY13, women and underrepresented minorities were a larger proportion of NSF science and engineering staff. Most gains were by women, especially White and Asian women. Some slight progress was made in the number and proportion of Hispanic staff; however, little progress was made for American Indians, Native Hawaiians/other Pacific Islanders, and African American staff. See Table 3.3 in Appendix A.

4. CEOSE ACTIVITIES, OUTCOMES, AND PLANS FOR THE FUTURE

CEOSE Activities for 2013-2014

Five regularly scheduled meetings were convened by CEOSE between February 2013 and October 2014. Key topics addressed included: changing demographics; increasing Hispanic participation in STEM; research to advance broadening participation; large-scale investments and diversity; direct support to underrepresented populations; innovation, interdisciplinarity and inclusion in action, broader impacts and broadening participation; inclusiveness and equity in biomedical research; and data, performance measurement, and evaluation. Discussions with NSF Senior Leadership and highlights of presentations are summarized below.

Discussions with the NSF Director and Deputy Director focused largely on the CEOSE 2011-2012 recommendation for a bold new initiative. Because broadening participation is a core value, nothing less than a comprehensive strategy of bringing together evidence/data and PK-20 partnerships to advance the science and the development of diverse human capital is required. It is important to understand how to leverage NSF's $7 billion broadening participation investment for building an inclusive science and engineering enterprise. Sustainable collaborations have to include involvement with other federal agencies, including the sharing and supporting of the best ideas for the development and advancement of inclusive talent in STEM. CEOSE, recognizing NSF's role as the intellectual catalyst or enabler, emphasized the importance of building on success and taking it to the next level; diverse pathways in a broad and extensive way by thinking in integrative ways; partnering with and engaging universities, schools and their communities; and increasing the direct support to individuals. CEOSE stressed the need for accountability of universities to ensure participation by all groups and the need for NSF to require and facilitate institutional transformation by providing the carrots and sticks to ensure accountability. Discussion with the IIA Office Head and the Assistant Directors of the research directorates noted the reactivation of the NSF Broadening Participation Working Group; CISE's national and regional collaborations for best practices and educational resources that advocate inclusion of all students; SBE/NCSES's data as a resource for broadening participation efforts; and BIO's policy mandating broader diversity and inclusion at BIO-funded conferences and workshops. It was stressed that going forward with this new CEOSE initiative, at least four key dimensions need to be taken into account: inclusion, relevance, scalability, and sustainability.

Highlights of Presentations:

Changing Demographics

The STEM workforce of the future is being impacted by changing demographics with implications for equity, national security needs, and educational needs. All major groups in the US are increasing in population but at different rates with Hispanics experiencing the fastest rate of growth. In 2010, just over one-third of the US population reported their race as something other than non-Hispanic White alone. Of the 27.3 million people added to the US population between 2000 and 2010, 25.1 million were ethnic/racial minorities. Overall, the US population is projected simultaneously to grow more slowly, continue aging, and become more diverse.[6]

Increasing Hispanic Participation in STEM

Findings on first-year retention for underrepresented students in the biomedical and behavioral sciences revealed that students had higher odds of persisting in STEM when they: (1) joined student organizations related to their major, (2) discussed course content outside of class, (3) participated in undergraduate research programs, (4) entered college with higher SAT scores and (5) attended an institution with a higher concentration of STEM students. Underrepresented students had lower odds of completion in STEM if they: (1) worked full-time, (2) initially aspired to earn a medical degree, or (3) attended a more selective institution. Latino degree aspirants were more likely to finish in STEM in six years, compared to non-STEM majors, when they: (1) had higher academic self-concept, (2) had higher high school grades, (3) had mothers with a higher level of education, and (4) intended to major in engineering as opposed to biological sciences. The recommendations for practice were to create academic bridge programs and research programs to help Latinos increase mathematics and science proficiency and further develop STEM interest and competencies and to enact pedagogical innovations in introductory classrooms (e.g., student-centered pedagogy and team learning). Institutions should make authentic undergraduate research experiences more broadly available, reduce student financial obligations, encourage faculty mentorship, and provide peer learning support. MORE—an umbrella organization of externally-funded STEM programs at California State University, Los Angeles—supported several suggestions for promoting equity and excellence: develop appropriate science curricula and pedagogies; create a campus climate that fosters success and excellence in all students, and provide all students with sufficient protected time for them to achieve excellence.[7] The Computing Alliance of Hispanic Serving Institutions (CAHSI) presented their efforts to increase Hispanics in computer science, a field where they are sorely underrepresented, as reported above. CEOSE members were also encouraged to explore the STEM Toolkit: Tools for Increasing Latina and Latino STEM Baccalaureates[8] developed from research on Hispanic-Serving Institutions, such as California State University, Los Angeles, the University of Texas at El Paso, and other member institutions in CAHSI.

Research to Advance Broadening Participation

Research at University of California, Berkeley, shows that women now represent a large share of the scientific talent pool; however, the evidence also demonstrates that after they receive their PhDs, they do not continue to advance in the research academic ladder. Interesting data include:

- In obtaining tenure, single women without children do as well as married fathers. Married mothers are 27% less likely to obtain tenure.
- Married women with children are 35% less likely than married men with children to take a tenure track job.
- About 41% of all postdoc mothers decide to change their plans away from becoming a research professor.
- Approximately 46% of women indicated that they wanted to be a research professor when they started graduate school but after childbirth the percentage went down to 11%.
- Only one in three women who take the fast-track university job ever become a mother; women science faculty are far less likely to be married with children than men—53% versus 73%.[9]

The American Institutes for Research (AIR), in response to a Congressional directive, solicited recommendations and feedback from a range of stakeholders with expertise on effective mechanisms to increase the recruitment and retention of members of underrepresented groups in STEM fields as well as expertise on the attainment of STEM degrees by underrepresented groups. The research documented important feedback from stakeholders:

- expand the definition of success to assess degree program quality, instructional quality, and value of degree earned;
- account for institutional differences and measure change over time on key indicators;
- include accountability criteria in RFPs and reward institutions that meet or exceed accountability standards;
- expand two-year institutions' capacity to remediate academically underprepared students for STEM coursework and successfully transfer students to four-year STEM degree programs;
- expand the capacity of minority-serving institutions to establish/maintain STEM research and institutional capacity, prepare students for STEM graduate education and STEM academic careers, and lead/contribute to scientific innovation;
- improve within-school community building and engage students in STEM research throughout their undergraduate experience;
- provide faculty development in the areas of mentoring, cultural competence, community engagement and outreach, etc.;
- align STEM degree preparation with workforce needs; promote the cross-fertilization of faculty and course development across STEM and non-STEM disciplines; and
- train STEM students to be creative and innovative entrepreneurs.[10]

Researchers at University of California, Santa Barbara, and University of Washington have conducted studies to investigate a crucial question: Could the mere presence of diversity initiatives blind people to seeing discrimination against women and minorities even when it clearly exists? There are several implications from several studies that were shared with CEOSE: 1) organizations need to be aware of the potential for discrimination, even when the organization is making progress toward diversity and 2) the diversity conversation should shift from showcasing diversity initiatives to showing accountability and effectiveness of diversity initiatives. An increased focus on using evidence-based approaches to manage diversity requires investing in figuring out what works to make diversity more scientifically and empirically grounded.[11]

Research at Ohio State University showed that underrepresented groups are interested in innovation, creativity, and exploration. The research revealed the importance of addressing all three components of engagement, at multiple education levels, to promote diversity in STEM: the behavioral form of getting students involved in their own learning, the cognitive form of what students think about when they have become engaged in STEM activities, and the emotional form of a sense of belonging. It was pointed out that

the sense of belonging [in a STEM career] must be satisfied continually with changing circumstances, conditions, and contexts.[12]

CEOSE members commented on new research that highlights the value of using non-cognitive metrics as a best practice in the graduate admission process. This may provide a valuable alternative to the overuse of standardized test scores, which the research shows suppresses gender and ethnic diversity in STEM graduate programs.[13]

Large-Scale Investments and Diversity

CEOSE received an overview of broadening participation efforts in four centers programs and the Major Research Instrumentation Program (MRI). Notable are the Engineering Research Centers (ERC) program requirements for strategic plans for diversity; the first HBCU-led ERC, North Carolina A&T's Revolutionary Metallic Biomaterials Engineering Research Center; the focus of Carnegie Mellon's ERC on persons with disabilities; an upcoming ERC Diversity Climate Survey; efforts by Materials Research Science and Engineering Centers to increase participation of underrepresented minority groups and persons with disabilities; the requirements for Science and Technology Centers to have diversity strategic plans and metrics for diversity; and the Major Research Instrumentation Program's guidance on broadening participation as well as its outreach workshops for minority-serving institutions (MSIs) to help increase the number of proposals from and awards to MSIs.[14]

Direct Support for Underrepresented Populations

The demand for more STEM workers is requiring the participation of individuals from underrepresented groups who are often low income and who face rising costs for both undergraduate and graduate STEM degrees. The data analyzed from the 2010 Survey of Earned Doctorates were alarming: 58% of African American PhD recipients in SBE, 25% of African American STEM PhDs, 44% of Hispanic PhDs in SBE, and 14% of Hispanic STEM PhDs accrued more than $30,000 in graduate student debt. CEOSE agreed that solutions to increase the number of STEM degrees must give consideration to the cost for students (including tuition, financial aid, and debt), cost to institutions, and cost to society, particularly if demand for STEM workers is not met.[15]

Innovation, Interdisciplinarity and Inclusion in Action

The University of Maryland Baltimore Campus has adopted an institutional approach focused on increasing underrepresented groups in STEM. This work has required a cultural shift in perspective and corresponding actions, largely driven by faculty engagement. They have transitioned from the replication of some aspects of the Meyerhoff Program to a scaling approach through *Innovation through Institutional Integration* (I^3). The I^3 award was recognized as an opportunity to challenge problems in diversity through a partnership approach or STEM community building within an institution to study the effects of several STEM interventions.[16]

Research at Barnard College shows that interdisciplinary research bridges many different disciplinary areas and it is front and center as a mechanism for addressing pressing issues today with direct connections to societal needs. Data showed that more women than men engaged in interdisciplinary research and that the non-majority faculty members were about 1.2 times as likely to be engaged in less traditional (generally

more interdisciplinary) research. Results suggested that if women and minorities are indeed more attracted by interdisciplinarity:

- Institutions interested in increasing interdisciplinary research and teaching may have a greater chance for success if they involve women and minorities.
- Institutions interested in increasing their diversity may have a greater chance for success if they value interdisciplinary scholarship and teaching.[17]

Broader Impacts and Broadening Participation

Institutions and organizations are responsible for helping their researchers understand and leverage broader impacts as an opportunity for innovative research. For example, the University of Missouri has established a broader impacts infrastructure that offers annual training to help Principal Investigators understand broader impacts and how to document implementation and share results of broader impacts plans. Scientists should no longer think of broader impacts as being outside the technical aspects of their research. The new view of broader impacts in relationship to intellectual merit is that the two are integrated and should be interdependent. As a standout example, in the Centers for Ocean Science Education Excellence (COSEE), scientists are being trained to think of broader impacts as an opportunity for creativity and not view the requirement as a burden. The Broader Impacts criterion is pointed out as being more than educational outreach and that broadening participation is not a separate activity but is embedded in the research process as contributions to societal needs, policy and economy. The Center for Advancement of Informal Science Education (CAISE) is addressing the nexus of formal and informal education in the context of broader impacts. The emphasis is on meaningful innovation strategies that are greater than just education and outreach but involve connecting cultures to science. It was pointed out that broader impacts can involve the development and testing of a variety of models with the level of intellectual rigor comparable to scientific research being conducted. CEOSE was encouraged to visit http://caise.inscie.org to learn more about inclusive resources and to become a part of the community engaged in discussions about Broader Impacts learning goals.[18]

Inclusiveness and Equity in Biomedical Research

The Chief Officer of Scientific Workforce Diversity at National Institutes of Health (NIH) stated that if students do not see others like themselves when they look at career trajectories, they are less likely to have the resilience to be able to persist when faced with some of the challenging issues of continuing in the program; therefore, it is essential to have diverse representation at faculty and leadership levels so that students from underrepresented groups can identify with STEM careers. Unfortunately, faculty members from underrepresented groups face challenges in research funding. The University of Kansas research team has mined NIH administrative data and revealed racial/ethnic disparities in research funding. The major finding was that there is a significant difference in R01 award probability for PhD scientists by race and ethnicity with African Americans having the lowest award probability. The resubmission data revealed that African Americans, Asians, and Hispanics are significantly less likely to resubmit unfunded grant proposals than Whites. On the other hand, data revealed that serving on review committees helps with obtaining an award, and increased publications can cut the funding gap in half.[19]

Data, Performance Measurement, and Evaluation

The convergence of technology, policy, and social issues brought Big Data to the forefront of scientific discovery and engineering with considerable potential for transforming learning and broadening participation in STEM. More to the point, heterogeneous and massive data represent a motivating influence on the profound transformation on the culture and conduct of scientific research and education. The use of Big Data and application of aligned techniques to the issues of workforce development and broadening participation may have considerable potential. There is a great need to develop a workforce with skills to analyze, understand, and make decisions based on diverse data. The field is challenged with the underproduction of degrees, the underrepresentation challenge, and the lack of presence in K-12. The current Administration is expecting federal agencies to utilize evidence to set priorities and find effective and cost-effective practices. NSF is advancing an integrated approach to agency evaluation, involving the integration of rigorous data analysis and external evaluation with business intelligence tools and performance measurement. CEOSE also received an overview of NSF text mining tools that are being developed in OD/IIA. Clustering techniques could be used to show the high relevancy of broadening participation topics and themes. CEOSE was encouraged to use the proposal search engine tool on www.Research.gov to explore some diversity queries and create visuals of themes and topics. Developmental evaluation should be coupled with implementation research to better understand the kinds of changes that need to happen and the best ways to support innovation.

Additional Topics

Additional sessions emerging from discussions with the director and during the presentations included:

- NSF Diversity and Inclusion Plan:

  Executive Order 13583 required an agency-specific diversity and inclusion plan for recruiting, hiring, training, developing, advancing, promoting, and retaining a diverse workforce. The NSF plan is reflective of employee engagement in diversity and inclusion conversations to ensure a shared direction and alignment in which diversity and inclusion is an integral part of the organization.

- NSF Strategic Plan:

  Broadening Participation is explicit in two objectives:

  - Goal 1/Objective 2: Integrate education and research to produce a diverse STEM workforce with cutting-edge capabilities
  - Goal 3/Objective 2: Build an increasingly diverse, engaged, and high-performing NSF workforce by fostering excellence in recruitment, training, leadership, and management of human capital

- Transparency and Accountability:

  NSF is committed to the principles that underlie transparency and excellence in management/accountability. NSF has a long-standing core value of *dedication to excellence* that has been embodied in the Foundation's strategic plans, investing optimally in both the financial and

human resources. It is critical that the Foundation continues to communicate with all stakeholders as to how and why funding decisions are made. In early December 2013, a notice was sent to Presidents of universities and other National Science Foundation awardees organizations, pointing out the dual goal of accountability and communication. Community buy-in was cited as essential as NSF moves forward in making the case for what science is funded and the value of that science. Principal Investigators need to help people understand the value of basic research and why their projects are worth the investments.

- International Engagement:

  Excellent science is happening around the world. NSF must be intentional and strategic in enabling all US scientists to partner worldwide. CEOSE was encouraged by the engagement of women and very concerned about low participation rates for underrepresented minorities (URMs). Members agreed that more attention needs to be given to greater involvement of persons with disabilities in global research opportunities. It was emphasized that URMs need to connect with countries, cultures, fellow researchers and students with which/whom they may have some affinity or cultural connection. Full engagement of all segments of society in international research collaborations was stated as essential for broadening participation in STEM for innovation and knowledge transfer. Other areas discussed were partnerships for international engagement, broadening participation across all fields, and financial barriers and perceptions about completion delays due to spending extra time studying abroad. Inclusion of possible broader impacts of broadening participation for both the US and the countries abroad should be considered and included in solicitations, as appropriate.

- Graduate Education:

  There were two recurring themes across national reports: the professional development of graduate students and pathways into and through graduate education. It was pointed out that broadening participation is not a stated goal for research assistantship (RA) support. Furthermore, it was emphasized that this is a key area for systemic impact in graduate education given that most of NSF's support for graduate students is through research assistantships. CEOSE members commented that who is allowed to do science is largely based on who is admitted into graduate school. CEOSE members provided cases of the value of using non-cognitive metrics as a best practice in the admission process.

- Executive Liaison Updates of some of NSF's specific investments/engagement:

  FY 13 plans for Career-Life Balance (CLB) included supplemental support for CAREER awardees with dependent care issues, such as, support for research technicians (or equivalent), and expanding such support to the Graduate Research Fellows and to postdocs on NSF research grants, and providing dual career supplements to the Institutional Transformation awards in the ADVANCE program. NSF hosted the 2013 Gender Summit- North America in the DC area. Other broadening participation activities include: Recent BIO policy (BI0 12-01), designed to ensure that barriers to full participation of underrepresented groups are examined and removed for conferences, meetings, workshops, and international congresses supported by the Directorate for

Biological Sciences; EPSCoR Track 3- Building Diverse Communities for STEM Learning and Innovation; and the Broader Impacts Infrastructure Summits in 2013 and 2014. In response to the 2009-2010 CEOSE Recommendations, the Foundation revised the broadening participation table in the annual Budget Request so it has greater rigor and reports differential growth by category of program.

- A congressional staffer met with the committee to enhance the strategic thinking of CEOSE going forward. She thought that CEOSE needed to communicate more strongly to Congress and the public the urgency of the situation regarding quality STEM education and outcomes, and to advocate the necessity of an all-inclusive diversity in STEM if the US is to be globally competitive. She further noted the need to include chambers of commerce and university spinoff companies and tech transfer offices in this conversation.

Outcomes of CEOSE Recommendation(s)

In the 2011-2012 report, CEOSE focused upon a single primary recommendation calling for a bold new initiative to broaden participation. The general idea has struck a positive chord within the agency, engendering discussion and enthusiastic support among many with others being receptive, but wanting more detail and specifics. The current report builds upon and advances that recommendation. Additionally, the NSF reconstituted the Broadening Participation Working Group, charged with suggesting options for new approaches toward creating "a bold new initiative" to augment the Foundation's ongoing efforts to increase participation in STEM from underrepresented groups. Appendix B summaries the work of this group, concluding that NSF should develop a multidimensional strategy that is responsive to the 2011-2012 CEOSE recommendation.

The Foundation also continues to respond to CEOSE recommendations. A table of prior recommendations and summaries of NSF responses to date can be found in Appendix C. A long standing recommendation of CEOSE has been for the establishment of an HSI Program at NSF. The program has not yet been established so we continue to recommend its establishment; particularly given Hispanics' role in the changing demographics of the nation and universities, and the research findings and best practices on Hispanics in STEM reported to the committee and mentioned above. However, good progress been made towards this end with the release of two DCLs: *Dear Colleague Letter – Stimulating Research on Effective Strategies in Undergraduate STEM Education at Two-Year Hispanic Serving Institutions* (NSF 14-064) and *Dear Colleague Letter - Announcement of Effort to Broaden the Participation of Students in Two-Year Hispanic Serving Institutions in Science, Technology, Engineering, and Mathematics (STEM)* (NSF 14-065). An obvious shortcoming of these is that they are limited to two-year institutions. Two-year institutions compose about half of all HSIs, where, unlike four-year institutions, Hispanic enrollment is comparable to the proportion of Hispanics in the nation, and transferring to a four-year institution is a major barrier to broadening Hispanic participation in STEM careers. These institutions are a very worthwhile focus, and it

is understandable why the Foundation chose to do so. A notable advancement of this DCL, as a prelude to an HSI Program with its own targeted funding, is that it applies agency-wide across directorates. This has the potential for creating disciplinary specific efforts, and generating innovation, buy-in and engagement within each of the directorates and disciplines; such a program should be applicable to all HSIs and be cross-directorates to more effectively advance HSIs and Hispanics in all areas of STEM.

Plans for the Future

CEOSE plans to further enhance messaging and marketing of its recommendation for a bold new initiative, to enhance interagency sharing, and to further address the grand challenges of broadening participation, through continuing to work synergistically with the NSF Assistant Directors and Office Heads, the CEOSE Executive Liaison, and the NSF Broadening Participation Working Group.

Also looking to the future, the NSF broadening participation portfolio must stay current with the broader issues within the scientific enterprise, such as:

- Open access to scientific data, including global activities and partnerships that enable sustainable research exchanges and collaboration among scientists and engineers from the underrepresented groups,
- Leveraging technology for anytime, anywhere learning environments for all, for example personalized and collaborative learning environments, mobile learning, massive open online courses, and
- Integration of formal and informal learning for improved access to and awareness of STEM knowledge and STEM careers.

5. SUMMARY RECOMMENDATION: AN IMPLEMENTATION FRAMEWORK FOR BOLDLY ADDRESSING THE 'GRAND CHALLENGE' OF BROADENING PARTICIPATION

In 2011-2012, the CEOSE Biennial Report focused on a single, bold recommendation that "NSF implement a bold new initiative, focused on broadening participation of underrepresented groups in STEM… that emphasizes institutional transformation and system change; collects and makes accessible longitudinal data; defines clear benchmarks for success; supports the translation, replication and expansion of successful broadening participation efforts; and provides significant financial support to individuals who represent the very broadened participation that we seek."

Based on our interactions with NSF staff and the overall positive response by NSF to the 2011-2012 CEOSE Biennial Report—including especially the reconstitution of a Broadening Participation Working Group with directorate representation across NSF—we are renewed in our conviction that NSF recognizes the importance of making the bold initiative recommended by CEOSE a reality. To advance this bold initiative toward addressing the grand challenge of broadening participation, we have discussed four major areas of concern that dramatically affect STEM and broadening participation. We summarize these below, followed by a framework of five specific components that we suggest will be needed in practice to successfully implement the bold new initiative recommended in the 2011-2012 CEOSE report.

Four major areas of underrepresentation affecting STEM and broadening participation

Over the past two years, we have engaged with stakeholders across NSF's leadership, including the two directors who served during this period, the Former Deputy Director, the Head of International and Integrative Activities, Assistant Directors of the NSF directorates; the program officers overseeing NSF's Centers programs, the program officers participating in working groups on broadening participation, the directorate-level advisory committees, the CEOSE liaisons from other federal agencies, and others. We are in agreement with NSF's four major areas of underrepresentation that dramatically affect STEM and broadening participation:

- **Under-production and Inclusion**. The under-production of degrees is a serious concern. Increased involvement of underrepresented groups in STEM is needed for a workforce that is representative of the changing demographics. Lessons learned from evidence-based practices highlight the need for multi-sector partnerships for transforming STEM disciplines.
- **Under-preparation and Relevance**. STEM education and workforce development should be coordinated, leveraged, and carefully and thoroughly measured and analyzed to determine performance outcomes. At all levels, there is a need to underscore the importance of scientific research by designing experiences relevant to students' lives and exploring different means of communicating the significance of STEM investments to a given community as well as the nation. NSF is expected to take a lead in sharing best practices and building the knowledge base so that researchers and program officers learn about what really works and what does not work.
- **Under-resourcing and Scalability**. There is a need to reward individual projects and *Focused* programs that are making a difference with additional resources to scale-up successful practices. There must be a balance between supporting new collaborative ideas and supporting the replication/adaptation of successful intervention and implementation strategies. NSF's connection

and integration of broadening participation with transformational frontier science is strongly encouraged; but the resources to support this conceptualization of BP are currently insufficient. Additionally, colleges and universities receive most of NSF funding. Higher education, however, is not sufficiently promoting the cutting-edge BP partnerships that cover all of schooling – PK-20+ – required to develop the full and diverse talent necessary for a representative and truly effective science and engineering workforce. While new technology will be essential for scaling up activities, it is critical that underrepresented communities have broad access to technology for content delivery and sufficient support to engage in inclusive virtual research opportunities. The lack of state-of-the-art STEM physical and cyber infrastructure must no longer be a limiting factor for minority-serving institutions. It is important to advance from a few success stories about a limited number of students to a more inclusive systemic approach, such as inter-institutional partnerships that have deep and wide national impacts. Advancing BP conversations for large-scale change will require engaging the STEM stakeholders/communities to both identify BP problems and work actively together to solve these problems in societally significant ways.

- **Under-participation and Sustainability**. Broadening participation impacts all of America. It is an intellectual problem and, as such, NSF is the appropriate agency to take the lead in developing a bold agenda that will lead to ongoing, substantive change and improvement in STEM equity and diversity. Science is strengthened by engaging a broader, diverse population in the pursuit and development of scientific knowledge. We are convinced that we can create a culture, implement practices and allocate resources to solve the current underrepresentation challenge, as well as address the new needs for the next generation of scientists and engineers through highlighting potential avenues to promote change that will drive sustainability.

<u>Five specific components of a plan to implement a bold new initiative to broaden participation at NSF</u>

The CEOSE 2011-2012 biennial report suggested some concrete steps that could be taken toward realization of the goal of a bold new initiative at NSF focused on broadening participation. For example, "this initiative might include several multi-site, geographically based, national experiments of foundational and implementation research involving universities, schools, and communities, inclusive of all underrepresented populations." Here we expand on the 2011-2012 report and suggest a framework of five specific implementation components that provide a means for realizing the overarching grand challenge of broadening participation identified in the CEOSE 2011-2012 biennial report: to *transform the STEM enterprise at all levels to fully engage all the nation's citizens—including women, underrepresented minorities, and persons with disabilities.*

1. *Develop and implement an effective preK-20+ system of STEM pathways.*
   Parity in the STEM workforce can be achieved by developing partnerships among local schools, colleges and universities, government and industry across the nation that will educate, inspire, train, and retain individuals in STEM at all levels of engagement, from pre-K and into the STEM workforce. Such interactions should aim to smooth progress along STEM pathways and increase the seamless participation of individuals—especially women, underrepresented minorities, and persons with disabilities—into STEM—at every stage. Integral to this will be to transform institutions of higher education into more inclusive institutions with the will, know-how, and the capacity to help build these effective pathways. It will also be essential to build greater research and teaching capacity at

those institutions that are already more inclusive, such as Hispanic-Serving Institutions (HSIs), or those with a mission focus on underrepresented minorities, such as Historically Black Colleges and Universities and Tribal Colleges and Universities, so that they may better meet their potential for significantly increasing and broadening the diversity of the nation's scientists and engineers.

2. *Provide stable and sufficient direct support for individuals.*
   It is vital to provide direct support for the individuals—students, postdocs, pre-professionals—who represent the very broadened participation that we ultimately seek. This direct support must be significant, consistent, and large scale—equal to the magnitude of the broadening participation challenge itself.
3. *Support the further development of a science of broadening participation grounded in empirical research*.
   Further develop and support a coherent body of scholarly work that, among other things, identifies models and approaches that are effective, increases understanding of why and how different approaches work, leads to an emerging, implementation-based theory of broadening participation, and that can facilitate ongoing federally-funded efforts addressing the science of broadening participation. This approach and the emerging implementation theory will provide a more informed basis for model identification, adaptation, and replication.
4. *Conduct field experiments to understand and mitigate the barriers to broadening participation.*
   Leverage the direct support for individuals and programs (see #2 and #3 above) as opportunities to conduct investigations that lead to a deep, systemic, scientific understanding of the factors that currently limit, filter out, and otherwise preclude the full engagement of individuals in STEM. Include assessment of the interventions to ensure that the outcomes of these experiments result in a more "open and frictionless" preK-20+ system of pathways (see #1, #2 and #3 above).
5. *Recognize the field specific nature of the broadening participation challenge.*
   Embed and engage the bold initiative within and across all NSF directorates and divisions, recognizing that different approaches will be required in different disciplines while optimally connecting and clustering activities between and among disciplines. Use the effort at NSF to guide collaboration with other federal agencies.

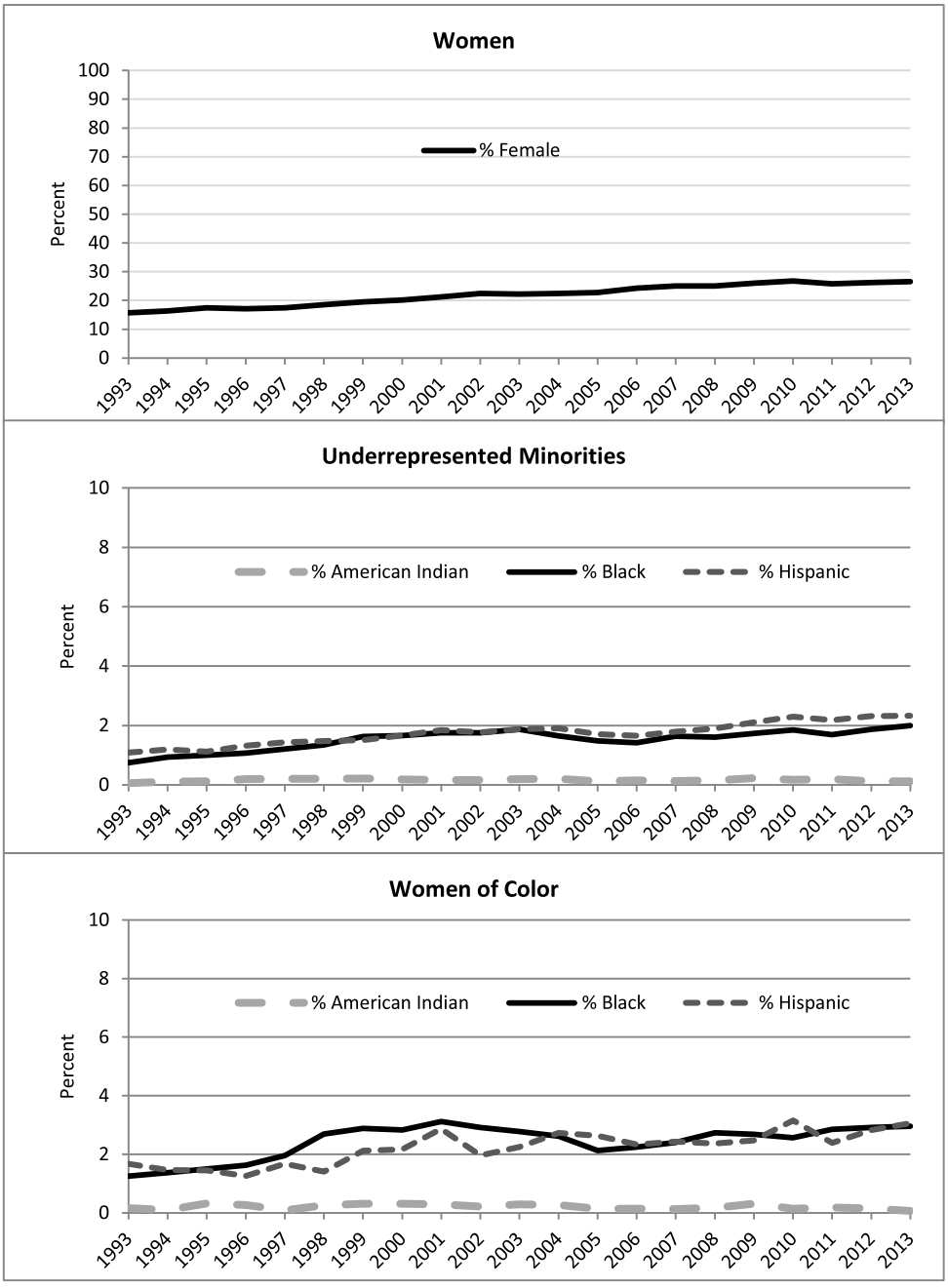
The final component listed above recognizes that, while CEOSE's mandate focuses our purview on NSF specifically, the enormousness of the grand challenge of broadening participation in STEM is such that cooperation and coordination beyond NSF is necessary. Indeed, the broadening participation challenge writ large is not NSF's challenge alone; it is the nation's challenge, and thus it is the nation's responsibility to solve.

We hope that the upcoming America Competes Reauthorization, as well as other legislation and appropriations, are informed by the CEOSE recommendation for a bold new broadening participation initiative. We also hope that Congress authorizes and allocates the necessary funding to NSF to effectively launch and carry out the bold new initiative. Indeed, we believe that NSF must serve as the primary ongoing catalyst for coordinated, multiple agency, national action. It is NSF's responsibility to provide the intellectual and scientific leadership if we are to develop a truly inclusive STEM enterprise that fully and effectively engages all of our citizens.

APPENDIX A
TABLES AND FIGURES

Figure 2.1

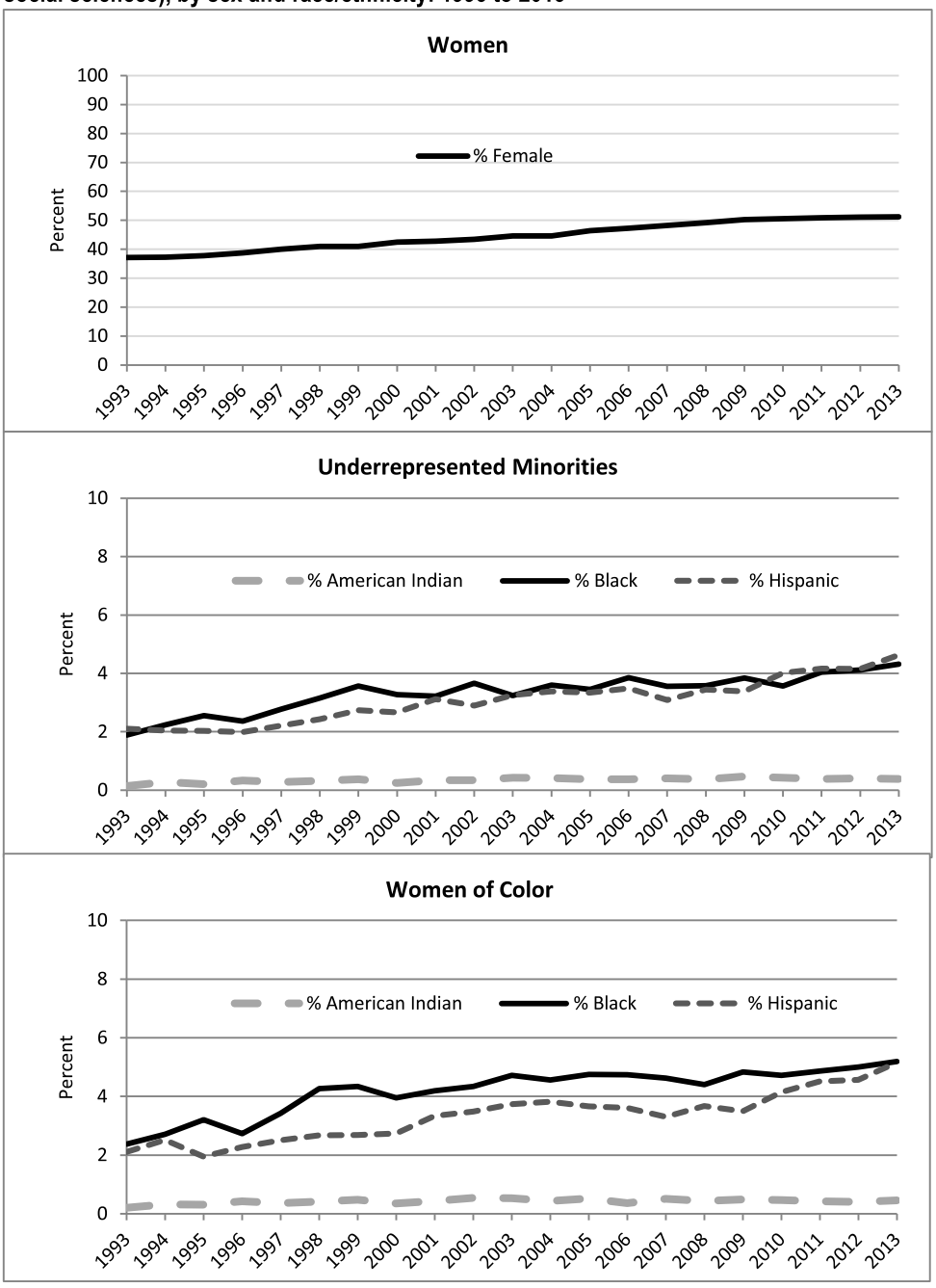
Doctorate recipients in low participation fields (engineering, physical sciences, mathematics and statistics, computer science), by sex and race/ethnicity: 1993 to 2013



NOTES: Prior to 2008 National Center for Education Statistics (NCES) used two doctoral degree categories: doctor's and first-professional. Beginning in 2008 NCES's reporting categories were: doctor's-research/scholarship, doctor's-professional practice, and doctor's-other. Data in this chart include only doctorates reported as doctor's-research/scholarship. Note differences in scale for vertical axes for women (100%) and minorities and minority women (10%) for these charts.
SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey.

Figure 2.2

Doctorate recipients in medium participation fields (agricultural sciences, biological sciences, social sciences), by sex and race/ethnicity: 1993 to 2013

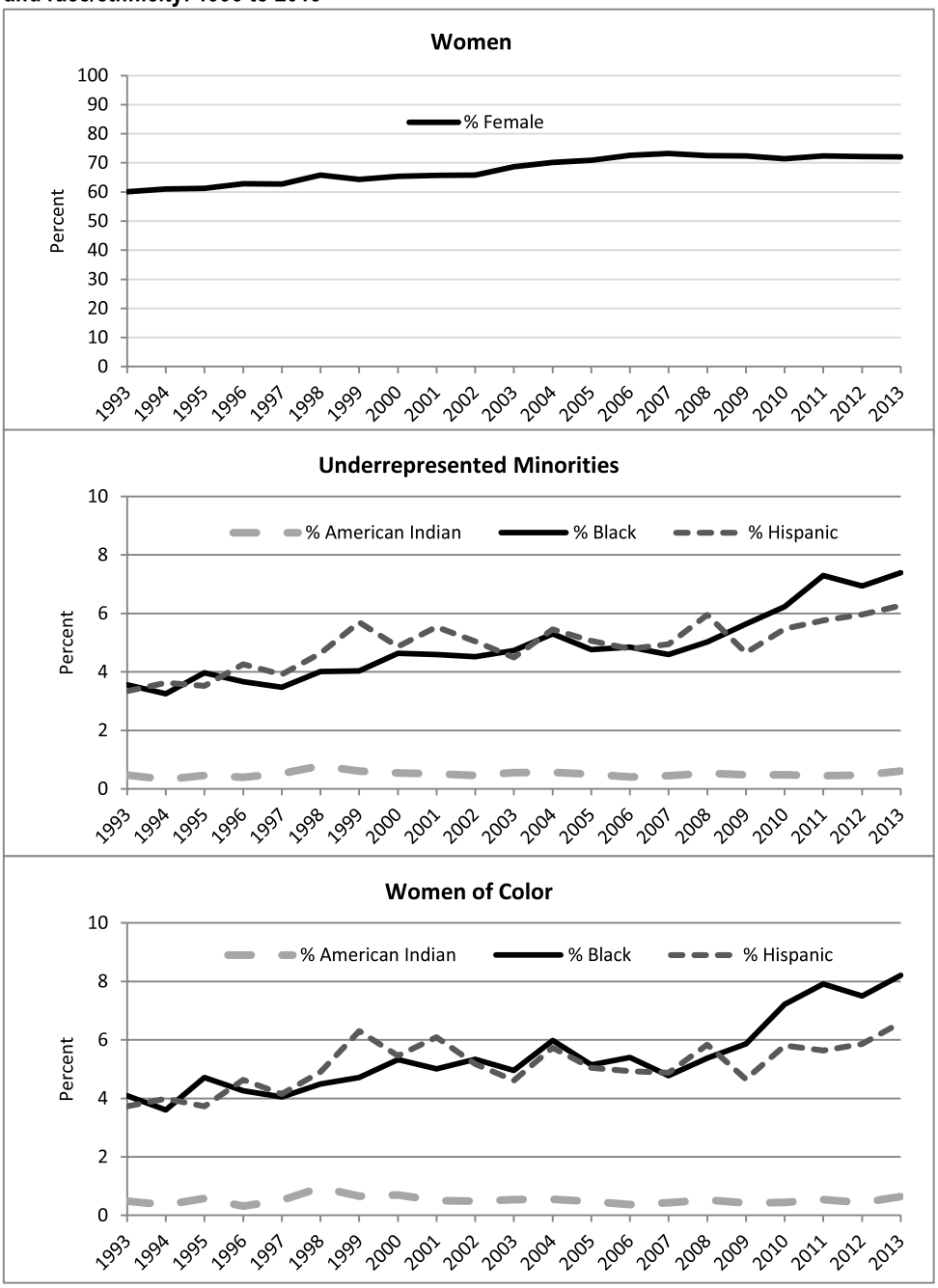


NOTES: Prior to 2008 National Center for Education Statistics (NCES) used two doctoral degree categories: doctor's and first-professional. Beginning in 2008 NCES's reporting categories were: doctor's-research/scholarship, doctor's-professional practice, and doctor's-other. Data in this chart include only doctorates reported as doctor's-research/scholarship. Note differences in scale for vertical axes for women (100%) and minorities and minority women (10%) for these charts.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey.

Figure 2.3

Doctorate recipients in high participation fields (medical/other life sciences, psychology), by sex and race/ethnicity: 1993 to 2013



NOTES: Prior to 2008 National Center for Education Statistics (NCES) used two doctoral degree categories: doctor's and first-professional. Beginning in 2008 NCES's reporting categories were: doctor's-research/scholarship, doctor's-professional practice, and doctor's-other. Data in this chart include only doctorates reported as doctor's-research/scholarship. Note differences in scale for vertical axes for women (100%) and minorities and minority women (10%) for these charts.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey.

Table 2.1

Doctorate recipients reporting one or more functional limitations, by broad field of study, sex, and citizenship: 2012

Demographic characteristic	One or more limitations of any type		Visual limitations		Hearing limitations		Walking limitations		Lifting limitations		Cognitive limitations[a]	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All doctorate recipients	2,587	5.1	1,193	2.3	498	1.0	191	0.4	307	0.6	918	1.8
Field of study												
Life sciences[b]	554	4.6	244	2.0	100	0.8	32	0.3	55	0.5	203	1.7
Physical sciences[c]	450	5.0	228	2.5	91	1.0	32	0.4	57	0.6	165	1.8
Social sciences[d]	439	5.3	155	1.9	89	1.1	41	0.5	52	0.6	185	2.2
Engineering	361	4.3	233	2.8	61	0.7	21	0.2	38	0.5	100	1.2
Education	280	5.8	125	2.6	63	1.3	27	0.6	36	0.7	79	1.6
Humanities	346	6.3	127	2.3	61	1.1	24	0.4	50	0.9	144	2.6
Other[e]	157	5.4	81	2.8	33	1.1	14	0.5	19	0.6	42	1.4
Sex												
Male	1,305	4.8	632	2.3	289	1.1	85	0.3	116	0.4	477	1.7
Female	1,282	5.4	561	2.4	209	0.9	106	0.4	191	0.8	441	1.9
Citizenship												
U.S. citizen/permanent resident	1,764	5.4	601	1.8	384	1.2	132	0.4	182	0.6	736	2.2
Temporary visa holder	823	5.6	592	4.0	114	0.8	59	0.4	125	0.8	182	1.2

[a] Includes functional limitations in concentrating, remembering, or making decisions because of a physical, mental, or emotional condition.

[b] Includes agricultural sciences and natural resources; biological, biomedical sciences; and health sciences.

[c] Includes mathematics and computer and information sciences.

[d] Includes psychology.

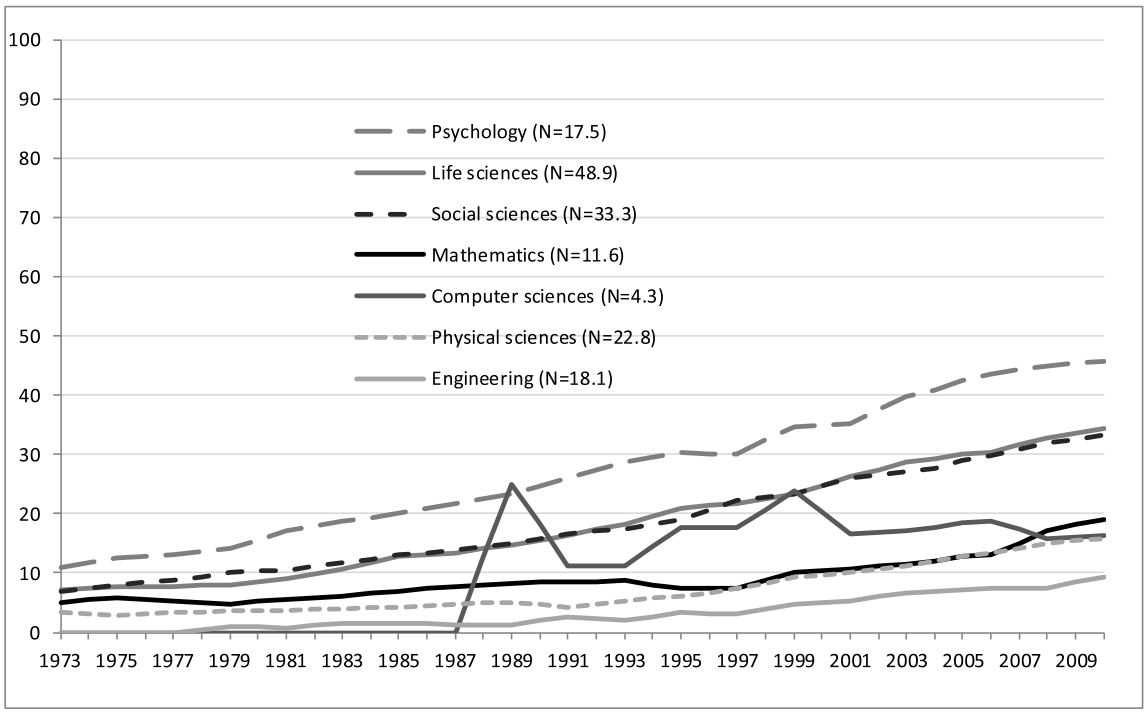
[e] Non-science and engineering fields not shown separately.

NOTES: Individual doctorate recipients could report more than one functional limitation. Survey asks degree of difficulty—none, slight, moderate, severe, or unable to do—an individual has in seeing (with glasses), hearing (with hearing aid), walking without assistance, lifting 10 pounds, or concentrating, remembering, or making decisions. Those respondents who answered "moderate," "severe," or "unable to do" for any activity were classified as having a functional limitation.

SOURCE: NSF, NIH, USED, USDA, NEH, NASA, Survey of Earned Doctorates, 2012.

Figure 2.4 Women as a percentage of full-time associate and full professors, by degree field: 1973-2010

Percent

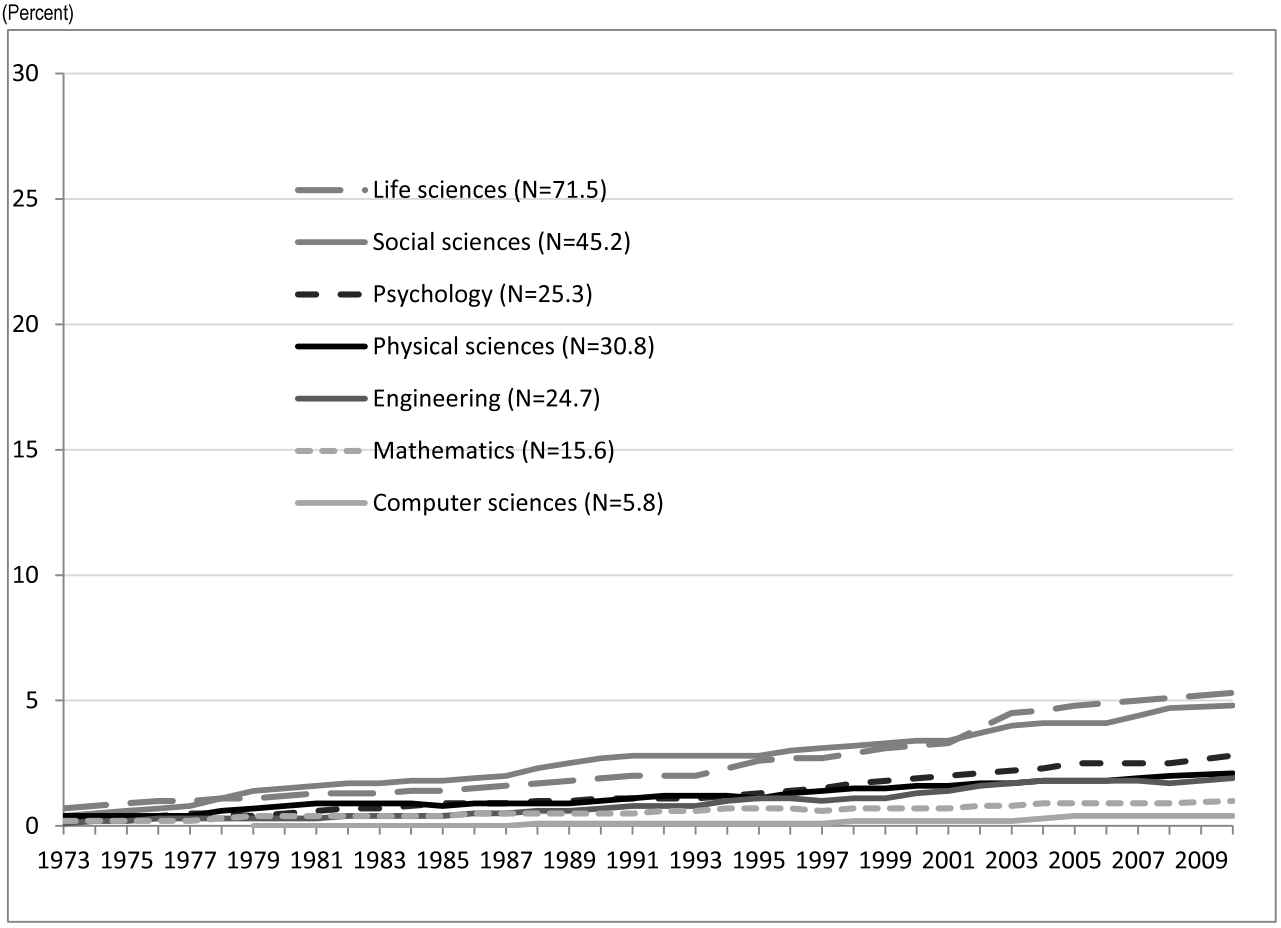


Notes: N=total number (in thousands) of full-time senior faculty in that field in 2010. Data collected in odd years from 1973 through 2003, then in even years from 2006 to 2010. The numbers of full-time associate and full professors in computer sciences before the mid 1980s are extremely small.

Source: National Science Foundation/National Center for Science and Engineering Statistics, Survey of Doctorate Recipients.

Figure 2.5 Underrepresented minorities as a percentage of full-time STEM faculty, by degree field: 1973-2010

(Percent)



N=Total number (in thousands) of full-time faculty in that field in 2010.

Notes Data collected in odd years from 1973 through 2003, then in even years from 2-6 to 2008. See appendix table A-3 for more detailed information by race/ethnicity.

Source: National Science Foundation/National Center for Science and Engineering Statistics, Survey of Doctorate Recipients.

Table 3.1

National Science Foundation

Programs to Broaden Participation

FY 2015 Request to Congress

(Dollars in Millions)

Group/Program	Funding Amount Captured	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change Over FY 2014 Estimate	
					Amount	Percent
Focused Programs		**$161.05**	**$168.50**	**$167.50**	**-$1.00**	**-0.6%**
ADVANCE	100%	15.25	16.46	14.90	-1.56	-9.5%
Alliances for Graduate Education & the Professoriate (AGEP)	100%	7.21	7.84	7.84	-	-
AGEP Graduate Research Supplements	100%	2.19	2.00	0.15	-1.85	-92.5%
Biological Sciences Minority Postdoctoral Fellowships	100%	2.50	2.50	2.50	-	-
Broadening Participation in Engineering (BPE)	100%	4.91	6.00	6.00	-	-
Career-Life Balance (CLB)	100%	3.99	1.30	1.00	-0.30	-23.1%
Centers of Research Excellence in Science & Technology (CREST)	100%	22.95	22.98	22.98	-	-
Engineering Graduate Research Diversity Supplements (GRDS)	100%	0.19	-	-	-	N/A
Excellence Awards in Science & Engineering (EASE)[1]	100%	4.70	5.82	5.82	-	-
Geosciences Postdoctoral Fellowships	100%	3.40	3.82	3.82	-	-
Historically Black Colleges & Universities Undergraduate Program (HBCU-UP)	100%	30.30	31.94	31.94	-	-
Louis Stokes Alliances for Minority Participation (LSAMP)	100%	42.03	45.62	45.62	-	-
Partnerships for Research & Education in Materials (PREM)	100%	5.55	3.72	6.43	2.71	72.8%
Partnerships in Astronomy & Astrophysics Research Education (PAARE)	100%	0.91	1.00	1.00	-	-
Pre-Engineering Education Collaboratives (PEEC)	100%	1.00	1.00	1.00	-	-
SBE Postdoctoral Research Fellowships-Broadening Participation	100%	0.59	1.50	1.50	-	-
Tribal Colleges & Universities Program (TCUP)	100%	12.39	13.50	13.50	-	-
SBE Science of Broadening Participation	100%	1.00	1.50	1.50	-	-
Emphasis Programs		**$446.08**	**$469.57**	**$495.84**	**$26.27**	**5.6%**
Advancing Informal STEM Learning (AISL)	58%	27.85	31.90	31.90	-	-
Centers for Ocean Science Education Excellence (COSEE)[2]	68%	0.67	-	-	-	N/A
Discovery Research K-12 (DR-K12)	72%	69.62	66.62	73.82	7.20	10.8%
Graduate Research Fellowship (GRF)	59%	143.34	177.00	196.73	19.73	11.1%
Innovative Technology Experiences for Teachers & Students (ITEST)[3]	70%	22.06	17.50	17.50	-	-
International Research Experiences for Students (IRES)	73%	2.26	1.64	1.64	-	-
Noyce Scholarships	59%	30.15	35.93	35.93	-	-
NSF Scholarships in STEM (S-STEM)[3]	57%	47.87	42.75	42.75	-	-
Ocean Sciences Research Initiation Grants (OCE-RIG)	100%	0.60	0.60	-	-0.60	-100.0%
Research Experiences for Undergraduates (REU) - Sites and Supplements	61%	45.21	45.89	45.83	-0.06	-0.1%
STEM, including Computing Partnerships (STEM-C Partnerships)[4]	72%	46.61	49.74	49.74	-	-
Computing Education for the 21st Century (CE21)	*68%*	*8.30*	-	-	-	*N/A*
Math Science Partnership (MSP)	*73%*	*38.31*	-	-	-	*N/A*

STEM Talent Expansion Program (STEP)	58%	9.84	-	-	-	N/A
Total, Focused and Emphasis Programs		**$607.12**	**$638.07**	**$663.34**	**$25.27**	**4.0%**
Geographic Diversity Program		**$147.60**	**$158.19**	**$159.69**	**$1.50**	**0.9%**
EPSCoR	100%	147.60	158.19	159.69	1.50	0.9%
Total, NSF		**$754.73**	**$796.26**	**$823.03**	**$26.77**	**3.4%**

Totals may not add due to rounding.

[1] The Excellence Awards in Science and Engineering (EASE) program is comprised of both Presidential Awards for Excellence in Science, Math and Engineering Mentoring (PAESMEM) and Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST).

[2] The COSEE program terminated in FY 2014.

[3] NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) and Innovative Technology Experiences for Students and Teachers (ITEST) are H1B Visa funded programs.

[4] In FY 2014, Computing Education for the 21st Century (CE21) and Math Science Partnership (MSP) merged into Science, Technology, Engineering, including Mathematics and Computing Partnerships (STEM-C Partnerships).

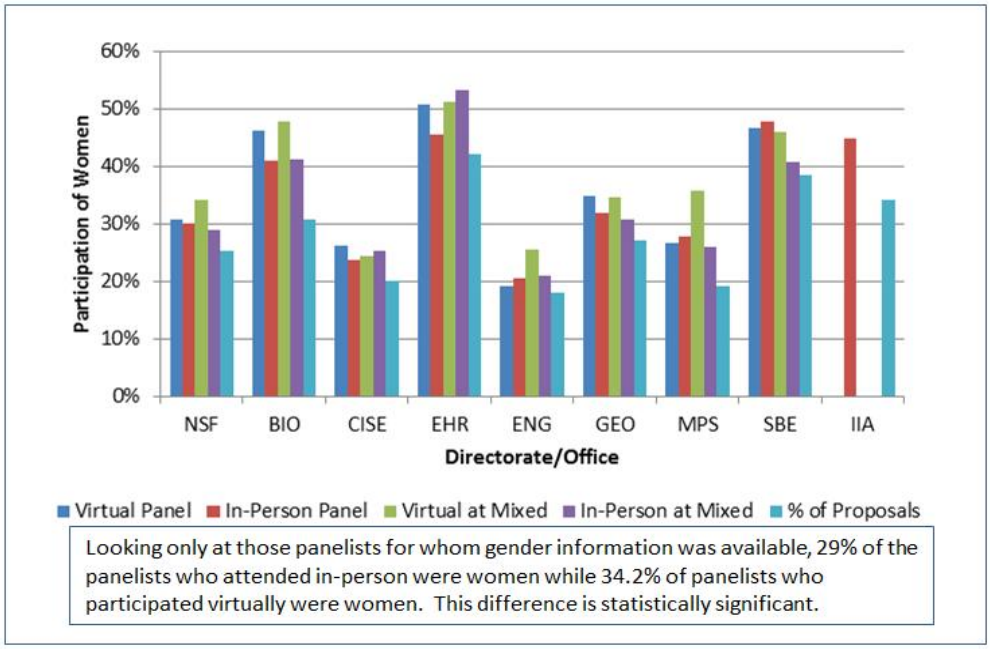
Source: National Science Foundation, *FY 2015 NSF Budget Request to Congress,* http://www.nsf.gov/about/budget/fy2015/pdf/10_fy2015.pdf

Table 3.2
Number of Principal Investigator Awards, by Gender, Race/ethnicity and Disability Status: FY 2005-FY2013

Group	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13
	Number								
All Principal Investigators	9,757	10,323	11,361	11,030	14,673	13,022	11,193	11,533	10,844
Female	2,131	2,186	2,489	2,553	3,313	3,003	2,632	2,789	2,575
Male	7,388	7,825	8,488	8,012	10,637	9,241	7,824	7,875	7,335
Unknown	238	312	384	465	723	778	737	869	934
American Indian/Alaska Native	24	29	27	23	24	22	26	18	22
Asian	1,306	1,520	1,796	1,796	2,464	2,116	1,891	1,920	1,889
Black/African American	187	194	241	223	298	265	236	258	192
Hispanic	331	367	425	382	535	484	439	416	407
Multiracial	78	59	67	55	89	99	89	93	90
Native Hawaiian/Pacific Islander	6	9	4	8	11	11	11	6	5
White	7,356	7,577	8,167	7,842	10,215	9,019	7,573	7,770	7,143
Unknown race	469	568	634	701	1,037	1,006	928	1,052	1,096
Persons with Disability	123	125	126	126	178	119	116	141	122
					Percent				
All Principal Investigators	100	100	100	100	100	100	100	100	100
Female	21.8	21.2	21.9	23.1	22.6	23.1	23.5	24.2	23.7
Male	75.7	75.8	74.7	72.6	72.5	71.0	69.9	68.3	67.6
Unknown	2.4	3.0	3.4	4.2	4.9	6.0	6.6	7.5	8.6
American Indian/Alaska Native	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Asian	13.4	14.7	15.8	16.3	16.8	16.2	16.9	16.6	17.4
Black/African American	1.9	1.9	2.1	2.0	2.0	2.0	2.1	2.2	1.8
Hispanic	3.4	3.6	3.7	3.5	3.6	3.7	3.9	3.6	3.8
Multiracial	0.8	0.6	0.6	0.5	0.6	0.8	0.8	0.8	0.8
Native Hawaiian/Pacific Islander	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0
White	75.4	73.4	71.9	71.1	69.6	69.3	67.7	67.4	65.9
Unknown race	4.8	5.5	5.6	6.4	7.1	7.7	8.3	9.1	10.1
Persons with Disability	1.3	1.2	1.1	1.1	1.2	0.9	1.0	1.2	1.1

Source: NSF Enterprise Information System, 03/27/2014.

Figure 3.1 Participation of Female Reviewers in Virtual, In-Person, and Mixed Panels during FY 2013



Source: Report to the National Science Board on the National Science Foundation's Merit Review Process Fiscal Year 2013 NSB 14-32 (May 12, 2014) http://www.nsf.gov/nsb/publications/2014/nsb1432.pdf

Table 3.3

Gender and Racial/ethnic Diversity of NSF's Scientists and Engineers: FY 2004-2013

	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13
	Number									
Men	272	270	321	340	378	413	400	390	396	390
American Indian/Alaska Native	2	3	3	2	1	2	2	2	1	1
Asian	33	27	38	46	47	47	46	43	47	49
Black or African American	13	7	12	13	11	15	15	14	15	11
Hispanic or Latino	8	9	7	7	9	13	11	12	17	19
Native Hawaiian/Other Pacific Islander	0	0	2	3	2	1	0	0	0	1
White	216	224	259	269	308	335	326	319	316	309
Women	161	186	222	234	270	292	292	294	298	306
American Indian/Alaska Native	0	0	1	3	1	0	1	2	1	3
Asian	13	14	16	18	23	26	25	31	40	38
Black or African American	27	26	30	28	33	31	28	27	26	24
Hispanic or Latino	5	6	7	8	9	11	13	11	13	14
Native Hawaiian/Other Pacific Islander	0	0	0	0	0	0	0	0	0	0
White	116	140	168	177	204	224	225	223	218	227
Both sexes	433	456	543	574	648	705	692	684	694	696
	Percent									
Men	62.8	59.2	59.1	59.2	58.3	58.6	57.8	57.0	57.1	56.0
American Indian/Alaska Native	0.5	0.7	0.6	0.3	0.2	0.3	0.3	0.3	0.1	0.1
Asian	7.6	5.9	7.0	8.0	7.3	6.7	6.6	6.3	6.8	7.0
Black or African American	3.0	1.5	2.2	2.3	1.7	2.1	2.2	2.0	2.2	1.6
Hispanic or Latino	1.8	2.0	1.3	1.2	1.4	1.8	1.6	1.8	2.4	2.7
Native Hawaiian/Other Pacific Islander	0.0	0.0	0.4	0.5	0.3	0.1	0.0	0.0	0.0	0.1
White	49.9	49.1	47.7	46.9	47.5	47.5	47.1	46.6	45.5	44.4
Women	37.2	40.8	40.9	40.8	41.7	41.4	42.2	43.0	42.9	44.0
American Indian/Alaska Native	0.0	0.0	0.2	0.5	0.2	0.0	0.1	0.3	0.1	0.4
Asian	3.0	3.1	2.9	3.1	3.5	3.7	3.6	4.5	5.8	5.5
Black or African American	6.2	5.7	5.5	4.9	5.1	4.4	4.0	3.9	3.7	3.4
Hispanic or Latino	1.2	1.3	1.3	1.4	1.4	1.6	1.9	1.6	1.9	2.0
Native Hawaiian/Other Pacific Islander	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White	26.8	30.7	30.9	30.8	31.5	31.8	32.5	32.6	31.4	32.6
Both sexes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: NSF Division of Human Resources Management.

APPENDIX B - NSF BROADENING PARTICIPATION OPTIONS

Level of Investment by Level of Boldness (Size and Novelty of Effort) versus Potential Impact

BOLDNESS	POTENTIAL IMPACT: LOW	POTENTIAL IMPACT: MEDIUM	POTENTIAL IMPACT: HIGH
FY16 High	• Call for Community Design Projects in response to the 2011-2012 CEOSE recommendation • Provide funding for BP infrastructure that PIs could "plug in" to for meaningful BP Broader Impacts	• Call for BP Institutes/Centers conducting BP research and increasing the number of UR scientists and engineers • Call for Partnerships/Centers that can translate BP research into scalable programs for widespread dissemination[1]	• Call for large-scale BP partnerships that cover research, implementation and scaling across preK-20+, focusing on institutional and systemic outcomes[2]
FY15 Medium	• Increase the availability of BP Supplements via DCLs from directorates • Make available BP data by subfields • Encourage PIs/faculty to participate in diversity meetings • Form a Rotator Corps for BP • Expand Science: Becoming the Messenger Workshop to have a BP focus	• Support additional replication of successful implementations[3] or additional partnering with model BP programs[4] • Leverage efforts like REU, I-Cubed (I^3), PULSE, etc. • Make supplemental funding available to all NSF research centers for BP goals (contingent on strong existing efforts) • Engage STEM Diversity Organizations and have an NSF BP presence at their national meetings	• Increase in number of Emphasis and other programs reaching the 50% threshold[5] • Offer support for mid- and large-scale BP theoretical studies with potential for large scale implementation • Identify strategic goals for BP for NSF that address all directorates. • Increase the prominence of BP language in the merit review criteria and in Annual and Final reporting
Immediate Implementation	• Provide BP Memo to NSF Staff from the Director • Enhance BP website with best/promising practices • More systematically inform NSF staff about best practices in BP • Form an agency-wide BP advocacy group to increase communication and identify cross-agency BP goals	• Provide Important Notice to Community about BP • Establish BP Policies for Workshops Agency-wide (see BIO) • More systematically inform panelists and reviewers about best practices in BP • Support NSF-wide workshops on BP from experts in the BP field	• Increase the prominence of BP language in solicitations, on NSF website and via social media used by OLPA • Use community blogs to promote BP discussions • Create BP IdeaShare for gathering ideas/input, etc.

[1] See perts.net and NCWIT.
[2] See the BPC Alliance Program in aggregate and former Systemic Initiatives, such as USP and RSI.
[3] See Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation, Page 12, Institutional Commitment to Leadership at Colleges and Universities to increase Diversity in Engineering and Science, a version of ADVANCE.
[4] See GEO LSAMP, and MPS AGEP.
[5] See Budget Table for Programs to Broaden Participation for FY2015.

Appendix C

Outcomes of CEOSE Recommendations Across the Years: 2004 to 2012

Recommendation Category/Recommendation	NSF Response Updated
Focused Programs:	
• Implement a bold, new initiative focused on broadening participation of underrepresented groups in STEM. (CEOSE 2011-2012)	• NSF BP Working Group has developed options in response to the 2011-2012 CEOSE recommendation.
• Augment Support to LSAMP, HBCU-UP and TCUP. (CEOSE 2009-2010)	• These three programs have had small direct increases to their program budgets and have been able to leverage co-funding and supplemental opportunities.
• Develop a Science of Broadening Participation (SBP) Program. (CEOSE 2009-2010).	• SBE and EHR have continued to issue SBP Dear Colleague Letters.
• Funding for programs aimed at increasing the number of successful students and faculty with disabilities should be increased. (2007-2008)	• NSF continues to support the RDE program and has funded individual BP projects with a disability focus elsewhere in the R&RA directorates (e.g., General & Age Related Disabilities Engineering (GARDE), and Broadening Participation in Engineering (BPE) in ENG and Broadening Participation in Computing (BPC) in CISE.
Minority-Serving Institutions (MSI):	
• Establish an HSI Program. (CEOSE 2009-2010)	• In FY 2014, two Dear Colleagues Letters were issued: Announcement of Efforts to Broaden the Participation of Students in Two-Year Hispanic Serving Institutions in STEM and Stimulating Research on Effective Strategies in Undergraduate STEM Education at Two-Year Hispanic Serving Institutions. A total of 15 proposals were submitted requesting $2.97 million. Seven awards were made for a total of $1.28 million for 2 supplements, 4 EAGER awards and 1 conference grant. It is anticipated that the DCLs will be revised for FY2015.
• Enhance research capacity and research opportunities at TCUs for more innovative distance-education and research technologies, collaboration with research institutions, and competitiveness with proposal writing. (CEOSE 2004-2005)	• The recent TCUP announcement (NSF 13-572) has the following tracks: Instructional Capacity Excellence in TCUP Institutions (ICE-TI) Projects; Broadening Participation Research in STEM Education (BPR) Projects; Targeted STEM Infusion Projects (TSIP); and Catalyzing Opportunities for Research and Education (CORE) Projects.
Broadening Participation Funding:	
• Increase broadening participation funding. (CEOSE 2009-2010)	• The NSF budget table in the FY 2015 request that details the Foundation's investment in programs to broaden participation shows funding growth. See discussion in Section 3 of the 2013-2014 CEOSE report.

• Increase the number of graduate fellowship awards to person from underrepresented groups in STEM (CEOSE 2007-2008)	• The 5-year trend data reported in the 2011-2012 CEOSE showed that underrepresented groups are funded at a slightly higher rate than majority applicants, with the exception of Pacific Islanders.
• Continue to support programs that address institutional transformation in academic and industry. (CEOSE 2007-2008)	• Institutional transformation continues to be a track within the ADVANCE program. NSF also initiated the activity, Innovation through Institutional Integration. Additionally, the ATE program continues to leverage innovation in technician education for systemic change in IHE-industry partnership for a highly competent and diverse technical workforce.
• Ensure that major new initiatives and programs are created to be fully inclusive in the areas of development, implementation, and funding. (CEOSE 2005-2006)	• Agency-wide or cross-directorate coordinating committees have this responsibility in the design and management of major NSF-wide initiatives.
Accountability:	
• Provide better guidance to COVs about how to assess broadening participation. (CEOSE 2009-2010)	• NSF is seeking CEOSE expertise in developing a few slides that respond to this recommendation to enhance the current COV training resources.
• Establish BP accountability goals and metrics. (CEOSE 2009-2010)	• Resources are on the NSF BP webpage to help with developing BP goals and indicators/metrics. Additionally, most BP programs have logic models that identify the metrics for monitoring outputs and outcomes. The recent report of the NSF BP Working Group includes examples of BP goals and metrics.
• Conducted a comprehensive review of impact evaluation findings of BP programs and use the review to determine what works. (CEOSE 2007-2008)	• The NSF Broadening Participation Working Group has conducted an inventory of what works that includes research and evaluation findings (See Pathways to Broadening Participation in Response to the CEOSE 2011-2012 Recommendation.)
• Expand the systematic and objective evaluation to access, understand, and report the effectiveness and impact of programs and policies on BP. (CEOSE 2003-2004) Assess the outcomes of its programs, investments, and activities with respect to impact on broadening participation and transforming institutions, and use the results to optimize policies and programs. (CEOSE 2005-2006)	• In addition to the ongoing program level evaluation, EHR is exploring the feasibility of a theme-based BP evaluation via STPI and EAC in IIA is planning to contract a third-party BP portfolio analysis and broader impacts evaluation.
• Provide explicit guidance to grantees such that their annual and final project reports identify the specific impact, if any, of the projects on broadening participation. (CEOSE 2005-2006)	• Rather than be prescriptive, BP resources are made available on the NSF BP webpage and programs have funded resource projects and networks to provide technical assistance to awardees as well as offer BP-focused accountability sessions at PI meetings. See for example, the report "Framework for Evaluating Impacts of Broadening Participation Projects" and the project "Infrastructure for Broadening Participation in STEM" (NSF award 1315956).

• Evaluate NSF programs and activities for MSI to recommend best practices. (CEOSE 2005-2006)	• NSF prepares an annual report on its investment in the aggregate and disaggregated to MSIs that includes type of support as well as brief descriptions of the projects. Greater use of this information is planned for the BP portfolio evaluation.
• Survey and report annually on the participation of women, underrepresented minorities, and persons with disabilities in each review panel, advisory committee, and committee of visitors (COV). (CEOSE 2005-2006)	• This information is collected annually and reported appropriately according to federal reporting requirements (e.g. COV reporting policy, MR annual report, and the FACA report).
Interagency BP Collaborations:	
• Facilitate collaborative efforts with other agencies to broaden participation. (CEOSE 2009-2010)	• NSF is working with NIH to stimulate interagency collaborations in the spirit of the CoSTEM recommendation to better serve groups traditionally underrepresented in STEM. Recently, NSF partnered with NIH in hosting the Gender Summit 3—North America.
• Enhance interactions with selected federal agencies to share ideas and best practices. (CEOSE 2007-2008)	• At the CEOSE meeting, Federal Liaisons continue to share BP updates that include the sharing of new opportunities and best practices. Additionally, the new Chief Officer for Scientific Workforce Diversity at NIH made a presentation at the June 2014 CEOSE meeting.
Women of Color in STEM:	
• Address the 9 recommendation from the Mini-Symposium on Women of Color in STEM. (CEOSE 2009-2010)	• NSF has funded a number of awards focusing on women of color in STEM, such as “Creating a Mentoring-focused Web Community for Women of Color in STEM” (award #1043737), “STEM Women of Color Conclave” award #1220582), and “Howard University ADVANCE-IT: Women of Color Faculty in STEM as Change Agents” (award #1208880).
Persons with Disabilities:	
• Have a designation similar to minority serving institution for institutions that serve students with special needs. (CEOSE 2007-2008)	• This recommendation will be revisited but the NSF Award Database does show support to institutions that serve students with special needs, e.g., Landmark College, and Gallaudet College.
• Have targeted support (i.e., scholarships, fellowships and internships) for STEM students with disabilities. (CEOSE 2007-2008)	• In addition to internship opportunities through the RDE program, NSF did issue a Dear Colleague Letter for Research Experiences for Veterans/Teachers (NSF 14124).

• Strengthen the alignment of research in technology with the needs of persons with disabilities. (CEOSE 2007-2008)	• NSF is supporting projects to leverage technology to address and/or be responsive to the needs of persons with disabilities: "CAREER: Reverse-Engineering the Bone-Cartilage Interface for Successful Joint Repair - Coupled with a New Program to Promote Diversity in Rehabilitative Bioengineering" (award #1055989), and "Workshop on Virtual Reality, Gaming and Individuals with Disabilities" (award #1445862).
Native Americans/American Indians:	
• Better serve Native Americans with existing NSF programs. (CEOSE 2007-2008)	• TCUP has continued to leverage support from the R&RA program with specific support for the Pre-Engineering Collaboration. The STCs program has funded an effort to encourage/enhance the integration of native ways of knowing and western science (Science and Technology Centers: Integrative Partnerships (NSF 14-600)).
• Support research and evaluation to provide a better understanding of Native American education and social issues. (CEOSE 2007-2008)	• NSF supported several relevant research projects, e.g. "Collaborative Research: The Cultural Context of Learning: Native-American Science Education" (Award #0815222) and "Beyond Earth: Weaving Science and Indigenous Culture" (Award #0917615).
• Work outside existing NSF programs to serve Native Americans. (CEOSE 2007-2008)	• NSF appoints Native Americans to serve on Advisory Committees and review panels. NSF celebrates National Native American Heritage Month. NSF has a representative for the White House Initiative on American Indian and Alaska Native Education. NSF ensures a presence at professional meetings of SACNAS and AISES.
BP Research:	
• Sponsor additional social science research that will advance understanding of the causes and effects of progress in and barriers to broadening participation in STEM at all levels—from learners to leaders. (CEOSE 2003-2004)	• EHR has a cross-cutting emphasis on broadening participation across its four divisions. Additionally, NSF Centers are held accountable for the implementation and reporting of results related to the requirement of having diversity plans; ERC, for example, is taking a lead in publishing proven/best practices. EPSCoR is piloting Track 3 – Building Diverse Communities. GEO and CISE have sponsored such research and are disseminating the results in various venues.
• Fund research to understand institutional transformation aimed at broadening participation in STEM. (CEOSE 2005-2006)	• The ADVANCE program has identified and disseminated a set of practices for successful transformation. Synthesis work is underway with the I-3 activities that will be relevant to this recommendation as well as newer efforts associated with building the broader impacts infrastructure at the institutional level. Additionally, the NSF BP Working Group has suggested the need for ADVANCE-like IT projects for minorities and persons with disabilities.

BP Policy Levers:	
• Continue to design and employ new policy levers. (CEOSE 2003-2004)	• CLB is the most recent policy lever to focus attention on diversity; visit: http://www.nsf.gov/career-life-balance/. Including diversity data in the annual merit review report for the NSB is another lever. The NSF BP Working Group has been charged to consider policies to enhance broadening participation.
Community Colleges:	
• Implement specific programs at community colleges. (CEOSE 2005-2006)	• The recent FY 2014 HSI Dear Colleagues letters target two-year institutions. NSF programs like ATE and S-STEM continue build capacity and human capital in STEM through opportunities at the community colleges.
Internal Collaboration:	
• Provide a cross-directorate process to share best practices and drive continuous improvement within NSF for BP. (CEOSE 2005-2006)	• EHR coordinates the Investing in Diversity series. Senior leadership has encouraged deeper collaboration between the efforts of BP and DI. Town Halls were conducted to gather internal input on the NSF Diversity Strategic Plan. NSF has reconstituted the NSF BP Working Group.

Note: A few recommendations were not included in the chart for the following reasons:

- The National Academy has completed reports on the underrepresentation challenge (e.g. *Expanding Underrepresented Minority Participation*).
- NSF issued in December 2012, the Dear Colleague Letter: SaTC EAGERs Enabling New Collaboration Between Computer and Social Scientists (NSF 13-037).
- IIA has an expert who works closely with NCSES and HRM to respond directly to CEOSE's requests for data and BP-related analysis.
- FASE has been archived.
- Some recommendations were directed to NSB and OSTP.

Updated in October, 2014

Endnotes

[1] This report only provides a brief presentation of the data, trends, and many aspects of broadening participation in science and engineering of concern to CEOSE. We refer the reader to the NSF web publication, *Women, Minorities, and Persons with Disabilities in Science and Engineering* for further detail at http://www.nsf.gov/statistics/wmpd/2013/.

[2] In low participation fields, women earned less than one-third, underrepresented minorities as a group earned 4 to 5%, and women of color as a group earned 1 to 2% of doctorates in 2012.

[3] In medium participation fields, women earned approximately half, underrepresented minorities as a group earned 8 to 10%, and women of color as a group earned 4 to 6% of doctorates.

[4] In high participation fields, women earned more than 70%, underrepresented minorities as a group earned 11 to 16%, and women of color as a group earned 8 to 12% of doctorates.

[5] http://www.nature.com/naturejobs/science/articles/10.1038/nj7504-303a

[6] Presentation by Dr. Jennifer Ortman from the Population Division of the U.S. Census Bureau.

[7] Presentations by Dr. Ann Gates, University of Texas El Paso; Dr. Sylvia Hurtado, University of California, Los Angeles; Dr. Alicia Dowd, University of Southern California; and Dr. Carlos Gutierrez, California State University Los Angeles.

[8] http://cue.usc.edu/tools/stem_focus.html

[9] Presentation by Dr. Mary Ann Mason, University of California, Berkeley.

[10] Presentation by Dr. Carlos Rodriguez, retired from AIR.

[11] Presentation by Dr. Brenda Major, University of California-Santa Barbara and Dr. Cheryl Kaiser, University of Washington.

[12] Presentation by Dr. Terrell Strayhorn, Ohio State University/

[13] http://www.nature.com/naturejobs/science/articles/10.1038/nj7504-303a

[14] Presentations by Dr. Lynn Preston, Dr. Mary Galvin, Dr. Dragana Brzakovic, Dr. Soo-Siang Lim, and Dr. Randy Phelps.

[15] Presentations by Dr. Rita Kirshstein, Managing Director, and Dr. Kristina Zeiser, Researcher of the American Institutes for Research.

[16] Presentation by Dr. Phil Rous, UMBC.

[17] Presentation by Dr. Stephanie Pfirman, Barnard College.

[18] Presentations by Dr. Susan Renoe, University of Missouri; Dr. Richard Tankersley (EHR/NSF); Dr. James Bell, CAISE.

[19] Presentations by Dr. Hannah Valantine, NIH; and Dr. Donna Ginther, University of Kansas.

NATIONAL SCIENCE FOUNDATION
COMMITTEE ON EQUAL OPPORTUNITIES IN SCIENCE AND ENGINEERING (CEOSE)
MEMBERSHIP 2013 – 2014

Dr. Wendy Raymond * (CEOSE Chair)
Vice President for Academic Affairs and
Dean of Faculty Professor of Biology
Davidson College
Davidson, NC 28035
Term: 02/01/2010-01/31/2013;
Chair Term: 02/01/2014-01/31/2016

Dr. Ira Harkavy *
Associate Vice President
University of Pennsylvania
Philadelphia, PA
Term: 06/01/2012-05/31/2015;
Vice Chair Term: 10/01/2014 -05/31/2017

Dr. Karl Booksh *
Professor of Chemistry
Department of Chemistry
Newark, DE 19716
Term: 09/09/2011-09/08/2014;
Extended Term: 09/09/2014-09/08/2015

Dr. Gregory Cajete
Director of Native American Studies
University of New Mexico
Albuquerque, NM
Term: 06/01/2012-11/01/2014

Dr. Nancy Cantor *
Chancellor
Rutgers University- Newark
249 University Ave.,
Newark, New Jersey 07102-1811
Term: 10/01/2014-09/30/2017

Dr. Cecilia A. Conrad (Former CEOSE Chair)
Vice President, MacArthur Fellows Program
MacArthur Foundation
Chicago, IL 60603-5285
Chair Term: 06/01/2012-01/31/2014
Co-Chair Term: 07/16/2011-05/31/2012
Terms: 02/01/2010-01/31/2013
Extended Term: 02/01/2013-01/31/2014

Dr. Evelynn Hammonds
Dean of Harvard College and Barbara Gutmann
Rosenkrantz,
Professor of the History of Science and of African and
African American Studies
Harvard University
Cambridge, MA 02138
Terms: 02/01/2009 - 01/31/2012;
02/01/2012 - 01/31/2015

Dr. Charles Isbell *
Professor and Associate Dean
Georgia Institute of Technology
Atlanta, GA 30332
Term: 06/01/2012-05/31/2015

Dr. Robert Jones *
President
University at Albany
Albany, NY 12222
Term: 06/01/2012-05/31/2015

Dr. Alicia Knoedler *
Associate Vice President for Research
Director, Center for Research Program Development
& Enrichment
The University of Oklahoma
301 David L. Boren Boulevard, Unit 1120
Norman, OK 73072
Term: 02/01/2014-01/31/2017

Dr. Louis Martin-Vega *
Professor and Dean
College of Engineering
North Carolina State University
113-B Page Hall
Campus Box 7901
Raleigh, NC 27695-7901
Term: 06/01/2014-05/31/2017

Dr. Robert Megginson *
Arthur F. Thurman Professor
University of Michigan
Department of Mathematics
3087 East Hall, 530 Church Street
Ann Arbor, MI 48109-1043
Term: 06/01/2014-05/31/2017

***** Current 2015 Members

NATIONAL SCIENCE FOUNDATION
COMMITTEE ON EQUAL OPPORTUNITIES IN SCIENCE AND ENGINEERING (CEOSE)

MEMBERSHIP 2013 - 2014 (cont'd)

Dr. George Middendorf *
Graduate Professor
Department of Biology
Howard University
Washington, DC
Terms: 02/01/2010-01/31/2013;
02/01/2013-01/31/2016

Dr. Maria (Mia) Ong
Principal Investigator
Education Research Collaborative
TERC
Cambridge, MA
Terms: 02/01/2008-01/31/2011;
02/01/2011-01/31/2014

Dr. Eugenia Paulus
Professor of Chemistry
Department of Chemistry
North Hennepin Community College
Brooklyn Park, MN
Term: 02/01/2010-01/31/2013

Dr. Alexander Ramìrez (Former CEOSE Vice Chair)
Former Executive Director of Information
Technology Initiatives HACU National Headquarters
San Antonio, TX 78229
Terms: 02/01/2009-01/31/2012;
02/01/2012-01/31/2015;
Vice Chair Term: 06/01/2012-05/31/2014

Dr. Keivan Gaudalupe Stassun *
Professor of Physics and Astronomy
Vanderbilt University
Department of Physics & Astronomy
Nashville, TN
Terms: 09/09/2011-09/08/2014;
09/09/2014-09/08/2015

Dr. Joseph Whittaker *
Dean and Professor of School of Computer,
Mathematical & Natural Sciences
Morgan State University
Baltimore, MD 21251
Terms: 09/09/2011-09/08/2014;
09/09/2014-09/08/2015

NSF Contacts

Dr. Wand E. Ward
Office Head and CEOSE Executive Liaison
Office of Integrative Activities (IIA)
Office of Director, NSF

Dr. Bernice T. Anderson
Senior Advisor and CEOSE Executive Secretary
Office of Integrative Activities (IIA)
Office of Director, NSF

* Current 2015 Members

Notes

Notes

Cover Photography Credit

Thinkstock by Getty Images

Broadening Participation in America's STEM Workforce

CEOSE

Committee on Equal Opportunities in Science and Engineering

National Science Foundation
4201 Wilson Boulevard, Suite 935
Arlington, VA 22230