CEOSE

Broadening Participation in America's STEM Workforce

2007-2008 Biennial Report to Congress

Committee on Equal Opportunities in Science and Engineering

CEOSE 09-01 August 2009

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 the Science and Engineering Equal Opportunities Act and (2) other policies and activities of the Foundation to encourage full participation of women, minorities, and other groups currently underrepresented in scientific, engineering, and professional fields [42 U.S.C. §1885(c) SEC 36(a)].*
>
> *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 [42 U.S.C. §1885(c) SEC 36(f)].*

CEOSE is composed of 15 persons from diverse STEM disciplines, drawn from diverse institutions in higher education, industry, government, and 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 collect and review information on the state of STEM education, training, and employment of women, underrepresented minorities, and persons with disabilities. Based on its findings, the Committee makes recommendations to the Foundation for improving the levels of participation of underrepresented groups within STEM professions. Committee members also interact with other Federal agencies, such as the Department of Defense, National Institutes of Health, Department of Energy, and the National Aeronautics and Space Administration, in forging trans-agency collaborations to broaden participation in the Nation's STEM workforce.

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This report is dedicated to Dr. William C. McCarthy, a dedicated member of CEOSE and one who contributed significantly to the Committee's knowledge of and actions for broadening the participation of persons with disabilities and other underrepresented groups in science and engineering. Dr. McCarthy died unexpectedly on July 28, 2009.

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Executive Summary

The "Rising Above the Gathering Storm" report released by the National Academies in 2005, among other recent important studies, has led to a critical wake-up call of how the U.S. is rapidly falling behind other countries in preparing its workforce for the 21st century global community. The 2007-2008 biennium saw increased attention to this matter primarily through the American Competitiveness Initiative (ACI), announced by former President George W. Bush in his 2006 State of the Union address. The ACI in turn led to the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act—or the America COMPETES Act—being passed in August 2007.

As part of its framework for improving American competitiveness, the COMPETES Act places emphasis on embracing the broader participation of U.S. citizens in science, technology, engineering, and mathematics (STEM). This emphasis is particularly important at the present time because of the rapidly growing minority population and shifting demographics in the U.S. as well as the rising average age of the STEM workforce. Yet actual gains in capturing underrepresented minorities, women, and persons with disabilities into STEM fields are not significant enough to impact the growing demand for U.S. citizens with these skills. In some areas the numbers of underrepresented persons are, in fact, decreasing. Provisions in Title VII of the America COMPETES Act authorize the National Science Foundation (NSF) to explore opportunities for meeting the goal of increasing the participation of underrepresented groups in the STEM fields.

In looking to the near-term and long-term future, President Barack H. Obama signed into law the American Recovery and Reinvestment Act (ARRA) of 2009 on February 17, 2009. Through an ARRA investment of $3 billion, the NSF is recognized as a major research and development agency tasked to cultivate new ideas and to prepare the next generation of STEM talent, objectives that are critical to the global economy, to health care, and to the overall standard of living.

This report documents only some of the many activities of the Committee on Equal Opportunities in Science and Engineering (CEOSE) during the 2007-2008 biennium in the context of national trends and NSF priorities. CEOSE partially realigned its traditional modus operandi to work more closely with NSF leadership in exploring ways to address the acute challenges in workforce development facing the U.S. today. The committee also strength-

ened a dialogue with other Federal agencies to cultivate partnerships required to address such significant challenges. This report first presents a snapshot status of different underrepresented groups in STEM fields in the U.S. Next, a brief synopsis is given of only some of the many activities and achievements of NSF in broadening participation. CEOSE actions over the past two years are then highlighted, followed by recommendations offered to NSF and future plans to be implemented by the Committee.

THE STATUS OF BROADENING PARTICIPATION IN AMERICA

Based on national test results, the proficiency of female and underrepresented minority fourth- and eighth-graders has improved in science and mathematics. However, assessed proficiency in these areas has not risen as significantly among high school students. The paucity of qualified science and mathematics teachers in poor and minority-intensive public schools could be a factor adversely impacting the achievement gap between minority and other primary and secondary school students.

Trends in post-secondary education disclosed that women and underrepresented minorities, and to some extent persons with disabilities, are increasing their enrollment in undergraduate and graduate education programs. Minorities are increasing their attainment rates for STEM-related associate's, bachelor's, and master's degrees. Whites still account for the largest share of these degrees. There was an overall decline in the number of doctorates awarded to U.S. citizens and permanent residents between 1998 and 2005, with the notable exception of African Americans and Hispanics, whose Ph.D.s in STEM fields increased by 10 and 6 percent, respectively. However, their actual numbers are still small.

Underrepresented groups made only marginal improvement in entering the overall STEM workforce between 1997 and 2006. Their numbers remained small relative to their representation in the general population. However, the rate of increase in women, underrepresented minorities, and persons with disabilities among the professoriate rose significantly, although once again their actual numbers are still small compared to the population at large.

NSF BROADENING PARTICIPATION PROGRAMS

Throughout the two-year period beginning in January 2007, the National Science Foundation remained committed to and actively involved in broadening participation of underrepresented groups and underfunded institutions in STEM. A Broadening Participation Working Group was formed in 2007 to explore ways for increasing the participation of underrepresented groups in NSF programs and for diversifying the pool of reviewers of NSF proposals. The efforts of the Working Group culminated in a new agency-wide action plan for broadening participation at NSF. Also, the Foundation's directorates and major program offices were actively engaged in developing strategic plans for broadening diversity, supporting specific programs, and addressing a number of challenges to involve underrepresented groups in the science and engineering enterprise.Finally, evaluation of NSF's portfolio of broadening participation programs continued, with some notable outcomes of program success.

HIGHLIGHTS OF CEOSE ACTIVITIES: 2007-2008

CEOSE held its six regularly scheduled public meetings at the National Science Foundation during 2007 and 2008. A total of 301 representatives from Federal agencies, educational institutions, professional societies and associations, other organizations, and NSF staff participated in these meetings. Thirty-nine major presentations were made to the Committee on a wide variety of topics that included: understanding interventions that encourage minorities to pursue research careers; the pros and cons of NSF's broader impacts criterion; Tribal Colleges and Universities and how NSF can better assist Native Americans to

enter the STEM enterprise; the lack of attention paid to persons with disabilities in science and engineering; the legal history of CEOSE; new and existing broadening participation initiatives of the National Aeronautics and Space Administration (NASA), Department of Energy (DOE), National Oceanic and Atmospheric Administration (NOAA), National Institute of Standards and Technology (NIST), U.S. Geological Survey (USGS), National Science Foundation (NSF), and other agencies; activities of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE); the impact of continuing budgetary resolutions on funding of broadening participation programs at NSF; the America COMPETES Act; the need for more impact evaluation data on broadening participation programs; and the necessity for increased inter-agency collaborations to advance diversity of the STEM workforce.

Inter-agency Collaboration Study

CEOSE commissioned a survey study in January of 2007 of Federal agencies with a STEM-related mission and workforce diversity programs. The purpose of the study was to gather information for use in developing and proposing strategies for inter-agency collaboration that would expand access to, support of, and leveraging opportunities for STEM education, training, and employment opportunities for women, underrepresented minorities, and persons with disabilities. NASA, Department of Defense (DOD), DOE, USGS, NOAA, NIST, NSF, U.S. Department of Agriculture (USDA), National Institutes of Health (NIH), Department of Labor (DOL), and the White House Initiative on Historically Black Colleges and Universities (WHI-HBCU) were included in the study sample.

Findings of the study included the following:

- All of the agencies focused on inclusiveness, specifically defined in terms of groups that they target for STEM education and employment opportunity programs. The term “broadening participation” was unique to NSF. DOD targeted the same demographic groups as NSF (i.e., women, underrepresented minorities, and persons with disabilities), while the other agencies were best described as focusing on a broader spectrum of demographic groups, except the WHI-HBCU, which focused exclusively on underrepresented minorities.

- Relaying their experiences in developing and implementing broadening participation and diversity programs, the Federal agency representatives learned a number of lessons. These included: funding for broadening participation and diversity programs has not kept pace with the growing demand for these programs; community college students, including minorities, work well in research laboratories; programs need flexibility to address the circumstances or personal needs of underrepresented students; recruiting minority students without relationship building is not effective in sustaining student interest in STEM careers; and agency leadership commitment to broadening participation and diversity is absolutely essential for the funding of internships, fellowships, and other program opportunities for underrepresented groups.

- Some key best practices were noted by the agencies and included: hands-on research experiences attract and sustain the interest of students; aligning a new program with an existing successful program helps to ensure success of the new program; providing a "personal touch" with lots of mentoring and attention to personal needs of the student helps sustain student interest in STEM education programs; providing incentive credits to laboratory researchers helps motivate staff and students in broadening participation activities; and having personnel dedicated to tracking students helps to ensure successful follow-up evaluation studies and activities.

- All of the agencies expressed an interest in collaborating with other STEM-related Federal agencies to support and improve the government's efforts to open STEM enterprises to all U.S. citizens.

- Finally, the agency representatives offered a number of recommendations for forming new and enhancing existing inter-agency collaborations. The recommendations were grouped into three major themes: (1) information-sharing, especially best practices for broadening participation efforts, (2)

joint funding of programs with common objectives, and (3) program coordination, e.g., common objectives and approaches.

Special Group Symposia

One traditional activity of CEOSE is the mini-symposium. Each meeting addresses a targeted underrepresented group or issue to further explore the challenges of and achievements in broadening participation. During the 2007-2008 biennium, CEOSE hosted two such mini-symposia.

On October 15, 2007, CEOSE hosted the **Mini-Symposium on Institutions Serving Persons with Disabilities in STEM**. The purpose of the symposium was to learn about institutions and programs that serve students and faculty with disabilities in the science, engineering, technology and mathematics fields. The objective was to determine the appropriate role of NSF in fostering increased participation of these individuals within education and the workforce. Approximately 60 individuals from several organizations attended the symposium, including Gallaudet University, Landmark College, National Technical Institute for the Deaf, American Association for the Advancement of Science, Association on Higher Education and Disability, Center for Applied Special Technology, National Federation of the Blind, NASA, IBM Corporation, and NSF.

Persons with Disabilities Symposium Recommendations

1. Institutions such as Gallaudet, National Technical Institute for the Deaf, Landmark College, and others should have a designation similar to *Minority Serving Institutions* (MSI) such that they can benefit from transition programs and partnerships with majority institutions on large research initiatives.

2. NSF-sponsored scholarships, fellowships, and research internships should be targeted to support undergraduate and graduate STEM students with disabilities.

3. The *Facilitation Awards for Scientists and Engineers with Disabilities* (FASED) should be broadened to include all STEM graduate students and faculty who are disabled and want to attend conferences or workshops.

4. Statistical and other data related to disabled persons involved in NSF programs and activities should be collected and reported by NSF on a regular basis.

5. Funding for programs that help increase the number and success of students and faculty with disabilities in STEM fields should be increased.

6. Research in technology for persons with disabilities should be strengthened by making sure projects are aligned with the specific needs of persons with disabilities.

On October 29, 2008, CEOSE and the NSF Centers Forum co-hosted the **Mini-Symposium on Broadening Participation of Native Americans in Science and Engineering: Lessons Learned**. The specific aims of the symposium were to (1) identify lessons learned and persistent barriers to broadening participation in STEM by Native American groups; (2) share ideas and experiences of community leaders as well as government officials; and (3) make recommendations to CEOSE and funding agencies on initiatives that need to be undertaken to improve participation opportunities for Native Americans in STEM. Approximately 50 individuals attended the symposium. The speakers represented a number of organizations that included Fond du Lac Tribal and Community College in Cloquet, Minnesota; Institute for Tribal Government at Portland State University in Oregon; School of Engineering at University of Alaska; Boston College in Massachusetts; University of Maryland at College Park; American Indian Higher Education Consortium, headquartered in Alexandria, Virginia; White House Initiative on Tribal Colleges and Universities; Northern Arizona University in Flagstaff; Jackson State University in Mississippi; Quality Education for Minorities Network, Inc. in Washington, D.C.; NASA; DOE; NIH; University of Texas at El Paso; Montana State University in Bozeman; and NSF.

Native Americans Symposium Recommendations

1. Serve Native Americans by expanding and fine-tuning existing NSF programs.

2. Work outside existing NSF programs with organizations such as the American Indian Higher Education Consortium (AIHEC), to enhance services targeting Native Americans.

3. Perform research and evaluations to provide a better understanding of Native American education and social issues.

4. Improve grant writing and NSF review processes for Native American investigators and institutions.

2007-2008 CEOSE RECOMMENDATIONS

With the foregone considerations as a backdrop, CEOSE offered several recommendations to the National Science Foundation during 2007-2008:

1. NSF should submit to the National Science Board for its consideration CEOSE's proposal to require that all NSF grant applicants must address, under the broader impacts criterion, the subject of broadening participation in their proposal submissions.

2. NSF should take the lead in proposing that all Federal STEM-related agencies have a "CEOSE-type" committee with advisory responsibilities for broadening participation.

3. NSF should enhance interactions with selected Federal agencies to enable and promote the sharing of ideas and information, particularly those on best practices, with the objective of increasing the access of women, underrepresented minorities, and persons with disabilities to science and engineering fields funded by the Foundation.

4. NSF should continue efforts to rapidly increase the number of graduate fellowship awards to persons from underrepresented groups in STEM.

5. NSF should consider conducting a comprehensive review of impact evaluation findings on its broadening participation programs, and use the review to determine and document what works and what does not.

6. NSF should continue to support programs that address institutional transformation in academia and industry to increase education and career advancement opportunities for underrepresented groups.

CEOSE PLANS FOR 2009-2010

Guided by its developing strategic plan and particular issues addressed in 2007-2008 that demand further attention, CEOSE plans to focus on a number of areas in 2009-2010 that are critical to its mission and include the following:

1. Finalize CEOSE's strategic and implementation plan for 2009-2013, including development of performance measures for the Committee's progress in carrying out its Congressional mandate.

2. Enhance interactions with selected Federal agencies to enable and promote the sharing of ideas and information, particularly those on best practices with the objective of increasing the access for women, underrepresented minorities, and persons with disabilities to STEM education, research, and employment opportunities.

3. Continue ongoing interactions with NSF's senior managers—including the director, deputy director, and officials in the research and education directorates, scientific and engineering organizations, and the community to better understand the challenges, commonalities, and differences *vis-à-vis* broadening participation faced by the diverse science and engineering fields funded by the Foundation.

4. Host a mini-symposium on research and evaluation of broadening participation programs, such that a better understanding can be gained as to what and how NSF programs work and for which particular underrepresented groups.

5. Study and discuss challenges encountered by women of color with the objective of better understanding their situations and identifying solutions to their problems in accessing STEM education and employment opportunities, such that appropriate recommendations can be made to NSF. Host a mini-symposium on women of color in STEM.

6. Study and discuss Minority Serving Institutions, particularly Tribal Colleges and Universities, Hispanic Serving Institutions, and Historically Black Colleges and Universities, with the objective of recommending to NSF strategies to enhance and strengthen these institutions.

7. Finally, continue to study, discuss, and promote institutional transformation as a critical element in the Foundation's broadening participation efforts and diversity initiatives.

Acronyms

AAAS — American Association for the Advancement of Science

ACCF — American Competitiveness in Chemistry Fellowship

ACIF — American Competitiveness and Innovation Fellowship

ADVANCE — Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers

AGEP — Alliances for Graduate Education and the Professoriate

AIHEC — American Indian Higher Education Consortium

AISES — American Indian Science and Engineering Society

ATE — Advanced Technological Education

BIO — Biological Sciences directorate

BPC — Broadening Participation in Computing

BRIGE — Broadening Participation Research Initiation Grants in Engineering

C-PATH — CISE Pathways to Revitalize Undergraduate Computing Education

CAA — Career Advancement Awards

CEOSE — Committee on Equal Opportunities in Science and Engineering

CISE — Computer and Information Science and Engineering directorate

CI-TEAM — Cyberinfrastructure Training, Education, Advancement, and Mentoring

COACh — Committee on the Advancement of Women in Chemistry

COMPETES — (as in America COMPETES Act) Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science

COV — Committee of Visitors

CREST — Centers for Research Excellence in Science and Technology

CRIF — Chemistry Research Instrumentation and Facilities

DGSE — Developing Global Scientists and Engineers

DMR — Division of Materials Research

DMS — Division of Mathematical Sciences

DOD — Department of Defense

DOE — Department of Energy

DOL — Department of Labor

EEC — Engineering Education and Centers

EHR — Education and Human Resources directorate

ENG — Engineering directorate

ERC — Engineering Research Center

FASED — Facilitation Awards for Scientists and Engineers with Disabilities

GEO — Geosciences directorate

GeoEd — Geoscience Education

GPRA — Government Performance and Results Act

GRF — Graduate Research Fellowship

GSE — Research on Gender in Science and Engineering

HBCU-UP — Historically Black Colleges and Universities Undergraduate Program

HHMI — Howard Hughes Medical Institute

HSI — Hispanic Serving Institutions

IGERT — Integrative Graduate Education and Research Traineeship

ITEST — Information Technology Experiences for Students and Teachers

LSAMP — Louis Stokes Alliances for Minority Participation

MPS — Mathematical and Physical Sciences directorate

MSI — Minority Serving Institutions

MS PHDS — Minorities Striving and Pursuing Higher Degrees of Success in the Earth System Sciences

NASA — National Aeronautics and Space Administration

NAEP — National Assessment of Educational Progress

NIH — National Institutes of Health

NIST — National Institute of Standards and Technology

NOAA — National Oceanic and Atmospheric Administration

NOBCChE — National Organization for the Professional Advancement of Black Chemists and Chemical Engineers

NSF — National Science Foundation

NSTC — National Science and Technology Council

OCI — Office of Cyberinfrastructure

OEDG — Opportunities for Enhancing Diversity in the Geosciences

OISE — Office of International Science and Engineering

OPP — Office of Polar Programs

PAARE — Partnerships in Astronomy & Astrophysics Research and Education

PAESMEM — Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring

PI — Principal Investigator

PIRE — Partnerships for International Research and Education

PREM — Partnerships for Research and Education in Materials

RAD — Regional Alliances for Persons with Disabilities

RAPD — Research to Aid Persons with Disabilities

RDE — Research in Disabilities Education

REU — Research Experiences for Undergraduates

SACNAS — Society for the Advancement of Chicanos/Latinos and Native Americans in Science

SBE — Social, Behavioral, and Economic Sciences directorate

SBIR — Small Business Innovation Research

SEA — Science Education Alliance

SGER — Small Grants for Exploratory Research

SOARS — Significant Opportunities in Atmospheric Research and Science

STEM — Science, Technology, Engineering, and Mathematics

STEP — STEM Talent Expansion Program

TCUP — Tribal Colleges and Universities Program

URM — Undergraduate Research and Mentoring

USDA — U.S. Department of Agriculture

USGS — U.S. Geological Survey

WHI-HBCU — White House Initiative on Historically Black Colleges and Universities

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Introduction

Much has been said in public dialogue recently about the need for our country to tap into the unused or under-used energy resources within our national borders, rather than depend so much upon the energy resources from other countries for which there is mounting global competition.[1] The same could be said for our science, technology, engineering and mathematics (STEM) workforce. We need to further invest in and tap more into the pool of American talent that has been under-utilized. But, as the Deputy Director of the National Science Foundation, Dr. Cora B. Marrett, noted in a recent speech at the University of Washington, "…national competitiveness is not the only rationale for developing [domestic] talent in a global context…science and engineering problems are ever more likely to be global in scope and the skills for handling them, distributed among nations." [2]

Groups such as women, underrepresented minorities, and persons with disabilities, which have been traditionally excluded from or marginalized within the American STEM workforce, represent a potentially rich American resource to advance science and engineering to new frontiers of discovery and utility. What makes this action compelling is the growing diversity and shifting demographics of American citizenry. By 2020, Hispanics, African Americans, Asians, and other minorities will together constitute almost one-half (47 percent) of the U.S. school age population.[3] To quote Dr. Wanda E. Ward, Acting Assistant Director of the National Science Foundation's Education and Human Resources Directorate,"…there is a national imperative and diversity…does, in fact, strengthen the scientific enterprise by the intellectual diversity of thought." [4] In addition to the issue of diversity and the richness it brings to innovation and discovery, there is the practical problem that many of our current scientists and engineers, who are largely White male baby-boomers, are nearing retirement.[5] Who will replace them?

[1] *For example, 81 percent of Americans support greater use of domestic energy resources. National poll conducted by The Polling Company, June 3, 2008, http://www.americansolutions.com .*

[2] *Dr. Cora B. Marrett, Expanding the Domestic Talent Pool. The Mary Ann & John Mangels Lecture, University of Washington, March 31, 2008.*

[3] *U.S. Census Bureau, http://www.census.gov/ipc/www/usinterimproj/(2004).*

[4] *Dr. Wanda E. Ward Remarks made at the Congressional Briefing, Building A Diverse Scientific Workforce, March 12, 2009 Reported in the COSSA Washington Update, vol. 28, no. 6, March 23, 2009.*

[5] *Science and Engineering Indicators 2008. Arlington, VA: National Science Board, January 15, 2008, Chapter 3, p. 7.*

Leveraging the present for the future is critical. Other advanced, as well as advancing, countries are pouring more and more resources and efforts into developing and utilizing their STEM talent. The more we lag behind in "growing" our own scientists and engineers, the more difficult it will be for the United States to maintain its premiere status in global science and technology—not to mention the impact a lagging American STEM workforce can have on the country's economic prosperity and national security.

Since its inception in 1980, the Committee on Equal Opportunities in Science and Engineering (CEOSE) has advised the National Science Foundation on broadening the diversity of the country's STEM workforce by promoting greater access for underrepresented groups to education and career advancement opportunities. In working towards the goal of equitable diversity in science and engineering, CEOSE has seen significant challenges, such as institutional and individual resistance to change, as well as funding limitations that hamper the availability of effective broadening participation programs. Undaunted by these challenges and through the sheer dedication and determination of its members, the Committee continues to forge ahead in a variety of efforts to positively influence policies and programs that help ensure that American citizens, irrespective of race, ethnicity, gender, or disability, have opportunities to develop and contribute their talents to the scientific, engineering and technological advancements of the 21st century.

Based on CEOSE's plans and priorities at the close of the 2005-2006 biennium, several themes characterized the activities of the Committee during the 2007-2008 biennial period. The themes included:

- Inter-agency Collaboration. As part of a strategy to foster Federal inter-agency efforts to broaden participation in STEM, CEOSE conducted a survey of broadening participation activities and programs of STEM-related Federal agencies and their receptivity to collaborating with NSF to expand and enhance education, training, and employment programs targeted to underrepresented groups in science and engineering.

- Special Group Symposia. CEOSE hosted two mini-symposia on the issues and solutions for broadening participation of two particularly under-attended-to groups in STEM: persons with disabilities and Native Americans.

- Broader Impacts Review Criterion. CEOSE had ongoing discussions with NSF leadership regarding the more explicit review of broadening participation elements of all proposals submitted to and awarded by the NSF. Recommendations were suggested for consideration by the National Science Board.

The following report profiles the current status of underrepresented groups in the science and engineering enterprise, highlights the achievements of NSF in broadening participation and the Foundation's funding of diversity-related programs, describes the activities of CEOSE during 2007-2008, tracks the outcomes of recommendations made to NSF in the 2005-2006 biennial report, summarizes the recommendations offered by CEOSE to NSF during 2007-2008, and articulates the Committee's plans for the next biennium.

1 The Status of Broadening Participation in America

Elementary students experimenting with widgets at Louisiana State University Summer Camp.

Certainly one of the main challenges to achieving diversity in the U.S. STEM workforce is the education pipeline. This chapter reports some important comparison data from the primary school grades to graduate school.

Based on national test results, the proficiency of female and underrepresented minority fourth- and eighth-graders has improved in science and mathematics. However, assessed proficiency in these areas has not risen as significantly among high school students. The paucity of qualified science and mathematics teachers in poor and minority-intensive public high schools appears to be a factor impacting the achievement gap between minority and other primary and secondary school students.

Trends in post-secondary education showed that women and underrepresented minorities, and to some extent persons with disabilities, are increasing their enrollment in undergraduate and graduate educational programs. Minorities are also increasing their attainment rates for bachelor's and master's degrees—although Whites still account for the largest share of these STEM degrees. There was an overall decline in the number of doctorates awarded to U.S. citizens and permanent residents between 1998 and 2005, with the notable exception of African Americans and Hispanics, whose Ph.D.s in STEM fields increased by 10 and 6 percent, respectively.

Underrepresented groups made only marginal improvement in entering the overall science and engineering workforce between 1997 and 2006. Their numbers remain small relative to their representation in the general population; but, the rate of increase for women, underrepresented minorities, and persons with disabilities among the professoriate rose significantly.

EDUCATION

Fourth and Eighth Grades

According to the most recently available data from the National Assessment of Education Progress (NAEP) tests, fourth- and eighth-graders improved their proficiency in mathematics and science between 1996 and 2007.[6] There were, however, some exceptions for certain racial/ethnic groups.

As displayed in Table 1-1, the average mathematics scores of fourth-graders increased from 1996 to 2007 across gender and all racial/ethnic groups. These increases in mathematics scores were statistically significant ($p<.05$) for gender and all racial/ethnic groups.

Among eighth-graders, the mathematics scores during this same period also significantly increased for males and females, as well as for all racial/ethnic groups, with the exception of American Indian/Alaska Native students.[7]

Achievement Gap in Mathematics

Although fourth- and eighth-graders from underrepresented groups demonstrated improved skill in mathematics, there was no consistent improvement in gap scores between male and female, or between White and underrepresented minority students (i.e., African American, Hispanic, American Indian, and Alaska Native). The gap score for White and African American fourth-graders declined from 34 to 26 between 1996 and 2007. This change was statistically significant ($p<.05$). However, changes in gap scores between male and female, or White and other minority fourth-graders, were not statistically significant. Since 1996, the gap between fourth-grade male and female mathematics scores has narrowed to 2 points. But, the gap between Whites and underrepresented minorities remains substantial, e.g., 26 for African Americans and 21 for Hispanics.

Table 1-1

Average Math Scores of 4th and 8th Grade Students
1996 versus 2007

4th Grader	1996 Scores*	2007 Scores*
Male	224	241**
Female	223	239**
White	232	248**
African American	198	222**
Hispanic	207	227**
Asian/Pacific Islander	229	253**
American Indian/ Alaska Native	217	228**
All 4th-Graders	224	240**
8th Grader		
Male	271	282**
Female	269	280**
White	281	291**
African American	240	260**
Hispanic	251	265**
Asian/Pacific Islander	288 *(2000)*	297**
American Indian/ Alaska Native	259 *(2000)*	264
All 8th-Graders	270	281**

*Data source: Nations Report Card Mathematics 2007. U.S. Department of Education, National Center for Education Statistics, 2007. *National Assessment of Educational Progress test scores on 0-300 scale. U.S. Citizens and Permanent Residents. ** Statistically significant difference at p<.05*

The mathematics gap score results for eighth-graders painted a similarly mixed picture. Only in the case of African Americans in relation to Whites did the gap score decline between 1996 and 2007, i.e., from 41 to 32, which was statistically significant ($p<.05$).The gap scores for African Americans and Hispanics versus Whites still remain substantial, i.e., 32 and 26, respectively.

6. *The Nation's Report Card Mathematics 2007. National Assessment of Education Progress at Grades 4 and 8. Washington, DC: U.S. Department of Education, National Center for Education Statistics, 2007.*
7. *Ibid. p. 26.*

Table 1-2

Average Science Scores of 4th and 8th Grade Students
1996 versus 2005

4th Grader	1996 Scores*	2005 Scores*
Male	148	153**
Female	146	149
White	158	162**
African American	120	129**
Hispanic	124	133**
Asian/Pacific Islander	144	158**
American Indian/ Alaska Native	129	138
All 4th-Graders	147	151
8th Grader		
Male	150	150
Female	148	147
White	159	160
African American	121	124**
Hispanic	128	129
Asian/Pacific Islander	151	156**
American Indian/ Alaska Native	148	n/a
All 8th-Graders	149	149

*Science scores for 2007 were not available at the printing of this report. Data source: Science and Engineering Indicators 2008, Table 1-7, U.S. Citizens and Permanent Residents. *National Assessment of Educational Progress test scores on 0-300 scale. ** Statistically significant difference at p<.05*

As shown in Table 1-2, changes in proficiency in science among fourth- and eighth-graders between 1996 and 2005 were mixed.[8] (The most recent data, disaggregated by gender and race/ethnicity, were available only from the 2005 NAEP report). Among fourth-graders, the average science scores increased for males and all racial/ethnic groups, except American Indians/Alaska Natives. These increases were statistically significant (p<.05). Asian Americans and African Americans were the only sub-groups of eighth-graders that showed a statistically significant increase in average science scores between 1996 and 2005.

Achievement Gaps in Science

Between 1996 and 2005, there were no statistically significant improvements in the achievement gaps in science scores between White and minority, or between male and female, fourth- and eighth-graders. As of 2005, fourth-grade science gap scores for female versus male and for White versus African American and Hispanic students were 4, 33, and 28, respectively. Among eighth-graders, the science gap scores for females, African Americans, and Hispanics were 4, 37, and 32, respectively.

Fourth- versus Eighth-Graders

Interestingly, the upward trend seen in the science scores for fourth-graders between 1996 and 2005 was less substantial for eighth-graders during this same period. For instance, the average science score for male eighth-graders stayed the same at 150 in 1996 and 2005. The average score for female eighth-graders decreased by 1 point from 148 to 147. The average science score for White eighth-graders increased by only 1 point from 159 to 160; for African Americans, the average science score increased by 3 points from 121 to 124; and for Hispanics, by 1 point from 128 to 129. Data for Asian/Pacific Islander and American Indian/Alaska Native eighth-graders were deemed questionable by NAEP and, therefore, were excluded from the analysis.

High School

The leveling off of mathematics and science proficiency evidenced among eighth-graders seemed to have continued among twelfth graders. For example, the average scores in science for twelfth-graders declined between 1996 and 2005 for both genders and all racial/ethnic groups, except Asian/Pacific Islanders.[9] See Table 1-3.

[8] *The Nation's Report Card Science 2005.National Assessment of Education Progress at Grades 4 and 8. Washington, DC: U.S. Department of Education, National Center for Education Statistics, 2005.*

[9] *The Nation's Report Card: 12th Grade Reading and Mathematics 2005. Washington, DC: National Center for Education Statistics, 2007, p. 14.*

Due to changes in the NAEP assessment content and administration, direct comparisons between average mathematics scores for 2005 and previous years could not be made.[10] However, a comparison was made between average mathematics results for twelfth graders in the years 1996 versus 2000. Across all racial/ethnic groups, with the exception of Asian and Pacific Islanders, there was a slight decline in scores; Whites went from 309 in 1996 to 307 in 2000, African Americans from 275 to 273, and Hispanics from 284 to 282. These results, however, were not statistically significant. The decrease in the average mathematics score for Asian/Pacific Islanders, from 315 to 305, was statistically significant ($p<.05$). Test data were not available for American Indians/Alaska Natives for 1996.[11]

Table 1-3

Average Science Scores of 12th Grade Students 1996 versus 2005

Group	1996 Scores*	2005 Scores*
Male	154	149**
Female	147	145
White	159	156
African American	123	120
Hispanic	131	128
Asian/Pacific Islander	147	153**
American Indian/ Alaska Native	144	139
All 12th-Graders	150	147**

*Data Source: Science and and Engineering Indicators 2008. U.S. Citizens and Permanent Residents, Table 1-7. *National Assessment of Educational Progress test scores on 0-300 scale. ** Statistically significant difference (p <.05) between 1996 and 2005.*

Public School Teacher Quality

Teacher quality plays a particularly pivotal role in the performance of primary and secondary school students in science and mathematics. With the generally under-resourced conditions of many of the Nation's public schools in urban and rural areas, one could reasonably theorize that the lower performance levels of the underrepresented minority students in mathematics and science could be attributable, at least in part, to the paucity of qualified mathematics and science teachers.

Although virtually all public school science and mathematics teachers have the basic qualifications of a college degree and full state certification, teachers in schools with low concentrations of minority and low-income students tend to have more education, better preparation and qualifications, and more experience than teachers in schools with high concentrations of such students.[12] Public secondary schools experience varying degrees of difficulty in attracting teachers qualified in mathematics and science. Approximately 74 percent of the schools report vacancies in mathematics, and on average, 54 percent in the biological and physical sciences.[13] Teacher shortages in science and mathematics located in high-poverty areas are much higher than in higher-income areas.[14] It would, therefore, be safe to infer that vacancy problems are probably more prevalent in schools with high concentrations of minority students than in other schools. Lately, the vacancy issue has been fueled by large numbers of teachers leaving the profession due to inadequate salaries, poor working conditions, and concerns for their safety.[15]

Salaries of science and mathematics teachers continue to lag behind salaries paid to individuals working in comparable professions, and the gaps have

[10] *Ibid. p. 14. Using the new NAEP scale score of 0-300, the average mathematics scores assessed in 2005 were 151 and 149 for males and females, respectively, 157 for Whites, 127 for African Americans, 133 for Hispanics, 163 for Asians, and 134 for American Indians/Alaska Natives.*

[11] *NAEP, 1996 and 2000 Mathematics Assessments.*

[12] *Science and Engineering Indicators 2008. Arlington, VA: National Science Board, vol. 1, ch. 1, p.5.*

[13] *Ibid.*

[14] *For example, Howard, T. C. Who Receives the Short End of the Shortage? Implications of the U.S. Teacher Shortage on Urban Schools. Journal of Curriculum & Supervision, 2003, vol. 18, no. 2, pp. 142-160.*

[15] *For example, Boyd D, Lankford H, Loeb S, Wyckoff J. 2005. Explaining the Short Careers of High-achieving Teachers in Schools with Low-performing Students. American Economic Review, 2005, vol. 95, no. 2, pp.166-71. Dolton, P. and van der Klaauw, Turnover of teachers: A competitive risks explanation. The review of Economics and Statistics, August 199, vol. 81, no. 3, pp. 543-550.*

widened substantially in recent years. In 2003, for instance, the median salary for a high school science and mathematics teacher was $43,000—lower than that of comparable professionals, such as computer systems analysts, and engineers, whose median salary ranged from $50,000 to $72,000.[16] The reader is cautioned that these median figures do not take into consideration other factors that could influence salary differentials, such as length of employment, seniority, or gender.

Taking these teacher-related factors together, the problem of improving the performance of primary and secondary school students in mathematics and science becomes even more formidable—but a problem that must be overcome, if the United States is to remain competitive in STEM in the future. Failure to address these and related issues of primary and secondary science and mathematics education places the resourcing of our college and university pool of prospective STEM professionals at risk.

Undergraduate Education

Community College

Two-year colleges are fast becoming a major source for science and engineering technicians as well as pathways for students to transfer to a STEM bachelor's degree program at a 4-year institution.

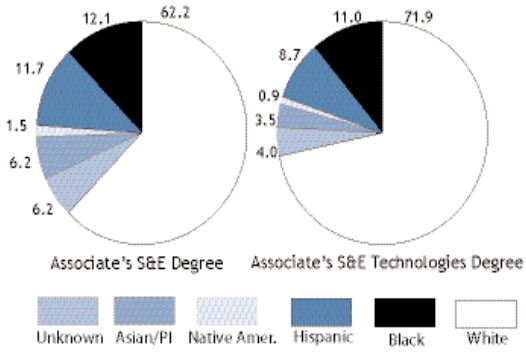
In 2004, approximately 6.2 million students were enrolled in community colleges. This population of students comprises about 44 percent of all undergraduates, with 41 percent being full-time and 59 percent part-time.

Of these 6.2 million students, 59 percent were females, 41 percent males, and approximately 28 percent were underrepresented minorities.[17] Latino students represent the fastest-growing racial/ethnic segment of community college students.[18]

Community college courses play a major role in mathematics preparation for undergraduates. In the fall of 2005, 1.7 million students were enrolled in mathematics and statistics courses at public 2-year colleges—representing a 26 percent increase over that for 2000.[19]

In 2005, a total of 44,368 associate's degrees in science and engineering were awarded by community colleges to U.S. citizens and permanent residents. Additionally in 2005, there were 76,580 associate's degrees awarded in science and engineering technologies. The majority of these degree recipients were White, as displayed in Figure 1. Overall, the number of STEM associate's degrees grew by 86 percent between 1996 and 2005, from 23,862 to 44,368. Women accounted for 51 and 40 percent of those receiving a STEM associate's degree in 1996 and 2005, respectively. White students accounted for the largest share of STEM associate's degrees in 1996 and 2005. Underrepresented minorities accounted for approximately 22 and 25 percent of STEM associate's degrees in 1996 and 2005, respectively (Table 1-4).

Figure 1.
Associate's Degrees Awarded by Community Colleges, 2005



Data source: Women, Minorities and Persons with Disabilities in Science and Engineering, National Science Foundation, Science Resources Statistics, 2008. Tables C-2 and 3.

16. *Ibid. pp. 5-6.*
17. *Women, Minorities, and Persons with Disabilities in Science and Engineering, 2007. Arlington, VA: National Science Foundation, Table B-3, p. 29.*
18. *Kent. A. Phillippe and Leila Gonzalez Sullivan, Trends and Statistics. Washington, DC: ERIC, 2005. National Profile of Community Colleges: Trends and Statistics. Washington, DC: ERIC, 2005.*
19. *Kirkman E, Lutzer KJ, Maxwell JW, Rodi SB. 2007. Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States: Fall 2005 CBMS Survey. Providence, RI: American Mathematical Society. http://www.ams.org/cbms.*

Table 1-4
Percent of STEM Associate's Degrees Awarded by Gender and Racial/Ethnic Group: 1996 - 2005

Group	Percent 1996	Percent 2005
Male	49.0	59.8
Female	51.0	40.2
Total	100.0	100.0
White	68.4	62.2
African American	10.1	12.1
Hispanic	10.6	11.7
American Indian/Alaska Native	1.9	1.5
Asian/Pacific Islander	6.5	6.2
Unknown Race/Ethnicity	2.5	6.2
Total	100.0 (23,862)	100.0 (44,368)

Data source: Women, Minorities, and Persons with Disabilities in Science and Engineering 2007, Tables C-1 and C-2, U.S. Citizens and Permanent Residents.. Excludes students awarded an associate's degree in S&E technologies.

Four-Year College

Total enrollment in a 4-year college grew from 7.2 million in 1997 to 8.2 million in 2004.[20] Approximately one-third of entering freshmen reported that they intended to major in a STEM field. More men than women planned to major in a STEM field (41 versus 26 percent). Among racial/ethnic groups, Asians/Pacific Islanders ranked the highest at 45 percent in planning to major in science or engineering, Hispanics at 37 percent, African Americans and American Indians at 34 percent, and Whites at 30 percent.[21]

It is estimated that 11 percent of all 4-year college students are persons with disabilities.[22] There were, however, no specific estimates available for undergraduates with disabilities who planned to major in a STEM field.

Since the 1990s, the number of persons awarded a bachelor's degree in STEM continued to grow. Between 1996 and 2005, the total number of U.S. citizens and permanent residents who attained a bachelor's degree in science or engineering increased by 21 percent from 369,927 to 447,559.[23] Women showed a higher rate of increase, 30 percent versus 14 percent for men. Among underrepresented minorities in STEM, the percentage change in STEM bachelor's degree attainment was also higher for women than for men. Between 1996 and 2005, the proportionate change for African American women was 47 percent versus 25 percent for African American men, 68 percent for Hispanic women versus 39 percent for Hispanic men, and 55 percent for American Indian/Alaska Native women versus 39 percent for American Indian/Alaska Native men.

The rate of increase in attaining a bachelor's degree in STEM for underrepresented minorities between 1996 and 2005 was significant. The highest rates of increase were for Hispanics (54 percent), American Indians/Alaska Natives (47 percent), and for African Americans (38 percent). However, as shown in Table 1-6, the percentage share of STEM bachelor's degrees for underrepresented minorities remains very small, compared to that for Whites.

Graduate School

Total enrollment of U.S. citizens and permanent residents in STEM graduate programs increased by 12 percent between 1998 and 2005, from 302,879 to 339,550 students.[24] Enrollment of women rose by 21 percent, compared to only 5 percent for men. There were far more White graduate students in STEM than other racial/ethnic groups. Similar to the trend for undergraduate enrollments, underrepresented racial/ethnic groups increased their enrollment in graduate programs at significant rates. For African Americans, the enrollment rate grew by 29 percent

[20] *Women, Minorities, and Persons with Disabilities in Science and Engineering, 2007. Arlington, VA: National Science Foundation.*
[21] *Ibid. Table B-8, p. 34.*
[22] *Ibid. Table B-6, p. 32.*
[23] *Ibid. Table C-12 to C-13, pp. 69-76.*
[24] *Ibid. Table D-2, p. 94 and Table D-3, p. 104.*

between 1998 and 2005, for Hispanics by 52 percent, and for American Indians/Alaska Natives by 32 percent. The increase in underrepresented minority graduate students was largely due to greater growth in enrollment rates of female minorities. For instance, African American females showed a 38 percent increase in enrollment versus 16 percent for their male counterparts, 64 percent for Hispanic females versus 40 percent for males, and 44 percent for American Indian/Alaska Native females versus 20 percent for males.

In 2004, the latest year for available data on persons with disabilities[25], about 7 percent of STEM graduate students were persons with disabilities. Women made up a moderately greater proportion of this underrepresented group than men (57 versus 43 percent). White graduate students were more likely to be persons with disabilities than students from other racial/ethnic groups. The reader is cautioned to view these data as tentative, because disabilities are self-reported and there tends to be underreporting.

Master's Degrees

The number of U.S. citizen/permanent resident graduate students who were awarded a master's degree in a STEM field increased by 18 percent, from 73,635 in 1996 to 86,563 in 2005.[26] Women showed a greater increase between 1996 and 2005 in the attainment of a STEM master's degree than men—34 versus 5 percent. Underrepresented minorities attained master's degrees in STEM fields at notable rates between 1996 and 2005. The percentage change for African Americans was 72 percent, for Hispanics 74 percent, and for American Indians or Alaska Natives 51 percent. Once again, however, the proportionate share of STEM master's degrees for underrepresented minorities remains substantially less than that for Whites (see Table 1-6).

Doctorates

Growth in total STEM doctorates between 1998 and 2005 increased by 3 percent from 27,273 to 27,974.[27] Persons with temporary visas accounted more for this increase in STEM Ph.D.s than did U.S. citizens or permanent residents.

The number of science and engineering Ph.D.s awarded to U.S. citizens/permanent residents actually declined by 12 percent between 1998 and 2005, from 18,271 to 16,024. African Americans, Hispanics, and persons with disabilities were the exceptions (see Table 1-5). These three underrepresented groups showed increases in the number of Ph.D. recipients, of 10, 6, and 2 percent, respectively.[28] Doctorates awarded to Whites declined by 12 percent, and those to American Indians/Alaska Natives and Asian/Pacific Islanders decreased by 30 and 24

Table 1-5

Percent of STEM Doctoral Degrees Awarded by Gender, Race, and Disability: 1998-2005

Group	1998	2005
Male	60.7	55.4
Female	39.3	44.6
Total	100.0 (18,271)	100.0 (16,024)
White	76.7	76.6
African American	3.5	4.4
Hispanic	4.1	5.0
American Indian/ Alaska Native	0.5	0.4
Asian/ Pacific Islander	11.8	10.2
Unknown Race/ Ethnicity	3.3	3.4
Total	100.0	100.0
Disabled Persons	1.5	1.7

Data source: Women, Minorities, and Persons with Disabilities in Science and Engineering 2007, Table F-11, U.S. Citizens and Permanent Residents; and Survey of Doctorates Earned, 1997-2006, Figure 3.

25. Ibid. Table D-8, p. 133.
26. Ibid. Table E-5, p. 160 and Table E-6, p. 167.
27. Ibid. Table F-1, p. 174.
28. Ibid. Table F-11, p. 190.

percent, respectively. Doctorates awarded to persons with disabilities declined by 4 percent between 1998 and 2005.[29]

Overall, underrepresented minority groups who are U.S. citizens or permanent residents are making some progress in attaining greater numbers of higher education degrees in science and engineering. However, the magnitude of that progress has yet to significantly alter their disproportionately low share in the total number of STEM degrees awarded. Table 1-6 shows that between 1998 and 2005, for example, African Americans and Hispanics made only marginal progress in raising their share of bachelor's, master's, and doctoral degrees. American Indians/Alaska Natives made almost no progress at all. With growing populations of minorities (particularly Hispanics and African Americans) and their increasing enrollment in undergraduate and graduate schools, it is anticipated that the underrepresented minority group's share in STEM degrees could also increase—but only given certain conditions, such as increased recruitment of underrepresented minorities into STEM education tracks; more effective interventions to increase their access to and retention within STEM education programs; increased focus on the part of majority professionals and institutions to eliminate racial and gender bias in the STEM enterprise; and viable career opportunities for advancement in the STEM workforce. CEOSE will continue to monitor and investigate this trend in STEM degree share among underrepresented groups.

Of particular note in Table 1-6 is that foreign nationals increased their share of graduate degrees in STEM—outstripping all U.S. minorities. In 2005, the percentage of foreign nationals who received a doctorate in STEM just about equaled that for White U.S. citizens.

EMPLOYMENT

According to the most recent and available data from the Bureau of Labor Statistics of the U.S. Department of Labor, growth of the STEM workforce is fast outpacing that of the country's overall workforce.[30] Employment within STEM grew at an annual rate of 3.6 percent between 1990 and 2000, compared to 1.1 percent for the entire workforce. Women constituted 26 percent of the college-educated STEM

Table 1-6

Percent Distribution of Higher Education STEM Degrees by Race and Citizenship: 1998 versus 2005

Group	Bachelor's		Master's		Doctorate	
	1998	2005	1998	2005	1998	2005
White	69.8	64.6	55.7	46.7	49.4	42.3
African American	7.8	8.4	5.2	6.3	2.1	2.3
Hispanic	6.6	7.5	3.7	4.5	2.5	2.6
American Indian	0.6	0.7	0.4	0.4	0.3	0.2
Asian/Pacific Islander	8.7	9.2	7.0	7.3	3.3	4.0
Foreign Nationals	3.8	3.9	24.1	27.9	35.7	41.2
Unknown Race and Citizenship	2.7	5.7	3.9	6.9	6.7	7.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Data sources: Bachelor's (Table C-6) and Master's (Table E-3) at http://www.nsf.gov/statistics/wmpd/race.cfm#degrees; and Doctorates (Table 3) at http://www.nsf.gov/statistics/nsf07305/content.cfm?pub_id=3757&id=2. Other racial/ethnic groups and persons with unknown citizenship are excluded from the above table. For bachelor's and master's degrees, foreign nationals include only persons with temporary visas; and for doctoral degrees, foreign nationals include persons with temporary visas and those who are permanent residents.

[29] *Ibid. Table F-15, p. 200.*

[30] *Science and Engineering Indicators 2008. Arlington, VA, p.3-5 and 3-6.*

workforce.[31] Minorities, traditionally underrepresented in STEM, make up just a small proportion of the STEM workforce. Collectively, African Americans, Hispanics, American Indians/Alaska Natives make up 21 percent of the U.S. population between the ages of 25 and 64 with a bachelor's degree,[32] but only 9 percent of the STEM workforce. (See Table 1-7). Persons with disabilities constituted 6 percent of the STEM workforce in 2006. In 1997, they made up 5.5 percent of the STEM workforce.[33]

Lack of Parity in Salaries

Disparity in annual salaries is an issue for women and minorities. In 2003, females in STEM occupations earned a median annual salary of $53,000, about 24 percent less than the median annual salary of $70,000 earned by male scientists and engineers.[34]

Similarly, the median annual salaries for underrepresented minorities were lower than that for White and Asian/Pacific Islander scientists and engineers. In 2003, the median annual salaries for Whites and Asian/Pacific Islanders were $67,000 and 70,000, respectively, compared to $60,000 for Hispanics and $58,000 for African Americans.[35] While these data do not take into account factors such as level of education and length of employment in STEM, they are nonetheless consistent with other research findings on the persistence of salary disparities between Whites and minorities in the Nation's general workforce.[36]

The STEM Teaching Workforce

One of the key segments of the STEM workforce is academia, where scientists, technologists, engineers, and mathematicians receive their basic and advanced instruction and training. The diversity of the STEM professoriate plays a major role in the recruitment, retention and development of the Nation's future and diverse STEM professionals. A professoriate that has been dominated by White males is beginning to change, although marginally since White males still far outnumber any other group among the ranks of science and engineering college and university faculty.[37]

Table 1-7

Demographic Composition of STEM Workforce: 1997 versus 2006

Group	1997 (#)	2006 (#)	1997 (%)	2006 (%)
Male	2,641,900	3,714,000	77.2	73.9
Female	780,300	1,310,000	22.8	26.1
White	2,832,200	3,677,000	82.7	73.2
African American	115,200	197,000	3.3	4.0
Hispanic	106,200	230,000	3.1	4.6
Amer. Indian/ Alaska Native	10,000	21,000	0.3	0.4
Asian American	356,900	810,000	10.4	16.1
Multiracial/ Other Race	1,700	89,000	0.5	1.7
Total	3,422,200	5,024,000	100.0	100.0

Data sources: Women, Minorities, and Persons with Disabilities in Science and Engineering reports: 2000, Table 5-2 for 1997 data and 2007, Table H-6 for 2006 data. Other race includes Native Hawaiians and Pacific Islanders.

[31] *STEM workforce is defined here as persons in science and engineering occupations with at least a college degree.*

[32] *Digest of Key Science and Engineering Indicators 2008. Arlington, VA: National Science Board, p. 10.*

[33] *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2000. Arlington, VA: National Science Foundation, Table 5-4, p. 216.*

[34] *Science and Engineering Indicators 2008. Arlington, VA: National Science Board, p. 3-5 to 3-6.*

[35] *Ibid. p. 3-7.*

[36] *For example, U.S. Census Data Release in April 2009 confirmed racial disparity between pay to Whites, Blacks and Hispanics.*

[37] *Women, Minorities, and Persons with Disabilities, 2007, Chapter 5, p.52.*

What is changing is that the rate of growth for full, associate, and assistant STEM professors is significantly higher for women and underrepresented minority groups. Between 1997 and 2006, the number of full professors decreased by 5 percent among Whites, as compared to increases of 25, 62, and 133 percent among African Americans, Hispanics, and American Indians/Alaska Natives, respectively. The percentage change for American Indian/Alaska Native full professors was dramatic, but the actual number of American Indian/Alaska Native full professors was small (see Table 1-8).

Between 1997 and 2006, women increased their numbers dramatically within the professoriate. The rates of growth were: +57 percent for full professors, +52 percent for associate professors, and +49 percent for assistant professors—compared to -7, -6, and +14 percent for men, respectively.

The foregone profile data represent only a partial picture of the status of broadening participation in America. A more comprehensive analysis would require more space than allowed in the present report. The Committee will, in its next biennial report, provide more extensive coverage of the demographic face of broadening participation, including a look into the disciplines being pursued by the underrepresented groups in STEM.

Table 1-8
Percent Change in Full-time STEM Faculty Positions at 4-Year Colleges and Universities by Race and Disability: 1997 versus 2006

Group	All STEM Faculty	Professor	Associate Professor	Assistant Professor
White: 1997	120,600	57,200	35,000	28,400
2006	123,800	54,400	35,700	33,800
% Change	**+3**	**-5**	**+2**	**+19**
Black: 1997	3,800	1,200	1,300	1,300
2006	5,500	1,500	1,700	2,200
% Change	**+45**	**+25**	**+31**	**+69**
Hispanic: 1997	4,000	1,300	1,400	1,400
2006	5,400	2,100	1,600	1,700
% Change	**+35**	**+62**	**+14**	**+21**
Amer Indian.: 1997	500	300	200	100
2006	1,200	700	300	300
% Change	**+140**	**+133**	**+50**	**+200**
Asian/PI: 1997	14,100	5,200	3,700	5,200
2006	19,300	6,400	5,000	7,900
% Change	**+37**	**+23**	**+35**	**+52**
Disabled: 1997	10,300	6,300	2,900	1,100
2006	10,300	5,800	2,400	2,100
% Change	**+0**	**-8**	**-17**	**+91**

*Data sources: (1997) Women, Minorities,and Persons with Disabilities, 2000, Table 5-15 and (2006) Women, Minorities, and Persons with Disabilities, 2007, Table H-25. * Black refers to African American and Native American refer to American Indian and Alaska Native. Numbers for the above three faculty groups do not add up to all faculty, because other faculty groups, e.g., instructors, are excluded from this table.*

2 NSF Broadening Participation Actions and Achievements

NSF CReSIS investigators conduct snow pit measurements for radar survey in Antarctica.

Throughout the two-year period beginning in January 2007, the National Science Foundation remained committed to and actively involved in broadening participation of underrepresented groups in STEM. A new agency-wide action plan for broadening participation programs was developed; and funding for programs dedicated to improving access to and retention within STEM education and professional development showed a modest increase. But more needs to be done in funding principal investigators from underrepresented Minority Serving Institutions. NSF's directorates and major program offices were actively engaged in developing strategic plans for broadening diversity, supporting specific programs, and addressing a number of challenges to involve underrepresented groups in the science and engineering enterprise. Finally, evaluation of NSF's portfolio of broadening participation programs continued, with some notable outcomes of program success.

What is the meaning of broadening participation? Pursuant to its enabling legislation, CEOSE has viewed broadening participation in terms of specific underrepresented groups, i.e., women, underrepresented minorities, and persons with disabilities. However, NSF has maintained a broader definition of broadening participation that includes all U.S. citizens, institutions, and geographic areas of the country.[38] In keeping with this broader definition, CEOSE has and will continue to address issues of institutional and geographic diversity, while maintaining its Congressionally-mandated focus on women, persons with disabilities, and underrepresented minorities (i.e., African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders).

NSF BROADENING PARTICIPATION ACTIONS IN FY 2007 AND 2008

NSF has remained committed to its goal to broaden participation of women, underrepresented minorities, and persons with disabilities throughout the Foundation, as well as in the Nation's science and engineering workforce. Seeded in 1980 with the establishment of CEOSE, broadening participation continues to be embedded within the Foundation's policies and programs. During fiscal years 2007 and 2008, NSF undertook several actions to further strengthen its diversity-related policies and to expand education and employment opportunities in STEM for all U.S. citizens.

NSF Broadening Participation Action Plan

In the spring of 2007, the Foundation formed a Broadening Participation Working Group,consisting of staff members from all of the directorates and major program offices. The Working Group's mandate was to develop an agency-wide action plan to (1) increase the participation of women, minorities, and persons with disabilities in NSF programs, and (2) increase the presence of traditionally underrepresented groups in NSF's pool of proposal reviewers.[39]

In August, 2008, the Working Group produced a document entitled "*Broadening Participation at the National Science Foundation: A Framework for Action*," that established over-arching program goals, identified and codified the Foundation's portfolio of broadening participation programs, and offered recommendations for subsequent actions in implementing the goals. Since then, NSF has updated and placed on the Internet its broadening participation portfolio to facilitate real-time program-officer changes to program descriptions and solicitations, and to advertise the programs to the general STEM community.[40]

Four categories of broadening participation programs were identified by the Working Group: (1) *focused programs* which have an explicit broadening participation program goal, and the majority of each award's budget goes to broadening participation activities (e.g., ADVANCE or LSAMP); (2) *programs with an emphasis on broadening participation* that include projects with broadening participation components, such as a project diversity plan and other components not necessarily related to diversity (e.g., *Science and Technology Centers or Robert Noyce Scholarships*); (3) *programs with broadening participation potential*, which have an eligibility criterion or other design feature that indicates a high likelihood that the awards made under the program will contribute to broadening participation (e.g., *Graduate Research Fellowships* or *Discovery Research K-12*); and (4) *other programs*, that are other budgeted broadening participation initiatives managed and funded in various ways by NSF directorates or program offices (e.g., *Next Generation Workforce* or SOARS).

New Policy Levers

Some program solicitations and announcements issued by NSF directorates and program offices explicitly require that proposals submitted for consideration include broadening participation as a component of the proposed projects. Other NSF solicitations and announcements include no such require-

[38] *Broadening Participation at the National Science Foundation: A Framework for Action p. 3.*

[39] *Minutes of June 5, 2007 CEOSE Meeting.*

[40] *http://www.nsf.gov/od/broadenigparticipation/bp.jsp (Framework) and www.nsf.gov/od/broadeningparticipation/bp_portfolio.jsp (Portfolio).*

ment. This situation was inconsistent with the Foundation's overall commitment to increasing diversity within STEM and undoubtedly sent mixed messages to the science and engineering communities. To correct this situation, NSF program announcements and solicitations are increasingly making use of additional review criteria and requirements to reinforce National Science Board policy, which states, "Broadening opportunities and enabling the participation of all [U.S.] citizens, women and men, underrepresented minorities, and persons with disabilities, are essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports." [41]

NSF BROADENING PARTICIPATION FUNDING

Total expenditures for NSF in FY 2007 amounted to $5.5 billion, of which approximately 16 percent was was spent for *focused* and *emphasis* programs. In FY 2008, estimated expenditures for NSF totalled $6.2 billion. Of this amount, 16 percent was spent on *focused* and *emphasis* programs.[42]

As can be seen in Table 2-1, funding for all of the active broadening participation programs in 2007 and 2008 increased by 5 percent between the two years; and funding for the *focused* and *emphasis* programs of the portfolio increased by 9 and 7 percent, respectively.

A direct comparison between the funding levels for 2007 and 2008 with that of previous years could not be made, because many of the portfolio's programs did not exist or were not funded prior to 2007. Table 2-2, however, does provide comparisons of funding levels for the *focused* programs since 2005. Programs included in this table represent only an illustration of NSF's *focused* programs. Funding increased for all of the programs in Table 2-2, with the exception of BPC, which showed only a slight decrease in funding between 2005 and 2008.

As shown in Table 2-3, the number of principal investigator (PI) grants awarded by NSF between 2007 and 2008 declined slightly, from 10,340 to 10,186. Awards received by men dropped by 7 percent, while those received by women increased by 4 percent. Results for awards made to underrepresented minorities were mixed. Grants made to African American PIs rose by 8 percent, although the numbers of grants to this group of PIs remained small. Grants made to the other underrepresented minority groups also declined.

Table 2-1
Funding of NSF Portfolio of Broadening Participation Programs: FY 2007 and 2008
(Dollars in Millions)

Program Category	FY 2007	FY 2008
Focused	380.95	415.62
Emphasis	503.33	540.68
Potential	571.22	566.23
Other	9.74	10.64
All	1,465.24	1,533.17

Data source: National Science Foundation Division of Budget, December 2008.

[41] *http://www.nsf.gov/pubs1999/iin125/iin125html.*
[42] *NSF Division of Budget.*

Table 2-2

NSF Funding of Illustrative Focused Broadening Participation Programs (BPP)
(In Millions)

BPP	FY 2005	FY 2006	FY 2007	FY 2008
ADVANCE	19.9	19.5	16.6	20.1
AGEP	15.0	14.6	15.3	15.9
BPC	n/a	14.2	13.5	14.0
CREST	15.6	17.8	18.8	25.0
HBCU-UP	25.3	25.7	27.9	29.7
LSAMP	35.6	36.1	38.1	40.5
RDE	5.0	5.3	5.4	5.9
GSE	9.9	9.7	9.9	10.1
TCUP	9.2	10.8	10.4	12.8

Data source: NSF Division of Budget, December 2008. Some other focused programs, such as, Diversity Collaborations and Facilitation Awards for Scientists and Engineers with Disabilities, were excluded because they were not funded in FY 2007 or FY 2008.
** According to the Bureau of Labor Statistics (www.bls.gov) the level of CPI-U for Nov. 2005 was 197.6 and for Nov. 2008 it was 212.4. The percent change between these two levels was +7%.*

Table 2-3

Number of Principal Investigators Who Received NSF Awards
by Gender and Race/Ethnicity: 2006-2008

Group	2006	2007	2008
Men	7,787	7,577	7,272
Women	2,241	2,295	2,332
White	7,546	7,326	7,114
African American	198	211	213
Hispanic	372	379	353
Native Hawaiian/ Pacific Islander	7	3	7
American Indian/ Alaska Native	24	26	21
Asian American	1,483	1,599	1,602

Data source: NSF Division of Budget, December 2008.

Those groups with the smallest number of awards, American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders, also showed a percentage decline. In 2007, 0.94 percent of the awards were made to persons with disabilities, and in 2008, 0.97 percent were made to this group.

The average duration of the awards remained virtually unchanged between 2007 and 2008 at 2.7 years. There were no statistically significant differences in project lengths that were associated with gender or race/ethnicity of the principal investigators.

The overall median grant amount decreased by 2.8 percent between 2007 and 2008, from $280,632 to $275,000. As shown in Table 2-4, White males far outnumbered all other racial/gender groups in receiving grants in amounts above the overall median in 2007 and 2008. In contrast, the percentages of awards awarded to both genders of underrepresented minorities were meager. Collectively, these minority groups accounted for 8 percent or less of all awards made in the two years.

Although their numbers were small, African American and Hispanic females received slightly more grants in amounts exceeding the median than did their male counterparts.

Finally, the demographics of principal investigators and co-principal investigators were analyzed. Averaged over 2007 and 2008, males were more likely to be PIs and co-PIs than females (74 percent); Whites were more likely to be PIs and co-PIs than other racial/ethnic groups (76 percent); investigators without disabilities were more likely to be PIs or co-PIs than those with disabilities (98.6 percent); and U.S. citizens were more likely to be PIs and co-PIs than non-U.S. citizens (80 percent).

Table 2-4

Percent of Race-Gender Groups Who Received Principal Investigator Awards Above Median Amount for 2007 and 2008

Race	2007	2007	2008	2008
	Male	Female	Male	Female
White	74.1	74.4	73.3	74.3
African American	2.0	5.0	2.0	4.0
Hispanic	3.9	4.0	3.0	5.0
American Indian/ Alaska Native	0.2	0.7	0.1	0.5
Native Hawaiian	0.1	0	0	0
Asian	15.0	10.0	16.0	12.0
Multiracial	0.6	1.0	1.0	1.0
Unknown	4.1	5.0	4.0	3.0
Total	100.0	100.0	100.0	100.0

Data source: NSF Division of Budget. FY 2007 Median Award = $280,632 and FY 2008 Median Award = $275,000.

BROADENING PARTICIPATION AT THE NSF DIRECTORATE LEVEL

In the last quarter of 2008, CEOSE conducted a survey of the Foundation's directorates and major program offices about their broadening participation plans, activities, programs, challenges, and best practices.[43] The survey results were encouraging. While more work remains to be done at NSF in expanding education and employment opportunities for the underrepresented groups in STEM, the importance of broadening participation was quite evident throughout the policies and programs of the Foundation's education and research directorates.

Broadening Participation Plans

In addition to the previously mentioned Foundation-wide action plan for broadening participation, all but one of the surveyed directorates had or was developing a directorate-wide or office-wide strategic plan to guide and ensure that broadening participation remains a priority. Biological Sciences (BIO), Education and Human Resources (EHR), Engineering (ENG), Geosciences (GEO), and the Office of International Science and Engineering (OISE) had strategic plans with goals and objectives for achieving broadened participation, measures to assess progress, and periodic staff reviews of the progress made towards greater diversity in STEM. Mathematical and Physical Sciences (MPS)[44] and Computer and Information Science and Engineering (CISE) had working groups that were developing strategic plans. Social, Behavioral, and Economic Sciences (SBE) had yet to develop a written plan.

The goals of the directorate-level plans were consistent with the Foundation-wide broadening participation action plan. In addition to focusing on underrepresented groups, the directorate plans also focused on broadening diversity among panel reviewers. The Geosciences directorate was the exception. The strategic plan for this directorate is primarily focused on building capacity in the participation of underrepresented groups in the geosciences as professionals across the board, but does not explicitly target panel reviewers.

Broadening Participation Programs

All of the surveyed directorates and program offices of NSF provided funding support for one or more of the broadening participation programs during 2007 and 2008. There were approximately 71 such programs. A review of all of them would be beyond the scope of this report. Presented next, therefore, are some examples of the *focused* or *emphasis* broadening participation programs of the directorates and program offices, along with highlights related to particular underrepresented groups of persons or institutions. For a more complete listing of NSF's portfolio of broadening participation programs, see *Broadening Participation at the National Science Foundation: A Framework for Action*, August 2008.

BIO

The *Undergraduate Research for Minorities in Biological Sciences* program (URM) provides support to academic institutions to establish innovative programs that engage undergraduates in year-round research and mentoring. Particular emphasis is placed on students from historically underrepresented groups in science and engineering.

Co-sponsored by the Biological Sciences and Social, Behavioral and Economic Sciences Directorates, the *Minority Post-doctoral Research Fellowship* program is intended to provide a small number of underrepresented minority Ph.D.s with opportunities for post-doctoral training.

Biological Sciences' *Research Initiation Grants and Career Advancement Awards* to broaden participation in biology (RIG/CAA) provide awards to beginning investigators only to undertake activities, such as acquisition of preliminary data or development of collaborations that will lead to formulation of com-

[43] *The Office of Polar Programs and the Office of Cyberinfrastructure, unfortunately, did not participate in the survey. See Appendix for survey methodology.*

[44] *The Chemistry Division had a broadening participation plan and was one of the first at NSF to develop one, but there was no directorate-wide plan for MPS.*

petitive grant applications to NSF at the conclusion of the RIG/CAA award. An emphasis is placed on investigators from underrepresented groups in STEM. BIO's approach to broadening diversity has been primarily to increase the numbers of traditionally underrepresented persons within the discipline. Initiatives have yet to be undertaken that would directly address institutional transformation of academic departments or industries where women, minorities, or persons with disabilities continue to be in small numbers.

BIO's plans for 2009-2010 are to continue its current portfolio of programs, which include the *Research Assistantship for High School Supplements* and *Undergraduate Research and Mentoring* programs. Solicitations for these two programs were not issued in 2007 or 2008.

CISE

Broadening Participation in Computing (BPC) is CISE's signature diversity program. BPC supports institutional (educational and industrial) alliances as well as demonstration projects designed to increase the number of Americans in the computing disciplines, with an emphasis on students from underrepresented groups in STEM. Because of the lack of role models in the professoriate, the BPC program also supports initiatives to develop effective strategies to encourage pursuit of academic careers in computing.

Pathways to Revitalized Undergraduate Computing Education (C-PATH) is a program that funds educational institutions and industry partners to better prepare the Nation's future generation of computer scientists and engineers. As a consequence, C-PATH also expects to attract diverse groups of individuals into the discipline, including women, underrepresented minorities, and persons with disabilities.

CISE also has special investment initiatives within its portfolio of broadening participation programs, i.e., CISE contributes to the funding of the Foundation-wide *Graduate Research Fellowship* program for women and provides support for persons with disabilities through investments in assistive technologies.

The directorate also participates in institutional transformation efforts within its community by collaborating with NSF's ADVANCE program, which is intended to change the culture of academia in making career advancement more accessible to women.

CISE had no plans for new programs in 2009-2010, but did plan to continue funding its current broadening participation programs.

EHR

The Human Resource Development (HRD) Division of the Education and Human Resources Directorate has traditionally provided the largest portfolio of *focused* broadening participation programs. All of the other directorates of the Foundation collaborate with EHR in the funding and implementation of HRD's *focused* diversity programs. Examples of these programs include the following:

Louis Stokes Alliances for Minority Participation (LSAMP) program is aimed at increasing the quality and quantity of minority students who successfully obtain a STEM baccalaureate degree. The program supports production of STEM bachelor's degrees through funding of institutional alliances that focus on recruitment, retention, and degree completion of undergraduates.

LSAMP's Bridge to the Doctorate program was created to interest and motivate more minorities to seek a Ph.D. in a STEM field, by offering two-year supplements to graduate students, and particularly in disciplines in which these groups are scarcely present, such as chemistry, physics, geosciences, and the polar research sciences.

Alliances for Graduate Education and the Professoriate (AGEP) is a program to increase the number of minorities and other underrepresented persons pursuing a career in the STEM professoriate, by supporting projects that develop innovative mod-

els for recruiting, mentoring, and retaining minority students in Ph.D. programs and projects that demonstrate effective strategies for identifying and supporting minorities who want to pursue academic careers.

Increasing Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE) is the directorate's signature program designed to facilitate the advancement of women scientists and engineers into senior faculty positions. Projects of particular interest to HRD are those that assess the policies and cultures of institutions that facilitate or inhibit support and acceptance of career advancement of women scientists and engineers.

*Research in Disabilities Education (*RDE) supports projects that increase the knowledge base of what facilitates participation and advancement of persons with disabilities in STEM, and projects that address assistive technology research and development.

Graduate Research Fellowships (GRF) provides fellowship support to all demographic groups, including the traditionally underrepresented groups in STEM. Other directorates participate in this program by contributing funds for certain disciplines and specific underrepresented groups.

Innovative Technology Experiences for Students and Teachers (ITEST) provides funds to support research and demonstrations that address questions pertaining to how best to identify, recruit, educate, and train individuals from the increasingly diverse U.S. population for the country's future STEM workforce.

Centers for Research Excellence in Science and Technology (CREST) invests in upgrading research capabilities and infrastructure of research-productive Minority Serving Institutions, by providing funds for the establishment and enhancement of research centers and supplements for institutional partnerships, including supplements for collaborations with the *Small Business Innovation Research and Small Business Technology Transfer* programs from the Engineering Directorate.

Advanced Technological Education (ATE) provides funds for curriculum development and education of teachers, primarily at community colleges in the high-technology fields, involving partnerships with four-year colleges. Another goal of the program is to promote and facilitate articulation between two-year and four-year programs for K-12 prospective teachers that focus on technological education.

Research on Gender in Science and Engineering (GSE) is a program that supports projects that contribute to the knowledge base addressing gender-related differences in learning and in the educational experiences that affect student interest, performance, and choice of careers in STEM.

*Integrative Graduate Education and Research Traineeship (*IGERT) program is intended to enhance graduate education in STEM fields through support of innovative education and training models, and to enhance diversity among graduate students pursuing a doctorate and career in STEM.

In addition to the above programs, EHR/HRD provides funding for Minority Serving Institutions to enhance their research capability, faculty, and student instruction in science and engineering. Examples of funded programs within this portfolio include the *Historically Black Colleges and Universities Undergraduate Program* (HBCU-UP), and *Tribal Colleges and Universities Program* (TCUP).

EHR plans to continue funding of the above programs in 2009 and 2010, and to place greater emphasis on the integration of newly funded projects with existing HRD-supported programs at grantee institutions. Other plans include standardizing metrics for tracking and evaluating broadening participation programs, focusing more on the role of community colleges for technician education, developing more international experiences for students from underrepresented groups, providing more technical assistance to minority investigators in producing quality proposals, and engaging professional societies more in efforts to broaden diversity in the STEM workforce.

ENG

Broadening Participation Research Initiation Grants in Engineering (BRIGE) provides funds for new faculty from all demographic groups and persons with disabilities to conduct research in engineering. The program is intended to expand the number of role models who will interact with an increasingly diverse student population and the workforce of the future; and to increase the number of engineering researchers at Minority Serving Institutions.

The Division of Engineering Education and Centers (EEC) invests multi-year funding for the establishment and operation of *Engineering Research Centers* (ERC). One of the goals of ERC is to support broadening participation. All ERCs are expected to develop and implement a diversity strategic plan. Additionally, ERC leadership, faculty and student participants are expected to be diverse and include individuals from underrepresented groups.

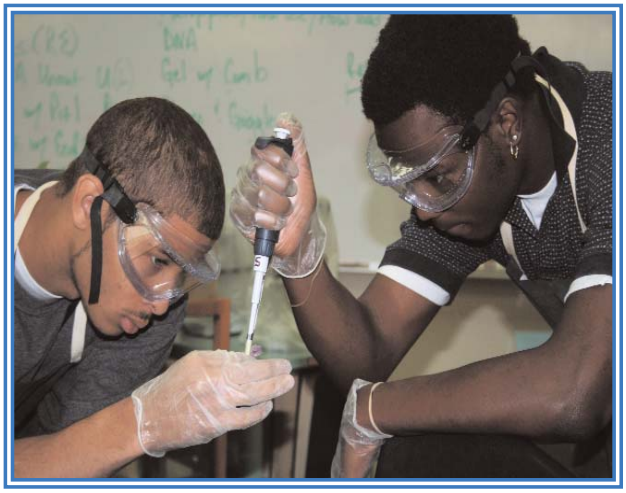
Engineering's Chemical, Bioengineering, Environmental and Transport Systems Division funds the *Research to Aid Persons with Disabilities* (RAPD) program, which is the only NSF program that specifically targets research and development of personal and environmental rehabilitation tools for persons with disabilities.

As part of its broadening participation thrust, ENG addresses issues of institutional transformation to better recruit, sustain, and advance women and minority faculty through involvement in the ADVANCE and CREST programs of EHR.

The Engineering Directorate's plans for 2009 and 2010 are to continue the above programs.

GEO

The Geosciences Directorate (GEO) offers several programs to broaden participation. *Opportunities for Enhancing Diversity in the Geosciences* (OEDG) is



High school students engaged in biotechnology study at summer academy of project SEEDBed (BIO Directorate)

a program that supports activities to increase the number of members of underrepresented groups who are involved in formal pre-college geoscience education programs; who pursue bachelor's, master's, and doctoral degrees in the geosciences; who enter geoscience careers; and who participate in informalgeoscience education programs. OEDG serves the twin goals of developing the future geoscience workforce and improving public literacy in the socially relevant geosciences. *Geoscience Education* (GeoEd), a related program, provides funding for pilot demonstrations of innovative educational approaches in teaching and learning geosciences. This program also supports integration with existing LSAMP, AGEP, and CREST projects at the grantee site.

Twelve Minority Serving Institutions are among 49 being supported through *Geosciences Teacher Training* (GEO-Teach), which seeks to strengthen preservice and in-service teacher content knowledge and pedagogy.

GEO also focuses on the institutional transformation aspects of broadening participation through its involvement in the ADVANCE and CREST programs.

For 2009 and 2010, GEO plans to update its diversity strategic plan, continue its existing broadening participation programs, and modify the 2009 OEDG solicitation to explicitly encourage submission of proposals from community colleges.

MPS

The Math and Physical Sciences Directorate (MPS) has been engaged in discussions regarding its role in broadening participation among the PIs and students supported by NSF funding across its divisions. Here are just a few examples of their activities.

Partnership in Astronomy & Astrophysics Research and Education (PAARE) is a program offered by the MPS Division of Astronomical Sciences to enhance diversity in astronomy and astrophysics research and education through funding partnership initiatives between Minority Serving Institutions and research institutions, and to increase the number and quality of students and faculty at Minority Serving Institutions.

The Division of Materials Research's (DMR) Centers and Facilities programs require grantees to develop a diversity strategic plan to broaden participation, and provide support for diversity initiatives through several other programs. For example, *Partnerships for Research in Education in Materials* (PREM), which DMR co-sponsors with EHR and the MPS Office of Multidisciplinary Activities, enables partnerships between Minority Serving Institutions and DMR Centers and Facilities.

The Mathematical Sciences Research Institutes, supported by the Division of Mathematical Sciences (DMS), have strategic plans for broadening participation. The institutes coordinate their broadening activities through a joint Diversity Committee comprising representatives from each institute. DMS also offers an integrated set of opportunities for broadening participation through its *Workforce* and *Infrastructure* programs.

The Chemistry Division's (CHE) new *American Competitiveness in Chemistry Fellowship (ACCF)* program requires post-doctoral associates to develop and implement their own diversity plan in the chemical sciences. CHE further supports broadening participation through workshops. In 2007, for example, it co-sponsored a workshop with other Federal agencies, entitled "Workshop on Excellence Empowered by a Diverse Academic Workforce: Achieving Racial and Ethnic Equity in Chemistry."

In addition to the above, the MPS Directorate contributes to institutional transformation efforts aimed at broadening participation through partial support of workshops designed to inform institutions about such matters. In many cases, other Federal agencies also contributed to these workshops. Following the lead of CHE's 2006 workshop on Gender Equity for Chemistry Departments, the following workshops were supported: "Gender Equity: Strengthening the Physics Enterprise in Universities and National Laboratories" (2007: PHY, DMR and AST); and "Gender Equity in Materials Science and Engineering" (2008: DMR and the Engineering Directorate). Other MPS-supported workshops focused on different underrepresented groups. In 2007, the Chemistry Division provided a supplement to the University of Michigan's ADVANCE program to develop a presentation on implicit bias in peer review that has been incorporated in all Chemistry Division panel orientation sessions and adopted by other divisions across NSF.

MPS plans to continue its current broadening participation efforts during 2009 and 2010.

OISE

While NSF's Office of International Science and Engineering (OISE) did not have any *focused* diversity-enhancing programs, most of the Office's programs included elements of broadening participation. For example, the *Developing Global Scientists and Engineers: International Research Experiences for Students* (IRES) program, which provides high-quality international research experiences for U.S. undergraduate and graduate students, requires that proposals include recruitment and broadening participation plans—including efforts that will be made to attract members of underrepresented groups. Another program, *Partnerships for International Research and Education* (PIRE), seeks to enhance research excellence via international partnership and collaboration,

promote a diverse U.S. science and engineering workforce that is prepared to engage with the global community, and develop international partnerships that enlist resources and commitments within and across institutions to strengthen the capacity for U.S. international engagement. The PIRE program solicitation requires that proposals include "Strategies and specific provisions, beyond the norm, for engaging significant participation of underrepresented U.S. groups and institutions, and researchers and students at all levels. As part of a recruitment strategy, PIs are encouraged to establish linkages with NSF-sponsored programs to enhance diversity (e.g., AGEP, LSAMP, HBCU-UP, TCUP, CREST, and ADVANCE), especially at their own institutions, and should describe such linkages in the proposal." For the 2009 PIRE competition, changes in international eligibility requirements were made, such that an additional 20 Minority Serving Institutions, as well as Gallaudet University, became eligible to submit proposals.

SBE

The Social, Behavioral, and Economic Sciences (SBE) Directorate contributes funding to the *Minority Postdoctoral Research Fellowship* and *Alliances for Graduate Education and the Professoriate* programs.

In June 2008, the Division of Behavioral and Cognitive Sciences sponsored a workshop entitled "The Science of Broadening Participation." The purposes of the workshop were to exchange research and theoretical perspectives, assess interest and activities in the pursuit of knowledge about broadening participation, and to inform research communities about this area of concern.

The Science Resources Statistics Division of SBE continued throughout 2007 and 2008 to provide data and assistance to researchers and others, including CEOSE, in relation to broadening participation in its periodic publication, "Women, Minorities, and Persons with Disabilities in Science and Engineering." The division also publishes other important documents related to broadening participation, including "The Survey of Earned Doctorates" and "The Science and Engineering Indicators."

CHALLENGES TO BROADENING PARTICIPATION

Many challenges are encountered by the directorates and program offices in their efforts to broaden participation for underrepresented groups within their respective STEM communities. These challenges are summarized as follows:

- There are a limited number of proposals submitted to NSF by underrepresented principal investigators, and the competitiveness of the proposals requires improvement. This challenge is underscored by the data provided in Table 2-3 on the small number of minority principal investigators awarded grants by NSF in 2007 and 2008.
- There are limited opportunities for Minority Serving Institutions to partner equitably with major research universities.
- Underrepresented minority students have a disproportionate lack of access to technology and cutting-edge STEM learning experiences, which result in many of them being ill-prepared for college level math and science courses.
- Persons with multiple underrepresented-group characteristics are not paid enough attention, e.g., minority females.
- There are insufficient opportunities for mentorships for underrepresented groups.
- There is lingering or unconscious bias among majority scientists towards women and underrepresented minorities in certain fields, e.g., mathematics.
- Although women have increased their numbers among doctorate-holders in science and engineering, they still face obstacles in advancing to senior level positions in academia and industry.
- The shortage of role models for underrepresented persons in STEM makes recruitment of these indi-

viduals difficult, especially in fields where the number of women, minorities, or persons with disabilities is extremely small.

- The financial limitations of poor minorities limit their ability to take advantage of education and training opportunities deemed essential for career success, e.g., traineeships that do not provide adequate funding for students to meet their personal financial obligations.

BEST PRACTICES IN BROADENING PARTICIPATION

Many best practices in broadening participation have emerged over the years and were adopted for use in NSF's portfolio of programs to improve access, retention, and advancement of underrepresented groups in science and engineering. Examples of these practices are summarized as follows:

- Conducting workshops or presentations on implicit bias increases the likelihood of equitable decision-making, e.g., Chemistry Division's workshops on implicit bias have led to the inclusion of implicit bias presentations for panel reviewers in other directorates as an effective tool for broadening perspectives in the NSF proposal-review process.

- Supporting collaborations between Minority Serving Institutions and major research institutions enhances the experience and competitiveness of the former. For example, the Partnerships for International Research and Education (PIRE) project titled, "*Africa Array: Imaging the African Superplume,* building African partnerships, and enhancing diversity in the geosciences" is a partnership involving North Carolina A&T State and Penn State Universities working with researchers and educators from various African countries on seismic projects. The project is jointly supported by OISE, GEO, and EHR.

- Strategically integrating new programs with proven ones, such as LSAMP, AGEP, RDE, or ADVANCE, enhances the effectiveness of the new programs. Also, exploring accountability measures of existing programs.

- Identifying and expanding program models that help to impact a greater number of persons from underrepresented groups, e.g., the initial LSAMP model was expanded into *Bridge to the Doctorate* to facilitate minority student achievement of terminal degrees in STEM.

- Providing supplements for existing fellowship, traineeship, and other student- or investigator-focused grants has been adopted by many of NSF's directorates and program offices as a means of sustaining researcher participation on NSF grant projects.

- Mentoring, as an element in all broadening participation as well as other STEM education programs, has been recognized as an essential requirement. For example, pursuant to the America's COMPETES Act, NSF now requires that all proposals for postdoctoral research and training include a mentoring component, and proposals that fail to comply are returned without merit review.

- Giving recognition awards to investigators and educators who contribute to broadening participation provides incentives to increase diversity, e.g., *Presidential Awards For Excellence In Science, Mathematics and Engineering Mentoring,* and the Chemistry Division's and Materials Research Division's *American Competitiveness and Innovation Fellowship* (ACIF) programs.

EVALUATION OF BROADENING PARTICIPATION PROGRAMS

Metrics and Measures

Identifying appropriate metrics for assessing the outcomes and impacts of broadening participation programs has been a major concern of NSF as well as its grantees, researchers, evaluators, and designers of programs. Beginning in 2006, with a 12-month grant from the Research, Evaluation, and Communication Division of EHR, a group of NSF grantee representa-

tives collaborated on identifying and defining metrics that could be generally accepted in evaluating the outcomes and effects of broadening participation programs.[45] It was the opinion of the collaborators that unless grantees are held publicly accountable for their progress in achieving broadened participation, there would be little to no incentive for grantees to adopt and report their program metrics. It was therefore recommended that grantee reporting of metric results be linked with affirmative action reports required by Federal agencies from the grantee institutions on an annual basis.

Researchers and educators involved in the project also devised major categories of metrics to measure participation at all academic and professional levels: (1) in research and research capacity-development by underrepresented individuals and institutions; and (2) in education and education capacity-development by underrepresented individuals and institutions. In addition, the project group devised a metric to assess (3) professional development and progression in academic settings of doctorate-holders from underrepresented populations in STEM; and (4) efforts by NSF's grantees to identify, attract, engage, support, and sustain participation by members of underrepresented groups and institutions. For each of the metric categories, a series of specific measures were recommended.[46] During 2007 and 2008, EHR took the lead in continuing to address the need for broadening participation metrics and measures, by holding additional workshops in this subject area.

Program Evaluation

All NSF programs, including those aimed at broadening participation, undergo an expert review every three years by the Committee of Visitors (COV). These reviews typically focus on how a program is being implemented in regard to its stated goals and NSF requirements. In addition, NSF programs are subject to third-party assessments by independent evaluators. Also, on the project level, grantees are required to assess and report on the progress of their activities in meeting the goals and objectives of the grant.

During 2007 and 2008, ongoing impact evaluation studies were carried out on several of NSF's broadening participation programs, including *Alliance for Graduate Education and the Professoriate, Advanced Technological Education, Louis Stokes Alliances for Minority Participation, Historically Black Colleges and Universities-Undergraduate Program, Centers for Research Excellence in Science and Technology, Tribal Colleges and Universities Program, Opportunities for Enhancing Diversity in the Geosciences, and Research Initiation Grants and Career Advancement Awards to Broaden Participation.* New or first-time evaluation studies were planned for programs such as *Broadening Participation in Computing, ADVANCE, Research in Disabilities Education, Research on Gender in Science and Engineering, and Broadening Participation Research Initiation Grants in Engineering* programs.

Highlights of the findings from some of NSF's broadening participation program evaluation studies are presented in Figure 2. CEOSE was only able to identify and review some of the impact evaluations of the *focused* broadening participation programs, and report here the summary findings. NSF should consider a more comprehensive review of the impact evaluation findings for all of its broadening participation programs and related initiatives, and use this review to identify and report what programs work, for which underrepresented groups, and in what settings. This would provide the Foundation's Broadening Participation Plan of Action with further guidance and direction as to future program investments, expansions, eliminations, or consolidation of efforts to enhance the quality and application of NSF's portfolio of broadening participation programs. A more detailed CEOSE review of evaluation of NSF's broadening participation portfolio is planned for CEOSE's 2009-2010 Biennial Report.

45. Norman L. Fortenberry, et. al., Metrics for Measuring Broadening Participation in NSF Programs, 2007.
46. Ibid.

Figure 2

Example Evaluation Highlights of Illustrative NSF Programs Focused on Broadening Participation

HBCU-UP

- Over 16,000 students have earned STEM bachelor's degrees from institutions with active HBCU-UP projects.
- In FY 2005-2006, almost 53 percent of HBCU-UP STEM bachelor's degrees were earned by female students.

LSAMP

- Close to 80 percent of program graduates sought additional education after obtaining a bachelor's degree, and two-thirds of participants later enrolled in graduate school, working towards a master's, doctoral, or professional degree.
- LSAMP participants pursued post-bachelor's coursework, enrolled in graduate programs, and completed advanced degrees at greater rates than did national comparison groups including nationally underrepresented minority (URM), White, and Asian students.

TCUP

- In FY 2005-2006, 442 STEM degrees and certificates were conferred by the 26 reporting TCUP institutions. Of that total, 31 percent (137) were bachelor's degrees, 55 percent (242) were associate's degrees, and 14 percent (64) were certificates.
- Alaska Native, American Indian, and Native Hawaiian students accounted for 52 percent of TCUP's 2005 Fall STEM enrollment at participating institutions and cohorts.

CREST

- Two hundred and seventy-two degrees were awarded to CREST participants from 2001 through 2003.
- The number of partnerships increased from 19 in 2001 to 77 in 2003 with each Center reporting partnerships with at least three entities.

GeoEd

- Between 2001 and 2008, Ph.D.s awarded to underrepresented minorities in the geosciences at AGEP institutions increased by 100 percent.

3 Highlights of CEOSE Activities: 2007-2008

L to R: Dr. Harris, CEOSE Chair presents service awards to Drs. Hartline and Lichter while Dr. Tolbert looks on.

CEOSE held its six regularly scheduled meetings at the National Science Foundation during 2007 and 2008. A total 301 representatives from Federal agencies, educational institutions, professional societies and associations, other organizations, and NSF staff participated in these meetings. Thirty-nine major presentations were made to the Committee on a wide variety of topics that included: understanding interventions that encourage minorities to pursue research careers; the pros and cons of NSF's broader impacts criterion; Tribal Colleges and Universities and how NSF can better assist Native Americans in entering the STEM enterprise; the under-attention paid to persons with disabilities in science and engineering; the legal history of CEOSE; new and existing broadening participation initiatives of NASA, DOE, NOAA, NIST, USGS, NSF, and other agencies; activities of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers; the impact of continuing budgetary resolutions on funding of broadening participation programs at NSF; the America COMPETES Act; the need for more impact evaluation data on broadening participation programs; and the necessity for increased inter-agency collaborations to further diversity in the STEM workforce.

Highlighted in this chapter are topic areas that were particularly focused on by the Committee during 2007 and 2008. Also presented in this chapter is a follow-up to CEOSE's 2005-2006 recommendations to help advance the Foundation's broadening participation agenda and effectiveness.

Leveraging existing relationships to broaden participation among Federal agencies with missions critical to the Nation's STEM enterprise, and increasing initiatives to open up more opportunities in STEM for persons with disabilities and Native Americans were major themes of CEOSE's activities during 2007 and 2008. In addition to these areas of concern, CEOSE continued its focus on promoting educational and employment opportunities for women and other underrepresented minorities. Throughout the two-year period, CEOSE was engaged in a multiplicity of activities of collecting and reviewing information about the status of broadening participation and advising NSF on policies and programs to further help match the face of the STEM workforce with the face of the American population.

INTER-AGENCY PARTNERSHIPS

A major conclusion drawn from CEOSE's 10-year study of NSF's performance in advancing diversity within the STEM workforce was that the Foundation must work with other agencies to achieve significant change.[47] Collaborations between and among other STEM-related Federal agencies must be established, in order to more effectively take advantage of and cultivate the underutilized talents of groups that have been traditionally underrepresented in the science and engineering enterprise.

CEOSE commissioned a survey study in January of 2007 of Federal agencies with a STEM-related mission and workforce diversity programs. The purpose of the study was to gather information for use in developing and proposing strategies for inter-agency collaborations that would expand access to and support for STEM education, training, and employment opportunities for women, underrepresented minorities, and persons with disabilities. The National Aeronautics and Space Administration (NASA), Department of Defense (DOD), Department of Energy (DOE), U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), National Institute of Standards and Technology (NIST), U.S. Department of Agriculture (USDA), National Institutes of Health (NIH), and the National Science Foundation (NSF) were included in the study sample. Collectively, these nine agencies accounted for 96 percent of the $59.8 billion dollars spent by the Federal government in FY 2007 on science and technology projects.[48] Two other agencies, the Department of Labor (DOL) and Department of Education's White House Initiative on Historically Black Colleges and Universities (WHI-HBCU) also expressed interest in collaborating with NSF and others to diversify the science and engineering workforce, and were added to the study group. Representatives from each of the agencies were interviewed in person and by phone. The interviews were guided by a questionnaire (see the Appendix). Additional interviews with other agency representatives were deemed necessary, but could not be done due to limited study resources. Albeit preliminary, the results reported here revealed that the agencies were similar as well as diverse in their broadening participation policies and programs.[49]

- All of the agencies focused on inclusiveness, specifically defined in terms of groups that they target for STEM education and employment opportunity programs. The term "broadening participation" was unique to NSF. DOD targeted the same demographic groups as NSF (i.e., women, underrepresented minorities, and persons with disabilities), while the other agencies were best described as focusing on a broader spectrum of demographic groups—except the WHI-HBCU, which focused exclusively on underrepresented minorities.

- Three of the agencies (NSF, NIH, and NASA) provided STEM programs that target persons with disabilities. All of the agencies provided STEM programs that target underrepresented minorities. Only three (NSF, NIH, and NASA) provided STEM programs that target all three underrepresented groups, i.e., women, minorities, and persons with disabilities.

[47] *Broadening Participation in America's Science and Engineering Workforce. The 1994-2003 Decennial and 2003-2004 Biennial Reports to Congress. Arlington, VA: National Science Foundation, December 2005.*

[48] *Office of Science and Technology Policy: www.ostp.gov/html/budget07.html*

[49] *Preliminary results were obtained from: Joining Forces to Broaden Participation in Science and Engineering, February 2008 (CEOSE 01-08), an unpublished draft document currently under review by the participating Federal agencies.*

- With the exception of the WHI-HBCU, all of the agencies evaluated their agency-wide broadening participation or diversity programs.

- The agencies employed a variety of evaluation approaches to assess their programs and activities. There was, however, no uniformity of evaluation approaches across agencies, making it difficult to compare results from similar programs. The agencies typically used program exit surveys, post-program follow-up studies, and descriptive analysis of program participants.

- Relaying their experiences in developing and implementing broadening participation and diversity programs, the Federal agencies learned a number of lessons. These included: funding for broadening participation and diversity programs has not kept pace with the growing demand for these programs; community college students, including minorities, work well in research laboratories; programs need flexibility to address the circumstances or personal needs of underrepresented students; recruiting minority students without relationship building is not effective in sustaining student interest in STEM careers; and agency leadership commitment to broadening participation and diversity is absolutely essential for the funding of internships, fellowships, and other program opportunities for underrepresented groups.

- Some key best practices were noted by the agencies and included: hands-on research experiences attract and sustain the interest of students; aligning a new program with an existing successful program helps to ensure success of the new program; providing a "personal touch" with lots of mentoring and attention to personal needs of the student helps sustain student interest in STEM education programs; providing incentive credits to laboratory researchers helps motivate staff and students in broadening participation activities; and having personnel dedicated to tracking students helps to ensure successful follow-up evaluation studies.

- NSF had already established some collaborations with other agencies, e.g., the Chemistry Division partnered with NIH and DOE in supporting the Committee on the Advancement of Women in Chemistry (COACh) and presenting "equity" workshops on women and implicit bias; the Biological Sciences Directorate collaborated with DOD on the *Research Experiences for Undergraduates* (REU) program; NSF and DOE have a memorandum of agreement in which students in the REU programs can use DOE laboratories; and the Geosciences Directorate joined with NASA in funding *Minorities Striving and Pursuing Higher Degrees of Success in the Earth System Sciences* (MS PHDS), a multi-year mentoring and leadership development program for undergraduate and graduate students in the geosciences.

- All of the agencies expressed an interest in collaborating with other STEM-related Federal agencies to support and improve the government's efforts to open STEM enterprises to all U.S. citizens. With the exception of DOL, all of the agencies were currently or previously involved in partnerships with other Federal agencies to increase diversity in science and engineering.

- Finally, agency representatives offered a number of recommendations for forming new and enhancing existing inter-agency collaborations. The recommendations were grouped into three major themes: (1) information-sharing, especially best practices and other information on broadening participation efforts; (2) joint funding of programs with common objectives; and (3) program coordination, e.g., common objectives and approaches.

Following distribution of the study's draft report to the participating agencies in the spring of 2008 for their review, CEOSE presented the preliminary findings and recommendations to Dr. Arden L. Bement, Jr., the NSF director, and the senior management team for review and discussion. Also, on October 2, 2008, CEOSE Chair, Dr. Wesley L. Harris, Dr. Lance Haworth, director of NSF's Office of Integrative

Activities, and the CEOSE Executive Liaison, Dr. Margaret E.M. Tolbert, met with members of the Subcommittee on Education of the National Science and Technology Council's (NSTC) Committee on Science to present the findings of the study. CEOSE expected that further action would stem from these discussions and would hopefully lead to expanded collaborations among the STEM agencies to enhance government-wide efforts to more fully leverage the Nation's human capital in responding to the growing national and global demands for STEM talent.

In the interim, representatives from the STEM agencies continued to attend the CEOSE meetings and provided updates on broadening participation activities within their respective agencies. Also, NSF's directorates continued the inter-agency collaborations that had already been established. After additional discussions to clarify the recommendations, the report will be issued in the future.

MINI-SYMPOSIUM ON INSTITUTIONS SERVING PERSONS WITH DISABILITIES IN STEM

On October 15, 2007, CEOSE hosted a mini-symposium on learning about institutions and programs that serve students and faculty with disabilities in order to determine the appropriate role of NSF in fostering increased participation of these individuals in STEM education and the workforce. Approximately 60 individuals from several organizations, including Gallaudet University, Landmark College, National Technical Institute for the Deaf, American Association for the Advancement of Science, Association on Higher Education and Disability, Center for Applied Special Technology, National Federation of the Blind, NASA, IBM Corporation, and NSF, attended the symposium. The discussions were highly informative and stimulating. One highlight of the meeting was the panel of three Ph.D. students, one deaf, one blind, and the other with attention deficit hyperactivity disorder. Their stories showed that, with the appropriate technological and motivational support, people with disabilities are not limited in what they can achieve in academia. What also emerged from the experiences of these three individuals was that needs of persons with different disabilities vary and that "the one size fits all" approach does not work. Each type of disability requires different assistive technologies, and individualized mentoring and other support.[50]

Some statistics revealing the importance of programs for persons with disabilities were reported at the symposium by NSF's Division of Science Resources Statistics. Approximately 11 percent of the U.S. population between the ages of 15-24 have a disability, and more than half of these individuals have learning disabilities. Of all undergraduates majoring in a STEM field, 11 percent have one or more disabilities, and 7 percent of graduate students in STEM have disabilities. Also, there is evidence that students with disabilities are much more likely not to obtain their bachelor's degrees, which may account for the drop-off in undergraduates pursuing graduate degrees in STEM. For example, only 1 percent of STEM Ph.D.-holders reported having disabilities.[51]

There are some institutions that serve large populations of persons with disabilities, e.g., Gallaudet University, a 4-year liberal arts university in the District of Columbia; the National Technical Institute for the Deaf, the undergraduate division of the Rochester Institute of Technology in New York; and Landmark College, a 2-year liberal arts college in Putney, Vermont. NSF supports programs at all three institutions. These NSF-sponsored programs include, for example, the *Science of Learning Center on Visual Language and Visual Learning* at Gallaudet, the *Deaf Initiative in Technology* at the National Technical Institute for the Deaf (NTID), and the *Universal Design in College Algebra: Customizing Learning Resources for Two-Year Students with Learning Disabilities* project at Landmark College. NSF also supports students with disabilities through other programs, such as the *Regional Alliances for Persons with Disabilities in STEM* (RAD).

While these NSF-supported programs represent a

[50] *CEOSE Mini-Symposium on Institutions Serving Persons with Disabilities in STEM, October 15, 2007, Final Report.*

[51] *These statistics should be viewed as suggestive rather than definitive, since data on persons with disabilities are often incomplete due to under-reporting.*

good-faith effort to assist persons with disabilities in education, the number and scope of these programs are limited in that these institutions do not enjoy the status of Minority Serving Institutions (MSI), which by definition are eligible to apply for NSF-supported research partnerships projects with research institutions. Another issue discussed during the symposium was that persons with disabilities are not always consulted by NSF in designing programs targeted for them. Consequently, certain needs of disabled persons are not taken into consideration in developing certain NSF programs.

Persons with Disabilities Symposium Recommendations

Based on the discussions at the mini-symposium and follow-up Committee discussions, six major recommendations for NSF to consider were agreed upon by the Committee:

1. Institutions such as Gallaudet, National Technical Institute for the Deaf, Landmark College, and others should have a designation similar to MSI so that they can benefit from transition programs and partnerships with majority institutions on large research initiatives.[52]

2. NSF-sponsored scholarships, fellowships, and research internships should be targeted to support STEM students with disabilities.

3. The *Facilitation Awards for Scientists and Engineers with Disabilities* (FASED) should be expanded to include all STEM graduate students and faculty who are disabled and want to attend conferences or workshops. This could be accomplished through the *Small Grants for Exploratory Research* (SGER) program or the *Regional Alliances* (RADs).

4. Data related to disability should be collected on a regular basis such as, (a) numbers of disabled principal investigators, successful and unsuccessful; and (b) numbers of disabled panelists, reviewers, Committee of Visitors (COV) members, and Advisory Committee members.

5. Funding for programs that help increase the number and success of students and faculty with disabilities in STEM fields should be increased, e.g., Regional Alliances and National Alliances based on discipline and/or disability.

6. The conduct of research in technology for persons with disabilities should be strengthened by ensuring that projects are aligned with their actual needs.

MINI-SYMPOSIUM ON BROADENING PARTICIPATION OF NATIVE AMERICANS IN SCIENCE AND ENGINEERING: LESSONS LEARNED

On October 29, 2008, CEOSE and the NSF Centers Forum co-hosted a mini-symposium designed to highlight strategies to increase the number of American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders in science and engineering. The Mississippi e-Center at Jackson State University was also instrumental in the development of the mini-symposium.

The goals of the symposium were to (1) identify lessons learned and persistent barriers to broadening participation in STEM by Native American groups; (2) share ideas and experiences of community leaders as well as government officials; and (3) make recommendations to CEOSE and funding agencies on initiatives that need to be undertaken to improve participation opportunities for Native Americans in STEM.

Approximately 50 individuals participated in the mini-symposium. The speakers represented a number of organizations that included Fond du Lac Tribal and Community College in Cloquet, Minnesota; Institute for Tribal Government at Portland State University in Oregon; School of Engineering at the University of Alaska; Boston College in Massachusetts; University of Maryland at College Park; American Indian Higher Education Consortium, headquartered in Alexandria, Virginia; White House Initiative on Tribal Colleges and Universities (TCU); Northern Arizona University in Flagstaff; DOE; Jackson State University in Mississippi; Quality Education for Minorities Network, Inc. in the District

[52] *Since the symposium, NSF has included institutions serving persons with disabilities as potential partners, along with other Minority Serving Institutions, in centers program solicitations.*

of Columbia; NASA; NIH; University of Texas at El Paso; Montana State University in Bozeman; and NSF.

A number of lessons learned from developing and implementing broadening participation programs for Native Americans were revealed from the symposium discussions. Derived from the professional experiences of the participants as well as from program evaluation data, these lessons included the following:

- K-12 teachers need to be taught how American Indian and other minority students learn, in order to better communicate classroom content.
- Greater use of technology in the classroom is needed to promote awareness, understanding, and application of science and engineering for American Indian students.
- American brand schools tend to "initialize" American Indian students, erasing the significance of their culture, language, and perspective—which destroys self-identification and self-worth. This initialization, in turn, negatively impacts the learning process. For instance, when the American Indian language and culture were integrated into the NSF *Rural Systemic Initiative*, the students learned.
- Mentoring is essential to the learning process for student success in STEM education programs.
- Opportunities to bridge between high school and college and between college and graduate school are effective in retaining American Indian and other minority students in the STEM pipeline.
- Funding to sustain projects over long periods of time are better than short-term funding, because desired changes in student motivation and performance cannot always be expected to occur within a one- or two-year timeframe.
- When the applied aspects of educational content are emphasized, students learn better. For example, showing students the practical applications of geoscience to land and water preservation interests the students more than simply lecturing on theory or scientific principles.
- Although "Native American" is a convenient category for grouping, there is wide diversity between and among American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders. Each group possesses different cultures and learning styles.

Native Americans Symposium Recommendations

A number of recommendations emerged from the mini-symposium discussions which were presented to the Committee for further review before being submitted to the NSF for consideration and action.[53]

1. Better serve Native Americans by expanding and fine-tuning existing NSF programs.

- Provide significant resources over sustained time frames (i.e., longer term grants) for TCU and other institutions serving Native American/Alaska Native/Native Hawaiian institutions.
- Build on the success of the now-defunct NSF *Rural Systemic Initiative* and explore its replication.

2. Work outside existing NSF programs to serve Native Americans.

- Encourage all NSF directorates to work with organizations, such as the American Indian Higher Education Consortium (AIHEC), to disseminate information to TCU, conduct workshops and meetings for TCU STEM faculty, and ensure that programs and technical assistance include TCU and other institutions serving Native American/Alaska Native/Native Hawaiian institutions.
- Work with and through professional societies and organizations such as AIHEC, the American Indian Science and Engineering Society (AISES), and the Society for the Advancement of Chicanos/Latinos and Native Americans in Science (SACNAS), to serve Native Americans; and support the formation and sustenance of AISES and SACNAS chapters at universities and TCU.

[53] *Minutes of CEOSE October 30-31, 2008 Meeting, p. 5.*

- Replicate successful projects (e.g., Howard Hughes Medical Institute's [HHMI] Science Education Alliance [SEA] at TCU, the Sloan program at the University of Arizona, and other successful programs at colleges that serve Native American students).

- Develop distance-learning mechanisms to enable scientists to appropriately assist remote TCU.

3. Perform research and evaluations to provide a better understanding of Native American education and social issues.

- Develop evaluation capacities of more Native Americans who can evaluate NSF projects, e.g., professional development in and the use of the Indigenous Framework for STEM Evaluation (developed with NSF funding), and other effective techniques.

Examples of research issues that might be considered are as follows:

- Examine the impacts of financial assistance (scholarships, fellowships and research funding), or lack thereof, on Native American performance and persistence in STEM fields.

- Identify elements that are effective in producing successful Native American education programs and disseminate them to the Native American and broader STEM communities.

- Study the concept of achievement and the impact across generations of severe cultural and societal events/histories, e.g. genocide, sustained denial of human rights, oppression, denial of education, legal punishment for seeking education, and roadblocks to the practice of cultural traditions and accomplishments in the broader society. This is intended to address "multi-generational grief."

- Examine social and psychological impacts on Native American youth who seek STEM training and those factors that ameliorate their alienation from their communities.

- Study the issue of data collection on the small Native American population, including communicating with tribes to obtain their interests and concerns about the release of annual data about them.

4. Improve grant writing and NSF review processes.

- Find ways to assist development and follow through of proposals for those TCU and institutions serving Native Americans, Alaska Natives, and Native Hawaiian that have demonstrated program implementation capabilities but who lack experience and personnel to respond to NSF announcements or knowledge about NSF procedures and requirements. Such assistance might be provided through an added or supplemental component to a grant.

- Include non-academics (program managers, parents, elders) in the development of new NSF programs and on program panels of interest to Native Americans.

- Increase the number of Native American reviewers.

OTHER KEY CEOSE ACTIVITIES

During the 2007-2008 biennium, the Committee on Equal Opportunities in Science and Engineering was also engaged in several other key activities, which are summarized as follows:

- Dr. Germán Núñez proposed that the broader impacts criterion of NSF's merit review criteria be revised so as to require principal investigators who submit proposals to NSF to address how their projects would help to increase or improve participation by members of underrepresented groups in STEM. As the broader impacts criterion is currently written, proposers do not have to address broadening participation and can still have their proposals approved for funding by NSF.[54] The proposed revision of the broader impacts criterion was subsequently refined by the Committee and submitted to the NSF director for consideration by the National Science Board, the Foundation's policy-making body.[55]

- CEOSE members Dr. Samuel L. Myers Jr., Dr. Beverly Karplus Hartline, Dr. Germán Núñez, and Professor Ashok Agrawal participated on a panel, "Lessons Learned: Broadening Federal Participation Efforts,"

[54] *Minutes of CEOSE June 5-6, 2007 Meeting, p. 4*
[55] *Ibid.*

Learned: Broadening Federal Participation Efforts," at the American Association for the Advancement of Science Conference in San Francisco on February 17, 2007. The Committee's Executive Liaison, Dr. Margaret E.M. Tolbert, organized and moderated the panel. The discussions included a synthesis of findings on the role of community colleges in increasing representation of women and underrepresented minorities in the STEM workforce, institutional transformation activities in academia, and ethnic/racial diversity on NSF's review panels.[56]

- As part of CEOSE's effort to "get the word out" about the importance of broadening participation, committee members Dr. Beverly Karplus Hartline and Dr. Muriel Poston co-authored the opening chapter of *Broadening Participation in Undergraduate Research: Fostering Excellence and Enhancing the Impact*—a new book published by the Undergraduate Research Council. The chapter, entitled "The Mandate for Broadening Participation: Developing the Best Minds and Solutions," underscores that increasing the inclusion of underrepresented groups in STEM is absolutely vital to the health, innovativeness, and the future global competitiveness of America's science and engineering workforce. The authors emphasize two essential and complementary mandates for broadening participation: (1) broader perspectives are essential for progress, and (2) fairness of opportunity.[57]

- Finally, CEOSE played a pivotal role in urging NSF to initiate a comprehensive review, understanding, and codification of its broadening participation efforts throughout the Foundation. NSF formed a Broadening Participation Working Group, headed by Dr. Victor Santiago of EHR and Dr. Celeste Rohlfing of MPS, which gathered input from staff, CEOSE, and individuals in the external STEM community. In August 2008, the Working Group produced an action plan including recommendations to improve Foundation policies and programs aimed at expanding access to, and career development opportunities in, STEM for underrepresented groups.

Members of CEOSE were very pleased that the action plan contained several recommendations that were previously made by the Committee, e.g., the need to increase the diversity and accountability of the Foundation's proposals review panels as well as advisory committees; and the need for more rigorous evaluations of the impact of the agency's broadening participation interventions.[58]

Concurrent with the work of this NSF Working Group, CEOSE formed an *Ad Hoc* Subcommittee on Broadening Participation to stay abreast of and provide input to the discussions and plans of the Working Group.

TRACKING OUTCOMES OF 2005-2006 CEOSE RECOMMENDATIONS TO NSF

In its 2005-2006 Biennial Report to Congress, CEOSE made some major recommendations for NSF to consider in moving forward with the Foundation's broadening participation agenda.[59] Summarized in this section are the outcomes to date of these recommendations:

Recommendation 1. NSF should expand its systematic and objective evaluations to assess, understand, and report the effectiveness and impact of its programs and policies on broadening participation.

Status: NSF incorporated this recommendation into the action plan developed by the Foundation's Working Group on Broadening Participation.[60]

Some of the programs included within NSF's broadening participation portfolio now emphasize in their

[56] *Minutes of CEOSE February 1-2, 2007 Meeting, p. 8.*

[57] *Beverly Karplus Hartline and Muriel Poston, The Mandate for Broadening Participation: Developing the Best Minds and Solutions. In Mary K. Boyd and Jodi L. Wesemann, Eds. Broadening Participation in Undergraduate Research: Fostering Excellence and Enhancing the Impact. Undergraduate Research Council, 2008, pp. 13-22.*

[58] *Minutes of CEOSE october 16-17, 2007 Meeting, pp. 8-9.*

[59] *2005-2006 Biennial Report to Congress of the Committee on Equal Opportunities in Science and Engineering, 2007, p. 28.*

[60] *Broadening Participation at the National Science Foundation. A Framework for Action, August 2008.*

solicitations the requirement for methodologically sound evaluations, e.g., LSAMP, AGEP, and BPC.

The Education and Human Resources Directorate, where most of the Foundation's broadening participation programs reside, continued to evaluate program outcomes with sound multi-method evaluation approaches.

According to the FY 2008 GPRA Report, however, there are still insufficient data provided to assess fully the outcomes and broader impacts of some of the broadening participation initiatives.[61] NSF continues to address this issue of improving evaluation data.

Recommendation 2. NSF should 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.

Status: As noted in Chapter 2, the Social, Behavioral, and Economic Sciences Directorate was in the process of developing a pilot initiative to formulate the theoretical structure and methodological tools for the "science of broadening participation." According to SBE's Assistant Director Dr. David Lightfoot, monies have yet to be designated for this initiative.[62]

Recommendation 3. NSF should continue to design and employ new policy levers that focus the attention of principal investigators and their institutions on diversity aspects of the broader impacts criterion, on embedding diversity goals in their research, and on designing and implementing sustainable institutional change that helps STEM become more inviting and supportive of women, underrepresented minorities, and persons with disabilities at all levels.

Status: An existing policy lever designed by NSF to further promote the importance of broadening participation was re-emphasized in the Foundation's latest version of its Grant Proposal Guide. Effective January 5, 2009, all proposals are required to integrate diversity into programs, projects, and other activities supported by NSF.

A preliminary internal analysis of NSF's proposal reviews between 2004 and 2007 revealed that the definition and significance of the broader impacts criterion of the Foundation's merit review criteria is not well understood by panel reviewers, and that, in many instances, their reviews lack detail about how a project meets or fails to meet the broader impacts criterion.[63] These findings clearly showed a need for further NSF guidance for reviewers as well as PIs about the importance of and a template for the broader impacts criterion, of which broader participation is a part.

Recommendation 4. To ensure that broadening participation is not lost among the many possible broader impacts encouraged by the Foundation, NSF should 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.

Status: The recommendation was incorporated into the Foundation's broadening participation action plan.

Recommendation 5. To engage and advance more American Indians in STEM, NSF should enhance research capacity and research opportunities at TCU, for example, by (1) supporting more faculty exchanges and innovative distance-education and research technologies, especially collaborations with research institutions; and helping TCU and their faculty to become competitive at proposal writing and more aware of grant opportunities.

[61] *Spencer, David B. and Dawes, Sharon, Report of the Advisory Committee for GPRA Performance Assessment FY 2008, July 31,2008, pp. 18-19.*
[62] *Statement made by Dr. Lightfoot at the February 20, 2009 CEOSE meeting.*
[63] *Max Bronstein, Analysis of Committee of Visitors (COV) Reports: 2004-2007, NSF Office of the Director, December 2007.*

Status: Through the Education and Human Resources Directorate's TCUP program, several effective projects have been funded that focus on increasing the numbers of undergraduate and graduate American Indian students in STEM fields. However, no information was available to CEOSE on projects that specifically focus on faculty exchange initiatives involving Tribal Colleges and Universities and majority academic institutions.

Recommendation 6. NSF should implement specific programs at community colleges that will result in an increased percentage of students pursuing STEM programs.

Status: Community colleges are included as eligible institutions to apply for grants within many of the Foundation's broadening participation programs, particularly programs targeting Minority Serving Institutions. Currently, for example, the Education and Human Resources Directorate funds a total of 165 community colleges in the ATE, TCUP, and STEP programs. The Foundation's latest effort is the *Small Business Innovation Research and Small Business Technology Transfer Supplemental Funding Program for Community College Research Teams.* This program encourages partnerships between community colleges and the small business community to form research teams.

Recommendation 7. An evaluation should be made of NSF programs and activities designed for Minority Serving Institutions (MSI), in order to recommend best practices to strengthen MSI-related programs.

Status: The Education and Human Resources Directorate conducts ongoing evaluations of its Minority Serving Institution programs.

Recommendation 8. NSF should provide a cross-directorate process to share best practices and drive continuous improvement within NSF to broaden participation of women, underrepresented minorities, and persons with disabilities.

Status: On an informal basis, the staffs of directorates that jointly fund or manage broadening participation programs communicate about best practices of these programs. But, there was no information available to CEOSE on any systematic cross-directorate mechanism for reviewing, discussing, and applying best practices to new or existing broadening participation programs.

Recommendation 9. NSF should fund research to understand institutional transformation aimed at broadening participation in STEM. Among other objectives, this research should determine if there is a common framework, set of practices, or sequence for successful transformation.

Status: The Foundation requires proposers for ADVANCE grants to include research that can contribute to the knowledge base for institutional transformation. Given the importance of institutional culture and practices in facilitating or inhibiting persons from underrepresented groups—other than women—from entering and advancing in STEM professions, NSF should also require that institutional transformation research be conducted as part of all of its broadening participation grants, i.e., including those that target minorities and persons with disabilities.

CEOSE will continue to monitor the outcome of its prior recommendations to NSF, and will report its findings in subsequent biennial reports.

4 Recommendations of 2007-2008 and Future Plans

Some significant progress was made by the National Science Foundation during 2007 and 2008 in broadening access to STEM education and career opportunities for women, underrepresented minorities, and persons with disabilities. But as the findings presented in this report show, more work needs to be done. Based on NSF's own research, NSF needs to provide more guidance to principal investigators, institutions, and proposal reviewers on the definition and importance of broadening participation. More research and effective programs are needed to increase the current marginal growth in doctorate-holding minorities in STEM. Greater attention is needed to make sure persons with disabilities are provided with access to assistive technologies to facilitate their education and career advancement in all STEM fields. Increased and longer-term funding opportunities targeting partnerships between TCU and research institutions are needed to further enhance TCU faculty. More graduate fellowship opportunities are needed for all students, but minority graduate students in particular. More financial investments in research and strategic interventions are needed to identify and address issues underlying the slowly closing gaps between White and minority secondary school students in math and science. This may require long-term collaborations between NSF and such agencies as the U.S. Department of Education. Other opportunities aimed at expanding STEM education and training programs for underrepresented groups can be achieved through further partnerships between Federal agencies with STEM-related missions. CEOSE initiated dialogue with these agencies on inter-agency collaborations; and NSF needs to follow up by taking a leadership role in fostering more systemic inter-agency activities.

NSF is to be commended for its continuing efforts in institutional transformation through the *ADVANCE* and *CREST* programs, but further receptivity and support for underrepresented groups on the part of mainstream academic institutions will only come about through more and sustained institutional transformation initiatives that target all demographic groups. Institutional transformation needs to be embedded in all of the Foundation's programs with built-in incentives to encourage institutional change.

2007-2008 CEOSE RECOMMENDATIONS

With the foregone considerations as a backdrop, CEOSE offered several recommendations during 2007-2008 to the National Science Foundation:

1. NSF should submit to the National Science Board for its consideration CEOSE's proposal to require that all NSF grant applicants must address, under the broader impacts criterion, the subject of broadening participation in their proposals.

2. NSF should take the lead in proposing that all Federal STEM-related agencies have a "CEOSE-type" committee with advisory responsibilities for broadening participation.

3. NSF should enhance interactions with selected Federal agencies to enable and promote the sharing of ideas and information, particularly those on best practices with the objective of increasing the access of women, underrepresented minorities, and persons with disabilities to science and engineering fields funded by the Foundation.

4. NSF should continue efforts to rapidly increase the number of graduate fellowship awards to persons from underrepresented groups in STEM.

5. NSF should consider conducting a comprehensive review of impact evaluation findings on its broadening participation programs, and use the review to determine and document what works and what does not.

6. NSF should continue to support programs that address institutional transformation in academia and industry, to increase education and career advancement opportunities for underrepresented groups.

Recommendations from Symposia:

To follow also are recommendations from the CEOSE-sponsored symposia on (1) institutions that serve persons with disabilities and (2) broadening participation of Native Americans in STEM. More detail on these recommendations can be found in Chapter 3, pages 31-36.

1. Institutions such as Gallaudet, NTID, Landmark College, and maybe others should have a designation similar to Minority Serving Institutions, such that they can benefit from transition programs and partnerships with majority institutions on large research initiatives.

2. NSF-sponsored scholarships, fellowships, and research internships should be targeted to support STEM students with disabilities.

3. The *Facilitation Awards for Scientists and En-gineers with Disabilities* (FASED) should be expanded to include all STEM graduate students and faculty who are disabled and want to attend conferences or workshops. This could be accomplished through the SGER program or the Regional Alliances (RADs).

4. Data related to disability should be collected on a regular basis: (a) number of successful and unsuccessful disabled PIs, and (b) number of disabled panelists, reviewers, COV members, and advisory committee members.

5. Funding for programs that help increase the number and success of students and faculty with disabilities in STEM fields should be increased: (a) Regional Alliances. and (b) National Alliances based on discipline and/or disability.

6. Research in technology for persons with disabilities should be strengthened by making sure projects are aligned with the actual needs of persons with disabilities.

7. Better serve Native Americans by expanding and fine-tuning existing NSF programs.

8. Work outside existing NSF programs to serve Native Americans.

9. Perform research and evaluations to provide a better understanding of Native American education and social issues.

CEOSE PLANS FOR 2009-2010

CEOSE is in the process of updating its strategic plan with a careful eye on NSF priorities and national policy and legislation, such as the America COMPETES Act. Also, particular issues addressed in the 2007-2008 biennium demand further attention. With these drivers, CEOSE plans to focus on a number of areas in 2009-2010 that are critical to its mission, which include:

1. Finalize CEOSE's strategic and implementation plan for 2009-2013, including performance measures for the Committee's progress in carrying out its Congressional mandate.

2. Enhance interactions with selected Federal agencies to enable and promote the sharing of ideas and information, particularly those on best practices with the objective of increasing the access for women, underrepresented minorities, and persons with disabilities to STEM education, research, and employment opportunities.

3. Continue interactions with NSF's senior managers—including the director, deputy director, officials in the research and education directorates, scientific and engineering organizations, and the community, in order to better understand the challenges, commonalities, and differences *vis-à-vis* broadening participation faced by the diverse science and engineering fields funded by the Foundation.

4. Host a symposium on research and evaluation of broadening participation programs, so that a better understanding can be gained as to what and how NSF programs work and for which underrepresented groups.

5. Study and discuss challenges encountered by women of color with the objective of better understanding their situations and identifying solutions to their problems in accessing STEM education and employment opportunities, so that appropriate recommendations can be made to NSF. Also, host a symposium on women of color in STEM.

6. Study and discuss Minority Serving Institutions, particularly TCU, HSI, and HBCU with the objective of recommending to NSF strategies to enhance and strengthen these institutions.

7. Finally, continue to study, discuss, and promote institutional transformation as a critical element in the Foundation's broadening participation efforts and diversity initiatives.

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Executive Liaison
Dr. Margaret E. M. Tolbert
Senior Advisor and
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National Science Foundation,
Arlington, VA
Term: 09/02 to present

APPENDIX SURVEY METHODOLOGY

During the winter of 2008-2009, the CEOSE consultant, Dr. Walter V. Collier, conducted in-person and telephone interviews with staff representatives from each of NSF's directorates and major program offices. Staff representatives were designated by assistant directors or program directors. The interviews were arranged in cooperation with the Office of Integrative Activities of NSF. The interviews were guided by the following questionnaire.

Interview Questionnaire

1. Does your directorate (or divisions within) have a broadening participation plan(s)? (Explain)

1a. Does the plan target diversity among grant participants as well as panel reviewers? (Explain)

2. Is broadening participation an explicit requirement in your directorate's program solicitations? (Explain)

3. What broadening participation programs or other initiatives did your directorate (or divisions within) support during FY 2007 and FY 2008? Which groups (i.e., women, underrepresented minorities, or persons with disabilities), institutions (i.e., graduate school, undergraduate school, community colleges, or K-12), or geographic locations (i.e., urban or rural areas) were targeted by these programs or other initiatives?

3a. Does your directorate (or divisions within) have programs or initiatives related to enterprise (or institutional) transformation in terms of broadening participation?

4. How much money was allocated for each of these programs or other initiatives in FY 2007 and in FY 2008?

5. Which of these programs or other initiatives have been evaluated, thus far? And by whom?

6. Did any of these evaluations focus on the impact of the programs or initiatives?

6a. Which programs have an impact on STEM pathways taken by underrepresented groups?

7. Would you consider these program/project impact evaluations to be rigorous?

8. Does your directorate partner with other directorates in broadening participation? And do the divisions within your directorate partner with one another in broadening participation? What about partnering with other Federal agencies in broadening participation?

9. What would you say are some major challenges in your field or community to broadening participation for traditionally underrepresented groups?

10. What would you say are some best practices or particularly effective strategies that your directorate has used for broadening participation?

11. Is your directorate (or divisions within) planning any new programs or other initiatives for FY 2009 or FY 2010 to broaden participation? If so, for which particular demographic groups, institutions, or geographic locations?

Group-specific Questions

1. What, if anything, did your directorate do to increase for persons with disabilities their access to or involvement in scholarship, fellowship or research internship programs during FY 2007 and FY 2008? What specific programs were involved?

2. What, if anything, did your directorate do to increase for Native Americans their access to or involvement in scholarship, fellowship or research internship programs during FY 2007 and FY 2008? What specific programs were involved?

3. Are your technology research programs aligned with the needs of persons with disabilities?

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