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ABSTRACT

This is the fourth report to the Congress of this committee; formerly known as the Committee on Equal Opportunities in Science and Technology. This report summarizes work accomplished since the April, 1986 report. The report contains recommendations for action to ensure the continued and expanded participation of women, minorities and the handicapped in science and engineering fields. Emphasis is placed on a comprehensive approach to the participation of underrepresented minorities, on specific intervention strategies for girls and women at key points along the educational pipeline, and on accessibility for persons with disabilities to scientific meetings. It is suggested that existing programs that have been demonstrated to work through replication or expansion of exemplary projects be encouraged. Areas to be explored by the Committee in the near future are identified. This document includes an executive summary with recommendations, discussions of the national context and the status of equal opportunity in the United States, and subcommittee reports. (CW)

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FOURTH REPORT TO THE CONGRESS

OF THE

COMMITTEE ON EQUAL OPPORTUNITIES IN

SCIENCE AND ENGINEERING

APRIL 1989

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April 1989

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PREFACE

This is the fourth report to the Congress of the Committee on Equal Opportunities in Science and Engineering (CEOSE), formerly known as the Committee on Equal Opportunities in Science and Technology. The Committee has three subcommittees:

Subcommittee on Minorities chaired by:
Dr. Mario J. Gonzalez, University of Texas at Austin
Subcommittee on Women chaired by:
Dr. Sally Wood, University of Santa Clara
Subcommittee on Persons with Disabilities chaired by:
Dr. Kimiko O. Bowman, Oak Ridge National Laboratory

At the suggestion of the Director Erich Bloch of the National Science Foundation, the Committee will, beginning with this Report, issue its reports to the Congress biennially. At his suggestion, the Committee has also reduced the number of its meetings from four to three per year and has increased the length of each meeting to two and a half days from two days. We have found these changes to be satisfactory.

This Report highlights the Committee's work since our April 1986 Report to the Congress. In it, we acknowledge the spirit of cooperation now existing between the Committee and the Foundation as well as the Foundation's responsiveness to our recommendations. The Report contains recommendations for further action to ensure the continued and expanded participation of minorities, women, and persons with disabilities in science and engineering fields. Emphasis is placed on a comprehensive approach to the participation of underrepresented minorities, on specific intervention strategies for girls and women at key points along the educational pipeline, and on accessibility of persons with disabilities to scientific meetings. In all areas, however, we encourage supporting existing programs that have been demonstrated to work through the replication or scaling up of exemplary projects with established track records. Areas to be explored by the Committee in the near future are also identified.

The Committee wishes to strongly convey to the Congress that major barriers to the participation in science and engineering facing minorities, women, and persons with disabilities still exist. These barriers must be removed once and for all if we are to achieve equity and if we are to meet the Nation's need for well-qualified scientists and engineers with U.S. citizens. In our view, this cannot happen in the foreseeable future without a coordinated effort at the national and at the state and local levels. Nationally, there must be cooperation and coordination among the various science-oriented agencies and an overarching consensus about what needs to be done and who should do it. Greater leadership from higher education and from industry is essential, for example, through the formation of alliances with local school districts. Such alliances might focus on strengthening science and mathematics instruction and on improving the preparation of students for advanced study in quantitative fields as well as for the increasingly technical jobs in the workplace.

Shirley M. McBay, CEOSE Chair

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

The Committee on Equal Opportunities in Science and Engineering continues to execute its major responsibilities of advising the Director of the National Science Foundation on programs for "enhancing the participation and advancement of minorities, women, and physically handicapped persons in science and engineering fields." The Committee is pleased to report to the Congress that our relationship with the Foundation is a very healthy one, due in no small measure to the current leadership at the Foundation: Director Erich Bloch and Deputy Director John Moore. Further, Director Bloch's personal interest and attention to the issues of concern to CEOSE have signaled their importance to Foundation staff and have led to significant improvements during his tenure at the Foundation.

There is greater cooperation from Program staff and a genuine increase in interest in working with the Committee to address barriers at various points along the educational pipeline. Program staff have not only responded to our recommendations for change but they have come forward with recommendations of their own. With the Director's support, they have developed program guidelines in response to our recommendations for: a comprehensive approach to increasing the participation of minorities in science and engineering; a program to fund potential model projects (although our recommendation was to fund exemplary projects); and special fellowships for women in engineering. In keeping with our recommendations, they have made modifications in such programs as the Minority Fellowships Program and they have funded studies and projects we have recommended (for example, support of a workshop on disabled scientists and engineers, and a study to determine the persistence in mathematics, science, and engineering of high ability minority high school students who had previously indicated interest in pursuing such fields in college).

Initiatives originating from within the Foundation have included the development of new programs such as the Minority Research Centers of Excellence, Research Careers for Minority Scholars, and an initiative to improve the research infrastructure at predominantly minority institutions. The Foundation also took the initiative to combine several programs for women into a coherent and better coordinated Research Opportunities for Women Program. We applaud these efforts.

Other positive developments include the Director's decision to establish an internal committee to review the Foundation's efforts on behalf of the groups of concern to CEOSE. We are also encouraged by the Director's decision to reflect in his speeches around the country an increasing concern for the underparticipation in science and engineering of the groups of interest to CEOSE. His willingness to convene the Presidents of the universities that are the leading recipients of NSF funds to talk about what they can do to enhance the participation of underrepresented groups in science and engineering is one more example of follow-through on a CEOSE recommendation and is one that is already beginning to produce results.

In general, we are encouraged by the responsiveness of the Foundation to our recommendations; however, action needs to be taken on some CEOSE recommendations

and several of these are reflected in the summary recommendations below.

We remain concerned about the low representation of minorities and persons with disabilities among senior staff at the Foundation as well as on the more than 70 advisory committees to the Foundation. Of special concern is the absence of minorities on the National Science Board. While we recognize that the decisions for Board membership are made in the White House, we strongly urge the Director of the Foundation as well as the current Board Chair to signal to the President that they consider minority representation on the Board to be critical, not only for equity reasons but for the perspective that such individuals can bring to the solution of one of the country's most urgent problems: the need for well-trained scientists and engineers at a time when enrollment of minorities in college is decreasing (even though their representation among the college-age population is increasing).

While we are pleased with the work of the government-wide committee established in response to another CEOSE recommendation, the committee has not been asked to assume an advisory role for science-oriented agencies that we consider to be critical. In view of the positive developments that have occurred over the years at the National Science Foundation, we strongly urge the Congress to:

> **Establish a government-wide CEOSE with subcommittees that would have advisory responsibilities for other science-oriented agencies such as the Department of Defense, the Department of Energy, the National Aeronautics and Space Administration, and the National Institutes of Health.**

We are also asking the Congress to encourage the Foundation to take action on behalf of minorities, women, and persons with disabilities as summarized below as well as on other recommendations outlined in the various subcommittee reports appearing later in this document.

MAJOR RECOMMENDATIONS RELATED TO MINORITIES

1. **The severe shortage of minority science and mathematics teachers, and of minority science and engineering university faculty must be addressed.**

Nationally, there remains a critical shortage of quality mathematics and science teachers despite several recent strategies to alleviate this shortage. The situation is particularly acute among minority teachers. For example, only 3% of mathematics and 5% of science teachers in grades 10 through 12 are Black. Comparable figures for Hispanic teachers are 1% for both mathematics and science. This unfortunate situation exists at a time when the high school population is increasingly minority and the dropout rate for minority high school students is already in excess of 50% in many large school districts. Furthermore, at the four-year college and university levels, Blacks represented only 1.6% of the tenure-track doctoral scientists and engineers in 1985 while Hispanics constituted only 1.1% of this group. This deplorable situation deprives both

minority and non-minority students of the opportunity to study under minority science and engineering scholars, and it prevents the academy from benefitting from their scholarly contributions. To correct these shortages, the Foundation needs to encourage and support innovative approaches to solving these problems, including school/university collaborations that focus on the production of pre-college science and mathematics teachers as well as cooperative efforts involving several universities that address the dearth of minority science and engineering faculty.

2. **Minority college-bound seniors with SAT-Math scores of 550 and above and interest in studying mathematics, science and engineering (MSE) represent a special target of opportunity for significantly increasing the participation of minorities in these disciplines.**

In January 1989 the Educational Testing Service released a study entitled Persistence of High Ability Minority Students in Science which found that 61% of minority students with SAT M of 550 or above and indicating an intent to major in an MSE field were persisting in their pursuit of science careers two years after they took the SAT, a rate equal to or greater than their white counterparts. Given the underrepresentation of minorities in the science and engineering workforce, and among university science and engineering faculty in particular, this pool of approximately 5000 students annually represents a major target of opportunity. These high ability students should be singled out for special nurturing beginning with the pre-freshman summer and continuing through to the postdoctorate level.

3. **More funds are needed to support projects that take a comprehensive approach to increasing the participation of minorities in science and engineering.**

Projects that intervene early and that provide enriching and reinforcing mathematics and science experiences to minority youth along the educational pipeline have reported significant results in terms of college enrollment rates and of majoring in MSE fields among student participants. Such past success under the old Resource Centers for Science and Engineering led to the Foundation's establishment of the Comprehensive Regional Centers for Minorities. The proposal pressure in this new Program is well beyond the Program's ability to respond and a large number of highly meritorious proposals are not being supported due to lack of funds. Additional funds are needed to allow the Program to establish at least 5 new centers per year with priority given to sites near the 25 largest school districts, 23 of which are now predominantly minority.

4. **Exemplary minority-focused intervention projects need to be replicated.**

If we are serious about increasing minority participation in science and engineering, it is incredible that we do not invest more in what we already know works. Highly successful programs such as the Lawrence Hall of Science's Mathematics, Engineering, Science Achievement (MESA), Johns Hopkins Center for the Advancement of Academically Talented Youth (CTY), and Clark Atlanta University's Saturday Science Academy ought to be replicated around the country.

While it is important to continue to support innovative projects with the potential for becoming models, it is callous, given the deplorable state of education for minority youngsters, to not replicate programs that we know are already making a difference.

5. **A modest minority postdoctoral program should be created.**

In 1975, Blacks received one percent of the Nation's approximately 8150 postdoctoral appointments in science and engineering; in 1985, they received less than two percent (1.8%) of approximately 11,800 such appointments. Hispanics fared only slightly better receiving respectively 1.0% and 2.1% of these awards. Such appointments are critical to faculty appointments in some of the sciences and so we urge the establishment of a modest minority postdoctoral program (20-25 awards annually) to help ensure that minorities will be more competitive as potential faculty members.

6. **University/School/Industry Partnerships that focus on inner city schools should be encouraged and supported.**

Twenty three of the largest 25 school districts are now majority minority. The dropout rates for underrepresented minority students in these districts frequently exceed 50%. Universities located near one of these 23 districts should be encouraged to take the lead in establishing alliances or partnerships with the inner city schools in the nearby district and with local industry as a way of strengthening the curricular offerings and improving student preparation at the schools. More specifically, such partnerships should be encouraged to develop activities designed to: (a) strengthen the science and mathematics offerings at the schools; (b) improve the students' written and oral communications skills as well as their reasoning and problem-solving skills; and (c) show students the relationship between what they are studying in school and what they will need to succeed in college, in the workplace, and in society in general. The National Science Foundation should provide funds to support the science and mathematics activities within such targeted alliances with the university and local industry providing support for all other activities, including the communications component and activities in the workplace.

MAJOR RECOMMENDATIONS RELATED TO WOMEN

1. **Support summer programs targeted at girls who have completed the ninth or tenth grades and who have demonstrated talent in mathematics and science.**

This approach is recommended as a strategy for building upon earlier successful experiences of girls with mathematics and science. Such efforts may range from one to six weeks and may be residential in nature, depending upon whether a given project's target audience is local, regional, or national in scope. Experiences should be technical and may range from field trips, to laboratory experiences to design competitions, to course work in mathematics, science, and technical writing. This initiative is similar to the very successful MITE (Minority Introduction to Science) and MITES (Minority Introduction to Engineering and Science) Programs offered during the summer on university campuses around the country.

2. Place greater emphasis on providing undergraduate research opportunities for women students.

The opportunity to participate meaningfully in the activities of a research group should be available to all undergraduates interested in MSE fields as early as the first term of their sophomore year. Since most research groups are likely to consist predominantly of male faculty and male graduate students, a special effort is needed to: (a) encourage these groups to seek out women undergraduates and (b) encourage women undergraduates interested in science and engineering to identify and join such groups. These small research settings serve not only to reinforce science principles previously studied as well as "the scientific method" itself, but they also provide unique opportunities for undergraduates to share the excitement of scientific discovery and to interact informally with faculty outside the classroom. Such situations provide the first real opportunity for mentoring and encouraging women students to persist in the study of science or engineering. It should be noted that a similar emphasis is needed for minority undergraduates as well since research groups consistently have very few underrepresented minority undergraduate students. In either situation, special efforts are often necessary to encourage the inclusion of others who are different from the majority of a group's members.

3. Provide special fellowships to encourage women to pursue graduate study in an engineering field.

This recommendation is being made in direct response to concerns about the break in 1986 in the steady growth over the previous ten years in the number of baccalaureate engineering degrees attained by women. There are also indications of declining interest in engineering among entering freshman women that began in 1983. These two situations argue not only for intervention at the pre-college and undergraduate levels as called for in earlier recommendations, but also for a major signal that women are being encouraged to continue beyond the baccalaureate level. Special fellowships for women in engineering provide such a beacon.

MAJOR RECOMMENDATIONS RELATED TO PERSONS WITH DISABILITIES

1. Support efforts to make scientific meetings more accessible to persons who are physically, visually, or hearing impaired.

The Foundation as well as other science-oriented agencies should take special steps to ensure that scientific meetings supported by these agencies are accessible to persons with disabilities. Such efforts should include sending all agency grantees requesting support for meetings copies of the barrier-free brochure developed by the AAAS as well as a check-off list for insuring meeting accessibility that was developed by members of the CEOSE Subcommittee on Persons with Disabilities. Proposers should be able to request funds to insure meeting accessibility and the availability of such funds should be highlighted in agency guidelines. Support should be provided to train a national pool of scientific interpreters for the hearing impaired that would be available to professional societies and others holding scientific meetings.

2. **Place a greater emphasis within existing Foundation programs on involving students with disabilities.**

Our longer term recommendation is for the re-establishment of a modest program to encourage and facilitate the pursuit of science and engineering by students with disabilities who have such interests and talents. As an interim step, our recommendation is that greater emphasis be placed on involving students with disabilities within all of the existing programs at the Foundation that focus on Human Resource development.

3. **Establish a position within the Foundation where the major responsibility will be to encourage the participation and support in science and engineering of persons with disabilities.**

Experience over the years has shown that the interest in and subsequent participation of specific groups in Foundation programs is significantly enhanced if there are staff members, especially in highly visible positions, who have specific responsibilities for encouraging such involvement. These individuals work with Program Officers throughout the Foundation as well as with others external to the Foundation who are concerned with the participation of underrepresented groups in science and engineering. The appointment of such a person, for example, within the Director's Office or the Foundation's Equal Opportunity Office would send an internal as well as external signal that the Foundation is concerned with the participation in science and engineering of persons with disabilities.

4. **Encourage the submission of research proposals by scientists and engineers with disabilities and maintain emphasis on rehabilitation research on behalf of disabled persons.**

This recommendation stems from the very low percentage of NSF Principal Investigators who are persons with disabilities and from the recent decision to merge existing Foundation programs in engineering that have a biology component into one program. As a start, Program Officers should consider doing a special mailing of Program guidelines to scientists and engineers with disabilities who were identified in a recent AAAS publication. While the consolidation of biomedical and biotechnical engineering programs within the Engineering Directorate may the consequence of a sound administrative decision, more effort is needed to reassure the Public that there will not be a reduction in emphasis on research to aid persons with disabilities.

A NATIONAL CONTEXT

CHANGING DEMOGRAPHICS AND THEIR IMPLICATIONS

Among the trends predicted in the Hudson Institute's Report Workforce 2000 to influence the remaining years in this century are two with direct implications for the work of CEOSE:

- The workforce will grow slowly, becoming older, more female, and more disadvantaged
- The new jobs in service industries will demand much higher skill levels than the jobs of today

More specifically, the Report projects that between now and the year 2000, almost two-thirds of the new entrants into the workforce will be women. Non-whites will make up 29% of the new entrants during this period, twice their current share of the workforce. Further, the occupational mix is expected to change, with significant rates of growth in positions for natural, computer, and mathematical scientists (68%). The occupations of the future will require more education and the fastest growing jobs will require much higher mathematics, language, and reasoning capabilities than current jobs, while slowly-growing jobs will require less.

The Office of Technology Assessment (OTA) identified two trends in its Demographic Trends and the Scientific and Engineering Work Force that could affect the supply of scientists and engineers:

- A decline in the college-age population in the next decade
- An increase in the representation of Blacks, Hispanics, and Asian Americans among 18-24 year-olds

Between 1982 and 1995, the number of 18-24 year olds will decrease by 22% from 30 million to 24 million. This drop in the college age population could lead to a drop in college enrollment of 12 to 16 percent between now and 1995. Each year, for the past decade, about 300,000 students (30% of all graduating seniors) receive baccalaureate degrees in science and engineering. Each year since 1972, the number of science and engineering master's degrees awarded has been in the 53,500 to 56,500 range. According to the OTA, the number of science and engineering doctorates peaked at 19,000 in 1972 and has been fluctuating between 17,000 and 18,000 per year since 1976. These relatively constant degree production rates coupled with the decline in the college age population could significantly affect the supply of scientists and engineers if no action is taken.

Although the overall college-age population is projected to decline by 22%, the percentage of minorities, including Asian Americans, in this age cohort will increase from 20 to 27% by 1998. This situation presents a unique opportunity to invest in the education and training of minority youth, not only for equity reasons but to meet the likely shortfall in scientists and engineers. However, such an investment must be serious and long term for not only do American

Indians, Blacks, and Hispanics receive degrees in quantitative fields at less than half the rates of whites, but there has been a decline in the enrollment of Black students in college since 1978 and the college-going rates of other underrepresented minority groups have slowed. Inadequate academic preparation negatively affects not only participation rates in higher education but the selection of quantitative majors as well.

As noted, women will make up almost two-thirds of the new entrants into the workforce. Their participation in science and engineering is significantly affected by stereotypical career expectations and by their treatment in the workplace both individually and as a group. If we are to meet our national needs for scientists and engineers and to benefit in the workplace from the special sensitivities and perspectives that women bring to an even greater degree, then we must intervene in these two key areas.

THE MOST INFLUENTIAL FACTORS IN THE SELECTION OF SCIENCE AND ENGINEERING FIELDS AS MAJORS

The Office of Technology Assessment (OTA), in its 1988 report Educating Scientists and Engineers From Grade School to Grad School, lists the following factors as most important in the selection of a science or engineering major:

- Being in the academic track
- Taking the most demanding science and mathematics courses
- Race and Ethnicity -- Being white or Asian rather than Black or Hispanic
- Sex -- Male rather than female
- Family Socioeconomic Status -- Being able to afford college
- Parents -- Having a parent who is a scientist or engineer
- Early Research Participation
- Intrinsic Interest -- Finding science enjoyable
- Having a good, enthusiastic science teacher and/or guidance counselor
- Participation in an intervention program
- Being in a science-intensive school

Clearly, we are unable to do very much about some of these factors (e.g., race/ethnicity, sex, having a parent who is a scientist or an engineer, or family socio-economic status); however, we can intervene in fairly obvious ways in some of the other areas on behalf of minority youth, girls, and youngsters with disabilities. We can begin by making certain that parents, teachers, guidance counselors, and the youth themselves are made aware of these factors early in the educational pipeline.

THE CURRENT REALITY

Blacks represent approximately 12% of the population, 10% of the current labor force, and less than 3% of employed scientists and engineers. While they constitute about 9% of college freshmen, they earn approximately 5% of the baccalaureate degrees and less than 3% of the doctorates in science and engineering. They are more likely than whites to be scientists rather than engineers and they are most likely to be social scientists or computer

specialists. Black enrollment in higher education is in a current decline after years of steady growth. More specifically, Black enrollment in science and engineering has declined 19.5% since 1981. Furthermore, two-thirds of Blacks enrolled in higher education are female with many talented Black males turning to the military where educational, training, and advancement opportunities are more clearly defined and achievable without incurring significant debt. Eighty percent of Black students in higher education are at predominantly white institutions while almost 50% of them are in two-year institutions.

Hispanics constitute approximately 7% of the population, 6% of the current labor force, and about 2% of employed scientists and engineers. About 30% of the employed Hispanic scientists and engineers are Mexican American and 15% are Puerto Rican. Hispanic scientists and engineers are about evenly distributed between science and engineering, although within science they are somewhat more likely to be social scientists. Hispanics earn about 3% of baccalaureate degrees and 2% of the doctorates awarded in science and engineering fields. More than 55% of Hispanics are in two-year institutions.

American Indians are less than 1% of the population and their representation among scientists and engineers as in the labor force is also less than 1%. As with Hispanics, most American Indian students are in two-year institutions.

Women represent more than 50% of the population, almost 44% of the current labor force, and approximately 15% of employed scientists and engineers. More than 1 in 4 scientists is female compared to only 1 in 25 engineers. At the baccalaureate level, women receive 45% of degrees granted in science fields and 15% of those earned in engineering. More than two-thirds of these degrees are in the social or life sciences. At the graduate level, women earned 30% of all master's degrees and 26% of all doctorates awarded in science and engineering.

Looking more closely at pre-college preparation, we can see from the tables below the need to intervene as early as middle school in an attempt to influence the type and level of mathematics and science courses taken by Black and Hispanic students. Indeed, both tables strongly argue for intervention on behalf of girls and of all of the non-Asian student groups listed to increase their enrollment in introductory physics as well as in advanced courses in biology, chemistry, mathematics, and physics.

Percentage of 1982 High School Graduates Who Have Taken College Preparatory Mathematics Courses by Sex, and Race/Ethnicity

Subject	All	Males	Females	Asian	Black	Hispanic	White
Algebra I	63	61	65	65	53	54	66
Algebra II	31	31	31	44	22	19	34
Geometry	48	47	49	68	33	28	53
Trigonometry	7	9	6	16	4	5	8
Other adv. math.	13	14	13	30	5	7	15
Calculus	6	6	5	15	2	2	6

SOURCE: OTA: ELEMENTARY AND SECONDARY EDUCATION FOR SCIENCE AND ENGINEERING December 1986, Page 45.

Percentage of 1982 High School Graduates Who Have Taken College Preparatory Mathematics Courses by Sex, and Race/Ethnicity

Subject	All	Males	Females	Asian	Black	Hispanic	White
General Science	30	30	30	24	33	34	29
Basic biology	74	73	76	78	74	69	75
Adv. biology	8	7	9	13	6	5	9
Chemistry I	24	25	24	41	19	13	27
Adv. chemistry	4	5	3	8	2	2	4
Geology	14	15	13	9	11	12	15
Physics I	11	15	8	27	6	5	13
Adv. physics	1	2	1	5	1	1	2
Unified science	28	30	26	17	34	21	27

SOURCE: OTA: ELEMENTARY AND SECONDARY EDUCATION FOR SCIENCE AND ENGINEERING, December 1988, Page 45.

TARGETED PROGRAMS AT THE NATIONAL SCIENCE FOUNDATION

The Foundation has in place a number of programs on behalf of minorities and women and these all seem to be attracting proposals of high quality. Several of these programs in fact do not have sufficient funding to support all of the highly meritorious proposals that are received. Examples of such programs are provided in the Executive Summary and Recommendations section of this Report. We are pleased to report that the Foundation's Fiscal Year 1990 Budget reflects continued support for all of the existing programs as well as funds for establishing special fellowships for women in engineering.

CEOSE expressed concern about the coordination and cohesiveness of the various NSF efforts on behalf of minorities and women given that they are all located in several directorates. The Foundation is addressing such issues through its own internal committee as well as through a recent major review of the different programs.

As discussed elsewhere, the Foundation does not have specific programs for persons with disabilities beyond the Facilitation Awards to the Handicapped Program which supports the participation of persons with disabilities within existing NSF-funded projects. We are recommending specific actions to remedy this situation.

RECENT EFFORTS OF AND FUTURE DIRECTIONS FOR CEOSE

CEOSE has kept abreast about innovative projects and research related to the participation in science and engineering of minorities, women, and persons with disabilities through various reports, through presentations by the directors of such projects, as well as through serving as program and proposal reviewers. We have reviewed on a regular basis existing NSF programs and activities that focus on these underrepresented groups. Foundation staff have asked CEOSE members to review proposed guidelines for new initiatives as well as other Foundation publications focusing on these groups. We have requested and received the overall staff profile and affirmative action plans for the Foundation as well as information on the composition of the Foundation's various advisory committees. Our concerns regarding representation among the senior staff and on advisory committees are expressed elsewhere in this Report.

We have also made specific recommendations to the Foundation on several fronts ranging from establishing new programs to supporting special projects that would provide new information for the Committee and the Foundation's use. Recommendations that have been acted upon as well as those requiring action are discussed throughout this Report.

While CEOSE will continue to have its advisory role to the Foundation as its major priority and will continue to engage in activities as described above, it will also move in some new directions over the next year. More specifically, CEOSE will:

(1) Explore new ways to influence the establishment of CEOSE-like Committees at other science-oriented agencies

For example, we will meet with directors of targeted programs in other agencies.

(2) Address some issues at the pre-college level

For example, we will focus on the production of minority science and mathematics teachers, on issues related to tracking, and on the counseling of girls and minority males away from science and mathematics.

(3) Examine some issues at the University level:

For example, we will focus on the production of minority science and engineering faculty; the hiring and promotion in science and engineering of minorities, women, and persons with disabilities by colleges and universities; and on the climate on campus for faculty and students who are members of these groups.

REPORT OF THE SUBCOMMITTEE ON MINORITIES

INTRODUCTION

Data presented to the Subcommittee on Minorities since the Committee's April 1986 Report to the Congress show some progress has been made in the recruitment and retention of minorities in mathematics, science, and engineering (MSE), although we are very concerned about the recent downturn in Black enrollment in higher education. Whatever improvements have occurred are totally inadequate given the following trends: the increasing representation of minorities in the general and the college-age population; the widening gap between the supply and the demand for engineers at a time when the college-age population is declining and is expected to continue to decline for the foreseeable future; and the anticipated "wave" of college and university faculty retirements beginning in the 1990s.

According to one source (San Jose Mercury News, May 9, 1988), 500,000 new faculty in all disciplines will have to be hired in the next 25 years. Science and engineering will have an especially tough time merely replacing retiring faculty because of the very small number of high school students who eventually earn doctorates in these fields. According to a recent NSF study, for every 10,000 high school sophomores, only twenty will earn a Ph.D. in an MSE field. The number of minorities at the end of this pipeline is obviously much smaller. Clearly, this almost negligible number will not go far in helping to alleviate the retirement problem, the national need for scientists and engineers, or in meeting the increasing need for role models at a time when the minority population is growing rapidly.

A comprehensive approach to the participation of minorities in mathematics, science, and engineering is needed from the pre-college to the postdoctoral levels. The current condition of pre-college education for most minorities is abysmal and, in the absence of radical changes in the schools they attend or the creation of an alternative school system, it will be necessary in the foreseeable future to supplement the educational activities of the regular school day with after school science and mathematics enrichment programs beginning as early as the third grade. For students already in the pipeline, intervention at critical points such as middle school will be necessary to address the alarming dropout rates among minority students occurring as early as ninth grade. The replication of exemplary pre-college enrichment projects is needed to address the poor preparation in science and mathematics those who remain in school receive. Retention at every level is key and must involve higher education, the local community, and as well as the state and federal governments.

NSF'S RESPONSIVENESS TO MINORITY ISSUES

Programs. CEOSE expressed serious concern over the Foundation's decision to mainstream the Minority Research Initiation (MRI) program. Initial data provided by Foundation staff show some increase beyond the previous level of support provided before mainstreaming which is a sign that this may have been a good decision by the Foundation. A final assessment cannot be made until more data from NSF are available.

Other programs aimed at promoting individual and group research at minority institutions and at institutions with significant minority populations (e.g., RIMI--Research Improvement in Minority Institutions) continue to do well and in some cases have expanded, although the participation of minority women in these and in programs targeted for women is still low. A new program (RCMS--Research Careers for Minority Scholars) is directed "at increasing the numbers of minorities in NSF-supported areas of science and engineering, and is somewhat similar to the undergraduate component of the NIH Minority Access to Research Careers (MARC)" program. This program directly addresses the minority retention issue by giving highest priority to "projects that significantly enhance the participating student's chances of remaining in the science and engineering pipeline, and going on to a career in science and engineering."

The Minority Graduate Fellowships Program has been expanded by increasing the total number of fellowships available and by guaranteeing a fellowship to eligible minority students before they finish their undergraduate education. Another relatively new program--Minority Research Centers of Excellence (MRCE)--is designed to "address the continuing shortage of minority scientists and engineers needed to maintain U.S. preeminence in fundamental research."

A program with a great deal of promise is the Comprehensive Centers for Minorities that supports "the establishment of major, regional centers designed to increase minority presence in science and engineering. The projects are intended to be centered at colleges and universities with significant minority enrollments, both institutionally and in science and engineering..." This Program results from a CEOSE recommendation to re-establish the very effective, Congressionally-mandated Resource Centers for Science and Engineering Program that was lost with the demise of the Foundation's Science Education Directorate in the early 1980s.

In terms of program availability, we see the need for a special initiative to address the severe shortage of minority teachers and university faculty trained in mathematics, science, and engineering as well as the need for a modest postdoctoral program to enable minorities to become more competitive for faculty positions at the university level. With the establishment of such initiatives, mechanisms will be in place to address the preparation and retention issue that exist along the educational pipeline.

Internal Hiring Practices. The following observations were made in the April 1986 CEOSE Report to the Congress:

> "Low number of minorities among professional staff at the NSF was a cause of much discussion within the Subcommittee. During the reporting period there was a net loss of minority staff at the GS-15 level. This was particularly disturbing in view of the relationship that has been observed between the presence of minority program staff and evidence of sensitivity to the concerns of minority researchers and institutions among the programs. The Subcommittee also expressed concern about the level of participation by minorities on Advisory committees and panels and as peer reviewers at the Foundation."

Numerous discussions during the intervening years since the 1986 Report indicate that the overall problem of low minority representation on the upper levels of NSF staff and on advisory committees and panels continues. For example, as of September 30, 1988, there were only 5 minorities (1 Black, 1 Hispanic, 3 Asians; all males) out of 97 Senior Executive Staff. As of November 30, 1988 the Foundation had 72 advisory committees with a total membership of 1046. Only 58 (5.5%) of these were underrepresented minorities. Minority hiring practices at the Foundation for senior personnel and the representation of minorities on NSF advisory committees suggest that progress is slow; the total numbers in both areas are disappointingly small. Efforts by the Foundation to improve this situation must be intensified.

NEW INITIATIVES

In its advisory role to the Foundation, CEOSE has made a number of recommendations designed to address recurring problems, including some that were cited earlier:

1. Hire an American Indian to work out of the Director's office or out of the STIA directorate. CEOSE should establish an American Indian task force from within the Committee.

2. Increase the numbers and success of minority non-social science proposals.

3. Support initiatives to increase the number of minority faculty at the university level. In this regard, consider implementing a ten-year program at each of the ten leading institutional recipients of NSF funds to attract 25 of the institution's science and engineering doctoral recipients into university teaching per year. Each group of 25 should include at least 10 women and 5 underrepresented minority group members.

4. Establish a postdoctoral fellowship program for minorities that would award 20 to 25 fellowships annually.

5. Support the preparation of a paper on mentoring of minority (and women) graduate students and junior faculty that would be distributed to all NSF grantees.

6. Consider adding as a condition for the receipt of research grants, the requirement that minority (and women) undergraduate or graduate students be a part of the investigator's research group.

SUMMARY

A study of high ability minority students interested in MSE fields that CEOSE urged be carried out found that "when minority students have the opportunity to acquire the skills and interests required for successful study in MSE fields, they persist in their MSE study to a degree that is as high if not higher than

that of White students." At the same time, recent statistics indicate that minorities are going to college at a decreasing rate at a time when the absolute number of minority high school graduates is increasing. Hence, the identification of a potential pool of minority scientists and engineers may represent a lost opportunity if we do not intervene.

Programs that help minority students bridge the gap between high school and college, that intervene beginning with the pre-freshman summer and continuing through the postdoctoral level, and that require evidence of commitment to the participation of minorities in projects must be put in place if we are to mount a serious effort for increasing minority participation in science and engineering.

REPORT OF THE SUBCOMMITTEE ON WOMEN

PARTICIPATION OF WOMEN IN SCIENCE AND ENGINEERING

Recent Trends

Over the past ten years there has been dramatic progress in increasing the participation of women in science and engineering; however recent changes in these trends are a cause for serious concern. The representation of women in the science and engineering workforce increased steadily from the mid 1970's to the mid 1980's, but over the past few years the participation rate appears to be leveling off at an unacceptably low percentage. The diminished attractiveness of science and engineering as a career option, implied by this change, is of concern in several respects. Demographic analyses, for example, show that the percentage of new entrants into the workforce between now and the Year 2000 who are female will exceed the male new entrants almost two to one. Over that same period, the occupational mix will also be changing resulting in an increasing demand for scientists and engineers. In addition, it has been reported that, over the next 25 years, American colleges and universities will need a half-million new professors, with the major exodus beginning in the early 1990s. Thus, if participation in science and engineering remains significantly lower for women while they are representing the largest share of new entrants into the workforce, clearly the pool of available new technical talent will be woefully inadequate to meet the science and engineering staffing needs in industry and academia.

The National Science Foundation's January 1988 Report Women and Minorities in Science and Engineering documents various trends (for example, degree attainment, representation in the science and engineering workforce, and salaries) by gender during the period 1976-1986. Data presented for that eleven-year span reflect substantial gains by women as their employment in science and engineering increased an average of 13% per year while male science and engineering employment increased only 6% per year. Major numerical gains by women are reflected in the following table:

	1976		1984		1986	
	Men	Women	Men	Women	Men	Women
Sci.	781,300	178,200	1,343,300	438,100	1,586,700	599,600
Eng.	1,350,300	21,400	2,139,600	74,500	2,341,100	99,000

Source: Abstracted from Appendix Table 1, "Employed Scientists and Engineers by field and sex: 1976, 1984, and 1986", Women and Minorities in Science and Engineering, National Science Foundation, January 1988, Page 79.

As can be determined from the table, the participation rate of women increased from one out of 5 scientists in 1976 to one out of four in 1986, and from one out of 64 engineers to one out of 25 during this period. Despite these gains, women constituted only 15% of the science and engineering workforce in 1986 while at the same time representing 44% of the total workforce.

Corresponding increases occurred in the number of employed doctoral scientists and engineers. For example, in 1985 one of every six doctoral scientists (57,000 out of 334,500) was female, up from one of every ten (21,800 out of 213,500) in 1975. During that same period, women doctoral engineers increased more than seven-fold (from 200 to 1500), resulting in an increase in their participation rate from 1 in 212 to 1 in 44.

Potential Problems in Future Participation Rates

Extrapolation of the respective participation rates paints a rosy picture for women in science and a promising picture for women in engineering; however, recent changes in these trends indicate that the participation rates have either leveled or started to decrease. Although the number of women receiving baccalaureate degrees in engineering increased steadily from under 1000 in 1975 to over 11,000 in 1985, the numbers begin to fluctuate after that. Further, the percentage of freshman women majoring in engineering peaked in 1983 at 17% following a steady rise and has fluctuated since that year.

The leveling or reduction in participation rates threaten the gains made over the past decade, and portend a decrease in the pool of science and engineering talent available to meet the nation's needs. The factors affecting motivation and career choices are undoubtedly complex, however, it is critical that we identify and address factors which discourage women from continuing to choose a career path in science or engineering.

Participation Along the Pipeline

At the pre-college level, the results of the mathematics assessment component of the National Assessment of Educational Progress (NAEP) reflect gender differences at the middle school level while the results on the science assessment component show males outscoring females at the elementary school level. In high school, females take fewer years of mathematics and science and are not as likely to be enrolled in advanced courses in these subjects as are males. This difference in number and level of courses contributes to the differences in SAT mathematics scores of males and females.

Among college-bound seniors in 1985, 28% of women and 48% of men indicated an interest in studying a science or engineering field. However, female interest in science and engineering appears concentrated in the life and health sciences and less so in quantitatively-based fields such as physics, chemistry, and engineering. This apparent lack of interest in quantitative fields occurs despite the fact that at the undergraduate level, women are well represented in mathematics itself. Furthermore, once in college, women seem to have significantly less trouble than men completing a quantitative baccalaureate. More specifically, 42% of the women, as opposed to 30% of the men, who begin

college with a quantitative major emerge after four years with a baccalaureate degree in a quantitative field. The table below shows actual bachelor's degree recipients in science and engineering by gender in selected years:

	1975		1980		1985	
	Men	Women	Men	Women	Men	Women
Sci.	162,373	92,482	132,783	99,960	133,745	110,123
Eng.	39,205	860	53,226	6,014	66,555	11,316

Source: Abstracted from Appendix Table 47, "Science and Engineering Bachelor's Degree Recipients by Field and Sex, 1975-1985", Women and Minorities in Science and Engineering, National Science Foundation, January 1988, Page 197.

As noted in The Office of Technology Assessment's 1985 Technical Memorandum, Demographic Trends and the Scientific and Engineering Work Force, "After college, 1 out of every 20 women, as opposed to 1 out of every 9 men, who receive quantitative B.A.s goes on to complete a quantitative Ph.D." In spite of this, significant strides have been made in doctoral degree attainment by women in science and engineering fields, as reflected in the following table:

	1976		1981		1986	
	Men	Women	Men	Women	Men	Women
Sci.	12,103	2,927	11,181	3,924	10,735	4,681
Eng.	2,780	54	2,429	99	3,151	225

Source: Abstracted from Appendix Table 49, Science and Engineering Doctorate Recipients by Field and Sex, 1975-86", Women and Minorities in Science and Engineering, National Science Foundation, January 1988, Page 203.

Participation rates of women in mathematics, science, and engineering along the pipeline strongly argue for intervention as early as age 9 for science and age 13 for mathematics to ensure that girls continue their prior interest and achievement in the respective areas. Programs and research to remedy this discrepancy at the precollege level could have a dramatic impact on overall participation rates for women in science and engineering. Efforts designed to increase interest and to better prepare girls in science and mathematics at the elementary and middle school levels are essential if the numbers of professional women in science and engineering are to increase significantly. Funding targeted to support such programs is strongly recommended.

Intervention is also needed at the graduate level to help women persist through

the doctoral program, once they are enrolled. More stable financial support at the graduate level, increased opportunities for research assistantships, and greater clarity about the benefits to be derived from an advanced degree are needed.

Compensation and Recognition in the Workplace. Barriers to the advancement of women both in promotion and compensation also discourage women from entering or continuing in careers in science or engineering. Women's salary rates still continue to be lower than that of men even after controlling for field choice, qualifications, and experience. Although there is variation across fields, women's salaries are between 70% and 85% of men's salaries. This is a significant disincentive. Why should a woman put effort into a career path where obvious gender-based limitations exist, especially when other professional options may be much more attractive and potentially satisfying? Inequities in science and engineering salaries must be conspicuously eliminated in order to attract more women into these fields.

There are issues in academe in addition to salary differences. For example, in 1985, 63% of male scientists and engineers in four-year colleges and universities had tenure while only 37% of the corresponding group of females had tenure. That year, there were 107,500 male tenured faculty in these fields and only 11,800 female tenured faculty, thus decreasing the likelihood that women would be chosen for senior, academic administrative positions.

Women are also less visible in decision-making roles in industry and government. In 1986, for example, more than 9% of all employed men scientists and engineers reported their primary work activity as the management of research and development in comparison with only 4.5 % of employed women scientists and engineers were in such positions. Such discrepancies only serve to reinforce the perception that significant barriers to advancement persist. A major effort must be made to make experienced women more visible to women entering the science and engineering workforce.

Participation of Minority Women in Science and Engineering

There is clear variation in the participation rates of women in science and engineering along racial and ethnic lines. For example, in 1986 Black women accounted for 11% of employed women, but only 5% of employed women scientists. On the other hand, Asian women were only 2% of the employed women but accounted for 5% of all employed women scientists and engineers. There are field differences as well. For example, approximately 20% of the Asian women in the 1986 science and engineering workforce were engineers in comparison to 14% of white women. Efforts targeted specifically to minority women are needed as are programs for women that focus on quantitative fields.

PROGRAMS FOR WOMEN AT THE NATIONAL SCIENCE FOUNDATION

Several programs of the National Science Foundation have been designed to increase the participation of women in research and in university teaching. The Visiting Professorship for Women (VPW) Program enables women faculty to spend

a year at a host university which offers new research opportunities. This program has the dual objectives of increasing research possibilities for women faculty and also of making women faculty more visible as role models and potential mentors.

The Research Opportunities for Women (ROW) Program provides assistance in three ways: research planning, entry level research, and career advancement. NSF decided to "mainstream" this program in Fiscal Year 1987 resulting in support that was more than double the amount allocated for ROW that year. More specifically, the Program began Fiscal Year 1987 with a floor of $2.45 million and ended with a recommended funding level of $5.45 million, with the difference provided by programs within the various directorates.

The VPW and ROW programs have been very successful in terms of attracting competitive proposals and of meeting the goals of the award recipients. The participation of racial and ethnic minority women in these programs is extremely disappointing and much work remains to be done by the Foundation.

With respect to the overall participation of women in programs within the Research Directorates of NSF, we note that women received 9.9% of the research awards but only 6.3% of research dollars.

REPORT OF THE SUBCOMMITTEE ON SCIENTISTS AND ENGINEERS WITH DISABILITIES

INTRODUCTION

The Subcommittee on Scientists and Engineers with Disabilities was formally created in July 1986 to consider the concerns of scientists and engineers with disabilities. It is the successor to the CEOSE Task Group on Disabled Scientists and Engineers established two years earlier. Issues of concern over the years to these two groups include: (1) science and engineering as viable career alternatives for students with disabilities, (2) physical accessibility to facilities, (3) accessibility of scientific meetings and materials; (4) use of laboratory equipment, and (5) physical safety. In addition, the Committee identified as a major problem the lack of accurate demographic data on people with disabilities. This lack of information affects the ability of the Foundation to establish programs to assist students or scientists and engineers with disabilities.

DEMOGRAPHICS ON SCIENTISTS AND ENGINEERS WITH DISABILITIES

Many people with disabilities do not identify themselves on surveys as being disabled, and consequently there is considerable uncertainty about the number of scientists and engineers with disabilities. The Foundation in its January 1988 report, Women and Minorities in Science and Engineering, states that "in 1986, about 94,000 scientists and engineers (about 2 percent of the total S/E population) reported a physical disability." The recently released interim report of the Federal Task Force on Women, Minorities, and the Handicapped in Science and Technology estimated that there are 36 million people of working age in the United States with some disability. Together these two estimates imply that scientists and engineers with disabilities represent only 0.26% of workers with disabilities, an extremely small percentage of the total.

In part to address this problem of inadequate demographic information, the Foundation funded a workshop organized by the American Association for the Advancement of Science (AAAS) and the American Statistical Association on the Demography of Scientists and Engineers with Disabilities. One of the findings of that workshop was that there are no federal agencies collecting data on the working disabled. In an effort to make scientists and engineers with disabilities more visible, the Foundation supported the preparation and publication by the AAAS of a directory listing approximately 950 such individuals. The directory, entitled Resource Directory of Scientists and Engineers with Disabilities, serves as a source of consultants, speakers, role models and peer reviewers, although it lists only a small fraction of the population of scientists and engineers with disabilities.

As an additional means of obtaining better data, the 1989 National Survey of Natural and Social Scientists and Engineers distributed by the NSF has been modified and we are also recommending to the Census Bureau that it collects data on employed persons with disabilities when the follow-up survey to the 1990 Census is conducted.

Programs at the National Science Foundation

The Foundation does not have a program targeted specifically for scientists or students with disabilities, with the exception of the Facilitation Awards for Handicapped (FAH) Scientists and Engineers Program. Awards through this program provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on a project that is funded by the NSF. To get an FAH award one must already be a recipient of a regular NSF research grant. At the urging of this Committee, a statement about FAH has appeared in each NSF program announcement since Fiscal Year 1987..

MAJOR ISSUES REQUIRING ATTENTION

- Accessibility -- The most serious problem for scientists, engineers and students with disabilities is that of accessibility all along the educational pipeline as well as in the work place. Physical and communication barriers exclude people with disabilities from many activities. The result has been that many intelligent and capable students with disabilities are discouraged or prevented from entering scientific and engineering careers. In addition, highly talented individuals who do achieve degrees in these fields frequently become mired in positions well below their abilities or they are forced out of professional involvement. Section 504 of The Rehabilitation Act of 1973 (passed in 1977 and amended in 1986) requires institutions receiving federal support to make their programs accessible to qualified people with disabilities. Some universities do not comply completely with this law and fail to make all areas of science and engineering programs fully accessible to all students. Also, there does not yet exist a comprehensive federal law that bars discrimination in industry towards people with disabilities. Many employers will not expend funds to make laboratories and offices accessible to disabled employees.

  Recommendation: We recommend that this law be amended to enforce its provisions and to require large employers, in particular federal agencies and their contractors, to set aside adequate funds in their annual budgets for improving accessibility for people with disabilities. If this recommendation were implemented, conditions would significantly improve.

- Barrier-free meetings -- Public Regulation 45-605 requires that activities receiving or benefiting from federal assistance be non-discriminatory. This means that scientific meetings supported in part or in total by NSF funds must be barrier-free. To help insure compliance with this legislation, all recipients of NSF funds must have clear information on how to conduct a barrier-free meeting for scientists and engineers with disabilities (mobility, hearing, sight impaired). The Foundation, as indeed is the case for each federal agency, is responsible for informing all of its grantees that they must comply with this law. This committee has prepared guidelines for use by the NSF in conducting barrier-free meetings. Moreover, NSF should play a leadership role in the removal of barriers that prevent many individuals with disabilities from contributing their talents and abilities to our nation's scientific and engineering

efforts.

Recommendations: (1) NSF should convene a meeting of representatives of professional scientific and engineering societies for the purpose of discussing the importance of barrier-free meetings to facilitate the participation of scientists and engineers. (2) NSF should institute a small grants program to assist in meeting additional costs that may result from making meetings barrier-free. (3) All NSF program guidelines should include statements about the availability of these funds and should contain a check-off list for use in planning barrier-free meetings. When support for meetings is requested from NSF, evaluation criteria for such proposals should include the extent to which the barrier-free issue is addressed. (4) To ensure meeting accessibility for deaf scientists, a national pool of scientific interpreters should be created. NSF should support the training of such interpreters.

- Education -- The Education for All Handicapped Children Act, Public Law 94-142, provides for services to educate children and youth with disabilities in the least restricted environment. Regular schools must accommodate the special needs of students with disabilities. However, there are no special provisions for pre-college students with disabilities to ensure that they receive the course work and accommodations that would allow them to choose to prepare for a career in a scientific or engineering field. Post-secondary students with disabilities, through the 504 regulations, receive support services as needed, but there is a lack of encouragement for students with disabilities to pursue science and engineering, and in many cases the laboratories are not accessible to all students. A special outreach program is clearly needed for gifted students with disabilities to pursue careers in science and engineering. These students are discouraged at all levels from pursuing science and engineering education. Examples include limited access to laboratories and laboratory equipment for mobility impaired persons and insufficient numbers of braille and recorded books in mathematics, science, and engineering for blind students.

  Recommendation: Existing science and engineering programs for women and minorities should be expanded to give special attention to students with disabilities.

- Higher Education -- Students with disabilities often have special expenses (for example, medical and rehabilitation costs, and the need for special equipment and housing), over and above those of other university students. These additional costs frequently discourage students with disabilities from pursuing advanced degrees. Therefore, fellowships that include funds to help cover these additional costs are needed to make it possible for talented students with disabilities to pursue doctoral study in science and engineering.

  Recommendation: The Foundation should develop a modest program, similar to the NSF Minority Fellowships Program, for students with disabilities that would provide additional support for the special needs of these students.

- Research Grants -- In 1987, the NSF awarded $1.4 billion to about 14,000 principal investigators. Among those 14,000 principal investigators, only 78, or about 0.55%, were disabled. Assuming that approximately two percent of all scientists and engineers are disabled as reported by NSF, the disabled are grossly underrepresented among the principal investigators. This is clear, even if these figures are not precise.

  Recommendation: The NSF should initiate a targeted research grant program for scientists and engineers with disabilities analogous to the programs for women and minorities.

- Development of Role Models -- Many hold the misconception that people with disabilities are disabled in all aspects. One way of addressing this problem is to increase the visibility of professors and research scientists who have disabilities and who are active in their chosen careers. In addition, NSF should lead the way in providing such role models by hiring persons with disabilities in senior level positions at the Foundation and by recommending such persons for membership on the National Science Board.

  Recommendations: (1) A scientist or engineer with a disability should be hired to work out of the Director's office of the NSF or out of the STIA directorate where several targeted programs are located. (2) A scientist or engineer with a disability should be appointed to the National Science Board.

- Travel Funds -- To maintain their professional competence, scientists and engineers must attend professional meetings and interact with their peers. But scientists and engineers with disabilities are less likely to be supported for travel because adequate facilities may not be available, special equipment or interpreters may be required, or other special requirements may result in extra expenses. Persons with disabilities often cannot take the cheapest transportation or stay in the most economical hotel room. They may need: business class air travel for long trips; special accommodations, such as a room with wheel chair access; special assistance with transportation; or someone to accompany them.
  Recommendation: A program should be initiated to support travel to meetings and conferences for scientist and engineers with disabilities and to provide funds to cover additional expenses associated with their travel.

SUMMARY

People with disabilities involved in or considering scientific and engineering careers face an intimidating array of problems, including physical and communication barriers, non-acceptance by their peers, and lack of encouragement and recognition. To achieve the Foundation's stated goal of developing the nation's human resources in the scientific and engineering fields, NSF should undertake more extensive and intensive efforts to increase participation of individuals with disabilities, including supporting bioengineering research on behalf of persons with disabilities. It should develop and implement appropriate

programs for people with disabilities at all levels, immediately, in spite of lacking accurate demographic data of people with disabilities. In addition to the direct benefits accruing from NSF programs for scientists and engineers with disabilities, indirect benefits can be expected as a result of NSF's leadership role in the scientific community and the example it sets for others.

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NSB-89-55

RESOLUTION APPROVED BY THE NATIONAL SCIENCE BOARD AT ITS 286TH MEETING ON MARCH 17, 1989 ON INTERNATIONAL COOPERATION OF GLOBAL ENVIRONMENTAL CHANGE RESEARCH

WHEREAS:

1. The global environment is indisputably changing, and some of the change is clearly man-made. Some of the changes are very threatening, and all of humanity is under the same threats. Global environmental change is becoming one of the most significant societal challenges of our time.

2. For the first time, we cannot only observe the global climate, but hope to understand it and make dependable predictions about it and human effects on it.

   There is currently a fortunate convergence that makes this hope possible:

   - a rapid maturing of the contributing sciences;
   - availability of radically more powerful tools: satellite sensors, instruments, computers, and associated methodologies; and
   - international cooperative institutions and structures.

3. Such a program of research will require unprecedented cooperation by the nations of the world, with each contributing resources, scientific understanding, and policy proposals.

THEREFORE, the National Science Foundation will seek to:

1. Increase and coordinate our own diverse research programs with internationally planned research programs.

2. Provide appropriate leadership to U.S. interagency coordination so as to develop a coherent program of national support for global environmental change research.

3. Work to establish effective mechanisms for planning the science agenda among the world's governments and international agencies.

4. Work toward full participation by the world's nations in the formulation, refining and implementation of the global research agenda.

5. Encourage the nations of the world to contribute resources and personnel to the global research agenda in measure and kind reflecting national capabilities.

6. Collaborate with all other nations in support of education programs focused on the research agenda.

7. Create educational opportunities to enhance full research participation by developing countries.

8. Work toward developing cooperative access to pertinent research facilities and research data in all nations and toward developing indigenous research activities relevant to the global environmental change program in all the participating nations.