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ABSTRACT

In this issue brief, a number of selected science and engineering concerns are discussed, along with initiatives that contain provisions to address these areas. These include the following: (1) precollege science and mathematics concerns such as teacher shortages, quality of science instruction, and the content of science courses; (2) mathematics education; (3) demographics and the science and engineering talent pool, (4) degree acquisition trends for minorities; (5) foreign-born national science and engineering students; (6) technical literacy of the U.S. population; and (7) role of federal policies in science and engineering education. Programs created by the National Science Foundation and the Department of Education's role through Title II of the Elementary and Secondary Education Act are discussed, and six brief summaries of federal legislation are provided. (KR)

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CRS Issue Brief

Science, Engineering, and Mathematics PreCollege and College Education

Updated June 18, 1991

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CONTENTS

Science, Engineering, and Mathematics Precollege and College Education

SUMMARY

An important aspect of U.S. efforts to improve economic competitiveness is the existence of a capable scientific and technological workforce. Considerable concern has been expressed about the future ability of the U.S. science and engineering base, however, to generate the technological advances needed to maintain economic growth. At present, the U.S. technological position may be threatened by possible shortages of scientists and engineers, and perhaps even more importantly, of the broader technical workforce. Charges are being made that many students complete high school scientifically and technologically illiterate. Even those students pursuing nonscientific and nonmathematical specialties are likely to require basic knowledge of scientific and technological applications for effective participation in the workforce.

Several published reports have found that there appear to be important shortcomings in science and mathematics education and achievement of U.S. students. According to these reports, not only are U.S. students less well educated than their predecessors, they are also less well trained in science and mathematics than are their peers in other industrialized countries. The decreasing student enrollments in science courses, declining achievement test scores, continuing decline in the number of high quality science and mathematics teachers, and the problems existing in the curriculum area, as noted by these reports, have directed considerable attention to precollege science and math instruction.

The number of college-age people in the United States peaked in 1983 and is expected to decline for at least several years. Of those now attending college, fewer are seeking careers in science and related fields. Coupled with that, the percentage of college science graduates seeking Ph.D.s has also declined.

The underrepresentation of minorities in science and engineering raises important concerns about both equal opportunity and the future capacity of the Nation to produce an adequate number of scientists and engineers for all purposes. Demographic data show a workforce increasingly comprised of minorities, groups that have been historically underrepresented in the sciences. At issue is, whether enough minorities can be encouraged to pursue degrees in science and engineering disciplines.

In this issue brief, a number of selected science and engineering concerns are discussed, along with initiatives that contain provisions to address these areas. These include: (1) precollege science and mathematics concerns; (2) mathematics education; (3) demographics and the science and engineering talent pool; (4) degree acquisition trends for minorities; (5) foreign-born national science and engineering students; (6) technical literacy of the U.S. population; and (7) role of Federal policies in science and engineering education.

ISSUE DEFINITION

Concern has been expressed about the status of the U.S. science and engineering base -- specifically the human talent, knowledge, and infrastructure that generates innovations and undergirds technological advances to achieve national objectives. Some analyses have shown that by 1995 there may be a significant shortage in the entry level science and engineering labor pool, and that scientific and technical fields could be significantly affected. Demographic data show a future with proportionately fewer young people and an increasingly larger workforce comprised of minorities and the economically disadvantaged. These groups, on which the economy must increasingly rely, have been historically underrepresented in science and engineering and related fields. The added dimension of a projected shortage in qualified science and mathematics instructors at the precollege and undergraduate levels could have serious consequences for the Nation's scientific and technological literacy and, therefore, on our capabilities to compete economically with other industrialized countries. Survey results also indicate that many science and mathematics teachers report they have inadequate subject background due to teaching out of field. The potential problems are of special concern to Congress, and have led to numerous proposals to strengthen precollege and college science, mathematics, and engineering education.

BACKGROUND AND ANALYSIS

For more than 25 years, the United States has experienced a lower rate of productivity growth in manufacturing than Japan, West Germany, the United Kingdom, and other European countries. In the past few years, U.S. students (precollege) have performed more poorly than students from Japan, West Germany, France, and the United Kingdom in virtually every major assessment of science and mathematics educational achievement. The National Science Foundation (NSF) found that, on the average, U.S. elementary schools devote approximately 15 minutes a day to science. A survey conducted by the National Science Teachers Association (NSTA) revealed that in 1986, of the Nation's 24,000 high schools, 29.6% offered no physics courses, 17.5% offered no chemistry courses, and approximately 8% offered no courses in biology. The survey also indicated that a disproportionate number of minorities were less prepared in the sciences in terms of skills and knowledge as a result of ineffective preparation because of disparate educational experiences compared to non-minorities.

Additional surveys have found that many teachers at the precollege level lack confidence in their knowledge about science and their understanding of science concepts. The concerns about teacher instruction parallel the character of school science. Many in the education community acknowledge that a disjuncture exists between the apparently inadequate school curriculum in science and the demands of living in a technological and scientifically driven economy.

Reports, including *A Nation At Risk* and *Educating Americans for the 21st Century,* have examined the state of U.S. science and mathematics education and called for a wide range of reforms to halt the "rising tide of mediocrity" in the educational system and cited the need for education to produce scientifically and technologically literate individuals.

More recently, a 1989 report of the American Association for the Advancement of Science, *Science for all Americans: A Project 2061 Report on Literacy Goals in Science, Mathematics, and Technology*, proposes reforms in all aspects of precollege science education for all students in order to ensure a scientifically literate citizenry. The report states that:

> "When demographic realities, national needs, and democratic values are taken into account, it becomes clear that the nation can no longer ignore the science education of any students. Race, language, sex, or economic circumstances must no longer be permitted to be factors in determining who does and who does not receive a good education in science, mathematics, and technology. To neglect the science education of any (as has happened too often to girls and minority students) is to deprive them of a basic education, handicap them for life, and deprive the nation of talented workers and informed citizens -- a loss the nation can ill afford." (American Association for the Advancement of Science, *Science for All Americans: A Project 2061 Report on Literacy Goals in Science, Mathematics, and Technology*, Washington 1989: 156-157.)

Some in the scientific community, however, conclude that the projected shortages in science and engineering personnel will not occur. They charge that career choices and market forces are more indicative of the future supply of scientists and engineers than are demographic determinants. They point out that past predictions of long-term shortages and surpluses have failed to materialize. Do both economics and demographics operate in determining the supply? Does one dominate the other, or do they work in concert in adjusting for the disparity between the projected supply and demand? Alan Fechter, executive director, Office of Scientific and Engineering Personnel, National Academy of Sciences, stated that the debate should not focus on whether there is a projected shortage, but on the "...nonwhites and nonmales, the numbers of foreign nationals and the numbers of women and minorities in science and engineering. There is an excess of some and a scarcity of others." (U.S. National Science Foundation, *Education and the Professional Workforce*, Mosaic, v.18, spring 1987: 15.)

PreCollege Science and Mathematics Concerns

Precollege (K-12) science and mathematics instruction has an important relationship to the future supply of U.S. scientific and technological personnel. The quality of instruction -- the strengths and weaknesses of the instructors regarding their scientific knowledge combined with their attitudes concerning the importance of science instruction -- has considerable influence on student interest toward perceptions about science and technology. However, a 1986 NSTA study found that the majority of science teachers at the precollege level rated their preparation for teaching in their respective disciplines as adequate or minimal.

Although educators are concerned about the projected shortages of qualified science teachers in the Nation's public schools, another concern is the preparation and qualification of the current teachers in the classrooms. The NSTA estimates that approximately 300,000 science and math teachers will be needed by 1995, an amount

that exceeds those currently teaching. Bill G. Aldridge, executive director of the NSTA, notes that approximately 30% to 40% of all science courses in U.S. schools are taught by teachers who were reassigned when increased science requirements in 1983 coincided with a teacher surplus resulting from declining enrollments. While there is an adequate number of qualified biology and life science teachers, there are shortages in qualified physical science teachers -- chemistry and physics. At the present time, approximately 60% of U.S. students take biology; 30%, chemistry; and only 18%, physics. The 1986 NSTA study of 8,000 high schools found that while physics teachers taught a full load of courses (five to six), approximately 80% were not physics classes, but included subjects such as math, business, and meteorology.

The NSTA has established certification standards for science teachers: 12 hours of college science to teach in elementary schools, 36 hours in junior high school, and 50 hours in senior high school. This is approximately twice what is required by most States today. Aldridge estimated that to provide the necessary training of new science teachers and the retraining of unqualified in-service teachers to meet these standards could cost approximately $300 million.

The shortage of qualified science teachers results, to some extent, from the individuals choosing teaching as a profession. Many women, who at one time traditionally chose teaching as a profession, have found more rewarding and lucrative careers in other fields. Also, both men and women with scientific and mathematical training are in increasing demand by the technology-based industries which pay higher salaries.

In addition to the quality of science instruction and the shortage of quality teachers, the content of the science courses has been found to be a major problem at the lower grades of the precollege level (K-6). Courses and curricula are often outdated in content and fail to address the different interests of students. On average, science on the K-6 level is taught for approximately 15 minutes a day and directly from a textbook. In addition, it has been found that almost 80% of elementary school teachers saved science instruction for the last period of the day, the time when students tend to be the least attentive. An alternate approach suggested by many educators encourages more "hands on" experiences, such as experiments, laboratories, and interactive exhibits, when teaching science. Research has found that this approach develops a more positive attitude about science and prompts students to elect more science courses in higher grades. (Ten years ago, approximately 53% of high school science classes provided laboratory experience for the students. At present, less than 39% of junior and senior high school science classes have laboratories.)

Mathematics Education

Mathematics is the "foundation" discipline for science and engineering and for general technical literacy. However, a 1989 report by the National Research Council, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, states that the majority of students leave school lacking sufficient preparation in mathematics to meet job prerequisites or undergraduate requirements for mathematical literacy. This is coupled with the projection that the increase in demand for mathematical scientists between the years 1986 and 2000 will be greater (29%) than the estimated growth in demand for all types of workers (19%). Data from major studies

show that deficiencies are prevalent from first through twelfth grade and in almost every phase of school mathematics. These assessments are supported with the following data:

(1) Non-U.S. citizens who take the Graduate Record Examination in mathematics average 100 points higher than U.S. students. The performance gap is twice as high in mathematics as in any other field -- the next highest being in physics, the most mathematical of the sciences;

(2) The mathematics achievement of the top 5% of twelfth grade students is lower in the United States than in other industrialized nations. The average twelfth grade mathematics student in Japan out-performs 95% of comparable U.S. twelfth graders; and

(3) U.S. eighth graders, who are about average in rote computation, are well below international norms in solving problems that require higher order thinking skills. (Lynn Arthur Steen, *Mathematics Education: A Predictor of Scientific Competitiveness*, Science, v.237, July 17, 1987: 251.)

Other data on the mathematical performance of U.S. students were provided in a 1985 report, *Second International Mathematics Study*, prepared by the Washington National Center for Education Statistics. Statistics indicated that eighth grade mathematics students in the United States, ranked lower than students from Japan, France, and Great Britain. In addition, among 20 industrialized and less-developed nations, U.S. students ranked 8th in statistics, 10th in arithmetic, 12th in algebra, 16th in geometry, and 18th in measurement. Japanese students ranked first in all five categories.

Primarily because of these assessments, considerable attention has been focused on mathematics instruction. The NSF has also sought to improve the overall curriculum development in mathematics. In 1984, the NSF supported the development of precollege programs specifically to reflect the impact of two key technologies, the calculator and the computer. These awards, inviting collaborative projects linking the mathematics education and mathematical sciences communities, addressed the programmatic problems of the K-6 mathematics curricular base. Proposals included emphasizing higher order thinking skills rather than rote calculations, teaching the applications of mathematics in conjunction with techniques rather than structuring it as an isolated subject with relatively few ties to applications, and integrating calculators and computers into the curriculum in order to allow students to explore contemporary strategies of investigation on their own rather than seeking constant advice from their instructor. All of the programs had as their basis the purpose to broaden the pool of competent mathematics learners and to coordinate efforts toward the goal of mathematical literacy for all children.

Demographics and the Science and Engineering Talent Pool

Any attempts by scientists and educators to address the expected shortfall of more than 560,000 science and engineering personnel by the year 2020 would be expected to include recognizing the demographic changes that are eroding the science and engineering workforce. The number of college age students is declining; this is expected to continue through 1996. After that time, the projections are for a rise back to the 1983 level by the year 2008. According to impending demographic realities, during the trough of the decline, 1994-1996, fewer people may be available to go into science and technical careers. Also, the number of students electing majors in science and engineering is decreasing. A survey conducted by the American Council on Education in conjunction with the Cooperative Institutional Research Program of the University of California, Los Angeles, found that in 1988, approximately 15.3% of entering freshmen selected sciences as majors (biological sciences, physical sciences, mathematics, and engineering), a decrease from 15.4% in 1987, 18.1% in 1980, and 21.3% in 1966. Freshmen interest in computer science in the fall of 1988 was unchanged from its 1987 level of 2.7%, but remained below its 1982 level of 8.8%. It should be noted that interest in engineering registered a marginal increase in 1988, to 8.6% from 8.5% in 1987, but well below its peak of 12% in 1977. The size of the population base, from which scientists and engineers are taken, yields some information about supply potentials. The Bureau of the Census, U.S. Dept. of Commerce, reports that since 1982, the population of 22-year-olds has declined, and is forecast to continue in this direction through 2000. The Bureau projects that a marked decline will occur during 1996-1998, at which time the number of 22-year-olds will be approximately 25% less than in 1982. Such future projections are cause for concern by some educators because of the strength of past linkages between the number of 22-year-olds and undergraduate science and engineering degrees.

In addition to lower numbers, the prospective 22-year-old pool will have a significantly different racial mixture than the past. The Bureau of the Census reports that in 1975, 14% of the 22-year-old population was composed of minorities; by 1995, the projected percentage will be 19%, and by the year 2005, 20%. Currently, blacks and Hispanics are 25% of the precollege level, and, by the year 2000, they will comprise 47% (this change has already occurred in California, Texas, and New Mexico). By the year 2020, today's minorities will become the majority of students in the United States. Concomitant with the increase in the minority population, the total population of 18- to 24-year-olds is projected to decrease more than 25% during this same period. Although there has been an increase in the participation of minorities in the science and engineering disciplines at the undergraduate level, it is over such a small base that the significance is muted. Questions are raised as to whether even the present low participation of minorities in the sciences can be maintained, and, more importantly, can be increased in the coming years.

At present, minorities comprise the majority of school enrollments in 23 of the 25 of the Nation's largest cities, with the Hispanic population growth forecast to be the fastest of all groups, primarily due to immigration, and black population growth following as second. By the year 2000, minority groups are projected to constitute the majority of the population in 53 major cities. However, today, a smaller proportion of minorities age 18 to 24 than of non-minorities has graduated from high school, and the college-going rates for these minorities who do graduate also is lower than those for non-minority high school graduates.

As a group, minorities, particularly blacks and Hispanics, have traditionally been underrepresented in the science and engineering disciplines compared to their fraction of the total population. Black enrollment in science and engineering alone has declined 19.5% since 1981. Concomitant with the underrepresentation and the recent downturn, blacks' and Hispanics' "persistence rate" (continuing in the program until graduation) in the sciences has been 29% as compared to the national total of 79%. Poor preparation in science and mathematics is said to be a major factor limiting the appeal of science and engineering to these groups and increasing attrition among those who do study the sciences. These demographic issues may affect the development of the scientific and engineering workforce and, consequently, the conduct of R&D in the 21st century. The role of minorities in the sciences is no longer viewed as just an equity issue; the demands of a scientific and technical workforce must also be met.

A report prepared by the Office of Technology Assessment (OTA), *Grade School to Grad School*, indicated that the projected decline in the science and engineering fields might be offset by labor market forces. The OTA report maintained that fewer graduates in the sciences and engineering disciplines do not necessarily translate into shortages in the workforce. However, both short- and long-term investments may be needed to address any possible shortages and to expand and diversify the Nation's science and engineering workforce at all levels. A short-term approach could be to invigorate the current science and engineering workforce by reducing attrition of undergraduate and graduate students, which would increase the pool of employable scientists and engineers within a few years. A long-term strategy could entail enlarging the base of potential scientists and engineers by working with schools and colleges, children and teachers, to enhance elementary and secondary science and mathematics curriculum.

Degree Acquisition Trends for Minorities

While recruitment remains an important problem for greater minority participation in the science and engineering labor force, retention of minorities in the educational pipeline once recruited appears to be a more serious problem. Even though freshmen enrollment of minorities has increased fivefold in the past 10 years, degree production in science and engineering has experienced only a threefold increase.

The proportion of degrees earned by non-Asian minorities is far below their proportion of the total population. Currently, blacks comprise approximately 12% of the population, yet account for 2.6% of all graduate science and engineering students. Data indicate, also, that in 1988, Hispanics were 1.8% of the graduate science and engineering population and Native Americans were a mere .5% of the same population. Even adjusting the data to account for the large number of foreign students yields relatively small percentages for these non-Asian minorities.

Additional data indicate that at the bachelor's level, blacks, Hispanics, Native Americans and women are better represented in the sciences and mathematics than in engineering. It should be noted that even in the science and mathematics groups, their representation is approximately 33% of their aggregate representation in the 22- to 24-year-old population. Asians, however, are represented twice as frequently among science and engineering bachelor's graduates as they are among 22-year-olds.

The underrepresentation of minorities in science and engineering is even more pronounced at the graduate level. Approximately 50% as many minorities receiving bachelor degrees in science and engineering enter graduate school in these fields compared to non-minorities. Data from the National Academy of Sciences, *Summary Report 1989: Doctorate Recipients from United States Universities*, show that in the science and engineering degrees awarded to U.S. citizens, blacks earned slightly more doctorate degrees in 1989 than in 1988, from 2.1% of the total awarded in 1988 to 2.2% of the total awarded in 1989 (the sciences include the physical, life, and social sciences). The proportion of Hispanics receiving degrees in 1989 dropped slightly from the previous year, 2.4% in 1988 to 2.3% in 1989. While Native Americans increased their level from 1988 to 1989, .4% in 1989 (55 awarded) from .3% in 1988 (45 awarded), they too continue to be a small percentage of the total. In addition, the *Summary Report 1989* found that blacks and Hispanics took more time to earn a doctorate than white or Asians, and women were enrolled longer than men. While statistical differences in discipline were evidenced, blacks consistently took a longer time to earn their degree. (Data on time-to-degree for Native Americans could not be analyzed because the numerical distribution among fields was too small to be statistically useful.)

The Bureau of the Census predicts that by the year 2020, minorities will constitute more than 35% of the total population of the United States. Given the goal of greater employment of non-Asian minorities in science and engineering, the policy dilemma is to find ways to increase the motivation and training of the underrepresented minorities.

Foreign-Born National Science and Engineering Students

A recent increase has been evidenced in the number of non-U.S. citizens who are attending U.S. science and engineering graduate schools. Data compiled by the NSF indicate that the participation of foreign students in U.S. science and engineering educational programs has been increasing at approximately 7% a year since the late 1970s. Within the science fields alone, foreign enrollment in the computer sciences has grown precipitously, averaging 21% a year during 1979-85. A report by the NSF, *Foreign Citizens in U.S. Science and Engineering: History, Status, and Outlook*, indicates that if the number of foreign students in engineering (the dominant subject interest to foreign students) rises 2% a year (it has been averaging 7% per year since 1975), foreign students will outnumber U.S. citizens by more than 3 to 2 by 1995.

The NSF also reports that in 1988, foreign students earned 36.6% of the 20,257 doctorates awarded in science and engineering. More specifically, foreign students were awarded 57.6% of the 4,190 doctorate degrees in engineering, an increase over the 49.3% earned in 1980, and 31.1% of the 16,067 science doctorates, an increase from the 19% earned in 1980. The increase recorded in full and part-time graduate science and engineering enrollments in doctoral programs in the past five years has been attributed primarily to foreign students. However, the number of foreign students doing postdoctoral research in engineering has witnessed a decline, 65.1% in 1985 to 41.2% in 1987. Postdoctoral research in the sciences by foreign students slightly increased during that same time period, 12% in 1985 and 13.7% in 1987.

There are divergent views in the scientific community about the effect of this increasing foreign presence in graduate science and engineering programs. Some argue that the universities benefit from a large foreign enrollment by supplying the needs of the university and consequently industry. Also, directors of industrial laboratories

acknowledge their dependency on non-U.S. citizens to staff their facilities. A counterargument is that the increasing number of foreign science and engineers electing to remain in the United States results in a "brain drain" in their home countries, many of which are newly industrialized or less-developed countries. Results of a study conducted by the Oak Ridge Associated Universities, *Foreign National Scientists and Engineers in the U.S. Labor Force 1972-1982,* estimated that 80% of the increase in foreign scientists and engineers between 1972 to 1982 consisted of undergraduate and graduate foreign students who elected to remain in the United States. The reality is that the dependency on foreign talent will likely continue to grow if the decline in U.S. students materializes. However, reports by the NSF and other organizations indicate that because foreign engineers comprise approximately 3.5% of the total U.S. engineering workforce, and increased regulations have made it more difficult for foreigners to work in selected laboratories, "...they are not displacing Americans to a significant extent." (National Academy of Engineering, *Foreign and Foreign-Born Engineers in the United States,* p. 6.) In addition, many in the scientific and academic community maintain that total demand for scientists will remain high enough to absorb nearly everybody.

Technical Literacy of the U.S. Population

Concern is being expressed about the technical literacy of the general U.S. population. This concern is related to the perceived decline in the quality of U.S. precollege science and mathematics instruction. A combination of advancing technology, growing international economic competition, and most importantly, changing demands of the workforce are causing the obsolescence of old skills and requiring improved levels of mathematics and science education. A significant number of the jobs in the service industries require a more scientific and technically based education than the traditional jobs in the manufacturing industries. However, data indicate that there appears to be an emerging workforce of individuals in our present educational system who may lack the technical background and analytical skills necessary to participate adequately in a world of advancing technology.

Two reports issued in 1983, *A Nation at Risk: The Imperative of Educational Reform,* Department of Education, and *Educating Americans for the 21st Century,* NSF, called for a wide range of educational reforms to halt the "rising tide of mediocrity" in the educational system and cited the need for education to produce individuals with greater scientific and technical literacy. The reports suggested that reform should be focused on primary and secondary education and on the production of high school graduates who are "extensively literate," who can think both clearly and logically, and who possess a firm foundation in mathematics and the sciences. Both reports noted that although students not electing to go to college do not usually require advanced courses in mathematics and science, they increasingly will need a working knowledge of those disciplines in order to perform their jobs with precision and understanding. A 1986 report by the White House Science Council Panel on the Health of U.S. Colleges and Universities yielded a similar analysis, concluding that the Nation's high schools were producing a majority of students who are unable to compete in an increasingly technological workplace.

Workforce 2000, prepared by the Hudson Institute for the Department of Labor, stated that if the U.S. citizenry does not become better prepared for work, industries

will purchase their technologies and send jobs overseas. The report concludes that the existing "intractable joblessness" will continue unabated. Assuring the quality of the U.S. workforce is a national priority that takes on greater salience as challenges to the U.S. economic position continue to mount.

Congressional Concerns and the Role of Federal Policies in Science and Engineering Education

National Science Foundation

Science, engineering and mathematics education and personnel have been a national concern, particularly since the 1950s. Many programs were created, mainly through NSF, to help ameliorate problems.

Prior to the October 1957 Soviet launch of Sputnik, there was considerable congressional interest regarding the state of U.S. science education. Following Sputnik, public demand was aroused for increased science education instruction. Congress responded to the demands by continually appropriating funds to NSF for science and engineering educational activities. NSF responded by sponsoring scientific training of graduate students through awarding graduate fellowships; establishing summer institutes for college teachers, which eventually expanded to include secondary and elementary school level teachers; establishing special projects in science education, which included programs to encourage the scientific interests of high ability secondary school students; creating the Course Content Improvement Program, which included a controversial precollege science education program *Man: A Course of Study* (MACOS); establishing the Women in Science and science education programs to assist minorities and the handicapped in science; and others.

In FY1981 the Reagan Administration abolished the NSF science education directorate on the grounds that such training was adequate or was a State responsibility. Congress restored the program, but in FY1982 funding for NSF science education programs received the lowest amount of support in 25 years -- $20.9 million ($70 million had been appropriated in FY1981). Although NSF recognized the problems existing in science education, it simultaneously encouraged private industry, scientific and professional organizations, State and local governments, and other Federal agencies to make the necessary contributions for their resolution. Support for science education from the Department of Education also was greatly diminished. Intense lobbying efforts and congressional actions led to restoration of Federal support for science education and the reestablishment of the Science and Engineering Education Directorate (SEE) on Oct 1, 1983. This directorate recently has been renamed and restructured into the Directorate for Education and Human Resources (EHR). The EHR will continue to support all programs formerly supported through the SEE in addition to institutional and individual development programs that previously were supported through research and related activities in FY1990.

The Administration's FY1992 budget request for the EHR directorate is $390 million, a 21% increase above the FY1991 estimate of $322.4 million and a 76.8% increase above the FY1990 appropriation of $220.6 million. The programs in this directorate are coordinated through the Federal Coordinating Council for Science, Engineering, and Technology (The FCCSET Committee, includes representatives of 16

Federal agencies and institutions that provide support for science and mathematics education. The cooperative effort of these agencies is intended to "promote maximum use of expertise in the agencies, to minimize program overlap, and to optimize the use of federal resources." The Committee has given precollege education the highest priority, followed by undergraduate and graduate level programs. U.S. National Science Foundation. Justification of Estimates of Appropriations to the Congress. Fiscal Year 1992. Washington, DC. January 1991. p. EHR-2.). The NSF's FY1992 budget requests a total of $582 million for all education and human resource development programs.

The NSF's FY1992 request gives increased emphasis to the precollege level. The request for this level is $253 million, a 19% increase above the FY1991 estimate of $212.6 million. According to NSF, existing programs, such as efforts to improve teaching of science and mathematics, will be augmented with enrichment activities for talented high school students. Special attention will be directed toward mathematics curriculum reform at the middle-school level. The Presidential Awards for Excellence in Science and Mathematics, once limited to middle-and secondary-level teachers, will be expanded to include elementary-level teachers. The Young Scholars Program, designed to draw students to careers in science, mathematics, and engineering, will be expanded. In addition, programs will be established to provide hands-on research experience in order to stimulate interests and increase the awareness of science and engineering careers.

NSF has proposed to improve the quality of undergraduate programs by requesting $133 million in FY1992, an increase of $31.05 million (31%) over the FY1991 estimate. New and expanded activities include: instrumentation and laboratory instruction; student research participation; faculty enhancement; and curriculum development in calculus and engineering. In addition, NSF proposes that both graduate and postdoctoral education will receive increased support. At present, approximately 18,100 graduate assistants, 3,900 postdoctoral associates, and 11,800 undergraduates are to receive support in FY1991. Interdisciplinary training opportunities in mathematics and biotechnology are to receive particular emphasis.

The Presidential Young Investigators program for new doctorates also will be expanded in FY1992. Presently, the FY1991 support for this program is estimated at $50 million. The annual involvement in this program approximates 6,500 students nationwide.

NSF also plans to increase support for individuals and groups who have historically been underrepresented in the sciences. Walter E. Massey, Presidential nominee for Director of the NSF, stated that:

> The dual problems of educational quality and quantity are most acute for those groups that have historically been underrepresented in science and engineering. Although these populations are becoming ever more important in our society, they still have very low rates of participation in science and engineering. Only 8% of the bachelor's degrees and 4% of the Ph.D.s in science and engineering are awarded to blacks and Hispanics, while the number of high school and college-aged women interested in scientific and engineering fields are only fractions of those of their male counterparts. Given modern society's growing appetite for scientific and engineering talent,

these factors, if unchanged, together with a general decline in the size of the college-age population as a whole, could combine to produce potentially serious problems for our scientific and engineering work force, and for the nation as a whole, by the turn of the century. (Confirmation testimony from Dr. Walter E. Massey before the Senate Labor and Human Resources Committee, Feb. 7, 1991. p. 2-3.)

The Human Resource Development (HRD) Subactivity will expand its focus and programs on the problems encountered by minorities, women and persons with disabilities pursuing scientific, mathematical, and technical careers. The Career Access Opportunities Program, once housed in the Office of Undergraduate Science, Engineering and Mathematics Education subactivity has been transferred to the HRD Subactivity to allow for closer monitoring among specialized human resource programs. Support for Faculty Awards for Women, Visiting Professorships for Women, Research Improvement in Minority Institutions, and Minority Research Centers of Excellence totals $18.25 million ($4.7 million above the FY1991 estimate, a 34.7% increase). A new program in the FY 1992 budget request, Alliances for Minority Participation, proposed at $10 million, will provide an expanded comprehensive approach to increasing the number and strengthening the science and mathematic skills of minority students pursuing undergraduate degrees and subsequently entering graduate programs in science, mathematics, and engineering.

The Research Career Development Subactivity will continue to focus on recruiting and retaining students in science and mathematics throughout the educational pipeline. The FY1992 budget request increases the annual stipend for Graduate Research Fellowships to $14,000. The number of new Fellowships will remain at 1,060 offers per year. In addition, the cost-of-education allowance received by the fellowship institution in lieu of fees and tuition would remain at $6,000. The Young Scholars Program for talented middle school and high school students will be enlarged to reach an additional 1,000 candidates and to prepare them for careers in science, mathematics, and engineering.

NSF Comprehensive Regional Centers for Minorities will receive grants totaling up to $12 million over 5 years to support local efforts (colleges, universities, community groups, and local and State governments) to increase minority participation in the scientific and technical workforce.

As part of the Minority Research Centers of Excellence (MRCE) program initiated in 1986, NSF has proposed the establishment of six minority research centers to "address the continuing shortage of minority scientists and engineers needed to maintain U.S. preeminence in fundamental research." Two of the centers already in operation, located at Howard University in Washington, DC, and Meharry Medical College in Nashville, TN, will each receive $5 million over a period of 5 years. NSF plans to support all six MRCEs for 5 years, at a funding level of $5 million for each center.

Department of Education

The Department of Education supports precollege science and mathematics through Title II of the Elementary and Secondary Education Act, as amended by P.L. 100-297 (prior authorization was under the Education for Economic Security Act, P.L.

98-377). The widespread national concern about the declining quality of mathematics and science programs in the Nation's schools and the concomitant decline in student performance on standardized tests contributed significantly to the enactment of this in mathematics and science program.

Title II provides, under formula, funds to State and local education agencies for programs to improve instruction in targeted subject areas -- science and mathematics. The funds are used mainly for training and retraining teachers in the particular areas. The FY1988 appropriation for this program was $119.7 million.

Under current law, the math/science education program of Title II is intended to improve instruction in mathematics and science; prior law included improvement of computer learning and foreign language instruction. Of the annual appropriation, 95% is to be allocated among the States on the basis of the 5- to 17-year-old population and the previous year's Chapter 1 (compensatory education) State allocations; prior law allocated 90% among the States solely on the basis of 5- to 17-year-old population. Current law provides 4% of the annual appropriation to the Secretary of Education for programs of "national significance"; prior law dedicated 9% to this purpose. Compared to prior law, current law increases the percentage allocated directly to local educational agencies (approximately 64% of the annual appropriation under current law, approximately 44% under prior law). Current law specifies in greater detail the activities authorized for local educational agencies, e.g., recruiting minority teachers to mathematics and science, and training teachers in instructional uses of computers in these subjects. The Secretary is newly required to submit a summary of State and local program evaluations biannually to Congress.

P.L. 100-297, signed by President Reagan on Apr. 28, 1988, also authorized the Star Schools Program Assistance Act to support statewide or multi-state telecommunications partnerships. Among their activities, the partnerships are designed to increase the availability of courses in mathematics, science, and foreign languages in elementary and secondary schools. A focus would be placed on those schools with significant numbers of disadvantaged students or in those schools with limited resources (materials) and corresponding courses in the selected subject areas. The 100th Congress appropriated $14.4 million for the Star Schools Program Assistance Act for FY1989.

LEGISLATION

H.R. 775 (Stokes)

Summer Science Academy Act of 1991. Establishes Summer Science Academies for talented high school students, particularly economically disadvantaged, minority participants, and for other purposes. Introduced Feb. 4, 1991; referred to Committee on Science, Space, and Technology, Subcommittee on Elementary, Secondary and Vocational Education Committee.

H.R. 2142 (Lowey)

Women and Minorities in Science and Mathematics Act of 1991. Amends the Higher Education Act of 1965 to add provisions, under various programs, for women and minorities currently underrepresented in the fields of science and mathematics to receive their training in such fields. Introduced Apr. 30, 1991; referred to Committee on Education and Labor.

S. 44 (Moynihan)

Amends the Immigration and Nationality Act to admit to the United States for permanent residence immigrants with an earned bachelor of science degree or post-graduate degree in the natural science, engineering, or computer science. Introduced Jan. 14, 1991; referred to Committee on Judiciary, Subcommittee on Immigration and Refugee Affairs.

S. 329 (Pell)

National Teacher Act of 1991. Directs the Secretary of Education to assume the obligation to repay selected portions of a student loan for any borrower employed as a full-time teacher: (1) in a school which qualifies for loan forgiveness for Perkins loan recipients who teach in such schools; and (2) of science, mathematics, foreign languages or any field in which a shortage of expertise has been determined. Provides loan forgiveness of one to five years. Introduced Jan. 31, 1991; referred to Committee on Labor and Human Resources, Subcommittee on Education, Arts, and Humanities.

S. 343 (Johnston)

Department of Energy High-Performance Computing Act of 1991. Directs the Secretary of Energy to establish: (1) a High-Performance Computing Program; (2) a management plan to carry it out; and (3) a national multigigabit-per-second network to be named the Federal-High Performance Computer Network. The Secretary is directed, also, to promote education and research in high performance computational science and related fields that are necessary in making the computing resources more accessible to graduate and undergraduate students, post-doctoral fellows, and the faculties from the Nation's educational institutions. Introduced Feb. 5, 1991; referred to Committee on Energy and Natural Resources, Subcommittee on Energy Research and Development. Hearings held, Apr. 11, 1991.

S. 685 (Glenn)

Summer Residential Science Academy Act of 1991. Directs the NSF to make grants, contracts, or agreements for not more than 50 Summer Residential Science Academies for talented, economically disadvantaged, minority students in grades seven through 12 to study science, mathematics, engineering and communications. Introduced Mar. 3, 1991: referred to Committee on Labor and Human Resources, Subcommittee on Education, Arts, and Humanities.