POLICY
INFORMATION
REPORT

Hispanics in Science and Engineering

A Matter of Assistance and Persistence

Educational Testing Service

Research and Development

Policy Information Center

CONTENTS

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Preface

This report is both about progress in increasing the representation of Hispanics in the science and engineering professions and about the many efforts that are needed to continue that progress towards more equal representation in these important professions. The view provided is both from the standpoint of the Hispanic population, and from the standpoint of the nation's need to increase the number of scientists and engineers to meet the future demands of a growing economy.

The report examines the supply side throughout the education pipeline—from early childhood education, through elementary and secondary school, to high school completion, to enrollment in—and completion of—college, and on to graduate education. Along the way, Paul Barton identifies the important areas where educational achievement will have to improve to result in an increase in graduate degrees in science and engineering. He describes both the need for assistance of various kinds along the way and the importance of persistence of Hispanic youth in completing their educations and continuing on at critical points in the education pipeline.

Looking into this future requires examining the demand and anticipated supply for these important occupations and addressing the question of whether the economy can absorb an increased supply of Hispanic scientists and engineers. The projections of the Bureau of Labor Statistics that are described in the report provide some cause for optimism.

This study was prepared for *Engineering Collaborations: Preparing Technical Talent for the Economic Upturn*, a joint conference of the National Action Council for Minorities in Engineering (NACME), Inc. and the National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM), Inc. The ETS Policy Information Center is pleased to provide this research for these organizations and their constituencies.

Drew Gitomer
Senior Vice President, Research and Development
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Executive Summary

While still underrepresented in higher education as a whole, Hispanics have been increasing their percentage of all science and engineering degrees awarded in the period from 1991 to 2000, rising

- from 4.5 to 7.2 percent of bachelor's degrees;
- from 3.1 to 5.2 percent of master's degrees; and
- from 3.2 to 4.1 percent of doctorate degrees.

At the same time, the young Hispanic population has been growing much more rapidly than the population as a whole, and this trend is projected to continue. From 2000 to 2015, growth in Hispanic 18- to 24-year-olds is projected by the Census Bureau to represent 61 percent of the total growth of all 18- to 24-year-olds. In this period, the Hispanic population is projected to grow by 45 percent, compared to just 1 percent for the White (non-Hispanic) population and 11 percent for the total population in that age range. This means that very large increases in the *numbers* of Hispanics earning degrees are required just to maintain the same proportions. The goal, of course, is to go beyond this toward having Hispanics represented in proportion to the share of the population they represent.

The outlook for employment is one key factor in determining whether or not there will be such large increases in the numbers preparing to enter science and engineering occupations. If the projected need is substantial, the expected growth of the Hispanic youth population is an opportunity to meet national needs for an adequate supply of scientists and engineers. The employment outlook projections from 2000 to 2010 are as follows:

- 9 percent growth for engineers, with 452,000 job openings;
- 69 percent growth for computer specialists, with 2,259,000 job openings;
- 6 percent growth for mathematical scientists, with 26,000 job openings; and
- 18 percent growth for physical scientists, with 124,000 job openings.

The outlook for employment requires projection of both supply and demand. In general, the U.S. Bureau of Labor Statistics estimates a favorable outlook for employment in science and engineering occupations, although there is variation among the various specific occupations in how favorable the outlook is.

A key factor in whether the future need for scientists and engineers will be met over the next 10 to 15 years is the impending retirements among the baby boom generation. The babies born in the first year after World War II turned age 55 in 2000; in the next decade and a half the "baby boom pig" will largely complete its journey through "the labor force python"—as demographers have sometimes put it.

Increasing demand for scientists and engineers and large-scale exits of baby boomers should mean there is substantial room for expanding employment of Hispanics in these occupations, if more can be attracted, and if more can be adequately prepared for these academically demanding fields.

The problem of achieving adequate preparation to enter graduate study is pervasive and not just a problem in the Hispanic community. To prepare for the future, we need to be aware of where we are and where we have come from.

- Just 20 percent of White twelfth graders and only 4 percent of Hispanic twelfth graders reach the "proficient" level in mathematics (as defined by the National Assessment of Educational Progress); students below this level are not likely candidates for science and engineering.

- To expand the pool of prepared youth from which to draw, more need to graduate from high school. But there has been no progress for three decades in increasing the overall high school completion rate, excluding the GED, and there has been only very slight progress in increasing the overall rate for Hispanic students. However, the completion rate for native-born Hispanics has risen substantially.

- The percent of Hispanic high school graduates entering college rose in the early 1990s, but has dropped back toward about half—while the overall rate rose to about two-thirds.

- College noncompletion rates are high and need to be reduced. About half of Hispanic 25- to 29-year-olds who have some college education did not get a 2-year or 4-year degree.

There will have to be improvement on these four fronts—high school achievement, high school completion rates, college entry, and college completion rates—to boost Hispanic representation in science and engineering, and in other professions as well. The need for improvement goes beyond Hispanics to the broader youth population as well. To raise achievement and promote completion to degree, the following are critical.

- *Starting Early.* Equalizing achievement will mean starting early—although progress can still be made at later points of intervention. Early childhood education beginning at age three can help level the playing field. A recent report of the Committee for Economic Development, a business organization, concluded: "For too long, the United States has paid lip service to the importance of preschool opportunities that prepare children for school without undertaking the level of investment needed to turn promises into reality."[1]

- *Ensuring Better Teaching.* Improvement in the quality of teaching in science and mathematics will be essential. We can get guidance here from the recent report of The National Commission on Mathematics and Science Teaching for the 21st Century, chaired by John Glenn. The report, *Before It's Too Late*, lays out a comprehensive plan.[2] It includes suggestions for establishing a system of quality improvement for teaching, increasing the number of mathematics and science teachers, and improving the working environment to make the teaching profession more attractive for science and mathematics teachers.

- *Raising Minority Achievement at the Top.* The focus has been on improving the academic skills of the lowest performers and equalizing average performance. Yet, average achievement will not produce scientists and engineers, and the 3 or 4 percent of Black and Hispanic students now reaching the proficient level on the NAEP assessment will not move us toward equality of representation in science and engineering occupations. The National Task Force on Minority Achievement, created by the College Board, provides a different and more appropriate focus in its report, *Reaching the Top*.[3] The report identifies a number of programs and efforts directed at increasing the number of high academic performers.

- *Addressing the Antecedents of Low Achievement.* The joint study by the National Center for Education Statistics and the National Science Foundation, *Understanding Racial-Ethnic Differences in Secondary School Science and Mathematics Achievement*,[4] provides a useful starting point for understanding and addressing the sources of low performance. These sources were found to include having less

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1 Committee for Economic Development, *Preschool for All: Investing in a Productive and Just Society*, Statement of the Research and Policy Committee, 2002.

2 *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, September 2000.

3 The College Board, *Reaching the Top*, Report of the National Task Force on Minority High Achievement, 1999.

4 Samuel S. Peng, DeeAnn Wright, and Susan T. Hill, *Understanding Racial-Ethnic Differences in Secondary School Science and Mathematics Achievement*, U.S. Department of Education, National Center for Education Statistics, February 1995.

access to learning materials and educational activities outside school; attendance at schools with lower achievement and more discipline problems; lack of persistent effort and lack of involvement in school; and enrollment in low track achievement courses.

- *Providing Assistance.* High-achieving minorities from lower income families need help of a variety of kinds to make good choices and navigate the transition from high school to college. Financial aid is an important factor. In high school, guidance and counseling is very weak and has generally been ignored in the education reform movement.

- *Promoting Persistence.* Getting into and beginning college is not enough; there has to be persistence to graduation. We can obtain guidance here from two sources:

  - The study of 5,500 high-ability minority students, titled *Persistence in Science of High-Ability Minority Students*, by Educational Testing Service.[5]

  - The U.S. Department of Education study, *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment*.[6] The highest predictor of persistence to college graduation was taking a rigorous curriculum in high school.

Meeting the need for better science and mathematics instruction, for an adequate supply of scientists and engineers over the next 10 to 20 years, and for more equality in the preparation and representation of minority populations in these professions are all interconnected. And while this report focuses on the science and engineering jobs essential to the economy, improving elementary and secondary education in science and mathematics would also address two other matters: the broader need for a skilled workforce generally, and the adequate preparation of students—particularly students of color who are underrepresented in higher skilled and higher paying occupations—to succeed in postsecondary education.

It isn't just tomorrow's innovative engineers and scientists who will drive our economy, but a larger cadre of well-educated workers in an array of fields that require quantitative and scientific knowledge. And beyond both a sufficient supply of scientists and engineers, and a large cadre of skilled workers, is the need to have a generally educated citizenry in a vibrant and democratic society. The task ahead is as daunting as it is necessary.

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[5] Thomas Hilton, et al. *Persistence in Science of High Ability Minority Students*, RR-89-28, Educational Testing Service, May 1989.

[6] Clifford Adelman, *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment*, U.S. Department of Education, June 1999.

Introduction

In May 2002, The Policy Information Center of Educational Testing Service published *Meeting the Need for Scientists, Engineers, and an Educated Citizenry in a Technological Society*.[7] The report looked at the national need for scientists and engineers, the trends in adequate preparation in math and science, and efforts needed to assure an adequate supply. It also examined the participation of people of color in science and engineering, and prospects for increasing participation.

This report is a companion to *Meeting the Need*. It focuses on the past representation of Hispanics in science and engineering, and examines the prospects for increasing their proportion in the years ahead.[8] While this report has considerable new information about recent trends and accomplishments in the Hispanic population, it also incorporates *Meeting the Need's* discussion of the general supply and demand in science and engineering and the policy considerations in expanding the population of young people who could qualify to enter these demanding occupations.

Section one looks at the gains made by Hispanics in science and engineering occupations. Section two presents the outlook for employment in these occupations through 2010. Section three reviews where the nation is and has come from in increasing the number of qualified students in the pipelines who are qualified to enter college and graduate education in science and engineering. It reviews achievement in school, graduation from high school, and entry into college and obtaining degrees. Section four examines prospects for progress, from early childhood education to strengthening the school curriculum, to increasing the proportion of high-achieving Hispanic and other people of color, to increasing the proportion of college entrants who persist and graduate.

The Appendix provides information in greater depth and detail for those directly involved in education policy and practice, in programs to increase Hispanic representation, and in counseling and other programs that serve Hispanic youth.

[7] www.ets.org/research/pic/meetingneed.pdf

[8] While the report provides statistics for all Hispanics combined, there is in fact considerable diversity among the subpopulation groups, for which separate data are not available.

Hispanics in Science and Engineering Education

In recent years, there have been impressive gains in the number of Hispanics receiving degrees in engineering, physical, mathematical, and computer sciences (see Table 1). The increases in bachelor's degrees ranged from 33 percent in mathematics to 89 percent in physical science, in master's degrees from 14 percent in mathematics to 105 percent in computer science, and for doctorate degrees from 8 percent in computer science to 56 percent in mathematics. The actual numbers of doctorate degrees were fairly small, however.

These increases for Hispanics are in sharp contrast to the trends for all American citizens and permanent residents, where the increases are negative or much lower. For example, while there was a 59 percent increase in bachelor's degrees in engineering for Hispanics, overall there was a decline of 5 percent.

Table 1: Number of Earned Degrees in Science and Engineering by Hispanics, 1991-2000

	1991	2000	Percent Change
Bachelor's Degree			
Engineering	2,566	4,068	+59%
Physical Science	533	1,010	+89%
Mathematical Science	480	640	+33%
Computer Science	1,215	2,035	+67%
Master's Degree			
Engineering	468	852	+82%
Physical Science	96	126	+31%
Mathematical Science	85	97	+14%
Computer Science	128	262	+105%
Doctorate Degree			
Engineering	61	80	+31%
Physical Science	81	95	+17%
Mathematical Science	9	14	+56%
Computer Science	12	13	+8%

Source: Susan T. Hill, *Science and Engineering Degrees by Race/Ethnicity of Recipients: 1991-2000*, National Science Foundation, NSF 02-329, Tables 4, 5, 6.

While these percentage increases are large, it is important to look at them in relation to all degrees awarded. When we look at Hispanic degrees as a percent of all degrees in science and engineering, we find that substantial progress was made during the 1990s. Figure 1 shows that this percentage increased from 4.5 to 7.2 for bachelor's degrees, from 3.1 to 5.2 for master's degrees, and from 3.2 to 4.1 for doctorate degrees. Thus, although Hispanics are still underrepresented among science and engineering degree-holders, their representation is growing.

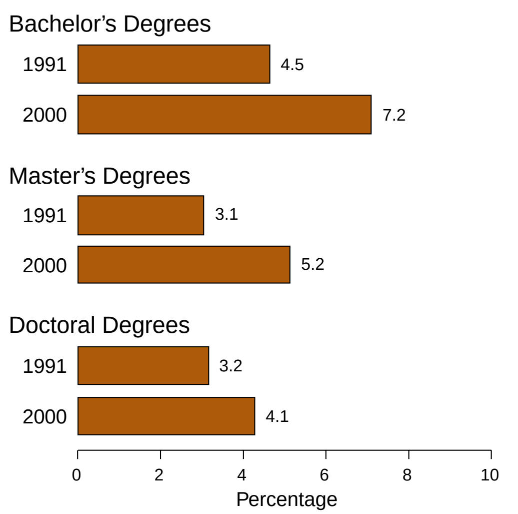
It would also be useful to be able to compare the rate at which Hispanic bachelor's degree holders in science and engineering persist and receive master's degrees, and of those, the rate of persistence to receive doctorate degrees. Once a bachelor's degree is attained, there may be little difference in the percent going on to advanced degrees. However, longitudinal data at this level of detail are not available to track population groups in this manner.

In looking at these data—both the number of degrees and the proportion of science and engineering degrees awarded—it is essential to bear in mind that the Hispanic population has grown tremendously over the past decade. While other minority groups have also increased their representation as the White percentage of the population has declined, the growth in the Hispanic population has been most dramatic.

This trend is expected to continue. The total population of 18- to 24-year-olds is projected to increase by 11 percent from 2001 to 2015 (middle projections) and the White (non-Hispanic) population by just 1 percent. The Hispanic population at this age will increase by 45 percent, however, and that growth represents 61 percent of the total growth over this period of time.[9] This means that the numbers of Hispanic 18- to 24-year-olds getting degrees would also have to increase by 45 percent just to stay even with current status.

[9] See Appendix Table, page 41.

Figure 1: Hispanic Degrees in Science and Engineering as a Percentage of All Degrees, 1991 to 2000



Source: Susan T. Hill, *Science and Engineering Degrees by Race/Ethnicity of Recipients: 1991-2000*, National Science Foundation, NSF 02-329, Table 3.

Clearly, it is imperative that we increase the numbers of Hispanic students who earn advanced degrees in science and engineering. This is evident from two perspectives. The first is from the perspective of equality. We need to strive to expand opportunities for Hispanics and other underrepresented minorities to enter these important, prestigious, and well-paid occupations. The second perspective focuses on the nation's employment needs. It is argued in this report that a number of factors combine to create a growing demand in the next 10 to 15 years for expanding the supply of scientists and engineers, and thus the goals of increasing equality and addressing economic need merge. The need to increase the general supply creates an opportunity to expand entry of Hispanics into the science and engineering labor force with some assurance that they in fact can be employed after they get their degrees. Over long periods of time, of course, we go through cycles of oversupply and undersupply in science and engineering, and nothing assures us that an oversupply will not occur again. However, the near-term future looks favorable for absorbing increasing numbers in most science and engineering occupations. The supply and demand factors are explored in the next section.

The Outlook for Employment in Science and Engineering Occupations

Projecting both supply and demand is a difficult business and involves assessing the changes occurring in the economy and in manufacturing and production processes, as well as the direction and speed of technological change. The supply as well as demand for qualified workers has to be projected in order to judge whether imbalances can be anticipated. In doing so, one must account for the historical role of immigration in meeting supply shortcomings, the use of work visas, and the increasing number of foreign graduate students educated in the United States and who plan to stay in the United States Below are summaries of assessments made by the U.S. Bureau of Labor Statistics (BLS) of the "Job Outlook" for the period 2000-2010.[10] Table 2 summarizes the BLS projections of average employment and total job openings for the period 2000-2010.

Outlook by Occupation

- *Engineers* - Overall engineering employment is expected to increase more slowly than the average for all occupations. However, job opportunities in engineering overall are expected to be good through 2010 because the number of engineering degrees granted is not expected to increase significantly over the 2000-2010 period.

- *Computer Software Engineers* - Computer software engineers are projected to be the fastest-growing occupation from 2000 to 2010. Very rapid growth in the computer and data processing services industry, which employs the greatest number of computer software engineers, should result in very favorable opportunities for those with the required skills.

- *Systems Analysts, Computer Scientists, and Database Administrators* - Systems analysts, computer scientists, and database administrators are expected to be among the fastest-growing occupations through 2010. Employment of these computer specialists is expected to increase much faster than the average for all occupations as organizations continue to adopt and integrate increasingly sophisticated technologies. The expansion of employment in this area will be driven by very rapid growth in computer and data processing services, which is projected to be the fastest-growing industry in the U.S. economy.

- *Physicists and Astronomers* - Historically, many physicists and astronomers have been employed on research projects, often defense-related. Because defense expenditures are expected to increase over the

Table 2: Projections of Employment and Job Openings, 2000-2010

Occupations	Average Employment 2000	Average Employment 2010	Percent Change	Total Job Openings 2000-2010
Total, All Occupations	**145,594,000**	**167,754,000**	**+15**	**57,932,000**
All Engineers	1,465,000	1,603,000	+9	452,000
Computer Specialists	2,903,000	4,894,000	+69	2,259,000
Mathematical Scientists	89,000	95,000	+6	26,000
Physical Scientists	239,000	283,000	+18	124,000

Source: Daniel E. Hecker, “Employment Outlook: 2000-10,” *Monthly Labor Review*, November 2001, pp. 65-66.

[10] These are abstracted from the *BLS Occupational Outlook Handbook*. More details can be found in the appendix.

next decade, employment of physicists and astronomers is projected to grow about as fast as the average for all occupations through the year 2010. The larger source of job openings, however, will be the need to replace physicists and astronomers who retire.

- *Atmospheric Scientists* - Employment of atmospheric scientists is projected to increase about as fast as the average for all occupations through 2010, but prospective atmospheric scientists may face competition if the numbers of degrees awarded in atmospheric science and meteorology remain near current levels.

- *Chemists and Materials Scientists* - Employment of chemists is expected to grow about as fast as the average for all occupations through 2010. Job growth will be concentrated in drug manufacturing and in research, development, and testing service firms.

- *Mathematicians* - Employment of mathematicians is expected to decline through 2010 because very few jobs with the title mathematician are available. However, master's and Ph.D. degree holders with a strong background in mathematics and a related discipline, such as engineering or computer science, should have good job opportunities.

Balancing Supply and Demand

The supply and demand for such a highly educated and trained workforce is a dynamic interaction, with success depending on a myriad of factors. No doubt many needed adjustments will occur as a result of the interplay of information, choices, and markets. The question is whether these adjustments will be adequate to meet the need.

According to the *Occupational Outlook Handbook*, produced regularly by the Bureau of Labor Statistics, opportunities are good to excellent in the highly respected and well-paid science and engineering occupations. And counselors, parents, and students generally get this message, even though the information systems available to help high school students make career choices are far from perfect. Nevertheless, we do go through periods of under-response and over-response, and of shortages, balances, and surpluses in the supply-demand cycles. The fact that employers fear shortages, and strong employer organizations are gearing up to increase supply, shows that the adjustment gears are beginning to turn.

While market forces are at work, we should not assume matters will take care of themselves. It is crucial to understand the large facts and emerging trends that pose barriers to a satisfactory adjustment.

One barrier is the well-recognized weaknesses in the preparation of elementary and secondary students in science and mathematics; the performance of U.S. students compared with those in other developed countries has caused consternation. Although the results of the comparisons are quite favorable at the fourth grade, U.S. students begin slipping behind after that level. There were encouraging signs of progress in mathematics in the 1990s, as measured by NAEP, but science performance failed to improve.

Under-performance in math and science constrains expansion in the proportion of high school graduates who can successfully prepare for the science and engineering professions. Science and engineering may wean some high-achieving students away from pursuit of other professions, but the proportion of those well enough prepared will establish limits. The fact is that science and engineering are at the top of the list in terms of demanding academic preparation. For example, we know that the prose and quantitative literacy requirements for engineers are 341 and 353 on a 0 to 500 scale, respectively, compared to the average requirement for all professional occupations of 332 and 328.[11]

The constraint of low to middling achievement in academic subject matter will likely yield only to sustained and intensive effort. Improving achievement is now in the spotlight, largely through what has become a standards and testing movement, and will not be detailed here.[12] Suffice it to say that higher academic achievement for more students will be critical to enlarging the pool from which colleges and graduate schools can draw.

The Baby Boom Retires. The huge presence of the baby boomers at the various stages of aging has transformed both the educational system and the labor market. In the next decade and a half—as demographers have sometimes put it—the baby boom pig will largely complete its journey through the labor force python. The babies born in the first year after World War II turned age 55 in 2000. Accordingly, the large cohort of baby boomer scientists and engineers, with all of its accumulated knowledge and experience, will soon be retiring.

The baby boomers represent a very large number of experienced professionals, and the effects of their impending retirement on the labor market will be considerable. In 1990, there were 11.6 million 55- to 64-year-olds in the labor force; and by 2010, that number is expected to be 21.2 million—about double the number in 1990. These numbers will rapidly diminish after 2010.

The full impact of the baby boom retirements may seem distant, but in fact the time span is not very long when you consider how long it takes to turn a graduating high school senior into a scientist or engineer with a master's or a doctoral degree. Additionally, many students now take from five to six years to achieve a bachelor's degree, and the time to get a degree in graduate studies has been lengthening. And if you need more high school seniors qualified to enter these fields, how many more years do you have to reach back? Clearly, the time for action is now.

Growth and Opportunity. As the baby boomers retire, where are the young people who will go to college and graduate school to be prepared to take their place? In 2001, there were 27.2 million 18- to 24-year-olds. By 2010, we can expect an increase of 11 percent, or 3 million, bringing the total to 30.2 million. There will be, however, a very big difference in the racial and ethnic composition of these young adults than was the case when the baby boomers flooded the colleges in the 1960s. In the next ten years, the minority population will grow much more rapidly than will the majority.

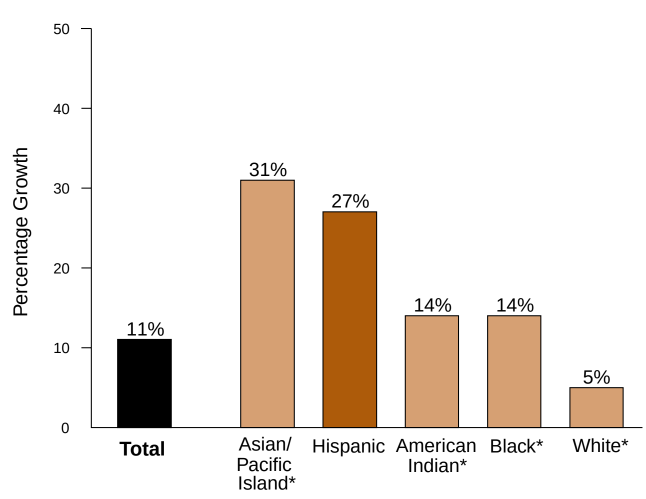
In Figure 2 we can see the difference in the growth rates over the decade. While White young adults aged 18 to 24 are expected to increase by just 5 percent from 2001 to 2010, this contrasts with a 14 percent increase among Blacks and American Indians, a 27 percent increase among Hispanics, and a 31 percent increase among Asian and Pacific Islanders.

If we look at the composition of this net growth for the decade (3 million 18- to 24-year-olds), the contrasts are considerably more striking (see Figure 3). Of the growth in 18- to 24-year-olds, just 3 in 10 will be White. Thirty-seven percent will be Hispanic, 19 percent Black, 11 percent Asian and Pacific Islander, and 1 percent American Indian. By 2010, 62 percent

11 Paul E. Barton, *What Jobs Require: Literacy, Education, and Training, 1940 to 2006*, Policy Information Center, Educational Testing Service, January 2000. To provide some perspective on how these scores compare, the average quantitative scores for persons with four or more years of college is 307 and for persons with just a high school education, 270.

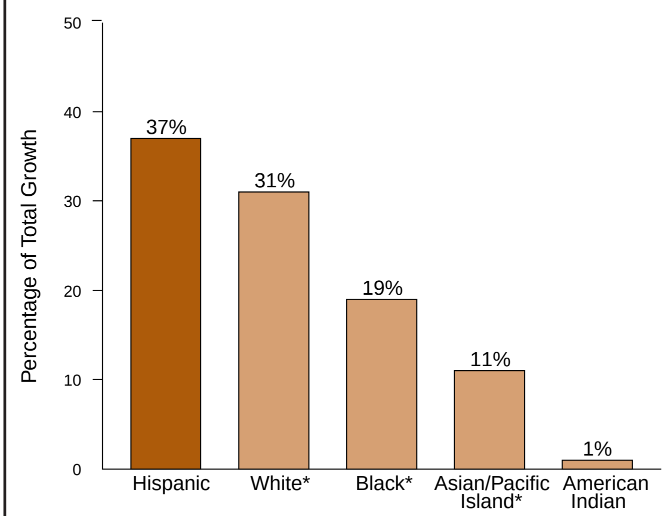
12 This author has argued that we must go far beyond these efforts; see Paul E. Barton, *Facing the Hard Facts in Education Reform*, Policy Information Perspective, Policy Information Center, Educational Testing Service, July 2001.

Figure 2: Population Growth of 18- to 24-Year-Olds, 2001 to 2010, by Racial/Ethnic Group



*Non-Hispanic
Source: U.S. Census Bureau. http://www.census.gov/population/projections/nation/summary

Figure 3: Percentage of Total Growth of 18- to 24-Year-Olds Among Racial/Ethnic Groups, 2001 to 2010



of the total population will be White, compared with 66 percent in 2001.

Looking out a bit farther, 61 percent of the growth in 18-year-olds from 2001 to 2015 will be Hispanic, with White non-Hispanics constituting only 6 percent of the growth. In other words, Hispanics are becoming an ever more important part of the labor supply.

What are the implications of these population trends? We need to increase the number of Hispanic students who complete college and graduate degrees (although their proportions have been rising). From the standpoint of equity, this will be a laudable undertaking. But it will also well serve the needs of the economy.[13]

The following section focuses on the education pipeline—the means through which we can increase the representation of Hispanic scientists and engineers. As we will see, numerous barriers must be overcome in order to realize this opportunity.

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13 A report readers may want to consult is *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology*, by the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, September 2000.

Moving Through the Education Pipeline

Looking forward to better preparation of more youth to enter the science and engineering fields requires that we be well grounded in the realities of what has been happening in the past, and where we stand today, from entry into elementary school to high school graduation and college entry and completion.

Achievement in School

If we are to attract new youth into science and engineering professions, do we have enough young people coming out of our schools to guide toward the colleges and graduate schools that produce them? The question is particularly relevant to efforts to greatly increase the representation of Hispanics and other minorities in science and engineering occupations.

Raising achievement has been high in the priorities of presidents and governors for the last two decades. The 1980s saw incremental success in that we narrowed some achievement gaps between majority and minority populations; however, we have not held on to all the ground we gained. And while we have raised average achievement scores in mathematics, science achievement has been flat.

As measured by NAEP, the fourth and eighth graders in all ethnic and racial subgroups made gains in average mathematics achievement in the 1990s. Twelfth graders also gained in mathematics from 1990 to 2000. The distribution of scores is very wide, however, and "average" scores are not good enough to enter science and engineering education. We need to know more specifically how students are doing in the upper reaches of the NAEP achievement scale. We will look at this for mathematics, a way of judging qualifications for science and engineering education.

NAEP classifies students according to three achievement levels reached on the assessment: "Basic," "Proficient," and "Advanced." Based on the NAEP description of what students at the Advanced level should know and be able to do, one might argue that this is the level of achievement needed by students leaving high school and entering science and engineering education. But in America, that would be dreaming, even after a decade and a half of real effort to set standards and raise math achievement. Only 2 or 3 percent of White twelfth graders reach the Advanced level, and minority students (except Asian and Pacific Islanders) are so few that NAEP does not report a percentage.

To be more realistic, we drop down a level to Proficient. NAEP gives this description of what twelfth-grade students at this level should know and be able to do:

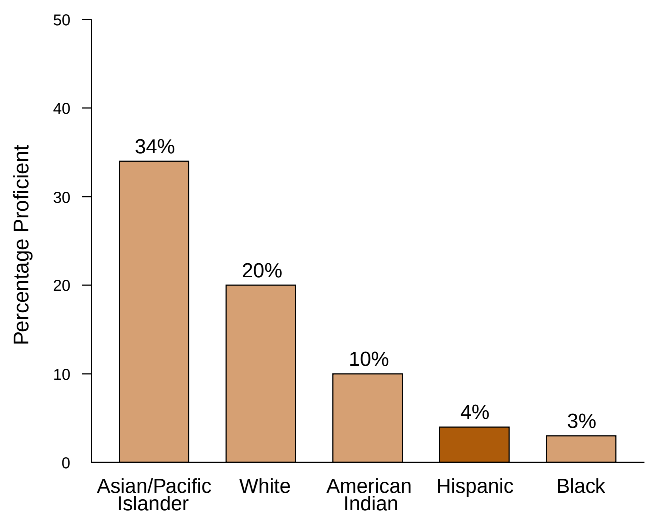
> *Twelfth-grade students performing at the* Proficient *level should consistently integrate mathematical concepts and procedures into the solutions of more complex problems in the five NAEP content strands.*
>
> *Twelfth graders performing at the* Proficient *level should demonstrate an understanding of algebraic, statistical, and geometric and spatial reasoning. They should be able to perform algebraic operations involving polynomials; justify geometric relationships; and judge and defend the reasonableness of answers as applied to real-world situations. These students should be able to analyze and interpret data in tabular and graphic form; understand and use elements of the function concept in symbolic, graphical, and tabular form; and make conjectures, defend ideas, and give supporting examples.*[14]

[14] The NAEP levels are set by the National Assessment Governing Board. James S. Braswell, et al. *The Nation's Report Card: Mathematics 2000*, U.S. Department of Education, National Center for Education Statistics, August 2001.

In the 1990s, there was a statistically significant gain in the percent of White twelfth graders who scored at or above the Proficient level, but no such gains for other groups. (There were some gains during the decade at the fourth and eighth grade levels.)

In 2000, 20 percent of White twelfth graders and 34 percent of Asian and Pacific Islanders students scored at or above the Proficient level on the NAEP mathematics assessment. In contrast, just 4 percent of Hispanic students scored at or above that level (see Figure 4).

Figure 4: Percentage of Twelfth Graders at or above the Proficient Level in NAEP Mathematics, 2000



Source: James S. Braswell, et al., *The Nation's Report Card: Mathematics 2000*, U.S. Department of Education, National Center for Education Statistics, August 2001.

There is no way to determine just what mathematics score on a NAEP test is necessary to successfully pursue majors in college leading to entry into science and engineering professions. It is not likely to be much lower than the Proficient level on NAEP. We do know that over the last 25 years or so, about a fourth of 25- to 29-year-olds have attained a bachelor's degree, somewhat above the percentage of White students who scored at or above the Proficient level on NAEP. Of course, most college majors do not require this level of mathematics. We can be sure that the small percentage of Hispanic twelfth graders at the Proficient level represents a formidable barrier to raising the representation of these minorities in science and engineering, absent very concerted and sustained national effort.

Completing High School

Raising the proportion of Hispanics with the academic achievement necessary to prepare for careers in science and engineering, as well as other occupations that require advanced study, requires not only reaching higher levels of performance in the elementary and secondary schooling periods, it also requires having a higher percent complete high school. Hispanics lag far behind in the proportion of students who complete high school and receive a diploma.

Over the last four decades there has been concern about the nation's high dropout rate, and particular concern about the high dropout rates of minority students. Over that period there have been almost countless surveys and studies of the dropout phenomenon. And there have been numerous campaigns to reduce dropping out, nationally and in individual states. It is possible that some of these efforts have had an effect in individual states, but not enough to affect the national average. Nationally, the overall high school completion rate (with students getting regular high school diplomas) has hovered around 70 percent—some estimates are lower—for the last three decades.[15]

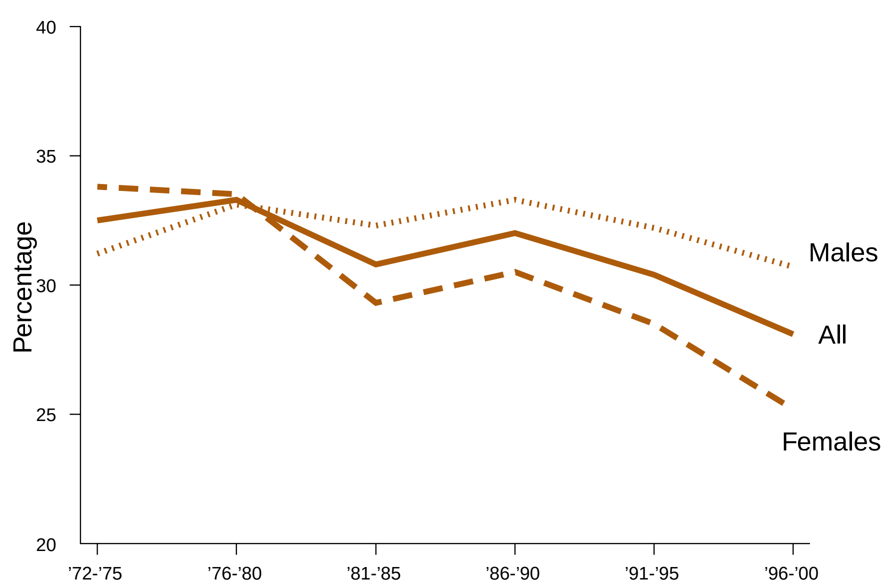
[15] The estimates are based on comparing high school diplomas to the average number of 17- and 18-year-olds in the same year. For a discussion of high school completion statistics, see see Paul E. Barton, *The Closing of the Education Frontier?*, Policy Information Report, Educational Testing Service, Policy Information Center, 2002. For an extended discussion, and several ways to estimate dropout rates, see Andrew Sum, et al., *The Hidden Crisis in the High School Dropout Problems of Young Adults in the U.S.: Recent Trends in Overall School Dropout Rates and Gender Differences in Dropout Behavior*, Center for Labor Market Studies, Northeastern University, February, 2003.

As can be seen in Figure 5, U.S. Department of Education statistics show the high school noncompletion rate for 16- to 24-year-old Hispanics dropping slightly from an average of 32.5 percent in the early 1970s (1972-75) to 28.1 percent in the last half of the 1990s (1996-2000). The improvement was partly due to a gradually declining noncompletion rate for females, dropping from 33.8 percent to 25.2 percent; the rate for males changed very little from the beginning of the period to the end. In this period, the Black noncompletion rate decreased from 21.2 percent to 13.2 percent, and the White rate from 11.8 percent to 7.4 percent.

Clearly, the steady immigration into the United States complicates our understanding of such seemingly simple statistical trends. Many Hispanic 16- to 24-years-olds went through the U.S. system of education, while others entered the United States at different grade levels in the system, or after the age of high school graduation was passed. The new arrivals brought varying degrees of previous education with them, both in terms of quality and quantity. Nevertheless, the net result is that almost three in ten Hispanics have no high school diploma, and while there is improvement for women, there is little change over this three-decade period for men.

It should be noted that these statistics count receiving the GED certificate as a high school diploma. The GED option is a useful one for people who did not receive a regular high school diploma. However, it does not have the same meaning as a regular diploma, particularly in terms of preparation to enter higher education in pursuit of professional level occupations.[16]

Figure 5: Percentage of High School Dropouts Among Hispanics, Age 16 to 24, 1972-2000



Note: This statistical series began in 1972. High school completions include the GED.
Source: National Center for Education Statistics, *Digest of Education Statistics 2001*, Table 108.

16 Barton, 2002 and Sum et al., 2003.

The noncompletion rate for Hispanic 16- to 24-year-olds is 28 percent, based on the statistics above that include the GED. The Department of Education has also published data for 18- to 29-year-olds that shows a noncompletion rate for Hispanics of 37 percent including the GED and 44 percent excluding it, compared to 13 percent and 18 percent for all 18- to 29-year-olds (1999).[17]

Accurate measurement of the high school completion rate, both for the nation and for individual states, has proven to be elusive for a number of reasons. A recent report has analyzed the problems and used several different methods of making estimates, showing completion rates lower than the above rates.[18] Also, the Manhattan Institute has issued a report providing state-by-state estimates for 1998 and 2000, by race and ethnicity, based only on public schools, and not including the GED certificate.[19] These rates are for a cohort of students going through high school.

According to the Manhattan Institute report, the estimated high school completion rates for Hispanics ranged from a high of 73 percent in Louisiana, to a low of 23 percent in Mississippi. The estimated rate for Texas was 57 percent, and California, 55 percent. These low completion rates among Hispanic youth are a serious limitation on the pool of young people with the academic achievement necessary to advance to institutions of higher education, and to succeed in reaching occupations such as those in science and engineering fields.

While these measures try to get at overall rates of high school completion, they miss an important aspect of Hispanic school experience referred to earlier: the difference between native-born and foreign-born Hispanics.[20] In the period from 1970 to 2000, the *native-born* Hispanic high school completion rate rose from 40 percent to 60 percent. Considerable progress has been made for Hispanic youth attending U.S. schools.[21] Also, the completion rate is higher than the overall rate among immigrant Hispanic youth who were ever enrolled in U.S. schools. Some of the variation in completion rates among the states could be due to the proportion who are native-born, as well as differences in the sources of immigration.[22]

Together, these data show only slight progress in the average high school noncompletion rate for all Hispanic students. Although rates for native-born Hispanic youths and for females have been improving, the rate for males has remained essentially unchanged in recent years. *Increasing high school completion rates will require very substantial and sustained efforts*. These efforts must address not only academic but also individual financial needs. For example, in the Hispanic community, there is often a need for teenagers to work. In fact, Hispanic teenagers "work and earn more than anyone else in their age group including Whites," according to a recent report by Richard Fry and B. Lindsay Lowell.[23] The working and studying behaviors of Hispanic youth are thoroughly explored in that report and provide insight into the complexity of the issues at hand.

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17 Derived from *Digest of Education Statistics, 2001,* National Center for Education Statistics, Table 107. The footnote to the table refers to unpublished data from the Current Population Survey.

18 Sum, et al., 2003

19 Jay P. Greene and Marcus A. Winters, *Public School Graduation Rates in the United States*, The Manhattan Institute, p. 2 and Table 2, 2002.

20 I am indebted to Richard Frey of the Pew Hispanic Center for educating me on the information available.

21 George Vernez and Lee Migell, *Monitoring the Education Progress of Hispanics*, RAND Corporation, DRU-2837-HSF.

22 National Center for Education Statistics, "Dropout Rates in the United States: 1995," July, 1997, NCES 97-473.

23 Richard Fry and B. Lindsay Lowell, *Work or Study: Different Fortunes of U.S. Latino Generations*, Pew Hispanic Center, 2002.

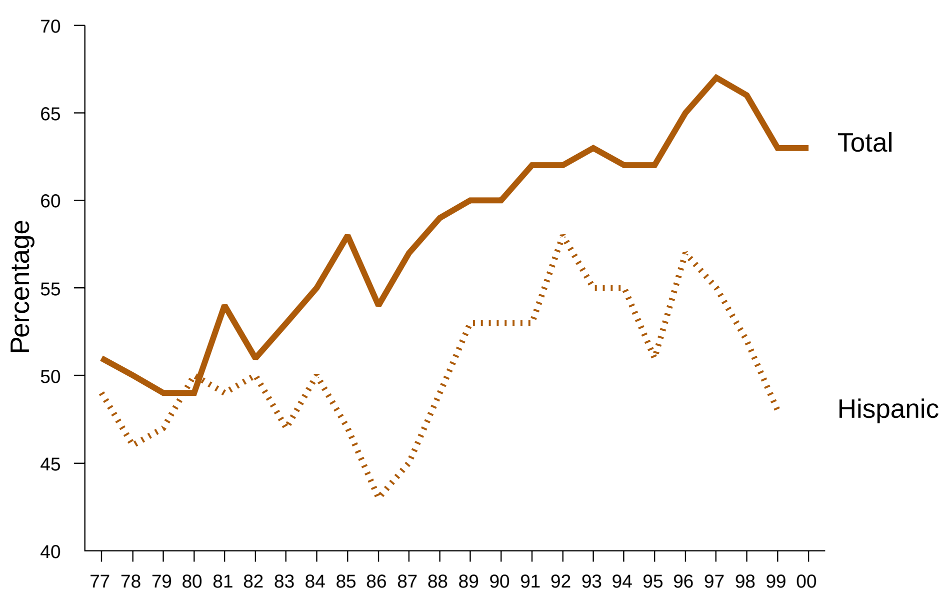
To increase the proportion of Hispanics who are equipped to complete college and enter the more financially rewarding science and engineering occupations, it will be necessary to ensure that more obtain a rigorous high school education—a critical point in the education pipeline.

College Entry and Persistence

Of Hispanic students who complete high school, how many enter college and get on a track that can lead to professional jobs and the highly demanding positions in science and engineering? Figure 6 shows the history of college entry back to the late 1970s. While the national college-going rate for high school graduates was right at the 50 percent mark from 1977 until the early 1980s, the Hispanic rate matched the rate for all graduates quite closely. Then, the national rate started a steady climb all the way to the late 1990s, moving to a peak of 67 percent in 1997. Since then it has slipped down to 64 percent in 2000.

The Hispanic rate of college entry stayed at about half—moving up and down a few percentage points—until 1990. Then it began to climb to the high 50s until the middle of the 1990s. For the next three years

Figure 6: College Enrollment Rates for High School Completers*, 1977 to 2000



Note: Annual data are used for total population, while a 3-year moving average is published by NCES for Hispanics because of variability of annual data due to smaller sample sizes.

*Individuals age 16 to 24 who graduated from high school or completed a GED during the preceding 12 months.

Source: National Center for Education Statistics, *The Digest of Education Statistics 2001*, Table 184.

it dropped back to 48 percent, and by the end of the decade it had returned to where it began in 1977 when statistics for Hispanics first became available.

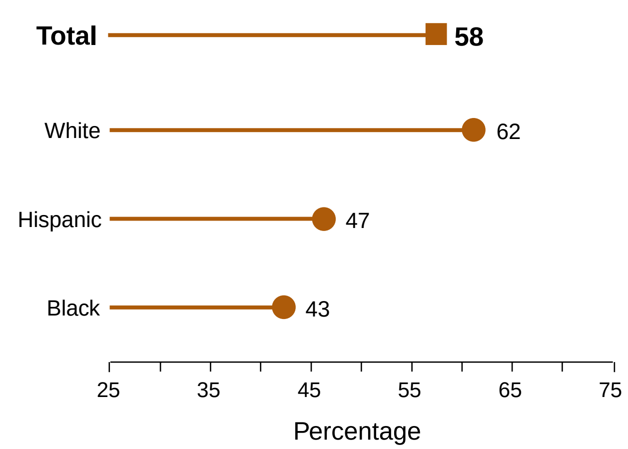
Enrolling in college is a good start. But getting to the higher rungs of the occupational ladder—and into science and engineering—requires completing college and obtaining a degree. The United States does not excel in moving students through college to completion. An ETS report published in 2002 concluded that "...it is clear that more and more young people are starting down the college path and not reaching their destination." It also reported that the United States "has lost it preeminence in the world in higher education completion rates, and 13 countries have a lower dropout rate."[24]

College completion rates generally are lower for minority students, as can be seen in Figure 7. While Whites (ages 25 to 29) with a four- or two-year college degree are 62 percent of those who have some college education, the percent is just 47 for Hispanics; more than half are starting and not earning degrees.[25]

In the fall of 2002, the Pew Hispanic Center issued a report titled *Latinos in Higher Education: Many Enroll, Too Few Graduate*. Author Richard Fry sums it up this way:

> *These findings clearly show that large numbers of Latinos finish their secondary schooling and try to extend their education but fail to earn a degree. Heretofore, policymakers and researchers concerned with Hispanic educational achievement have focused most intently on issues related to primary and secondary education, especially high school dropout rates. Those issues are undoubtedly important. This report, however, demonstrates that significant gains can be made with policy initiatives targeted at Latinos who graduated from high school, who applied for and were granted admission to a two- or four-year college and who were enrolled.*[26]

Figure 7: 1998 College Completion, 25- to 29-Year-Olds with a Four- or Two-Year Degree as a Percentage of Those with Some College, by Racial/Ethnic Group



Source: Derived from Bureau of the Census Current Population Survey, unpublished data.

In terms of getting more Hispanics qualified to enter science and engineering, it is especially important that we help assure that high-achieving Hispanic youth persevere to a degree. It is a matter of assistance to help college entry and completion, and a matter of conditions that promote persistence on the part of the students.

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24 Barton, 2002.

25 The data source does not permit examining completion rates separately for those entering two- and four-year colleges.

26 Richard Fry, *Latinos in Higher Education: Many Enroll, Too Few Graduate*, Pew Hispanic Center, 2002, p. V.

Challenges and Prospects for Progress

This report has been about the outlook for supply and demand for science and engineering occupations, the state of preparation of students to pursue these occupations in colleges and graduate schools, the relative preparation of Hispanic youth, and the extent to which Hispanics are making headway in increasing their representation in these professions. In order to look at the position and prospects for Hispanics, we have to look at the total situation in these professions, for prospects would be bleak if we were facing surpluses in these occupations at a time when we were trying to expand minority representation.

In order to examine the needs of science and engineering generally, we have to be concerned with the adequacy of academic preparation generally, as well as of underrepresented minorities. The United States has well-recognized weaknesses in turning out a high proportion of high-achieving students in math and science; these are simply magnified when we look at the preparation of minorities in math and science—the critical prerequisites for successful pursuit of degrees in science and engineering.

We find a very high rate of under-preparation of Hispanics and other under-represented minorities, and it is also the case that large percentages of these students are going to schools where most all of the students have low achievement. Thus, there is an intertwining of measures needed to raise Hispanic student achievement, and measures needed to raise achievement in under-performing schools generally.

The measures that are receiving priority in the standards-based education reform movement are intended both to raise achievement overall and to reduce gaps between majority and minority student populations.[27] And when we look at where we are going to get more scientists and engineers from our population growth, we run into the stark fact that the minorities are the majority. Among 18- to 24-year-olds, Whites will constitute only 31 percent of the net growth in that population up to 2010, and 62 percent of that total population group. There is thus no clear demarcation between a discussion of the needs in the science and engineering arena in general, and a discussion of the needs of increasing Hispanic and other minority representation in specific.

Starting Early. The medical profession and the Surgeon General have established that cigarette smoking causes lung cancer, and warn us not to start. But we are also told that if we have been smoking, no matter how long, we improve our chances if we stop. Likewise, our best chances for increasing achievement in mathematics and science will come from greatly expanded *early* childhood development and education. This will provide more equal starting points, which is critical if we are to: a) reduce the inequities of achievement in the K-12 period of education, and b) enlarge the pool of high school graduates who are prepared to pursue careers in science and engineering.

The National Assessment of Educational Progress has well established that the achievement disparities found among racial-ethnic groups in the twelfth grade are also found in the eighth and fourth grades. These disparities do not just spring up from nowhere; they are already there when young children enter school, and even earlier, as a result of the different life experiences in the early years.[28] In fact, a longitudinal study currently being carried out by the National Center for

[27] However, we have made no progress in reducing gaps between achievement of the majority and minorities in the period of emphasis on standards-based reform. For one account, see Paul E. Barton, *Raising Achievement and Reducing Gaps: Reporting Progress Toward Goals for Academic Achievement in Mathematics*, a report to the National Education Goals Panel, January 2002.

[28] Richard J. Coley, *An Uneven Start: Indicators of Inequality in School Readiness*, Policy Information Report, Policy Information Center, Educational Testing Service, March 2002.

Education Statistics provides clear evidence that disparities in cognitive development are present when children begin kindergarten.[29]

Clearly, we can do things later that will reduce inequality of achievement in grade school and high school. But these measures will be less effective, and the gains smaller and likely more expensive, the longer we delay. The case for an early start is not only being made by professionals in the field of early childhood development. Early intervention is recognized as critical to all goals for educational achievement, and for the economy and nation as a whole. The prestigious Committee for Economic Development, a business organization, released a report in February 2002 entitled *Preschool for All: Investing in a Productive and Just Society*. It had this to say:

> *For too long, the United States has paid lip service to the importance of preschool opportunities that prepare children for school without undertaking the level of investment needed to turn promise into reality. Just as we have long seen elementary and secondary education for all as a societal responsibility, we must now undertake to extend educational opportunity to all children age 3 and up.*[30]

Improving Mathematics and Science Instruction and Curriculum. The quality of teaching in mathematics and science has recently been put under the microscope by the National Commission on Mathematics and Science Teaching for the 21st Century, chaired by John Glenn. The Commission was composed of 25 leaders from the fields of government, business, and education. The urgency of the situation is conveyed by the title, *Before It's Too Late*. Its perspective is this:

First, at the daybreak of this new century and millennium, the Commission is convinced that the future well-being of our nation and people depends not just on how well we educate our children generally, but how well we educate them in mathematics and science specifically . . .

Second, it is abundantly clear from the evidence already at hand that we are not doing the job that we should do—or can do—in teaching and use of ideas from these fields. Our children are falling behind; they are simply not "world class learners" when it comes to mathematics and science . . .

Third, after an extensive, in-depth review of what is happening in our classrooms, the Commission has concluded that the most powerful instrument for change, and therefore the place to begin, lies at the very core of education—with teaching itself . . .

Fourth, we believe that committing ourselves to reach three specific goals can go far in bringing about the basic changes we need. These goals go directly to issues of quality, quantity, and an enabling work environment for teachers of mathematics and science . . . Specifically, we offer suggestions on how to:

- *Establish an ongoing system to improve the quality of mathematics and science teaching in grades K-12;*
- *Increase significantly the number of mathematics and science teachers and improve the quality of their preparation; and*
- *Improve the working environment and make the teaching profession more attractive for K-12 mathematics and science teachers.*[31]

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[29] For early findings and a description of the survey, see Jerry West, Kristin Denton, and Elvira Geronimo-Hausken, *America's Kindergartners*, National Center for Education Statistics, 2000.

[30] Committee for Economic Development, *Preschool for All: Investing in a Productive and Just Society*, a Statement of the Research and Policy Committee, 2002.

[31] *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century*, September 2000.

The Commission provides a thorough assessment of the state of mathematics and science teaching and a comprehensive set of measures to improve it. Strengthening instruction is critical to getting more students at the top level of achievement needed to enter science and engineering, and critical to reducing the wide disparity by race and ethnicity that now exists at the Proficient level of performance on the NAEP math and science assessments.

We note a very recent and promising development in the Southern Regional Education Board's High Schools That Work Consortium involving 26 states and over 1,100 high schools. The consortium is launching a "Pre-Engineering Course of Study" that begins in the middle grades and extends through high school. The goal is to "increase the number and quality of engineers and engineering technologists by providing:

- A fully developed curriculum for high schools;

- A middle grades technology curriculum;

- Extensive training for teachers;

- Training for school counselors;

- Access to affordable equipment; and

- College-level certification and course credit."[32]

High Minority Achievement. Many analyses and proposals have dealt generally with the gap between majority and minority achievement. Typically they point to the difference in average scores, or to the much higher incidence of low scores on standardized tests. The specific focus of this report is increasing the proportion of high scorers. We have pointed out that this proportion among Hispanic students lags far behind White students (who lag behind Asian American students). However, not long ago, the shortage of high achievers was dealt with in depth by the National Task Force on Minority High Achievement appointed by the College Board. After over two years of work, it issued a report titled *Reaching the Top*. Its concern about high achievement differed from earlier efforts that addressed the gap in general. The report stated the task force's goal this way:

> *The National Task Force on Minority High Achievement was convened by the College Board to address a relatively neglected aspect of the situation: the reality that far too few Black, Hispanic and Native American students are reaching the highest levels of achievement. The Task Force also has been asked to address a related issue: the fact that large disparities in achievement exist between students from these groups and White and Asian American students at essentially all socio-economic levels. Until many more underrepresented minority students from disadvantaged, middle class, and upper class circumstances are very successful educationally, it will be virtually impossible to integrate our society's institutions completely, especially at leadership levels. Without such progress, the United States also will continue to be unable to draw on the full range of talents in our population during an era when the values of an educated citizenry have never been greater.*[33]

The roots of unequal achievement are deep in the American economy and society. But it is not just a problem of getting achievement up to some minimum (the way we approached it in the 1970s). It is also getting a higher portion up to a maximum. A new and comprehensive analysis of literacy in America, from an international perspective, carried the title *The Twin*

32 This will be carried out by SREB through a partnership with Project Lead the Way, Inc. See *HSTW Presents a Pre-engineering Program of Study*, Southern Regional Education Board, Atlanta, or visit these websites: www.sreb.org and www.pltw.org.

33 The College Board, *Reaching the Top*, *Report of the National Task Force on Minority High Achievement*, 1999.

Challenges of Mediocrity and Inequality. After establishing the extent of inequality and mediocrity in adult literacy in the United States, the authors warn:

> *The continued high levels of inequality in literacy, math, and science knowledge among elementary and secondary students, young adults, and the entire adult population of the United States do not bode well for the future outlook on inequality in the schools, the economy, the labor market, and our social and civic life. If we fail to reduce the degree of inequality in literacy skills over the coming decade, then the cognitive demands for access to most high-skilled, high-wage jobs in the U.S. labor markets and for actual participation in civic and political life will create a bifurcated distribution of economic and political rewards in the future.*[34]

We can add that we will be unlikely to meet the expanding need for scientists and engineers with this degree of mediocrity in achievement, nor will we be successful in further raising the proportion of minority group members in these professions.

Sources of Inequality and Mediocrity. It is probably impossible to use the tools of social science research to unravel all the determinants of educational achievement, although sufficient brainpower, unlimited access to all the relevant data, and adequate resources for analyzing it, might get us reasonably close. The undertaking seems as monumental as the project to map the human genome. Even if we succeeded, in the end we would be left with a voluminous list of factors and conditions found to be "associated" (correlated) with academic achievement; actual "causes" would remain elusive.

We do know that a large set of school factors, student characteristic factors, family and resource factors, and community factors is involved in academic achievement. Various research efforts have tackled pieces of this mystery, using data sets often designed for other purposes; some light filters through the clouded windows. We will not attempt a synthesis here. But one fairly recent study by the staff of the National Center for Education Statistics is particularly relevant to the topic of this report and is quite comprehensive.

This study and report was a collaborative effort between the National Center for Education Statistics of the U.S. Department of Education and the Division of Science Resource Studies of the National Science Foundation. It uses several databases, the most important of which is the National Longitudinal Study of eighth graders and the first follow-up study when they were tenth graders. The report, *Understanding Racial-Ethnic Differences in Secondary School Science and Mathematics Achievement*,[35] used the conceptual framework shown in Figure 8 and derived from a synthesis of previous research.

The analysis involved 39 variables clustered in accordance with the above framework. The principal findings were as follows:

- The underrepresentation of Blacks, Hispanics, and American Indians in science and mathematics-related fields "reflects in large part the outcomes of their education at all levels."

- All racial-ethnic groups of students were found to "have equally positive attitudes toward science and learning in school, and they have similar aspirations for science and mathematics-related careers."

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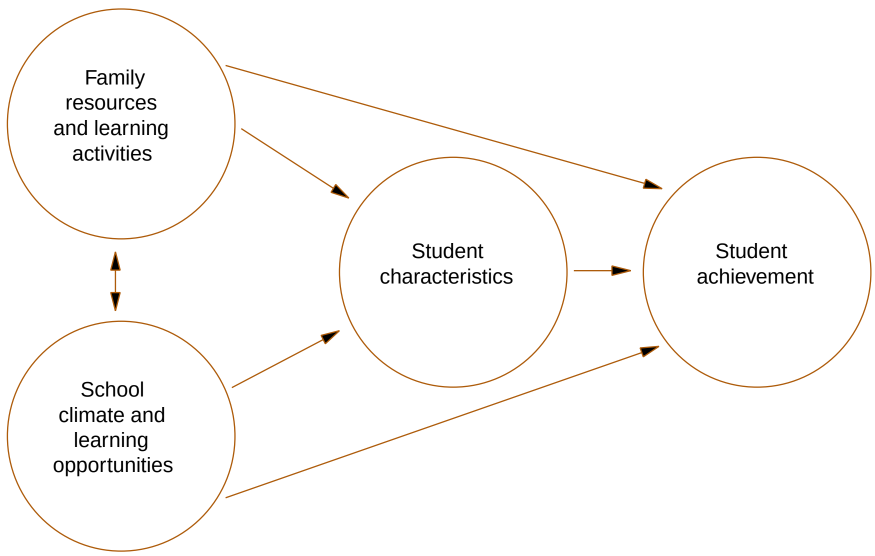
[34] Andrew Sum, Irwin Kirsch, and Robert Taggart, *The Twin Challenges of Mediocrity and Inequality: Literacy in the U.S. from an International Perspective*, Policy Information Report, Policy Information Center and the Center for Global Assessment, Educational Testing Service, February 2002.

[35] Samuel S. Peng, DeeAnn Wright, and Susan T. Hill, *Understanding Racial-Ethnic Differences in Secondary School Science and Mathematics Achievement*, U.S. Department of Education, National Center for Education Statistics, February 1995.

Figure 8: Conceptual Framework for Studying Science and Mathematics Education



Source: Samuel S. Peng and Susan T. Hill, *Understanding Racial-Ethnic Differences in Secondary School Science and Mathematics Achievement*," National Center for Education Statistics, February 1995.

- As many minority students grew older, however, interest waned as they fell behind in science and mathematics achievement.

- The following factors were found to be associated with lower achievement in science and mathematics:

a. **Socioeconomic status and home support for learning**. "A larger percentage of these minority students come from families in poverty, and their parents are more likely to have low educational levels and to be unemployed. Thus, they are less likely to have learning materials and educational activities at home and to participate in educational activities outside of school. Their parents are less likely to provide adequate mentoring or role models for science and mathematics learning and also are less likely to have high educational expectations for them."

b. **School characteristics**. "A larger percentage of these minority students attend disadvantaged schools where the overall academic and supporting environments are less conducive to learning. Their schools have lower achievement scores and more discipline and safety problems. Their schools also do not or cannot place as much emphasis on learning and grade completion as other schools. Students in these environments are less likely to have a strong peer group or community support to encourage them to work hard in school."

c. **Level of school involvement**. "A larger percentage of the minority students suffer from the lack of persistent effort and active involvement in school. They are perceived more often by teachers as being inattentive and frequently disruptive in class. They are also more likely to fail to complete homework and to perform below their ability."

d. **Type of high school program**. "A larger percentage of these minority students reported that they were in a low track achievement group and non-college preparatory high school programs. Consequently, they have received less rigorous academic training and have failed to obtain enough preparation,

> competence, or motivation to take more high-level courses that prepare them for science and mathematics-related fields."

According to the study's authors, "each of the(se) home, school, and individual factors separately accounts for a small proportion of the achievement differences between these minority students and white and Asian students, based on the results of regression analyses. However, when these variables are considered jointly, their relationship with achievement differences is higher, i.e., the achievement differences are 45 percent less than if the students have the same value on all selected variables in the study." In other words, numerous factors are associated with differences in science and mathematics achievement, and all together, they explain less than half of the achievement differences. But the 45 percent that is associated with achievement is higher than typically found in such studies, and not to be dismissed lightly.

A Matter of Assistance and Persistence. Even for those high-school students who reach a level of achievement that qualifies them to enter college with the goal of pursuing a science or math degree, a number of hurdles remain. They need the counseling and support that will help them realize they can go to college and succeed. And they need help with all of the associated tasks that need to be done—finding the right college, taking admissions tests, filing applications, obtaining recommendations, and completing financial aid forms. The ratio of counselors to students in high schools is pitifully low, and this vital element has largely been ignored over the last two decades of education reform.

Not only will counseling and guidance be in short supply for this assistance, but many students from backgrounds deficient in resources lack the help at home and from relatives that is readily available to students with higher income parents who themselves are college graduates. For those who seek to increase college attendance among those qualified to go, this is a situation not to be ignored. Beyond increasing the ratio of guidance counselors to students, the need for guidance and counseling support could be met with supplementation from volunteers and from staff loaned by the personnel offices of concerned corporations.

The financial barriers to higher education have received considerable attention. Since the 1970s, federal and state financial aid programs have emerged and become critical to increased college attendance among minority students who are not in the upper brackets of family income.

An adequate supply of candidates for graduate study, of course, requires an adequate supply of college students in science, mathematics, and engineering who persisted and completed four years (or more) and received their degrees. However, a high proportion of those who enter college in all fields fall by the wayside. It is especially important for science and engineering that we help insure that high-ability Hispanic and other minority students persevere to a degree.

In 1989, Educational Testing Service completed a large research project on the subject of persistence, undertaken at the request of the National Science Foundation's Committee on Equal Opportunities in Science and Engineering. The goal was to determine why some high-ability minority students persist and some do not. High ability was defined as achieving SAT mathematical scores of 550 or above; the sample consisted of 5,000 underrepresented minority students. The findings were as follows:

- High-ability minority students persisted to an unusually high degree. The non-persistent mostly transferred to other fields; few were dropouts.
- In general, what seemed to distinguish the persisters most from the balance of the sample was: 1) their finding the study of math, science, or engineering at the college level enjoyable, interesting, or rewarding; and 2) their personal commitment to mathematics, science, and engineering as a career. Taken together,

these results point to the critical importance of the educational climate of undergraduate schools, and especially the quality of instruction in first year math and science courses.

- "At the high school level, what distinguished the persisters most from the other groups was their greater participation in math and science clubs, in honors courses and advanced placement courses in math and science, and in science activities."

  "College-based minority recruitment/enrichment programs also made a difference."

  "The persisters reported that scientists and engineers they knew or knew about or met in summer jobs and part-time work, especially minority scientists and engineers, influenced them more than parents, friends, and teachers did, although these figures were still important . . . high priority should be given to programs that provide promising minority students with opportunities for part-time and summer work in science and engineering."

- When other factors are controlled, "Ethnicity per se contributed little to the prediction" of persistence.[36]

These findings relate to those students already enrolled in college. Another key question is, what kind of students graduating from high school actually persist in college? An answer to that question will tell us a lot about how to improve the high school experience for minority—and all—students showing an interest in science and mathematics, as well as how to identify candidates for college who are likely to complete their degrees.

A very important and recent research study has found that the intensity of the high school curriculum is the most important factor in predicting whether a minority student will successfully complete college and receive a bachelor's degree. This finding emerges from an extensive analysis of "High School and Beyond" Longitudinal Survey data, including student transcripts, carried out at the U.S. Department of Education.[37] The rigor of the high school courses taken is a better predictor of completion to degree than either test scores or GPA/class rank, as seen in Table 3.

Examining courses taken is important in identifying minority students with the best chance to succeed. Taking rigorous courses may help make up somewhat for lower standardized test scores. Of course, schools that offer more rigorous courses may also often be schools that have better student support systems in place.

Table 3: Percent Completing to Bachelor's Degree*

Highest 40% on Scale	White	Black	Latino	Asian
Rigorous Curriculum	86	73	79	89
Test Scores**	81	67	67	95
GPA/Class Rank	79	59	57	85

*Among students who entered 4-year colleges directly from on-time high school graduation.
** Scores on tests given as part of the Longitudinal Study, not on SAT or ACT tests.

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36 Thomas L. Hilton et al., *Persistence in Science of High-Ability Minority Students*, RR-89-28, Educational Testing Service, May 1989.

37 Clifford Adelman, *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment*, U.S. Department of Education, June 1999.

Clifford Adelman, the study's author, summed up the results as follows: "If we are genuinely interested in improving the degree completion rates of minority students, which of these indicators would we rather use? The answer, as they say, is a 'no-brainer': the only field on which we can exercise change. A test score is a snapshot of performance on a Saturday morning. Secondary school grades—and the relative standing that they produce in 'classes' where the student body may be constantly changing—carry as much reliability as a pair of dice.[38] But the intensity and quality of curriculum is a cumulative investment of years of effort—in schools, teachers, and students, and provides momentum into higher education and beyond. It obviously pays off."

* * * *

Together these facts and research findings can help inform and guide efforts to find ways and means of raising the preparation of students generally—especially Hispanic and other minority students—who are prepared to pursue college and graduate degrees and ultimately careers in science and engineering. This review covers a long time period, from the cradle to the graduate degree. The earlier the effort is made, the more likely the success will be. But there is also realization that improvement can be made at any stage we begin.

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38 R. Elliott and A. C. Strenta, "Effects of Improving the Reliability of the GPA on Prediction Generally and on Comparative Predictions for Gender and Race Particularly," *Journal of Educational Measurement, 25* (4), pp. 333-347 (as cited in Adelman, 1999).

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Engineer Occupations Projections to 2010

Employment in engineering occupations will grow by 138,000, or 9 percent, from 2000 to 2010, with 432,000 total job openings to fill. While growth in some specialities will be modest, three will grow by 25 percent or more.

Growth in Engineering Occupations*

(Numbers in Thousands)

	2000	2010	Growth		Total Job Openings** 2000-2010
			Number	Percent	
All Engineers	**1,465**	**1,603**	**138**	**9**	**432**
Aerospace Engineers	50	57	7	14	22
Agricultural Engineers	2	3	0	15	1
Biomedical Engineers	7	9	2	31	4
Chemical Engineers	33	34	1	4	7
Civil Engineers	232	256	24	10	60
Computer Hardware Engineers	60	75	15	25	23
Electrical and Electronic Engineers	288	319	31	11	84
Environmental Engineers	52	66	14	26	24
Industrial Engineers	198	210	12	6	45
Marine Engineers and Naval Architects	5	5	0	2	1
Materials Engineers	33	35	2	5	9
Mechanical Engineers	221	251	29	13	94
Mining and Geological Engineers, including Mine Safety	6	6	0	-1	1
Nuclear Engineers	14	14	0	2	3
Petroleum Engineers	9	8	-1	-7	2
All Other Engineers	253	254	1	0	51

*David E. Hecker, "Employment Outlook: 2000-10," *Monthly Labor Review*, November 2001, page 65.
**Job openings due to growth in the economy and the net replacement needs resulting from workers who leave the labor force or transfer to other occupations.

Computer and Math Occupation Projections to 2010

Employment in Computer Specialist occupations will grow by almost 2 million — almost 70 percent — from 2000 to 2010, with 2.26 million total job openings to fill; some specialties will almost double. Mathematical Science occupations will experience no or modest growth, although Operations Research Analysts will increase by 8 percent.

Growth in Computer and Mathematical Occupations*

(Numbers in Thousands)

			Growth		Total Job Openings**
	2000	**2010**	**Number**	**Percent**	**2000-2010**
Computer Specialist Occupations	**2,903**	**4,894**	**1,991**	**69**	**2,259**
Computer Programmers	585	680	95	16	217
Computer Scientists and Systems Analysts	459	729	269	59	309
Computer Software Engineers	697	1,361	664	95	711
Computer Support Specialists	506	996	490	97	512
Database Administrators	106	176	70	66	74
Network and Computer Systems Administrators	229	416	187	82	197
Network Systems and Data Communications Analysts	119	211	92	78	97
All Other Computer Specialists	203	326	123	61	141
Mathematical Science Occupations	**89**	**95**	**5**	**6**	**26**
Actuaries	14	15	1	5	3
Mathematicians	4	4	0	-2	0
Operations Research Analysts	47	51	4	8	19
Statisticians	19	20	0	2	3
Miscellaneous	5	5	0	3	1

*David E. Hecker, "Employment Outlook: 2000-10," *Monthly Labor Review*, November 2001, page 65.
**Job openings due to growth in the economy and the net replacement needs resulting from workers who leave the labor force or transfer to other occupations.

Life and Physical Scientists Occupations Projections to 2010

Employment in Life and Physical Sciences will grow by 77,000 -— almost a fifth — from 2000 to 2010, with 217,000 job openings to fill. The percentage increase will be the same for both Life and Physical Scientists. The highest growth rate will be among Medical Scientists. The largest number of job openings will be among Environmental and Geo-Scientists.

Growth in Life and Physical Scientists Projections*
(Numbers in Thousands)

			Growth		Total Job Openings**
	2000	2010	Number	Percent	2000-2010
Life Scientists	**184**	**218**	**33**	**18**	**93**
Agricultural and Food Scientists	17	19	2	9	7
Biological Scientists	73	88	15	21	42
Conservation Scientists and Foresters	29	31	2	8	12
Conservation Scientists	16	18	1	8	7
Foresters	12	13	1	7	5
Medical Scientists	37	47	10	27	18
All Other Scientists	28	33	4	16	15
Physical Scientists	**239**	**283**	**44**	**18**	**124**
Astronomers and Physicists	10	11	1	11	4
Atmospheric and Space Scientists	7	8	1	17	3
Chemical and Materials Scientists	92	110	18	19	47
Chemists	84	100	16	19	43
Materials Scientists	8	9	2	20	4
Environmental Scientists and Geo-Scientists	97	118	21	22	52
All Other Physical Scientists	33	36	3	9	17

*David E. Hecker, "Employment Outlook: 2000-10," *Monthly Labor Review*, November 2001, page 66.
**Job openings due to growth in the economy and the net replacement needs resulting from workers who leave the labor force or transfer to other occupations.

JOB OUTLOOK FOR ENGINEERS

- **Overall engineering employment is expected to increase more slowly than the average for all occupations. However, overall job opportunities in engineering are expected to be good through 2010 because the number of engineering degrees granted is not expected to increase significantly over the 2000-10 period.** Projected employment growth and, thus, job opportunities vary by specialty, ranging from a decline in employment of mining and geological engineers to faster-than-average growth among Environmental Engineers. Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to further increase productivity, as investment in plant and equipment increases to expand output of goods and services. New computer and communications systems have improved the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past and to collaborate on designs with other engineers throughout the world. Despite these widespread applications, computer technology is not expected to limit employment opportunities. Finally, additional engineers will be needed to improve or build new roads, bridges, water and pollution control systems, and other public facilities.

- The number of bachelor's degrees awarded in engineering began declining in 1987 and has continued to stay at about the same level through much of the 1990s. The total number of graduates from engineering programs is not expected to increase significantly over the projection period.

- Although only a relatively small proportion of engineers leaves the profession each year, many job openings will arise from replacement needs. A greater proportion of replacement openings is created by engineers who transfer to management, sales, or other professional occupations than by those who leave the labor force.

- Most industries are less likely to lay off engineers than other workers. Many engineers work on long-term research and development projects or in other activities that continue even during economic slowdowns. In industries such as electronics and aerospace, however, large cutbacks in defense expenditures and government research and development funds, as well as the trend toward contracting out engineering work to engineering services firms, have resulted in significant layoffs for engineers.

Source: Extracted from the *Occupational Outlook Handbook, 2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR COMPUTER SOFTWARE ENGINEERS

- **Computer software engineers are projected to be the fastest growing occupation from 2000 to 2010.** Very rapid employment growth in the computer and data processing services industry, which employs the greatest numbers of computer software engineers, should result in very favorable opportunities for those college graduates with at least a bachelor's degree in computer engineering or computer science and practical experience working with computers. Employers will continue to seek computer professionals with strong programming systems analysis, interpersonal, and business skills.

- Employment of computer software engineers is expected to increase much faster than the average for all occupations as businesses and other organizations continue to adopt and integrate new technologies and seek to maximize the efficiency of their computer systems. Competition among businesses will continue to create an incentive for increasingly sophisticated technological innovations, and organizations will need more computer software engineers to implement these new technological changes. In addition to employment growth, many job openings will result annually form the need to replace workers who move into managerial positions, transfer to other occupations, or who leave the labor force.

- Demand for computer software engineers will increase as computer networking continues to grow. For example, the expanding integration of Internet technologies and the explosive growth in electronic commerce-doing business on the Internet-have resulted in rising demand for computer software engineers who can develop Internet, Intranet, and other web applications. Likewise, expanding electronic data processing systems in business, telecommunications, government, and other settings continue to become more sophisticated and complex. Growing numbers of systems software engineers will be needed to implement, safeguard, and up-date systems and resolve problems. Consulting opportunities for computer software engineers also should continue to grow as businesses increasingly need help to manage, up-date, and customize their increasingly complex computer systems.

Source: Extracted from the *Occupational Outlook Handbook, 2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR SYSTEMS ANALYSTS, COMPUTER SCIENTISTS, AND DATABASE ADMINISTRATORS

- **Systems analysts, computer scientists, and database administrators are expected to be among the fastest growing occupations through 2010. Employment of these computer specialists is expected to increase much faster than the average for all occupations as organizations continue to adopt and integrate increasingly sophisticated technologies.** Growth will be driven by very rapid growth in computer and data processing services, which is projected to be the fastest growing industry in the U.S. economy. In addition, many job openings will arise annually from the need to replace workers who move into managerial positions or other occupations or who leave the labor force.

- The demand for networking to facilitate the sharing of information, the expansion of client/server environments, and the need for computer specialists to use their knowledge and skills in a problem-solving capacity will be major factors in the rising demand for systems analysts, computer scientists, and database administrators. Moreover, falling prices of computer hardware and software should continue to induce more businesses to expand computerized operations and integrate new technologies. In order to maintain a competitive edge and operate more efficiently, firms will continue to demand computer specialists who are knowledgeable about the latest technologies and are able to apply them to meet the needs of businesses.

- Increasingly, more sophisticated and complex technology is being implemented across all organizations, which should fuel the demand for other computer occupations. There is a growing demand for system analysts to allow firms to maximize their efficiency by using available technology. The explosive growth in electronic commerce-doing business on the Internet-and the continuing need to build and maintain databases that store critical information on customers, inventory, and projects is fueling demand for database administrators familiar with the latest technology.

Source: Extracted from the *Occupational Outlook Handbook*, 2002-2003, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR PHYSICISTS AND ASTRONOMERS

- **Historically, many physicists and astronomers have been employed on research projects-often defense-related. Because defense expenditures are expected to increase over the next decade, employment of physicists and astronomers is projected to grow about as fast as the average for all occupations, through the year 2010. The need to replace physicists and astronomers who retire will, however, account for most expected job openings.** The Federal Government funds numerous noncommercial research facilities. The Federally Funded Research and Development Centers (FFRDCs), whose missions include a significant physics component, are largely funded by the Department of Energy (DOE) or the Department of Defense (DOD), and their R&D budgets did not keep pace with inflation during much of the 1990s. However, Federal budgets have recently increased for physics-related research at these centers, as well as other agencies such as NASA. If R&D funding continues to grow at these agencies, job opportunities for physicists and astronomers, especially those dependent on Federal research grants, should be better than they have been in many years.

- Although research and development budgets in private industry will continue to grow, many research laboratories in private industry are expected to continue to reduce basic research, which includes much physics research, in favor of applied or manufacturing research and product and software development. Nevertheless, many persons with a physics background continue to be in demand in the areas of information technology, semiconductor technology, and other applied sciences. This trend is expected to continue; however, many of these positions will be under job titles such as computer software engineer, computer programmer, engineer, and systems developer, rather than physicist.

- For several years, the number of doctorates granted in physics has been much greater than the number of openings for physicists, resulting in keen competition, particularly for research positions in colleges and universities and in research and development centers. Competitive conditions are beginning to ease, because the number of doctorate degrees awarded has been dropping, following recent declines in enrollment in graduate physics programs.

- Opportunities may be more numerous for those with a master's degree, particularly graduates from programs preparing students for applied research and development, product design, and manufacturing positions in industry. Many of these positions, however, will have titles other than physicist, such as engineer or computer scientist.

- Persons with only a bachelor's degree in physics or astronomy are not qualified to enter most physicist or astronomer research jobs but may qualify for a wide range of positions in engineering technician, mathematics, and computer- and environment-related occupations.

Source: Extracted from the *Occupational Outlook Handbook*, *2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR ATMOSPHERIC SCIENTISTS

- **Employment of atmospheric scientists is projected to increase about as fast as the average for all occupations through 2010, but prospective atmospheric scientists may face competition if the number of degrees awarded in atmospheric science and meteorology remain near current levels.** The National Weather service (NWS) has completed an extensive modernization of its weather forecasting equipment and finished all hiring of meteorologists needed to staff the upgraded stations. The NWS has no plans to increase the number of weather stations or the number of meteorologists in existing stations for many years. Employment of meteorologists in other Federal agencies is expected to decline slightly as efforts to reduce the Federal Government workforce continue.

- On the other hand, job opportunities for atmospheric scientists in private industry are expected to be better than in the Federal Government over the 2000-10 period. As research leads to continuing improvements in weather forecasting, demand should grow for private weather consulting firms to provide more detailed information than has formerly been available, especially to weather-sensitive industries. Farmers, commodity investors, radio and television stations, and utilities, transportation, and construction firms can greatly benefit from additional weather information more closely targeted to their needs than the general information provided by the National Weather Service. Additionally, research on seasonal and other long-range forecasting is yielding positive results, which should spur demand for more atmospheric scientists to interpret these forecasts and advise weather-sensitive industries. However, because many customers for private weather services are in industries sensitive to fluctuations in the economy, the sales and growth of private weather services depend on the health of the economy.

- There will continue to be demand for atmospheric scientists to analyze and monitor the dispersion of pollutants into the air to ensure compliance with Federal environmental regulations outlined in the Clean Air Act of 1990, but employment increases are expected to be small.

Source: Extracted from the *Occupational Outlook Handbook, 2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR CHEMISTS AND MATERIALS SCIENTISTS

- **Employment of chemists is expected to grow about as fast as the average for all occupations through 2010. Job growth will be concentrated in drug manufacturing and in research, development, and testing services firms.** The chemical industry, the major employer of chemists, should face continued demand for goods such as new and better pharmaceuticals and personal care products, as well as for more specialty chemicals designed to address specific problems or applications. To meet these demands, chemical firms will continue to devote money to research and development-through in-house teams or outside contractors-spurring employment growth of chemists. Strong demand is expected for chemists with a master's or Ph.D. degree.

- Within the chemical industry, job opportunities are expected to be most plentiful in pharmaceutical and biotechnology firms. Biotechnological research, including studies of human genes, continues to offer possibilities for the development of new drugs and products to combat illnesses and diseases which have previously been unresponsive to treatments derived by traditional chemical processes. Stronger competition among drug companies and an aging population are contributing to the need for innovative and improved drugs discovered through scientific research. Chemical firms that develop and manufacture personal products such as toiletries and cosmetics must continually innovate and develop new and better products to remain competitive.

- In most of the remaining segments of the chemical industry, employment growth is expected to decline as companies downsize and turn to outside contractors to provided specialized services. As a result, research and testing firms will experience healthy growth. To control costs, some chemical companies, including drug manufacturers, are increasingly turning to these firms to perform specialized research and other work formerly done by in-house chemists. Despite downsizing, some job openings will result from the need to replace chemists who retire or otherwise leave the labor force. Quality control will continue to be an important issue in the chemical and other industries that use chemicals in their manufacturing processes. Chemists also will be needed to develop and improve the technologies and processes used to produce chemicals for all purposes, and to monitor and measure air and water pollutants to ensure compliance with local, State, and Federal environmental regulations.

Source: Extracted from the *Occupational Outlook Handbook*, *2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

JOB OUTLOOK FOR MATHEMATICIANS

- **Employment of mathematicians is expected to decline through 2010 because very few jobs with the title mathematician are available. However, master's and Ph.D. degree holders with a strong background in mathematics and a related discipline, such as engineering or computer science, should have good job opportunities.** However, many of the workers have job titles that reflect their occupation, rather than the title mathematician.

- Advancements in technology usually lead to expanding applications of mathematics, and more workers with knowledge of mathematics will be required in the future. However, jobs in industry and government often require advanced knowledge of related scientific disciplines in addition to mathematics. The most common fields in which mathematicians study and find work are computer science and software development, physics, engineering, and operations research. More mathematicians also are becoming involved in financial analysis. Mathematicians must compete for jobs, however, with people who have degrees in these other disciplines. The most successful jobseekers will be able to apply mathematical theory to real-world problems, and possess good communication, teamwork, and computer skills.

- Private industry jobs require at least a master's degree in mathematics or in one of the related fields. Bachelor's degree holders in mathematics usually are not qualified for most jobs, and many seek advanced degrees in mathematics or a related discipline. However, bachelor's degree holders who meet State certification requirements may become primary or secondary school mathematics teachers.

Source: Extracted from the *Occupational Outlook Handbook, 2002-2003*, U.S. Bureau of Labor Statistics, downloaded 12/26/01.

Percentage Distribution of Bachelor's Degrees in Science and Engineering
by Race/Ethnicity and Sex, 1991-2000

Hispanics have increased their proportion among those who receive bachelor's degrees in science and engineering, from 4.5 percent in 1991 to 7.2 percent in 2000

	Total		Men		Women	
	1991	2000	1991	2000	1991	2000
Total						
U.S. Citizens and Permanent Residents	100	100	100	100	100	100
Hispanics	4.5	7.2	4.1	6.6	4.9	7.8
White Non-Hispanics	80.9	71.2	82.5	73.5	78.9	69.0
Asians/Pacific Islanders	6.0	8.9	6.2	9.4	5.6	8.4
Black Non-Hispanics	5.8	8.3	4.4	6.2	7.6	10.4
American Indians/Alaskan Natives	0.4	0.7	0.3	0.6	0.4	0.7
Unknown Race/Ethnicity	2.5	3.6	2.5	3.8	2.5	3.6

Source: Science and Engineering Degrees by Race/Ethnicity of Recipients: 1991-2000, Susan T. Hill, National Science Foundation, Table 1, June 2001.

Percentage Distribution of Master's Degrees in Science and Engineering
by Race/Ethnicity and Sex, 1991-2000

Hispanics have increased their proportion among those who receive master's degrees in science and engineering, from 3.1 percent in 1991 to 5.2 percent in 2000

	Total		Men		Women	
	1991	2000	1991	2000	1991	2000
Total						
U.S. Citizens and Permanent Residents	100	100	100	100	100	100
Hispanics	3.1	5.2	2.9	4.9	3.6	5.4
White Non-Hispanics	79.9	71.6	79.8	72.5	79.9	70.4
Asians/Pacific Islanders	7.7	10.2	8.5	10.9	6.4	9.5
Black Non-Hispanics	3.8	6.4	3.1	4.8	5.0	8.2
American Indians/Alaskan Natives	0.4	0.5	0.3	0.4	0.5	0.5
Unknown Race/Ethnicity	5.2	6.1	5.6	6.4	4.6	5.9

Source: Science and Engineering Degrees by Race/Ethnicity of Recipients: 1991-2000, Susan T. Hill, National Science Foundation, Table 2, June 2001.

Percentage Distribution of Doctorate Degrees in Science and Engineering
by Race/Ethnicity and Sex, 1991-2000

Hispanics have increased their proportion among doctorate recipients from 1991 to 2000, from 3.2 percent to 4.1 percent

	Total		Men		Women	
	1991	2000	1991	2000	1991	2000
Total						
U.S. Citizens and Permanent Residents	100	100	100	100	100	100
Hispanics	3.2	4.1	3.0	3.7	3.3	4.8
White Non-Hispanics	83.8	78.5	83.5	79.6	84.8	77.4
Asians/Pacific Islanders	7.4	10.2	7.7	10.5	6.7	9.6
Black Non-Hispanics	2.9	4.3	2.6	3.3	3.5	5.7
American Indians/Alaskan Natives	0.3	0.5	0.3	0.5	0.4	0.7
Unknown Race/Ethnicity	2.6	2.3	3.0	2.5	1.4	1.8

Source: Science and Engineering Degrees by Race/Ethnicity of Recipients: 1991-2000, Susan T. Hill, National Science Foundation, Table 3, June 2001.

College Enrollment Rates* of All 18- to 24-year-olds and 18- to 24-year-old High School Graduates, by Race/Ethnicity, 1975-2000

During the period 1975 to 2000, about a fifth of Hispanic 18- to 24-year-olds were enrolled in college. The percent of 18- to 24-year-old high school graduates enrolled was 36 percent in 1995, about the same as in 1975, although slightly higher than in the 1980s.

	Enrollment as a percent of all 18- to 24-year-olds				Enrollment as a percent of all 18- to 24-year-old high school graduates			
	Total	White Non-Hispanic	Black Non-Hispanic	Hispanic	Total	White Non-Hispanic	Black Non-Hispanic	Hispanic
1975	26.3	27.4	20.4	20.4	32.5	32.3	31.5	35.5
1980	25.6	27.3	19.4	16.1	31.8	32.1	27.6	29.9
1985	27.8	30.0	19.6	16.9	33.7	34.9	26.0	26.8
1990	23.0	35.1	25.4	15.8	39.1	40.4	32.7	28.7
1995	34.3	37.9	27.5	20.7	42.3	44.0	35.4	35.2
2000	35.5	38.7	30.5	21.7	43.2	44.1	39.3	36.2

* Degree-granting institutions
Source: National Center for Education Statistics, *Digest of Education Statistics, 2002,* Table 187.

Projected Population of 18- to 24-Year-Olds by Race/Ethnicity, 2001 to 2015

	2001	2015	Percent Change	Percent of Growth
Total	27,187	30,254	+11	100
White, Non-Hispanic	17,839	18,031	1	6
Black, Non-Hispanic	3,892	4,307	+11	14
HISPANIC	4,114	5,978	+45	61
Asian & Pacific Islander	1,093	1,674	+53	19
American Indian	249	264	+6	0

Source: Projections of the Total Resident Population by 5-year age groups, race, and Hispanic origin with special age categories, 2001 to 2015; Population Division, U. S. Census Bureau (Middle Projections).

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