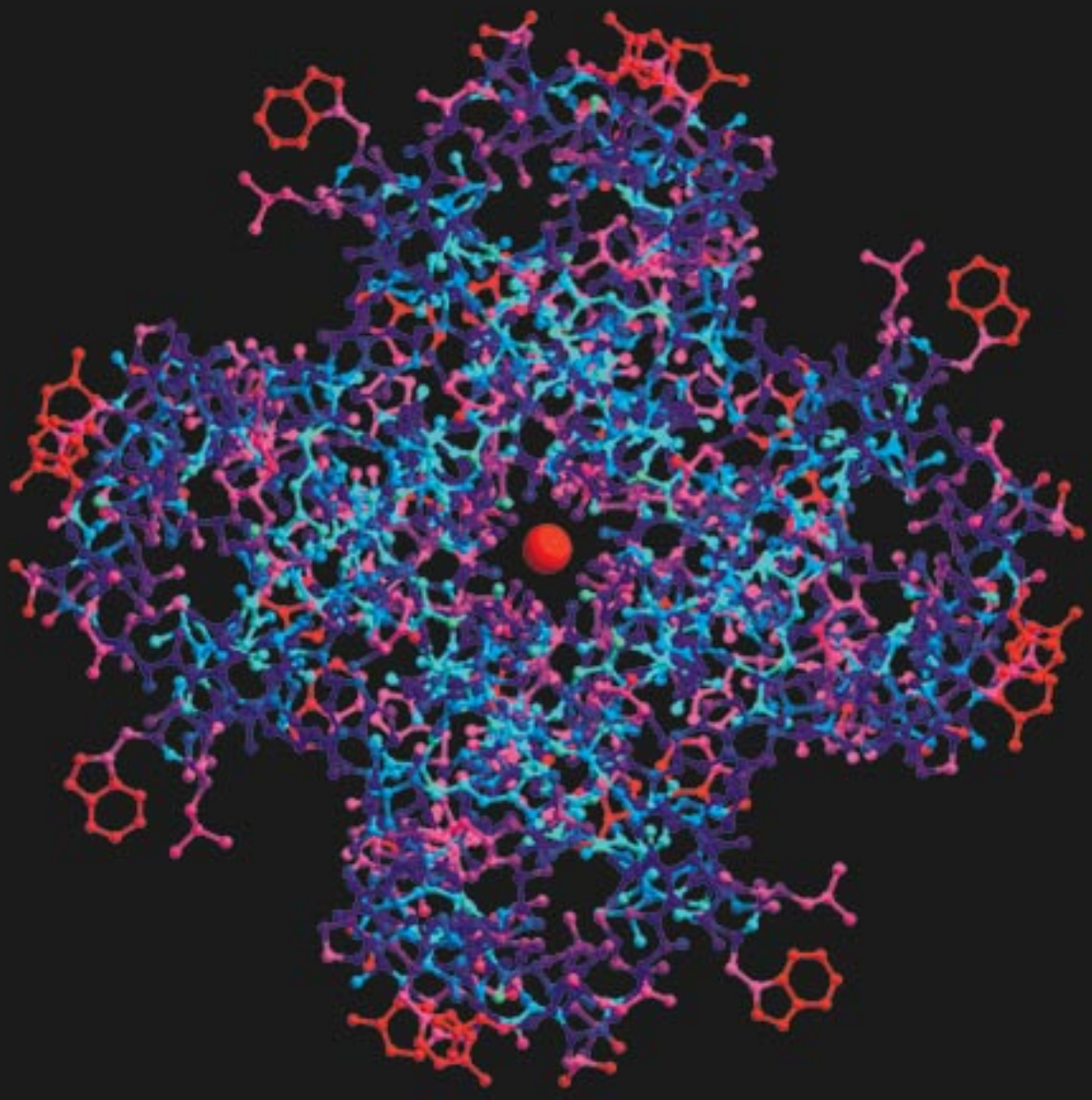
An Emerging and Critical Problem of the Science and Engineering Labor Force



A Companion to
Science and Engineering Indicators 2004

NATIONAL SCIENCE BOARD

NSB

The Message of the 2004 S&E *Indicators:* An Emerging and Critical Problem of the Science and Engineering Labor Force

Every two years the National Science Board supervises the collection of a very broad set of data trends in science and technology in the United States, which it publishes as *Science and Engineering Indicators (Indicators).* In preparing *Indicators* 2004, we have observed a troubling decline in the number of U.S. citizens who are training to become scientists and engineers, whereas the number of jobs requiring science and engineering (S&E) training continues to grow. Our recently published report entitled *The Science and Engineering Workforce/Realizing America's Potential* (NSB 03-69, 2003) comes to a similar conclusion. These trends threaten the economic welfare and security of our country.

If the trends identified in *Indicators* 2004 continue undeterred, three things will happen. The number of jobs in the U.S. economy that require science and engineering training will grow; the number of U.S. citizens prepared for those jobs will, at best, be level; and the availability of people from other countries who have science and engineering training will decline, either because of limits to entry imposed by U.S. national security restrictions or because of intense global competition for people with these skills. The United States has always depended on the inventiveness of its people in order to compete in the world marketplace. Now, preparation of the S&E workforce is a vital arena for national competitiveness.

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Even if action is taken today to change these trends, the reversal is 10 to 20 years away. The students entering the science and engineering workforce in 2004 with advanced degrees decided to take the necessary math courses to enable this career path when they were in middle school, up to 14 years ago. The students making that same decision in middle school today won't complete advanced training for science and engineering occupations until 2018 or 2020. If action is not taken now to change these trends, we could reach 2020 and find that the ability of U.S. research and education institutions to regenerate has been damaged and that their preeminence has been lost to other areas of the world.

There Are No Quick Fixes

There is general agreement that the science and technology enterprise, built on people with skills in S&E, is of vital importance to the nation's health, security, and prosperity. There is less recognition of the corollary: that continued production of a workforce with skills in science and engineering requires sustained support at a national level.

Resources to develop an S&E workforce are not like the money supply, where changes can bring measurable response in days or weeks. Years or decades of effort are needed to build facilities for education, train faculty, and support students through an educational pipeline of 16 years or more. Any significant increase in the number of U.S. citizens who become scientists and engineers requires sustained long-term commitment.

Trends in the Science and Engineering Workforce

The number of jobs requiring S&E skills in the U.S. labor force is growing almost 5 percent per year. In comparison, the rest of the labor force is growing at just over 1 percent. Before September 11, 2001, the Bureau of Labor Statistics (BLS) projected that S&E occupations would increase at three times the rate of all occupations. The rise projected by the BLS was 2.2 million, representing a 47 percent increase in the number of S&E jobs by 2010. The rates of increase between 1980 and 2000 ranged from 18 percent for the life sciences to 123 percent for jobs in math and computer science (all data are from *Indicators* 2004, Chapter 3, unless otherwise noted).

The average age of the S&E workforce is rising. Many of those who entered the expanding S&E workforce in the 1960s and 1970s (the baby boom generation) are expected to retire in the next 20 years, and their children are not choosing careers in S&E in the same numbers as their parents (*Indicators* 2004, Overview). The percentage of women, for example, choosing math and computer science careers fell 4 percentage points between 1993 and 1999.

Growth in the S&E labor force has been maintained at a rate well above the rate of producing S&E degrees because a large number of foreign-born S&E graduates have migrated to the United States. The proportion of foreign-born students in S&E fields and workers in S&E occupations continues to rise steadily. Persons born outside the United States accounted for 14 percent of all S&E occupations in 1990. Between 1990 and 2000 the proportion of foreign-born people with bachelor's degrees in S&E occupations rose from 11 to 17 percent; the proportion of foreign-born with master's degrees rose from 19 to 29 percent; and the proportion of foreign-born with PhDs in the S&E labor force rose from 24 to 38 percent.

Could the News Get Worse?

By attracting scientists and engineers born and trained in other countries to the United States to work, we have maintained the growth of the S&E labor force without a commensurate increase in support for the long-term costs of training and attracting native U.S citizens to these fields. Two trends are operating to disrupt this equilibrium; thus, this shortcut to a trained workforce is not likely to continue.

Global competition: Since the 1980s other countries have increased investment in S&E education and the S&E workforce at higher rates than the United States has. Between 1993 and 1997 the OECD countries (Organisation for Economic Co-operation and Development, a group of 40 nations with highly developed market economies) increased their number of S&E research jobs 23 percent, more than twice the 11 percent increase in S&E research jobs in the United States.

Slower entry: Visas for students and S&E workers have been issued more slowly since the events of September 11, owing to both increased security restrictions and a drop in applications. The U.S. State Department issued 20 percent fewer visas for foreign students in 2001 than in 2000, and the rate fell further between 2001 and 2002.

Recommendations

From parents to the Federal leadership, Americans are working to improve education in the United States. The people who will fill the nation's science and technology jobs 20 years from now are currently in school. They will choose advanced training in colleges and universities sometimes far from their home communities and, in still other communities, will contribute to the labor force over decades. The investments involved in growing a workforce trained in science and engineering must be made at local, state, and national levels, and in every region.

We all share responsibility with our local communities to make quality education in math and science a priority and to recognize the impact this education will have on the national workforce far into the future. We share responsibility with our states to make colleges and universities strong and to make science and technology education accessible to all the citizens who choose them. The Federal Government has primary responsibility for supporting higher education in science and technology at levels that allow the study of science or engineering, and future careers in these fields, to be competitively attractive with other fields. If the Federal Government ensures that parents see science and engineering careers as promising practical choices for their children's futures, those parents will insist on quality education in the precollege years. Quality education in math and science is everyone's challenge and responsibility. The nation's economic welfare and security are at stake.

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Model of the potassium channel in the bacterium *Streptomyces lividans*. (Cover image reprinted with permission from *Science* volume 280, number 5360, issue of 3 April 1998, copyright 1998 AAAS.)

This paper and the report *The Science and Engineering Workforce: Realizing America's Potential* (NSB 03-69) are available at the NSB web site www.nsf.gov/nsb/documents