

STEM Sell

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Between 1994 and 2003, employment in science, technology, engineering and math (STEM) fields grew by a remarkable 23 percent, compared with 17 percent in non-STEM fields, according to federal data. The Bureau of Labor Statistics predicts continued strong growth in STEM job openings through 2014, with emphasis on life sciences, environmental sciences and engineering. The median salary of STEM workers is 66 percent higher than that of non-STEM workers, according to the National Association of Colleges & Employers. Clearly, STEM workers fuel our economy not only with high incomes and spending, but, more importantly, through innovation and entrepreneurship.

Yet there is a growing gap between the supply of students graduating from U.S. college science and engineering programs and demand for STEM workers. This is exacerbated by international competition. In 2006, the United States graduated 70,000 engineers, but China graduated 300,000 and India, 150,000. In addition, Chinese and Indian engineering students now prefer to stay in their countries after graduating, contributing to the high growth of their economies and competing directly with the United States.

If the United States is to preserve its scientific and economic leadership in the global knowledge-based economy, we must increase the number of college graduates trained in STEM disciplines. That means creating and sustaining a STEM pipeline stretching from pre-kindergarten through grade 12 to college and on to industry.

National Science Foundation (NSF) studies indicate that three factors contribute to building a strong pipeline: early exposure to STEM careers via role models and mentors; solid K-12 math and science preparation; and effective college retention programs.

Successful pre-college programs generate excitement for STEM

careers by helping students solve real-world problems using science, math and engineering principles and incorporating hands-on experiences. One exemplary program is the West Point Bridge Design Contest. The contest has provided tens of thousands of middle and high school students with a realistic and engaging introduction to engineering by allowing them to design a virtual bridge and test it. This spring, Wentworth Institute of Technology, in collaboration with Boston's Museum of Science, launched a Design Initiative program in which students from Shawsheen Valley High School and Hyde Park High School (also known as Engineering Park) visited the Wentworth campus to perform laboratory experiments with our faculty and to brainstorm about and build projects with our engineering students.

Early exposure to STEM programs is especially important for minority and female students. Although women comprised nearly half of all U.S. paid workers in 2000, they held just one quarter of U.S. STEM jobs, according to the Commission on Professionals in Science and Technology. NSF research indicates that girls perform in math as well as boys in middle school but lose confidence in their math abilities in high school. Moreover, Goodman Research Group has shown that college women opt out of engineering in their freshman or sophomore year not because they are unable to perform, but because they lose self-confidence.

Partnerships among institutions of higher education, industry and other interested groups can change this. Through the NSF Alliance for Minority Participation, Wentworth has partnered with the University of Massachusetts and several Massachusetts community colleges in outreach and retention efforts aimed at tripling the number of STEM students over the next five years. This summer, approximately 60 high

school students will travel to Wentworth to work on "Green Building Design." And the institute's Students Loving Adventures in Mathematics (SLAM) enrichment program, sponsored by the Mathematical Association of America, will expose 25 to 30 underrepresented students from Boston high schools to the beauty and importance of mathematics as well as careers available to graduates with a solid understanding of math.

Wentworth has also reached out to female students. We recently hosted "A Day of Magic: Engineers in Training," in which 40 young women from Boston's Parkway Academy of Health and Technology, Urban Science Academy and John D. O'Bryant School of Math and Science got a chance to meet outstanding women engineers and participate in technical workshops such as "Create Your Own Electricity," "Spaghetti is Stronger Than You Think," "Math in the Real World," and "Chemistry You Didn't Know About." We are also working with the Girl Scouts and United Way's "Today's Girls ... Tomorrow's Leaders" initiative to provide exciting gender-specific STEM programs that will build girls' self-confidence while stressing how engineering and technology improve lives.

Building interest in STEM careers is important, but we also need to ensure that K-12 students receive adequate math and science preparation. The 2005 *Nation's Report Card* shows students are not sufficiently prepared for STEM-degree programs. Only 23 percent of 12th-grade students perform at the level of proficiency in math. The 2003 Trends in International Mathematics and Science Study (TIMSS) shows U.S. 4th- and 8th-graders lagging their international counterparts in both math and science preparation (in 12th and 15th place in math for 4th and 8th graders, respectively, and 6th and 10th place in sciences). A few states, such as Texas and Massachusetts, have

embarked on efforts to improve pre-college education by requiring more emphasis on STEM curriculum. The 2001 Massachusetts Science and Technology/Engineering Curriculum Framework is an example.

Higher education must also be an active partner in efforts to ensure proper preparation for rigorous STEM curricula. At a recent summit organized by Wentworth for 10 high school headmasters from the Boston Public Schools, the message I heard repeatedly from administrators was clear: schools are looking to build long-term sustainable partnerships with institutions of higher education to help address the challenges faced by students.

Partnerships can identify and develop innovative ways to pair resources, funds, materials, expertise and support to provide enrichment experiences that expose students to STEM fields, strengthen skills in specific subjects and preview the college experience for students who may be the first in their family to consider college.

Partnerships with other public- and private-sector organizations will be another key factor in recruiting and retaining students in STEM programs. A good example is the Texas Engineering and Technology Consortium, a public/private partnership of companies, higher education and the state of Texas formed to increase the number

of engineering and computer science graduates through outreach and retention programs. The state appropriates up to \$5 million annually to match contributions from industry, the federal government and other non-state sources.

To preserve U.S. economic competitiveness, educational institutions at all levels, the government, professional societies and the private sector have to come together to share best practices and support outreach activities for all, but particularly for underrepresented students. We must identify local high schools to build lasting relationships with and enable our college students to serve as mentors and tutors. We must encourage opportunities to share and leverage faculty resources for teacher training and course development support. And we must partner with industry to build financial support for STEM education, demonstrate the excitement and possibilities the field offers and arm our students with the tools for academic, personal and professional success.

STEM fields, particularly biotechnology, are big with regional economic boosters. But not all is a celebration. When Boston hosted a major gathering of biotechnology firms in May, a group called BioJustice launched a weeklong series of teach-ins, workshops, protests and marches to draw attention to the biotech industry's work making genetically engineered foods, question the industry's role in developing an accessible health care system and support community resistance to plans for a federal bioterror lab in Boston's low-income Roxbury neighborhood. In fact, activists have shadowed the annual conventions of the Biotechnology Industry Organization, the world's largest biotech gatherings, with their own campaigns and protests since 1999, according to Brian Tokar, director of the Biotechnology Project at Vermont's Institute for Social Ecology. For more, visit: <http://www.biodev.org/>

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Closing the Engineering Gender Gap: Viewers Like You

BRIGID SULLIVAN

Gielle Eng was a high school junior with a penchant for the performing arts when she first learned about auditions for a new children's television series to air nationwide on PBS. Her interest wavered, however, when she learned the focus of the new series: engineering. "I definitely had a lot of misconceptions about engineering," says Eng, who recently graduated from Boston Latin

High School. "I thought it was all technical and computers and programming. I never really imagined myself doing anything related to engineering."

Despite her misgivings, she went through with the audition, and eventually was selected from hundreds of high school students to appear in the first season of *Design Squad*, a new PBS reality series from Boston public broadcaster WGBH that follows two

teams of high-schoolers as they solve a series of engineering challenges.

Eng's initial hesitation about engineering is symptomatic of a longstanding problem in America's innovation-based economy: women pursue college degrees and professional jobs in engineering at much lower levels than men. According to the National Science Foundation, just 16 percent of the 2005 college