The science of science education

More minority students need to be lured into the sciences. One program has been a resounding success.

Opinion

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At most universities, freshman chemistry, a class I've taught for nearly 40 years, is the first course students take on the road to a career in the health professions or the biological or physical sciences. It's a tough course, and for many students it's the obstacle that keeps them from majoring in science. This is particularly true for minority students.

In 2005, more than two-thirds of the American scientific workforce was composed of white males. But by 2050, white males will make up less than one-fourth of the population. If the pipeline fails to produce qualified nonwhite scientists, we will, in effect, be competing against the rest of the world with one hand tied behind our backs.

We've been able to survive for the last several decades in large measure because of the "brain drain" -- the fact that the most able students from other countries, particularly China and India, have come here to study science at our best universities and, in many cases, have stayed to become key players in our scientific endeavors.

At many top schools, including my own, international students constitute from 30% to 70% of the doctoral candidates in math, physics and chemistry.

The situation might be tolerable, if embarrassing, were it not for recent changes in world economies and attitudes toward science and education. As a result of dramatically increased investment by other countries in science, the brain drain is not just slowing, it appears to be changing direction.

International students and post-docs are returning to their home countries in much greater numbers after reaping the benefits of an American education, and many who have worked for years at U.S. companies and universities are being lured home by offers of new labs, easy access to research funding and the comforts of their native culture.

We need to ensure that American science draws on all of our population, not just selected, and shrinking, segments of it. But how?
When I was nominated five years ago for a Howard Hughes Medical Institute professorship -- a chance to receive $1 million over four years to improve science education -- I began to think harder about that question.

The most promising approach I came across was developed by Uri Treisman at UC Berkeley in the late 1970s. Treisman wanted to understand why, over a 10-year period, there was not a single year in which more than two black or Latino students at Berkeley received grades of B-minus or better in first-term calculus. He set up a study to follow 20 African American and 20 Chinese American students with comparable socioeconomic backgrounds. His findings defied the stereotypes.

Treisman demonstrated that several widely held assumptions -- that black students were less motivated or less prepared or had less family support -- could not explain their lower grades. His conclusion was that "the black students typically worked alone" while "the Chinese students learned from each other."

Using this insight, he constructed "an anti-remedial program," open to all but populated primarily by minority students, which emphasized "group learning and a community life." The results were dramatic, with participants in the program not only outperforming their minority peers but their white and Asian American classmates as well.

As it turned out, my university, Brandeis, already had a program that utilized team-building and peer support as mechanisms to help students survive and thrive academically. The program, run by the Posse Foundation, works with universities to select and coach "posses" of 10 inner-city students who then attend, in a group, some of the country's top universities. The program is remarkably successful, producing a graduation rate over 90%. But even the Posse Foundation fell short in the sciences. Fewer than 10% of its students graduated in science, even though nearly half started off intending to do so.

With the enthusiastic support of the Posse Foundation's president, Deborah Bial, and the financial backing of the Howard Hughes Medical Institute, we initiated a project to develop science posses at Brandeis. Each December, 10 students from New York City are selected from hundreds of applicants.

In January, they begin eight months of weekly after-school training sessions involving academics, problem-solving, team-building and communication skills. In July, they come to Brandeis for a two-week "boot camp" designed to give them not only a flavor of campus life but also a realistic sense of how hard one has to work and how much one must rely on peers, teachers and mentors to succeed in science at a competitive university.

When the students arrive in September, they are provided with a graduate student mentor, who meets with them regularly and serves as a resource for academic and personal issues. They are offered the opportunity to work part time in research laboratories in order to earn needed cash and to appreciate the sense of community in a research group.
The program has been a resounding success for our first group of Science Posse Scholars, who, if judged solely by the high schools they came from and their SAT scores, would not have been predicted to succeed in science. Nine of the 10 successfully completed general chemistry last year, and six of them made the dean's list.

All of them have worked in research labs and/or participated in summer science programs across the country. One is actively engaged in a project aimed at finding a cure for Lou Gehrig’s disease, and is committed to pursuing it through medical school and beyond. Another recently told me that he plans to be the U.S. surgeon general someday. I think he just might.

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