SCIENCE EDUCATION

How to Create a Science Teacher for $200,000

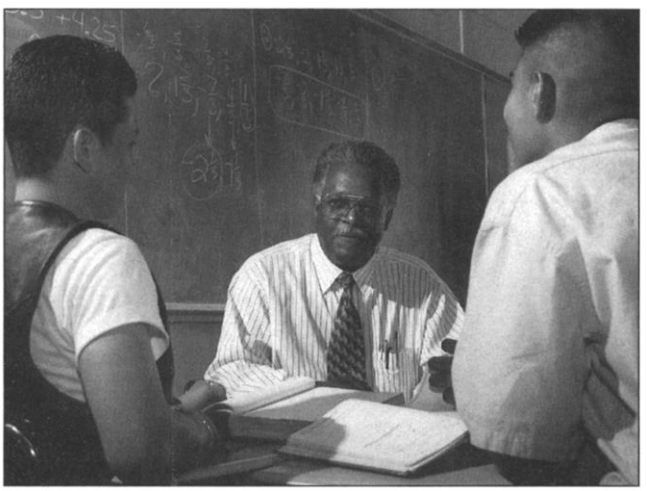
Ambitious efforts launched 5 years ago to recruit laid-off defense workers into math and science teaching are now a distant memory. Here's why

Design engineer Peter Goudeaux struggled to find work after being laid off from General Dynamics during a recession that swept through Southern California's aerospace industry in the early 1990s. The sluggish economy also put a crimp in the consulting business of aerospace engineer Ernesto Golan. But in 1995 the prospects for both men brightened when they were accepted into a program to retrain high-tech professionals for careers in Los Angeles and nearby urban school districts.

The 5-year, $5 million Defense Reinvestment Initiative (DRI)—funded by the Department of Defense (DOD) and run by the National Academy of Sciences (NAS)—aimed to retool some of the thousands of skilled workers cast adrift by a shrinking defense industry to help ease the severe shortage of public school math and science teachers. For the 54-year-old Golan, born in Cuba, it was a chance to revive a long-dormant desire to be a math teacher. And the 56-year-old Goudeaux saw it as an opportunity to move "from what some people say is a negative, designing weapons systems, to a positive, teaching kids." Three years into their new careers as secondary school math teachers, the two men say that the rewards of helping disadvantaged students far outweigh such hassles as a long commute and up to 58 students in a classroom. "I want to keep teaching for as long as I can," says Goudeaux.

But the transformation of Goudeaux and Golan from cold warriors to gentle mentors is the exception, not the rule, for DRI. A recent evaluation by the academy's Center for Science, Mathematics, and Engineering Education (books.nap.edu/books/NI001000/html) found that the program managed to train only 12 of a projected 60 fellows and put just nine of them into the classroom, resulting in an embarrassingly high cost of nearly $200,000 per teacher. "We certainly can't afford to do it that way," says Michael McKibbin, a member of the DRI advisory board and head of the California Commission on Teacher Credentialing. The commission runs an $11-million-a-year internship program that last year put 7000 would-be teachers into the classroom—at a cost less than 1% that of DRI.

DRI did accomplish something, though: It proved that it's possible to recruit talented minority educators like Goudeaux and Golan into urban schools with high minority student populations. And the new teachers are dedicated to their work. "Most of the fellows got offers to return to their [former] jobs when the economy improved," says McKibbin. "And to their credit, they didn't want to go back. I consider that a success."



In the trenches. Peter Goudeaux is one of the very few who made a successful transition from laid-off defense engineer to math teacher.

DRI wasn't the only program to fall short in its attempt to solve the twin challenges of retraining a defense-oriented workforce and strengthening science in the classroom (see sidebar). But, at a time when many state and federal officials are trying to attract people from other professions into teaching, it offers important lessons in what works and doesn't work in retraining science and math professionals.

Good intentions

DRI was the result of an unlikely partnership between NAS President Bruce Alberts, who has long argued that working scientists and engineers must play a role in the systemic reform of urban science and math education, and Deputy Defense Secretary John Deutch, who wanted to lift Southern California out of a steep recession. The Administration announced the program with great fanfare in early 1995 (*Science*, 27 January 1995, p. 443). Fellows would receive a stipend of $22,000 and undergo a 14-month training program. To choose candidates who could handle the expected intellectual and psychological challenges, DRI administered a questionnaire to measure whether their personality was suited for an urban classroom and tested their knowledge of the subject they would be teaching. The rigorous screening process ruled out all but 15 of 61 applicants, five short of the 20 slots available in the first year. Three dropped out during training, leaving only 12 graduates. "We may have selected out some good people," admits educational consultant Maureen Shiflett, who ran the program before retiring from the academy in 1998, "although I think [the battery of tests] does a good job of finding people who have a passion for teaching."

But even before the first class had finished training, Deutch had left to become director of the Central Intelligence Agency. A few months later, Pentagon officials informed Shiflett that they were withdrawing the remaining $3.2 million in projected funding. The news was a crushing blow, forcing the cancellation of a planned second class of 40 fellows. "We had front-loaded a lot of expenses and spent a lot of time negotiating with schools in preparation for our second cohort," explains Shiflett. "We had planned to cut back once things were running smoothly."

For the Pentagon, the project had become a luxury it could no longer afford. "It did a lot of things for a lot of people who were trying to improve math and science in inner city schools," says Toby Holliday of the Defense Department's Office of Economic Adjustment, which oversaw the DRI program. "But DOD was interested in helping to ease the transition from defense to civilian employment for laid-off aerospace workers. And from a selfish perspective, it was not seen as a cost-effective way to transition workers."

After DOD pulled out, the academy received $125,000 from the Arthur Vining Davis Foundation to re-create DRI at a nearby Long Beach school district. But the new program, called Urban Teacher Preparation (UTP), could afford stipends only half the size of those given to DRI fellows. The reviving economy made the amount seem even smaller. The smaller stipends and stiffer competition for high-tech talent proved fatal: UTP collapsed after attracting only 10 applicants, none of whom were

Congress Killed Even Bigger Program That Didn't Pass Muster

The Defense Reinvestment Initiative (DRI) was just one of a flurry of well-intentioned programs in the early 1990s designed to retrain displaced defense workers. Like DRI, most of them fell far short of the mark. A $55 million Department of Defense (DOD) program called the Manufacturing Education and Training (MET) program, for example, sank without a trace in 1995 after a hostile Congress turned against it and defense officials decided that retraining wasn't part of the department's mission. The demise of the MET program pulled the financial rug out from under efforts by university officials to improve local science and math instruction, and many initiatives folded. "It's a classic case of a program ending in a whimper," says a White House aide who follows technology policy. "The people disappear, and there's no follow-up. Plus, there was so much Republican hostility" that nobody even attempted a rescue.

MET was part of the Technology Reinvestment Project (TRP), an early Clinton Administration initiative that grew rapidly to $625 million a year before collapsing. TRP was supposed to find civilian applications for military "assets"—people as well as hardware—no longer needed for defense programs in the post–Cold War era (*Science*, 25 March 1994, p. 1676). MET funded 57 campus-based projects that ranged from revamping the undergraduate engineering curriculum to converting aerospace engineers into biotechnology specialists. Many projects included retraining high-tech workers to be school teachers.

But when Congress killed off TRP, seeing it as a heavy-handed intrusion into the private sector, defense officials quickly decided to get out of the retraining business. The National Science Foundation (NSF), which ran MET for the Pentagon, never formally evaluated it, admits Marshall Li, who managed the portfolio of MET projects. And absent funding, NSF has no plans to look back. "DOD has moved on," he says, "and we're not likely to do an evaluation unless there is a future in it."

Interviews with several former project directors suggest that many of the grantees feel the same way. "It's dead and buried," says George Bekey, a professor of computer science at the University of Southern California in Los Angeles, a partner in the seven-school Southern California Coalition for Education in Manufacturing Engineering that was awarded nearly $4 million in 1994 to '96. "Any program like that is dependent on federal subsidies, and ours dried up." A similar consortium of institutions in the northeastern United States that received $2 million "is on hold," says engineering professor Harold Knickle of the University of Rhode Island, who notes that the project nonetheless helped his university to create undergraduate courses, bolster efforts to attract and retain minorities, and establish ties with local industries.

However, the end of federal support was only the last straw for some MET projects, which discovered belatedly that they were out of touch with economic realities. "Biotech retraining under TRP didn't work," says Peter Cote, chief financial officer for the Massachusetts Biotechnology Institute (MBI), which received half of a planned $1 million MET grant in 1994 to help 100 defense workers move into what was assumed to be a brighter future in a burgeoning industry. "The biotech industry typically hires people right out of school, not those starting a second career, and they can attract people at a much lower salary. The TRP program didn't achieve what it set out to do because people just weren't attracted to the program." Cote noted that MBI "isn't in the education business anymore," choosing instead to support start-up biotech companies.

One low-budget retraining effort involving the military has managed to have an impact on math and science education. A 5-year-old program, Troops to Teachers, has helped 3400 retiring officers connect with an appropriate academic program and receive retraining as teachers through a network of 20 state offices. "These people have been in public service for all or most of their careers," says the Pentagon's John Gantz, who runs the program, "and they see teaching as simply a continuation of that commitment." Although Troops to Teachers has no specific target audience, a 1998 study found that participants are much more likely than the overall pool of teachers to be male, minority, and trained in science and math. **–J.D.M.**

deemed qualified. "There was concern that some of the candidates would have gotten eaten alive in the classroom," says Lisa Isbell, an administrator with the Long Beach schools.

The DRI program, meanwhile, ran into another unexpected problem: Not one of the 12 DRI math fellows passed the required certification test for nonmajors on the first try, and half of them still lack regular certification. Officials were stunned. By focusing on pedagogy rather than content, DRI had misjudged how much these would-be teachers already knew in their core subject area. "Most of them are engineers, not math majors," says Shiflett. The program could have achieved a much higher success rate, she notes, had it accepted applicants with Ph.D.s in math. "But all they wanted to do was teach calculus to advanced students planning to go to top colleges," she notes. "That wasn't the point of this program."

Making a difference

Indeed, DRI fellows were expected to work among inner city children with poor academic backgrounds. And by all accounts, the handful of graduates have made a small but important contribution to that goal. In his first year at a middle school in Compton, for example, Goudeaux taught as many as 58 kids in a general math class, pushing them to achieve beyond the low levels previously expected of them. But Goudeaux says he incurred the wrath of administrators after a local newspaper ran a photograph showing his students peering out of broken panes of glass and sidestepping buckets scattered around his classroom to catch the rain from leaky roofs, and was not invited back for a second year.

Goudeaux went to the Will Reid Continuation School in Long Beach, which offers an alternative academic program for troubled teenagers. "It's their last chance to stay in a regular school," he says about his students, "and I love working with them. I went to high school in the worst neighborhoods and took remedial math because they didn't think I could learn," he recalls about growing up in public-housing projects in New Orleans and Chicago. "But I turned out OK. And I think these kids can, too."

Golan, who is bilingual, says that DRI lets him "give something back to the minority community." He's starting his fourth year at Los Angeles's Bell High School, which serves a neighborhood that assistant principal Sandra Seegran describes as "an entry port for Hispanic families who move to a better neighborhood once they make more money." She says that Golan, who has taught everything from general math to advanced-placement statistics, "is making a real contribution to our school."

Both men plan to continue teaching, but not necessarily at their present school. Golan admits that he "had hoped to have more contact with college-bound students." And Goudeaux, now in his third year at Reid, has begun taking graduate courses to qualify for a job at a junior college, where he hopes to teach students more likely to pursue careers in science and engineering.

Shiflett believes that DRI, for all its faults, shows that the government can make a small but important dent in a major national problem. "Education is a life-or-death matter for urban kids. And that's where we should be sending our best teachers. There's no cheap way to produce good teachers. But the ones who stay are working where they're needed the most." **–JEFFREY MERVIS**