



America's Brain Drain Crisis

Why our best scientists are disappearing, and what's really at stake | BY KATHRYN WALLACE

WILLIAM KUNZ IS a self-described computer geek. A more apt description might be computer genius. When he was just 11, Kunz started writing software programs, and by 14 he had created his own video game. As a high school sophomore in Houston, Texas, he won first prize in a local science fair for a data encryption program he wrote. In his senior year, he took top prize in an international science and engineering fair for designing a program to analyze and sort DNA patterns.

Kunz went on to attend Carnegie Mellon, among the nation's highest-ranked universities in computer science. After

ILLUSTRATED BY MICK WIGGINS

college he landed a job with Oracle in Silicon Valley, writing software used by companies around the world.

Kunz looked set to become a star in his field. Then he gave it all up.

Today, three years later, Kunz is in his first year at Harvard Business School. He left software engineering partly because his earning potential paled next to friends who were going into law or business. He also worried about job security, especially as more companies move their programming overseas to lower costs. "Every time you're asked to train someone in India, you think, Am I training my replacement?" Kunz says.

Things are turning out very differently for another standout in engineering, Qing-Shan Jia. A student at Tsinghua University in Beijing, Jia shines even among his gifted cohorts at a school sometimes called "the MIT of China." He considered applying to Harvard for his PhD, but decided it wasn't worth it.

His university is investing heavily in cutting-edge research facilities, and attracts an impressive roster of international professors. "I can get a world-class education here and study with world-class scholars," Jia says.

These two snapshots illustrate part of a deeply disturbing picture. In the

disciplines underpinning our high-tech economy—math, science and engineering—America is steadily losing its global edge. The depth and breadth of our problem is clear:

- Several of our key agencies for scientific research and development will face a retirement crisis within the next ten years.

- Less than 6% of our high school seniors plan to pursue engineering degrees, down 36% from a decade ago.

- In 2000, 56% of China's undergraduate degrees were in the hard sciences; in the United States, the figure was 17%.

- China will likely produce six times the number of engineers next year than we will graduate, according to Mike Gibbons of the

American Society for Engineering Education. Japan, with half our population, has minted twice as many in recent years.

There are many more unnerving developments, and they add up to this: As other countries create the learning centers and jobs to hang on to their best and brightest, the United States is losing a dependable pipeline of talent. Moreover, we are doing remarkably little to educate and train a next generation of scientists and engineers.

"Most Americans are unaware of

Scientists and engineers make up less than 5% of our population, but create up to 50% of our GDP.

how much science does for this country and what we stand to lose if we can't keep up," says Shirley Ann Jackson, president of Rensselaer Polytechnic Institute and chair of the American Association for the Advancement of Science. David Baltimore, president of the California Institute of Technology and a Nobel laureate, puts it bluntly: "We can't hope to keep intact our standard of living, our national security, our way of life, if Americans aren't competitive in science. Period."



The Tide We Can't Control

It's a new world, and we barely seem to have noticed. Places we associate with inexpensive low-end manufacturing are going high-tech in a big way.

The spotlight is mainly on China and India, for good reason. The Chinese economy is surging, fueled by increasingly sophisticated engineering, producing everything from automobiles to semiconductors. India has nearly as robust an economy, powered by a cheap English-speaking labor force who excel in software and services.

Along with these emerging giants, countries like Japan, South Korea and Singapore are also challenging America's dominance. If present trends continue, 90% of all the world's scientists and engineers will be living in Asia by 2010, according to Nobel laureate Richard E. Smalley, professor of chem-

istry and physics at Rice University.

Who can be surprised, then, that jobs in software development and research are migrating to places like Bangalore, India, and Shanghai, China? "We go where the smart people are," says Howard High, a spokesperson for Intel. "Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next ten years." Joining Intel in expanding operations in Asia are hundreds of companies, like IBM, Microsoft and General Electric. True, cheap labor is a draw. But if it wasn't highly skilled labor as well, there'd be no brain drain from the United States.

"Other nations get it," says Debra Stewart, president of the Council of Graduate Schools. "We got where we are by our research and universities. Our success hasn't been lost on the rest of the world."

China, for instance, has set a national goal of turning 100 universities into world-class learning centers. It's more than an academic exercise to the leadership in Beijing. Most of the top ministers in China's government have degrees in science, points out Zhong Lin Wang, professor of nanotechnology at Georgia Tech and a visiting professor at several universities in China. "That's quite a difference from a government made up of lawyers," he says.

Already, a commitment to education is paying dividends for other countries, at our expense. Ten years ago, American companies and engineers were granted 10,000 more U.S.

patents than foreign companies. Now, that margin is down to 4,000, and six of the top ten companies are foreign.

Our talent pool is thinning in part because it was filled for so long by political refugees. Jewish emigration from Nazi Germany brought us many remarkable scientists, including Albert Einstein and Edward Teller, and more came in later years from the former Soviet Union. "The dirty little secret is that most of America's publishings and prizes over the last decades were either authored or won by foreigners who came here to work," says David Baltimore. "We're starting to see dents in American shares because these bright people are either going home after studying here or not coming here at all."

For now, we remain a huge magnet for international students, hosting 600,000. Yet at the graduate level, applications from China dropped 45% last year, and 28% from India.

"We can't draw people here by turning on a spigot anymore," says Debra Stewart.



The Crisis We Created

In January 2001, the Hart-Rudman Commission, tasked with finding solutions to our major national security threats, concluded that the failures of our math and science education and our system of research "pose a greater threat ... than any potential conventional war."

The roots of this failure lie in pri-

mary and secondary education. The nation that produced most of the great technological advances of the last century now scores poorly in international science testing. A 2003 survey of math and science literacy ranked American 15-year-olds against kids from other industrialized nations. In math, our students came in 24th out of 28 countries; in science, we were 24th out of 40 countries, tied with Latvia. This test, in conjunction with others, indicates we start out with sufficient smarts—our fourth-graders score well—but we begin to slide by eighth grade, and sink almost to the bottom by high school.

Don't blame school budgets. We shell out more than \$440 billion each year on public education, and spend more per capita than any nation save Switzerland. The problem is that too many of our high school science and math teachers just aren't qualified. A survey in 2000 revealed that 38% of math teachers and 28% of science teachers in grades 7-12 lacked a college major or minor in their subject area. In schools with high poverty rates, the figures jumped to 52% of math teachers and 32% of science teachers. "The highest predictor of student performance boils down to teacher knowledge," says Gerald Wheeler, executive director of the National Science Teachers Association. To California Congressman Buck McKeon, a member of the House Committee on Education and the Workforce, it comes down to this: "How can you pass on a passion to

your students if you don't know the subject?"

Perhaps it's no surprise that, according to a 2004 Indiana University survey, 18% of college prep kids weren't taking math their senior year of high school. "When I compare our high schools to what I see when I'm traveling abroad, I'm terrified for our workforce of tomorrow," Microsoft chairman Bill Gates told a summit of state governors earlier this year. "Our high schools, even when they're working exactly as designed, cannot teach our kids what they need to know today."

Government has been culpable also by shortchanging research in the hard sciences. "Basic research is the fundamental underlying driver of our high-tech economy," Jackson of RPI says. In the wake of 9/11, Congress pledged to double the budget of the National Science Foundation (NSF) over five years; that now looks like a pipe dream, especially since Congress actually cut the NSF budget by \$105 million in 2005. That takes money from an agency whose extensive funding has helped develop technologies in areas that are essential to our competitiveness, from the Internet to nanotechnology.

The Bush Administration has also proposed cutting the fiscal 2006 budget for research and development in

such key federal agencies as the National Oceanic and Atmospheric Administration and the National Institute of Standards and Technology, the latter of which acts as a liaison with industry and researchers to apply new technology.

"Funding cuts are job cuts," says Rep. Vernon J. Ehlers, Republican of Michigan and a member of the

Science Committee in the House. Reduced funding has put the squeeze on research positions, further smothering incentives for students to go into hard science.

A weaker pipeline is especially alarming because the science and engi-

neering workforce is graying. For instance, the National Nuclear Security Administration, an agency that responds to nuclear and radiological emergencies here and abroad, will soon experience a retirement crisis, according to the GAO. NASA, too, has an aging staff: In just a few years, a quarter of its workforce will be eligible to retire.

"We will see in our lifetime the foolishness of our budget choices today," says New York Congressman Sherwood Boehlert, who is chairman of the House Science Committee. "I see America falling to the middle of the pack if we don't make serious changes now."

In a survey of science literacy, students in the U.S. came in 24th of 40 countries, tied with Latvia.



What We Must Do

We've done it before. The Manhattan Project, the technology surge that followed Sputnik: We've demonstrated that we can commit ourselves to daunting goals and achieve them. But we can't minimize the challenges we're facing.

We need out-of-the-box thinking, of the sort suggested by experts in a report released in October called "Rising Above the Gathering Storm." A study group within the National Academy of Sciences, which included the National Academy of Engineering and the Institute of Medicine, came up with innovative proposals. Among them are:

- Four-year scholarships for 25,000 undergraduate students who commit to degrees in math, science or engineering, and who qualify based on a competitive national exam;
- Four-year scholarships for 10,000 college students who commit to being math or science teachers, and who agree to teach in a public school for five years after graduation;
- Extended visas for foreign students who earn a math or science PhD in the United States, giving them a

year after graduation to look for employment here. If they find jobs, work permits and permanent residency status would be expedited.

Many experts are also urging that non-credentialed but knowledgeable people with industry experience be allowed to teach. That experiment is already underway at High Tech High in San Diego. Conceived by Gary Jacobs, whose father founded Qualcomm, this charter school stresses a cutting-edge curriculum, whether it's classes in biotechnology or web design. To teach these courses, the school hires industry professionals. High Tech High also arranges internships at robotics labs, Internet startups and university research centers.

In just five years, 750 kids have enrolled, three classes have graduated and the vast majority of students have gone on to college. One of the success stories is Jeff Jensen, class of 2005, who was a decidedly apathetic student before High Tech High. He is now a freshman at Stanford University on a partial scholarship, planning to study chemistry or medicine.

IBM is one of the companies encouraging its workers to teach. This past September, IBM announced a tuition-assistance plan, pledging to pay for

At our graduate schools, applications from China have dropped by 45% and India by 28%.

teacher certification as well as a leave of absence for employees who wish to teach in public schools.

The philanthropic arms of corporations are also getting involved. The Siemens Foundation sponsors a yearly math, science and technology competition, considered the Nobel Prize for high school research and a great distiller of American talent. Honeywell spends \$2 million each year on science programs geared to middle school students, including a hip-hop touring group that teaches physical science, and a robotics lab program that teaches kids how to design, build and program their own robot. "We've found that if we don't get kids excited about science by middle school, it's too late," says Michael Holland, a spokesperson for Honeywell.

State governments have shown that they, too, can take bold steps, as several have done in creating public high school academies that focus on the hard sciences. Among the first

of these was the North Carolina School of Science and Mathematics (NCSSM), opened in 1980, and its track record explains why these academies have taken off elsewhere. NCSSM boasts the highest SAT scores of any public school in the state. The vast majority of its graduates have gone on to college, and a number of them have started their own tech companies.

AS IMPORTANT as all these initiatives are, they barely begin to take us where we need to go. Our shortcomings are vast, and time, unfortunately, is working against us.

"The whole world is running a race," says Intel's Howard High, "only we don't know it." No one knows whether or when the United States will relinquish its lead in that race. Or how far back in the pack we could ultimately fall. But the first order of business is to recognize what's at stake—and get in the game.

YOU CAN BANK ON IT

Days after my wife passed away, I received a very sympathetic letter from my bank. Nevertheless, business is business, so the note included this reminder: "Any checks written by the deceased after the date of death will not be honored for payment."

C.E. ZECH



The Fort King (Ocala, Florida) Presbyterian Church published this plea to parishioners in its newsletter: "Please note: When you give cash amounts in your offering, realize that the bank will not accept foreign coins, washers or buttons. Thank you."

Submitted by HOBART THOMAS