# Fixing the STEM pipeline

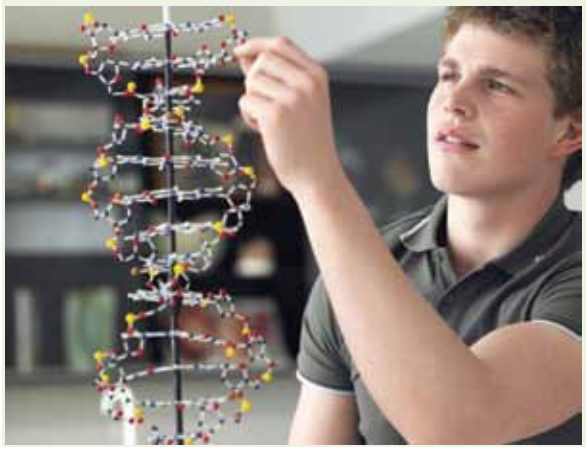
STEM high schools

State STEM networks

Mentoring opportunities

Workshops for STEM teachers

STEM scholarships



By PHIL DAVIES
Senior Writer

As any good engineer can tell you, a pipeline is only as sound as its component parts. If it has bottlenecks or leaky joints, it can't perform at anything close to top capacity. So it is with STEM. Whether or not there is a STEM crunch—too few science and technology students graduating from Ninth District colleges and universities to meet employer demand—educators, state officials and many employers say that not enough science or technology students are making it all the way through the pipeline from elementary school to the workplace.

The K-12 learning environment is widely seen as a major contributor to the problem. Many middle and high school students do poorly in science and advanced math, or avoid those subjects because they're considered boring or too difficult. (In Minnesota, 2015's graduating high school class will be the first required to complete a chemistry or physics course.)

There's evidence to support the idea that potential STEM workers are falling by the wayside in the education system. Nationally, less than 40 percent of college freshmen who declare their intention to major in a STEM field end up getting a STEM degree, according to the President's Council of Advisors on Science and Technology.

And U.S. high school students post lower math and science scores on international tests than peers in many other developed countries. It may not be a coincidence that students from high-scoring countries such as Canada, Korea and China account for a rising share of the graduating classes of STEM degree programs in the district. (For more about international college students in the district, see "Flying colors," page 9.)

But earnest efforts are afoot across the Ninth District to increase the flow of homegrown STEM graduates into the workforce.

## Get your geek on

The past five years have seen a groundswell of initiatives in the district intended to encourage more students to pursue STEM degrees and to improve science and technology teaching at all levels of education.

Several district states have developed STEM networks, broad-based programs designed to engage a wide variety of stakeholders in the STEM effort. The Twin Cities-based Minnesota STEM Network describes itself as "a community of practice" for STEM education and workforce development that includes schools, government agencies, businesses and community groups. An outgrowth of SciMathMn, a nonprofit focused on STEM education from prekindergarten through college, the organization seeks to raise public awareness of STEM,

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promote effective STEM teaching and boost the number of students pursuing STEM careers.

A $300,000 appropriation by the 2013 North Dakota Legislature established that state's STEM Network. Executive Director David DeMuth Jr., a physics professor at Valley City State University, says the nascent network will foster a teaching and learning philosophy—based on the engineering design process—in which students work cooperatively in teams to solve problems. Five regional STEM networks are planned in the state, including one representing Indian tribes.

STEM schools represent another broad approach to getting students involved in science and technology. Public schools in every district state—among them Richfield STEM School in Minnesota and Fond du Lac STEM Institute in Wisconsin—have embraced the STEM designation, although STEM schools are not certified as such by any official body. Some simply beef up offerings and requirements in science, math and related subjects, while others emphasize novel approaches such as interdisciplinary and project-based learning.

A variation on STEM schools—and the latest buzzword in K-12 education—is the STEAM school. Since 2010, a number of middle and high schools in district states have adopted curricula that blend math, science and the arts.

Other STEM initiatives in the district focus on discrete student populations or fields of study within STEM. A program developed last year at South Dakota State University (SDSU) aims to improve STEM education in the state, emphasizing rural areas where one instructor may be called upon to teach several science and technology subjects. The Institute for STEM Education Enhancement supports workshops for science and math teachers, and administers federal grants for college juniors and seniors pursuing secondary school teaching certificates in math and science.

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"The goal is to … encourage more students to go into STEM education," said Institute Director Sharon Vestal, who teaches math education at SDSU. "We all know that's a necessary part of the big STEM picture, because we can't recruit students if we don't have awesome teachers out there."

Racial minorities earn science and engineering degrees at less than half the rate of whites, according to the National Science Foundation. In Minnesota, the goal of the NorthStar STEM Alliance is to double every five years the number of minority students at 14 higher education institutions in the state receiving STEM bachelor's degrees. NorthStar, funded by the National Science Foundation, tutors college students and provides mentoring, internship and undergraduate research opportunities. Alliance members include the University of Minnesota, Carleton College, the Science Museum of Minnesota and the Minnesota High Tech Association (MHTA).

## The future of industry

Efforts to promote STEM education include direct intervention in the career-building process by employers, who have a vested interest. The more young people who study science and technology in secondary school and go on to earn STEM degrees, the larger the pool of potential STEM recruits.

In Montana, over 1,000 high school students take part in a privately funded program that awards $10,000 in prizes for learning computer programming online. Computer science is not part of the core curriculum in Montana public schools (or in most school districts across the country). "Introducing computer science in K through 12 allows students to apply math in a way that makes their core studies more interesting," said Greg Gianforte, a Bozeman tech entrepreneur who co-founded CodeMontana last fall and has covered most of its startup costs.

Gianforte said that one of the program's goals is "to raise awareness that there are careers for people who work with computers in Montana," so that high school students will be motivated to study computer science in college—and stick around to take jobs in burgeoning technology hubs such as Bozeman.

Scholarships are another example of private sector efforts to increase the number of STEM graduates entering the workforce. For the past several years, the MHTA Foundation has awarded more than $70,000 annually in scholarships to Minnesota undergraduates pursuing degrees in STEM or STEM teaching. Awards can include internships at MHTA member companies.

And Land O'Lakes, the giant dairy cooperative, offers $5,000 annual scholarships to juniors and seniors studying food, agriculture and natural resource sciences at the University of Minnesota. "Our goal with the scholarship program is to support students who want a career in agriculture, and STEM fits right into that," said Lydia Botham, director of the Land O'Lakes Foundation. "Science and technology are key components to the work we do at Land O'Lakes, and these students are the future of our industry." f

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cade. A caveat applies to job projections: Labor markets are dynamic, with constant shifts in supply and demand due to wage changes, industry slowdowns and other factors. But a 2010 analysis by the Georgetown University researchers estimated that, from a base year of 2008, total U.S. employment would increase 10 percent through 2018. But the number of STEM jobs was projected to grow by 17 percent during that time.

In district states, many STEM occupations are expected to see strong growth over the next seven years, according to future growth estimates for different occupations prepared by state labor departments.

In North Dakota, for example, jobs for civil engineers were projected to increase by one-third from 2010 to 2020. In Montana, a 50 percent rise in employment for developers of system software was projected over that period. And in Minnesota, the ranks of biomedical engineers were expected to swell by 66 percent.

Demand is also likely to rise for STEM graduates in non-STEM fields because of the increasingly technical nature of the U.S. and global economy.

Sharon Vestal, director of a program at South Dakota State University to enhance rural STEM education, sees modern farming as a burgeoning STEM occupation: "Frankly, agriculture is becoming more of a science. The equipment is run by computers, and [farmers] use GPS mapping to plant and apply fertilizer. In order for South Dakota to stay competitive in terms of agriculture, we need more people who are educated in soil science and plant science and GPS and all those things."

If expectations for job growth within and outside core STEM occupations come to pass, district universities and colleges will likely need to prepare for more students, especially in computer science and engineering. Recent enrollment trends since the recession indicate that young people are already responding to market signals.

The University of Minnesota's College of Science and Engineering has seen a 13 percent rise in undergraduate enrollment since 2009 due to revived student interest in—and higher employer demand for—degrees in mathematics, civil engineering and other STEM degrees. To accommodate this growth, the university's Twin Cities campus plans to hire 100 new STEM faculty members this year, Kaler said.

At UND's College of Engineering & Mines, enrollment has increased over 80 percent since 2007, when the oil boom took hold in North Dakota. Biberdorf says universities in the state "grasped onto the need rather quickly" to produce more engineers in a number of subfields—civil, mechanical, petroleum—to meet demand from oil companies, construction firms and other employers in the Bakken oilfields. In 2010, UND launched the state's first petroleum engineering degree program. Seven students enrolled the first year; this spring, 211 students are in the program, which has suffered some growing pains.

In Montana, MSU's computer science department is poised to sharply increase the size of its spring graduating class due to big enrollment gains over the past five years. As of last fall, the number of bachelor's degree candidates had rebounded to 281, almost twice the number of students enrolled in 2007.

"The good news is that … we're about to double the number of our graduates, even compared to a year ago," Paxton said. He added that "it's exciting … and it's also scary" because of the added teaching burden being borne by computer science faculty. Despite the enrollment surge, the department still has the same number of instructors it employed in 2007. f

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