

STEM

Gets a Boost from Business

Business leaders are partnering with elementary schools to help increase students' interest and achievement in STEM.

BY LINDA ROSEN

STEM—science, technology, engineering, and mathematics—has become a fixture of the education debate, and much effort already has been put toward improving student performance. Yet troubling statistics persist: On the latest round of testing for the National Assessment of Educational Progress (NAEP), only 40 percent of fourth graders nationwide were found to be proficient in math, and students at all grade levels were especially weak in inquiry-based science.



Business leaders, like education leaders, are acutely aware of what this could mean for the future of our country: Young people might be unprepared for rewarding jobs and the demands of informed citizenship, businesses may not find the talent they need to keep innovating, and the economy may stagnate with too little innovation.

To turn the tide, we must start with math and science in elementary school. Business leaders, understanding this, are increasingly partnering with educators and one another to curtail the flow of talent away from STEM-related careers by investing in our nation's youngest learners. That, in fact, is a major focus of Change the Equation (CTEq), a nonprofit, nonpartisan, CEO-led initiative that is mobilizing the business community to improve the quality of pre-K-12 STEM learning in the United States.

Shared Vision

Business leaders are not in a position to make detailed judgments on best teaching practices or to determine what works best for an individual school with its own unique set of circumstances. However, business and education leaders do share a com-

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STEMworks Database, hosted by CTEq, features **programs that deepen young people's learning in STEM**. The database aims to be a critical resource for funders, program developers, educators, and STEM advocates alike.

Engineering is Elementary **partners lessons in engineering with science curricula already in place** in public schools. The website features resources such as lesson plans and professional development workshops and programs.

mon vision of excellent teaching and learning in math and science. They know that such teaching and learning inspires and engages young learners, giving them exciting, real-world examples of the application of math and science. It aligns to business world's need for people who can apply knowledge and work collaboratively, and it whets students' appetites for the possibilities inherent in a STEM-based career.

Yet what happens in elementary classrooms often does not match this aspiration. Time for science in the classroom has dwindled, making it difficult for teachers to conduct the project-based learning that can spark interest. Addressing these problems can form the start of a solution. Professional development, hands-on learning, and after-school programming are three tactics that are among the most promising for supporting students' performance in STEM.

Professional Development

Business leaders instinctively grasp the need for professional development because they know how important it is to cultivate talent. Professional development is especially critical in elementary school math and science, because elementary teachers tend to lack content knowledge and confidence in these subjects. Programs that address this weakness can be effective when they strengthen teachers' grasp of the content while equipping them to convey it to young students in a way that promotes understanding and prevents misconceptions.

Professional development programs that bolster teachers' knowledge and confidence can be particularly effective if they strengthen teachers' grasp of the content while equipping them to convey it to young students in a way that promotes understanding and prevents misconceptions.

Intel Math, which operates in schools across Arizona, California, Illinois, and Connecticut, among

SPOT-LIGHT

on a

STEM SCHOOL

First-graders at the Richfield STEM School are responsible for the same subjects as their peers at other Minnesota schools. But one thing's different—they're also in charge of worms and soil.

"For first graders, their year-long project is compost," says Joey Page, principal of the K-5 program, the only one in the district focused on STEM. For the first six weeks of school, each of Richfield STEM School's 800-plus students raises Monarch butterflies. Then, each grade launches into other year-long projects, like composting.

"That's what I tell them: They're in charge of dirt," says Page. "At the end of the year, they have to give some dirt to the fifth graders for their terrariums and to the kindergarteners for their gardens."

Amidst a national backdrop of calls for enriching STEM education and preparing students for high-demand technical careers, Richfield offers students opportunities to get their hands dirty—sometimes literally—with project-based math and science learning. But as an intensive STEM school, Richfield takes this goal a step further, intentionally embedding science, technology, engineering, and math into every subject.

To achieve its mission of engaging students in "authentic, real-world, expeditionary learning," the school

has developed its own inquiry-based, interdisciplinary curriculum that is deeper in science and engineering than district standards. Page, who came on board at the school in 2009 to help it transition to its STEM emphasis in 2010, says school staff spent a lot of time looking at other STEM schools, devising a curriculum that is both organic and place-centric.

"We have a beautiful courtyard garden and a nature preserve nearby. Our STEM curriculum leans more toward environmental engineering," he says. Fourth graders dip into chemical engineering when they test local water's pH, for instance; fifth graders explore civil engineering by designing dams with the Science Museum of Minnesota. And other subjects lend themselves perfectly to STEM, Page says. Fourth graders can read about Duke Ellington in language arts, explore how a horn makes sound, and see how math and music intertwine to form quarter-notes and eighth-notes.

"One question we're always asking is, 'Where is STEM?'" says Page. "We make sure we're pulling it in intentionally."

Preparing teachers to weave STEM into the curriculum has been a big part of Richfield's success. When the school opened, teachers had to earn elementary STEM certification within two years.

"As a principal, I wanted to have a deep staff development plan. Our teachers had zero experience in engineering because it's not part of any elementary program," he says.

The school partnered with the National Center for STEM Elementary Education at St. Catherine University to usher two cohorts of educators through the year-long certification program, which gave teachers the opportunity to bond and boost their confidence in teaching STEM. After working throughout the year on

coursework with videos, blogs, and meetings on staff development days, teachers hosted an engineering fair to present their culminating projects to students, filling the Richfield gym with Rube Goldberg machines.

"One of the most powerful things of the last two years has been showing our students that their teachers are learners too," says Page.

As teachers and students have delved into STEM together, the school has honed its curriculum, teamed with The Works Museum to construct the W.O.W. Room (an interactive, hands-on "gym" for stretching science "muscles"), and discovered ways to redefine technology.

"The 'stuff' doesn't make the STEM school," says Page of the SMART Boards, computer labs, and digital tools that are already present in plenty of schools in his district. "It's not just stuff we plug in. It's a tool, and we can make technology."

The W.O.W. Room features stations for computer programming, for instance. First graders make flashlights, while fifth graders build catapults. But *what* Richfield's students create isn't necessarily as important as *how* they do it. Hands-on projects like these offer play with a purpose, leveraging fun to lay foundational skills—collaboration, logic, innovation, and most of all, critical thinking.

"STEM fits very well into the natural curiosity that kids have," Page says. STEM schools aren't necessarily on a mission to create a generation of NASA scientists or top engineers, just curious problem-solvers who can make an impact on their world.

"We want kids to understand how the world works," he says. "We also want kids to understand how to make it *better*. I think *that* encompasses what STEM is."

Meredith Barnett
Associate Editor
NAESP



Newly STEM-certified teachers demonstrate the inner workings of Rube Goldberg machines at the Richfield STEM School's Make It Move engineering fair.

Joey Page is principal of the Richfield STEM School and president-elect of the Minnesota Elementary School Principals' Association. Follow him on Twitter @stemprincipal for the latest updates from Richfield's classrooms.

other states, is an intensive professional development program for K-8 teachers created by CTEq member Intel. It has increased teachers' understanding of math and confidence in teaching the subject. In New Jersey and Pennsylvania, the Merck Institute for Science Education partners with school districts to deliver science professional development to educators who serve some 100,000 students. Merck, another CTEq member, provides major support for the initiative, which encourages inquiry-based learning in elementary schools.

As elementary principals prepare for Common Core math standards—and perhaps new common science

standards down the road—they should look for sustained professional development programs with a clear vision for what teachers should know and be able to do. The best programs also clarify for teachers how this vision can improve their practice. Principals should ask: Does the program adhere to commonly accepted standards for effective professional development? Is it job embedded?

Hands-On Learning

Businesses also have rallied around programs to bring more hands-on learning into classrooms. Employers need people with the ability to apply knowledge in practical and innovative ways, and many say that ability is

hard to come by. The problem starts as early as fourth grade, as revealed by the NAEP results. Initiatives such as Engineering is Elementary integrate project-based learning in engineering—the hands-on application of content in a concrete, problem-solving manner that excites and engages young learners—into science curricula already in schools. The program serves about 2 million students in every U.S. state.

Principals should look for programs that tie engaging and authentic activities to academic content standards. Just as important, they should insist on programs that train teachers to deliver engaging instruction.

Principles for Effective Partnerships

When considering a partnership with local business leaders to enhance STEM education in their schools, principals should take the following guidelines into consideration.

IDENTIFY AND TARGET A COMPELLING AND WELL-DEFINED NEED. For example, help STEM teachers become more effective in improving student learning, help students gain the STEM skills they need to prepare for college and the workforce, or focus on populations underrepresented in the STEM education pipeline and STEM workforce.

DETERMINE THE AMOUNT OF TIME NEEDED for the effort to have the intended, sustained impact, and confirm that the business leaders can make the time commitment.

PROVIDE INFORMATION ABOUT LOCAL, STATE, OR NATIONAL STEM CONTENT STANDARDS so that business leaders can properly align the programming.

IDENTIFY WAYS TO INCORPORATE ACTIVE, HANDS-ON LEARNING where students: ask questions; define and make sense of problems; develop and use models; plan and carry out investigations; analyze and interpret data; use mathematics, computational thinking, and abstract reasoning; construct explanations and/or design solutions; engage in arguments using evidence; obtain, evaluate, and communicate information.

ENSURE THAT PROGRAMS ADDRESS THE NEEDS OF GROUPS THAT ARE UNDERREPRESENTED IN STEM FIELDS, such as females and underrepresented minorities.

ENSURE THAT DIVERSE LEARNERS' NEEDS ARE ACCOMMODATED THROUGH TAILORED INSTRUCTION.

Young women and minority students begin leaking out of the STEM “pipeline” at a young age.

After-School Programming

In many schools, finding the time for more engaging, hands-on math and science learning in a tight daily schedule just isn't possible. In these instances, school leaders can encourage after-school programming to fill the void. Strong after-school programs in STEM areas often complement and enhance the work of schools. The best of them get students excited about STEM by helping them tackle real-world challenges.

One program that has helped businesses nationwide reach thousands of students each year is the Junior FIRST Lego League, which is active in thousands of cities across the country. Like many strong after-school programs, FIRST uses small groups and an informal setting to engage students. Elementary students get the chance to work with adults, including STEM professionals from local businesses, to design, build, test, and program robots before competing against other schools. Initiatives such as these give them the opportunity to apply STEM concepts in a real, tangible, and exciting way. Many scouting clubs, 4-H Clubs, Boys and Girls Clubs and similar programs are increasing their programming in STEM, often with the support of the business community. Principals who are looking for ways to extend the currently scarce time for science may want to identify STEM afterschool programs that complement—without mimicking—their math and science curricula. Such programs can strengthen students' academic foundation while making STEM fun.

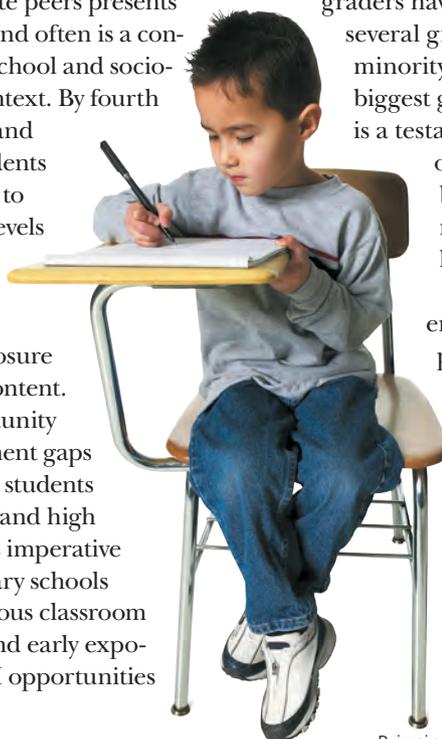
Underserved Populations

No discussion of STEM is complete

without touching upon the two populations of historically underrepresented groups. Women and minorities are far less likely than their white, male classmates to major and pursue a career in STEM. Given the demand for STEM skills in the work force, businesses and educators alike realize that they must focus on these two groups specifically—and early—so that they do not squander the needed talent and potential of millions of young people.

Young women and minority students begin leaking out of the STEM “pipeline” at a young age. Despite little or no difference in performance at the elementary-school level, girls assume that math is for boys as early as second grade. The lack of female STEM role models—only one in four STEM professionals is a woman—only exacerbates this stubborn problem.

The gap between minority students and their white peers presents itself earlier and often is a consequence of school and socioeconomic context. By fourth grade, black and Hispanic students often are two to three grade levels behind their white peers, and they have less exposure to rigorous content. These opportunity and achievement gaps only widen as students enter middle and high school, so it is imperative that elementary schools provide rigorous classroom instruction and early exposure to STEM opportunities



that will provide a strong foundation for students as they progress through the education system.

To address these areas of need, many businesses have specially supported programs that focus on young girls and minority students. Such programs as Techbridge Girls and GirlStart, which are in communities across the country, serve elementary girls by exposing them to hands-on STEM-based inquiry in an empowering, girl-centric setting. Similarly, a recent initiative by CTEq member companies has brought such programs as FIRST, Intel Math, and Engineering is Elementary to more than 100 new sites that specifically serve low-income, minority students. By increasing these partnerships and opportunities, schools have a greater chance of reaching all students who may become passionate about STEM.

Partnering for Success

Amid all the worry about our elementary students' math and science performance, it's easy to forget that elementary students have made big gains in the past two decades. Fourth graders have made the equivalent of several grade levels of progress, and minority students have made the biggest gains of all. This success is a testament to the dedication of educators working with business and other community leaders to improve the lot of children.

We know from experience that improvement is possible, but we also know just how far we still have to go. Working together, we can brighten the future of millions of American children. 

Linda Rosen is chief executive officer of Change the Equation.