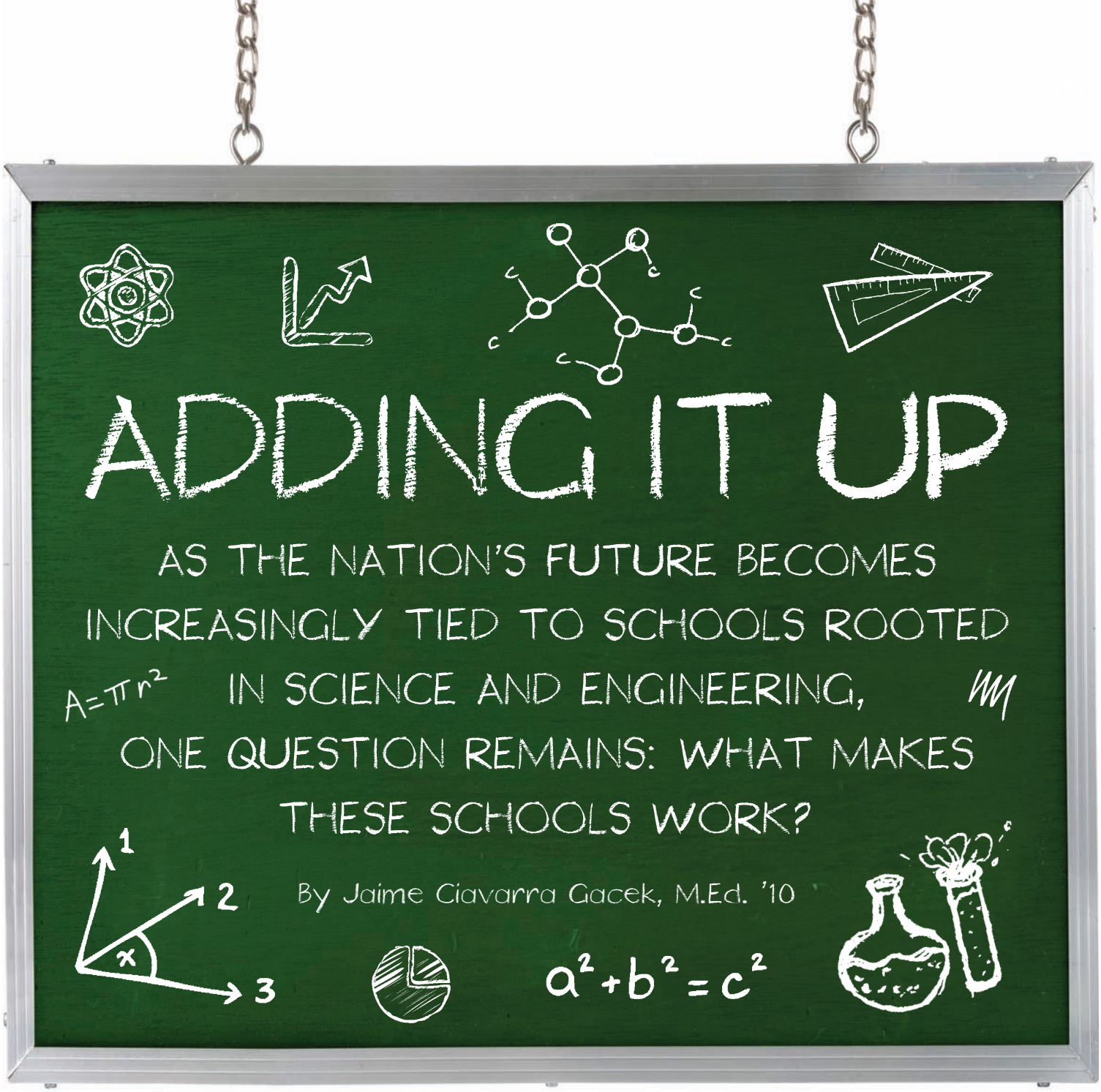

By Jaime Ciavarra Gacek, M.Ed. '10

President Barack Obama has called it the "Sputnik moment" of our time.

The critical science and math skills of U.S. students lag behind their peers in other countries; the percentage of U.S. undergraduates earning science- and engineering-related degrees is dwarfed by that of countries like Japan and China; and businesses in recent years have reported difficulty filling skilled jobs in fields related to science, technology, engineering, and math. By some counts, the nation over the next decade will need to produce around a million of these workers above current graduation rates in order to keep pace.

"Half a century ago when the Soviets beat us into space with the launch of a satellite called Sputnik, we had no idea how we would beat them to the moon," the president said in his 2011 State of the Union address. "The science wasn't even there yet. NASA didn't exist."

For a nation that led the way in space after Sputnik, these statistics are prompting fear about the country's economic well-being, national security, and ability to meet employment needs.

Once again the nation finds itself in a race to "win the future," as President Obama put it; a race that hinges on education.

Some policymakers are pinning their hopes on specialized schools rooted in science, technology, engineering, and math—so-called STEM schools. These have existed for more than a century and in recent years have gained popularity. In 2010 the President's Council of Advisors on Science and Technology called for the creation of at least 1,000 STEM schools over the next 10 years—200 high schools and 800 middle and elementary schools—and 100,000 STEM teachers.

What remains for educators is one big question that looms between the uncertainty of this "Sputnik moment" and future preeminence: What exactly is effective STEM education?

Sharon Lynch, of GW's Graduate School of Education and Human Development, is leading a team of researchers to find out.

"You can put a label on a school, but what goes on inside that school is really, really important," says Dr. Lynch, a professor of curriculum and pedagogy.

Dr. Lynch and her team,

funded by a $2.8 million grant from the National Science Foundation, are studying what established STEM high schools are doing well to help inspire students and prepare them for college and careers, with the aim of providing a blueprint that could be used to launch STEM high schools with a solid foundation.

More specifically the team is studying "inclusive" STEM high schools—those that are open to all students, bucking a long history of competitive admissions processes that favor students who have already demonstrated their talents and abilities with the subject areas.

This will give the researchers insights, for first time, into how these schools affect underrepresented groups in STEM fields, including African Americans, Hispanics, women, and students from low-income families or rural areas. Women and minorities constitute about 70 percent of college students but earn only about 45 percent of STEM degrees, according to a 2012 report by the President's Council of Advisors on Science and Technology.

"If we're really going to change the nature of education in the United States, to have skilled workers at all different levels, we need to approach it differently," Dr. Lynch says. "When you are taking regular kids and getting them interested in STEM fields, you are capturing a broader swath of the population and changing the identity of who does STEM in the U.S.

"The economy needs STEM workers at all different levels, but more importantly these schools are truly opening opportunities up to all kinds of kids," she says. "... It's a very different proposition, but something that needs to happen."

Over the next three years, the team will visit 12 inclusive STEM high schools across the nation to capture different models in different states.

So far, the team has initiated three of its case studies at schools in Texas, North Carolina, and California. The research aims to represent a variety of geographic regions and both rural and urban schools. Of the schools chosen for the study so far, all are public high schools. The researchers say they would also consider charter schools, which receive both public and private money.

Dr. Lynch—along with co-researchers Tara Behrend, a GW assistant professor of organizational sciences; Barbara Means, a researcher from the nonprofit research institute SRI International; and Erin Peters Burton, an assistant professor of science education from George Mason University—visits the targeted schools looking for how the administrators and teachers implement 10 components identified by the team. Those include using STEM-focused curricula integrated across all subject areas, emphasizing project-based learning, and connecting with students through technology.

A constant relationship with real-life problems is critical, says Dr. Behrend. At one school, the research team saw a geometry class designing houses using engineering software. In order to complete the project, the students needed to know geometric and trigonometric functions to solve problems like how a door should swing open, or what the incline of the staircase should be.

"THESE SCHOOLS ARE TRULY OPENING OPPORTUNITIES UP TO ALL KINDS OF KIDS...IT'S A VERY DIFFERENT PROPOSITION, BUT SOMETHING THAT NEEDS TO HAPPEN."

"We're looking for that connection with the real world; it's so important for preparing and inspiring them for future careers," Dr. Behrend says.

The benefit of this type of learning, she says, is two-fold. "Not only are these kids really interested in it, but when state assessments come along they score quite high."

In addition to collecting test assessment data and observing the classroom culture, the researchers are setting up focus groups with students and parents to discuss the characteristics of each school, talking with community business leaders about opportunities afforded to students outside of the school building, and they are surveying teachers on their experience, background, and preparation.

The researchers haven't yet made public which schools have been chosen for the case studies, but Dr. Lynch notes that one—an inclusive STEM high school in Texas—boasts that 100 percent of its 2011 graduating class was admitted to college and 80 percent attended that fall. The national average for attendance is about 64 percent.

A strength of that school, she says, is that it provides a more personalized education, where there is an attempt by teachers and administrators to understand a child and his or her academic goals. This is important to propelling minorities into STEM careers, she says, which have seemed closed off or unattainable for underrepresented groups for so many years.

"These schools aren't set up to meet kids just with academic work. They are also helping them understand the context of STEM and what kinds of careers evolve from these fields. These young people are applying to college with the skills of upper-class to middle-class kids but sometimes, while the families are behind them, the families can't provide them with that knowledge of how to get to what they want," Dr. Lynch says. "When we talk about opportunity structures, it's about providing the kind of social capital that many middle-class people take for granted."

None of this, however, is to say that the research team or experts in the field tout STEM schools as a panacea for the nation's educational woes. This study comes at a critical time: Despite what appears to be a trend in creating STEM schools, the researchers say no rigorous, on-site comparative studies of these schools have been published yet in scholarly journals.

"Would we fall behind if we didn't have these schools? It's not clear. There are many countries that don't have these

GW professors Tara Behrend (left) and Sharon Lynch (right) are part of an NSF-funded research team studying the drivers of success at STEM high schools, especially among minorities and other groups that are underrepresented in STEM fields.

WILLIAM ATKINS

focused schools and are doing quite well, in fact better than the U.S. [on international tests]," says Martin Storksdieck, the director of the Board on Science Education at the National Research Council of the National Academy of Sciences. "This research has real, practical implications. There's a push to really crank out STEM capable youth, and researchers want to know: Do these schools provide a real benefit?"

What is clear, the research team says, is that the rush to create STEM-focused schools may have pitfalls unless a clear notion is developed for what constitutes a successful STEM school.

A planned second phase of the study will take four of the 12 case study schools and compare the experiences and outcomes of a student with those of a student at a nearby typical public high school. The aim, Dr. Behrend says, is to give a rich snapshot of "a day in the life" of these students, including what their classes look like, what extracurricular activities are available, and what their peer groups consist of.

Dr. Lynch says they are consciously "trying to avoid what some documentaries did [like the 2010 film *Waiting for Superman*, about lottery charter schools], which give you the impression that if you get into one school you're in great shape, but at the [typical] school you're doomed."

The truth might be found somewhere in between as the researchers begin to tease apart what's known and what's believed. The only sure thing for now is that the race toward the future is well underway, and studies like this may help illuminate the course.

"Many studies and policymakers have recently pointed to the fact that we need a more STEM-literate work force, that we need more STEM-focused curriculum," Dr. Lynch says. "This project may help reveal the 21st century version of a path to the American dream." GW

LAGGING BEHIND

Educational achievement in the United States has fallen to the middle of the pack among developed nations, especially in STEM subjects, according to the latest edition of the Program for International Student Assessment (PISA) report, coordinated by the intergovernmental Organization for Economic Cooperation and Development (OECD).

The international tests rank the knowledge of 15-year-olds every three years. In 2009, the U.S. ranked 17th in science and 25th in mathematics among 34 OECD member nations.

MATHEMATICS LITERACY SCALE
OECD average: 496

OECD Country	Score		
South Korea	546	Austria	496
Finland	541	Poland	495
Switzerland	534	Sweden	494
Japan	529	Czech Republic	493
Canada	527	United Kingdom	492
Netherlands	526	Hungary	490
New Zealand	519	Luxembourg	489
Belgium	515	United States	487
Australia	514	Ireland	487
Germany	513	Portugal	487
Estonia	512	Spain	483
Iceland	507	Italy	483
Denmark	503	Greece	466
Slovenia	501	Israel	447
Norway	498	Turkey	445
France	497	Chile	421
Slovak Republic	497	Mexico	419

SCIENCE LITERACY SCALE
OECD average: 501

OECD Country	Score		
Finland	554	Czech Republic	500
Japan	539	Norway	500
South Korea	538	Denmark	499
New Zealand	532	France	498
Canada	529	Iceland	496
Estonia	528	Sweden	495
Australia	527	Austria	494
Netherlands	522	Portugal	493
Germany	520	Slovak Republic	490
Switzerland	517	Italy	489
United Kingdom	514	Spain	488
Slovenia	512	Luxembourg	484
Poland	508	Greece	470
Ireland	508	Israel	455
Belgium	507	Turkey	454
Hungary	503	Chile	447
United States	502	Mexico	416

315: The number of STEM high schools and programs nationwide, according to a 2008 study by SRI International. Barring any fixed definition of a STEM school, though, the number is a moving target. The President's Council of Advisors on Science and Technology in 2010 called for the creation of at least 200 STEM-focused high schools and 800 middle and elementary schools over a decade.

THE STEM ADVANTAGE

According to a 2011 report by the U.S. Commerce Department:

- STEM occupations were projected to grow by 17 percent between 2008 to 2018, compared to 9.8 percent for non-STEM occupations.
- STEM workers earned 26 percent more per hour than their non-STEM counterparts.
- More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers.
- In 2010, 7.6 million people—or 1 in 18 U.S. workers—held STEM jobs.