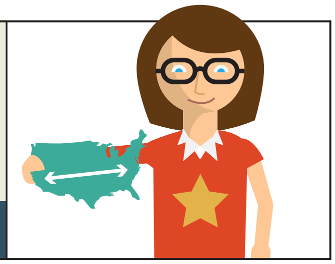
REDESIGNING SCHOOLS

REACHING ALL STUDENTS WITH EXCELLENT STEM TEACHERS

EDUCATION LEADERS' BRIEF



In the U.S., STEM subjects—science, technology, engineering, and math—face urgent needs: Employers need more STEM-trained workers, and more students need advanced STEM education to get these jobs. But schools face a shortage of skilled STEM teachers. Some organizations have begun to address the gaps, but recruiting and retaining excellent STEM teachers remains a serious challenge. This is due at least in part to lower pay and fewer career opportunities in teaching than other jobs for those with STEM skills.

There is another way. Schools that extend the reach of excellent teachers and their teams to more students, for significantly higher pay, within budget, may be able to attract and keep far more STEM teachers. This "Opportunity Culture" strategy provides more students with access to excellent STEM teachers and allows these teachers to help their peers succeed.

In this brief, we summarize:

* the grim facts about STEM employment and learning in the U.S. today
* the emerging efforts to stem the shortage, and
* the ways that an Opportunity Culture can augment these efforts.

Readers can view this brief and more detail in slide deck form and find other helpful materials on **OpportunityCulture.org.**

STEM JOBS IN THE U.S.

Is the hand-wringing over STEM shortages warranted? Statistics and projections suggest yes:[1]

* STEM jobs are projected to grow by 13 percent from 2012–22, versus 11 percent in all occupations. That means 1 million new STEM jobs.
* Only 5 percent of U.S. workers work in science and engineering jobs—but they drive 50 percent of U.S. economic expansion, thus creating other jobs. For each new job in software, technology, and life sciences, five jobs are created. For each new job in manufacturing, by comparison, only 1.6 jobs are created.

A STEM job created in the U.S. benefits the whole economy, and these jobs are going to be plentiful.

How does that matter for education? Ninety-two percent of new STEM jobs will require some post-secondary education.[2] K–12 schools must get today's students college-ready in these subjects.

But ready or not, college students continue to turn away from STEM courses. The U.S. has one of the lowest ratios of STEM to non-STEM bachelor's degrees in the world—with the percentage of students receiving STEM bachelor's degrees actually declining from 24 percent in 1985 to 18 percent in 2009—and from 18 percent to 14 percent for master's degrees.[3]

92 percent of new STEM jobs will require some post-secondary education.

Not all STEM jobs require STEM degrees, of course—but, likewise, not all STEM graduates enter STEM positions.

Those numbers make U.S. employers nervous. A 2013 survey of Fortune 1000 companies' recruiters found that only 50 percent could find job candidates with STEM bachelor's degrees "in a timely manner"—and 47 percent said that shortage limits business growth. Only 16 percent said they could find enough minority applicants with STEM degrees. That talent shortage leads to lower productivity, said 56 percent of those surveyed—which further limits the creation of other jobs driven by STEM work.[4]

STUDYING STEM—WHY SO FEW?

Students simply aren't prepared when they leave high school to pursue college STEM degrees. Grim international comparisons continue to highlight U.S. deficiencies, and a recent study made clear they affect students from all levels of society, including children of well-educated parents:[5]

* The U.S. ranked lower than 29 of the international education systems participating in math and lower than 22 of those participating in science, according to the 2012 Program for International Student Assessment (PISA).[6]
* And only 44 percent of 2013 high school graduates who took the ACT met college readiness benchmarks in math, and just 36 percent met the science benchmark.[7]

Too few U.S. high school students are prepared to pursue STEM topics in college.

Among the 20 largest school districts, only 55 percent of schools with the *lowest* minority enrollment offer calculus, dropping to an even worse 29 percent of schools with the *highest* minority enrollment.[9]

What's going on? At least part of the answer seems straightforward: Students aren't prepared because the U.S. lacks enough STEM teachers—setting up a vicious cycle that limits the number of new teachers. We need 25,000 new STEM teachers *each year* to replace teachers who retire or leave the profession—but one survey showed fewer than 9,000 high-schoolers who would be "highly qualified" saying they would be interested in teaching.[10]

In addition, too few college education majors are qualified to be STEM teachers. A Michigan State University researcher reports that only 10 percent of the education majors in the bottom 25 percent of university education schools are taking the courses they need, according to international standards, to teach middle school math. But that bottom 25 percent of schools produces 60 percent of middle school math teachers.[11]

Meanwhile, successful STEM students see a stark choice in pay—for example, the median starting salary for chemical engineering majors is $67,500, versus $37,200 for education majors.[12] Some students graduating with college loan debt or other financial pressures cannot feasibly choose to teach, given the alternatives.

How much do highly skilled STEM teachers matter? Research shows that students taught by teachers with both a bachelor's and master's degree in math showed an increase in math scores of more than a third of a year of schooling compared with students taught by teachers without those degrees.[13]

Unfortunately, when schools do hire teachers with relevant degrees—as more than 70 percent of high school math and science teachers held in 2007–08—many don't stay. More than 40 percent of high school STEM teachers leave teaching within their first five years,[14] blaming low teacher salaries and a lack of classroom resources, autonomy, and effective professional development, among other issues.[15]

Instead, students are largely being taught by teachers with little STEM expertise. Only 2 percent of fourth-graders in 2011 had math teachers who had undergraduate degrees in math. Only 30 percent of eighth-graders had math majors as math teachers in 2013, and fewer than half had science teachers who majored in science in 2011.[16]

STARTING TO STEM THE SHORTAGE

Faced with these statistics, national and state groups are trying to close the STEM gap.

- In 2009, President Obama started **Educate to Innovate**, to move U.S. students in a decade from the middle to the top of world in science and math, increasing STEM literacy, improving STEM teaching, and expanding STEM education and career opportunities for underrepresented groups such as woman and minorities.[17]
- The large **100Kin10** collaborative, led by Carnegie Corporation of New York and including more than 150 foundations, federal and state agencies, museums, universities, corporations, school districts, and nonprofits, aims to provide U.S. classrooms with 100,000 STEM teachers in 10 years.[18] Partners in 100Kin10 recognize and elevate successful STEM training practices, share information about activities and strategies, and publish work illustrating good practices in STEM teaching.
- **Change the Equation** has made efforts to better match the supply and demand for STEM teaching, working at 134 sites with its "Igniting Learning" projects that help corporations support STEM teaching in their communities. Begun in 2010 and led by CEOs eager to motivate the business community to collaborate with philanthropic and advocacy efforts to improve STEM learning and teaching quality, the initiative created "Vital Signs," an interactive tool that shows the supply and demand of STEM skills in every state.[19]
- The nonprofit **National Math and Science Initiative** provides increased instruction and teacher support for Advanced Placement courses, through training and mentoring of teachers, tutoring students, holding study sessions, and providing access to videotaped lessons. It reports that the number of passing AP scores at 566 partner high schools rose 10 times faster than the national average, especially among female, African-American, and Hispanic students.[20]
- States using the **Common Core Standards**—which emphasize challenging content and include trigonometry and calculus—focus their curricula on higher-level learning in STEM subjects and applying STEM knowledge to solve problems. That aligns with the teaching practices of most countries that excel in STEM learning outcomes.[21]

The U.S. has one of the lowest ratios of STEM to non-STEM bachelor's degrees in the world.

- Universities are offering targeted preparation for STEM teachers. The University of Texas's **UTeach** program, used by 35 universities, boasts a retention rate of 80 percent of teachers still teaching after five years; 88 percent of UTeach graduates are math and science teachers.[22] In New York, Stony Brook University worked to boost its minority graduation rate, increasing Hispanic students' graduation rate from 42 percent in 2004 to 58 percent in 2010. Its **"STEM Smart"** program provides support for disadvantaged high school and college graduates to pursue degrees in hard sciences.[23]

CREATING AN OPPORTUNITY CULTURE: CLOSE THE STEM GAPS

Unfortunately, even with multiple programs focused on recruiting and retaining more math and science teachers, the U.S. will still come up short in providing all students with excellent STEM teachers, those who close gaps rapidly.

Excellent teachers, those in roughly the top quartile, help students make an extra half-year of progress every year, on average, compared with typical teachers, and three times as much progress as with teachers in the bottom quartile. Students who start one to two years behind, as do many children living in poverty, need teaching at this level for two to four consecutive years in each subject to catch up. Middling students need these teachers consistently, too, to leap to honors work and rising international standards.

But even if the U.S. could double recruitment of top talent, cut top-teacher attrition in half, and triple the dismissal of the least-effective teachers, about 60 percent of classrooms would still be without excellent teachers—and accomplishing all that would be unprecedented.

Meanwhile, students can't wait. **What can schools do now? They can extend the reach of the excellent STEM teachers they already have to more students, for more pay, within current budgets—retaining great teachers, and creating a compelling profession for future great STEM students to enter**.

We call this an **Opportunity Culture,** in which new school models use job redesign and age- and child-appropriate technology to save great teachers time to **reach more students and lead and develop other teachers on the job** to use their methods and materials.

In the Opportunity Culture initiative's first implementation year, seven schools in two states piloted Opportunity Culture models. In its second year, more than 30 schools did so, in four districts located in three states. The third year appears poised to see more than 60 pilot schools in at least eight districts spread across four states. The number of schools is expected to double, or more, every year, in part due to teacher demand for these models' paid leadership roles that let teachers keep teaching and provide on-the-job development and collaboration.

School teams with teachers on them choose and adapt the models that best fit their schools, following the **Opportunity Culture Principles** (see below).

Those models include Multi-Classroom Leadership, Elementary Specialization, and Time Swaps (see Figure 1). Some districts also may experiment with remotely located teachers in the hardest-to-staff subjects, such as physics and calculus. Others may add a small number of district-level hybrid roles that allow great teachers to work on district-wide instructional functions that support an Opportunity Culture, while continuing to teach part time.

In the new models, schools add paraprofessionals to reduce teachers' administrative workload and to supervise students during skills practice and project work at school. This allows teachers to plan and collaborate, and to improve instruction together, during school hours. Teachers also can reach more students this way. Because paraprofessionals cost less than teachers, schools can pay teachers more, within budget. In many schools, some non-classroom specialists shift into new roles in the classroom, and this frees even more funds to increase both their pay and that of other classroom teachers.

For example, in one of the first pilot sites, Charlotte-Mecklenburg Schools (CMS), a **multi-classroom leader** (MCL) in a middle or high school can lead a math or science team while continuing to teach. These teachers help determine their optimal teaching load reduction to strike a balance between directly teaching students, co-teaching students with their teams, coaching, and planning.

OPPORTUNITY CULTURE PRINCIPLES

Teams of teachers and school leaders must choose and tailor models to:

1. **Reach more students with excellent teachers and their teams**
2. **Pay teachers more for extending their reach**
3. **Fund pay within regular budgets**
4. **Provide protected in-school time and clarity about how to use it for planning, collaboration, and development.**
5. **Match authority and accountability to each person's responsibilities**

Some use digital instruction for a portion of their teams' instruction, and others do not. To become an MCL responsible for four or more teachers' worth of students, a teacher must have received an excellent rating for at least three of the previous four years. By the fifth year of teaching, an MCL may earn a salary supplement of up to $23,000. This does not close the STEM pay gap entirely, but brings STEM teachers much closer to their private-sector peers.

Teachers may also extend their reach directly, instead of leading other teachers, through **Elementary Specialization** or **Time Swaps.** In CMS, these teachers, who may or may not use digital instruction for a portion of teaching, can earn a supplement of $9,800 once they have a similar track record of excellence.

New and effective teachers who haven't yet achieved consistent excellence also share in the rewards: In CMS, those who join Opportunity Culture teams are immediately eligible for pay supplements of about $1,500 to $3,000. They earn while they learn, by working collaboratively with outstanding peers. Pilot schools quickly saw how teams' free time must be co-scheduled, so that teachers have time to plan and improve together.

Most sites have been conservative with pay increases so far, and yet most are paying excellent teachers supplements ranging from 10 to 50 percent of average teacher pay—sustainably, rather than with temporary grants. The pay potential is much higher, once schools have completed implementation and some teachers advance along new career paths. (See the **Pay Teachers More** and **Teacher Career Paths** pages of **OpportunityCulture.org.**)

All of these changes, if implemented in far more schools, would help address the challenges of STEM teaching today—the scarcity of talent, low pay, lack of development on the job, and the shortfall in great school leaders who appreciate the importance of STEM subjects. An Opportunity Culture can help make other efforts to attract and retain excellent STEM teachers more successful, and leverage and reward the many outstanding STEM teachers already in U.S. schools today.

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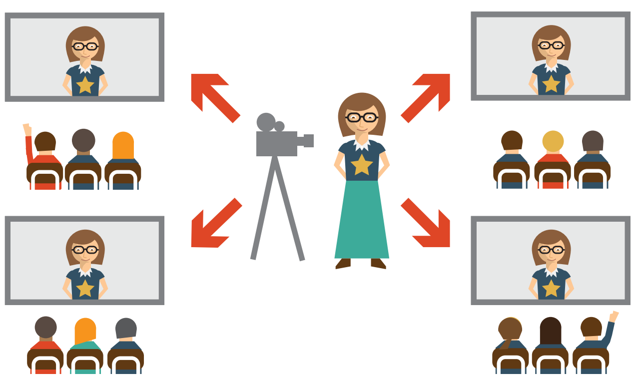
Building an Opportunity Culture for America's Teachers

Public Impact

FIGURE 1. School Model Snapshots

MULTI-CLASSROOM LEADERSHIP

Teachers with leadership skills both teach and lead teams or "pods" of other teachers in order to share strategies and best practices for classroom success. Responsible for achieving high growth for all classrooms in the pod, the teacher-leader determines how students spend time and tailors teachers' roles according to their strengths.

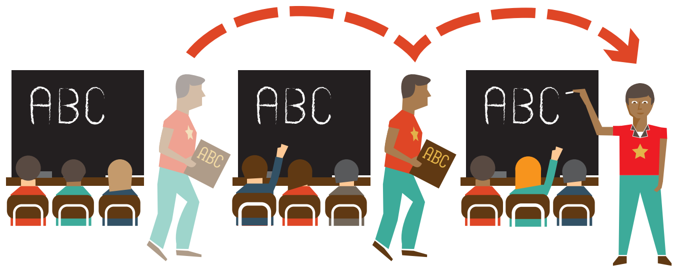


REMOTE TEACHING

Schools without enough excellent teachers can enlist accountable remote teachers down the street or across the nation. Remote teachers use technology to provide live, but not in-person, instruction, while on-site teammates manage administrative duties and develop the whole child.

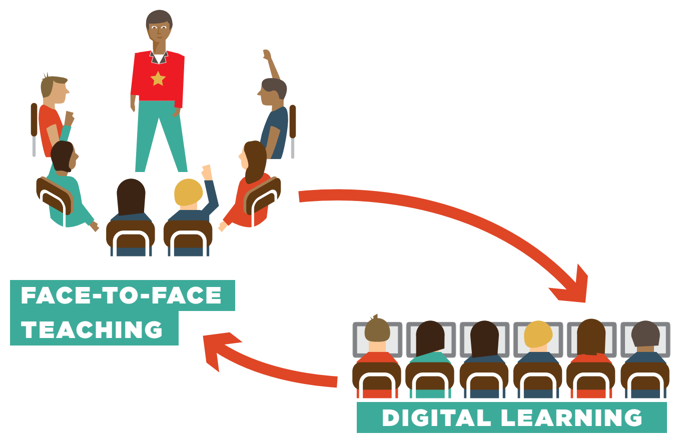
CLASS-SIZE INCREASES

Excellent teachers teach larger classes, by choice and within limits, in some cases shifting students from other teachers' classrooms.



ELEMENTARY SPECIALIZATION

A school's best teachers teach only their best subject(s)—such as math/science or language arts/social studies—while teammates take care of students the rest of the time and cover administrative work. This allows specialized teachers to instruct multiple classrooms of students and gain more time for planning and collaboration.



TIME-TECHNOLOGY SWAPS

Students spend part of the day engaged in self-paced digital learning. Digital instruction replaces enough of top teachers' time that they can teach more students, using face-to-face teaching time for higher-order learning and personalized follow-up. Teachers can use part of their freed time for planning and collaboration. A related model calls for a **Time Swap** without technology, replacing digital instruction time with time for offline skills practice and projects.

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