Opportunity Culture for All

Reaching All Students with Excellent STEM Teachers

Companion to the Education Leaders’ Brief
What is STEM?

Science + Technology + Engineering + Math

STEM
Overview

- U.S. STEM Teaching and Learning Today
- Initiatives to Address Challenges
- Opportunity Culture Can Close STEM Gaps
STEM job growth is projected to outpace other sectors of the economy

Projected STEM job growth

• 13% from 2012–2022 vs. 11% in all occupations
• 1 million more jobs than in 2012

5% of U.S. workers employed in science and engineering drive 50% of U.S. economic expansion.

5 jobs created for each new job in software and life sciences vs. 1.6 jobs created for every new job in manufacturing

92% of STEM jobs require at least some post-secondary education.
Too few STEM degrees for job growth

• U.S. has one of lowest ratios of STEM to non-STEM bachelor’s degrees in world.
• The number of post-secondary STEM degrees has increased, but the percentage of students pursuing these degrees has decreased.
Businesses report STEM candidate shortage

... Only 16% see enough African-American, Hispanic and American Indian applicants with STEM degrees.

2013 survey of talent recruiters for Fortune 1000 companies found ...

... Only 50% find candidates with four-year STEM degrees “in a timely manner.”

... 56% of respondents cite lower productivity as a direct result of STEM talent shortages.

... 47% cite the shortage as limiting business growth.
The 2012 Program for International Student Assessment (PISA) results showed lackluster performance in STEM subjects for U.S. students.

Math
- 26% of U.S. students scored below level 2 (baseline proficiency level) compared with 8% of students in Singapore.

Science
- 18% of U.S. students scored below level 2 (baseline proficiency level) compared with 5% of students in Estonia.

The U.S. ranked lower than 29 of the international education systems participating in math and lower than 22 of those participating in science.
The U.S. lags behind top performers in math and science

In math and science, the U.S. lags behind:

- Singapore
- Hong Kong
- Korea
- Japan
- The Netherlands
- Estonia
- Finland
- Canada
- Switzerland
- Poland
U.S. high school graduates are not prepared for college STEM coursework

- Fewer than half of high school graduates are academically prepared for first-year college science and math courses.
- In 2013, only 44% achieved or exceeded the ACT college-readiness benchmark for math, and only 36% for science.

**ACT benchmarks provide a tool for determining whether a student will be successful in college-level math and science courses.**
Supply of STEM teachers is insufficient for K–12 STEM instructional needs

The need: 25,000 new STEM teachers each year

The supply: less than 9,000 each year

- Challenges for STEM teacher recruitment include:
  - Too few education majors who are both interested and capable
  - Too few STEM majors who would be willing to earn less as a teacher
STEM-trained teachers teach more

Teacher credentials have a marked effect on student achievement in math—even when taking into account parent education levels and socioeconomic factors.

Students taught by teachers holding 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 whose teachers did not share these credentials.
Student time on STEM affects learning

The Center on Time and Learning determined that fourth-graders engaging with science lessons every day through inquiry-based learning or project-based instruction scored 16 points higher on the 2009 NAEP than other students.

But excellent math and science teachers aren’t easy to retain ...
High school STEM teachers don’t stay

NCES data from 2007–08 shows that 70% of high school math teachers held a major in their subject area, and 82% of high school science teachers held a postsecondary degree in their subject area.

... more than 40% of high school STEM teachers leave the profession within their first five years of teaching.
High school STEM teachers don’t stay

Why do high school teachers leave?

Research from the University of Pennsylvania found that teachers leave the profession because of:

- Ineffective professional development
- Lack of classroom resources
- Low salaries
- Discipline issues
- Lack of classroom autonomy
- Weak administrative support

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High school STEM course shortfall hurts all—but students of color lose most

Need is particularly acute at high-poverty and high-minority schools.

According to 2009–10 Department of Education Office of Civil Rights data ...

In only 50% of high schools sampled in the 20 largest school districts.

Calculus

Offered in schools where Hispanic students make up 20% of students...

Offered in 55% of schools with the lowest minority enrollment. vs. Offered in 29% of schools with the highest minority enrollment.

but...

...only 10% of students are enrolled in calculus.

Algebra II

Offered in 82% of schools with the lowest minority enrollment.

vs.

Offered in 65% of schools with the highest minority enrollment.

Physics

Offered in 66% of schools with the lowest minority enrollment.

vs.

Offered in 40% of schools with the highest minority enrollment.
Salaries for education majors can’t compete with other STEM jobs

Class of 2013 Starting Salary by Undergraduate Degree

- Engineering: $63K
- Computer Science: $59K
- Business: $55K
- Communications: $45K
- Math & Science: $43K
- Education: $41K
- Humanities: $38K

Education pay falls short

Median earnings for wage/salary workers over age 25 with a bachelor’s degree:

- Science & Engineering: $66,000
- Education: $44,000
STEM teachers lack basic prep

- 4th-graders with math teachers who majored in math: 2%
- 8th-graders whose math teachers majored in math: 30%
- 8th-graders whose science teachers have an undergraduate major in science: 48%
- 8th-graders with science teachers who took three or more advanced science courses: 63%
STEM teachers lack basic prep

Only 11% of teachers from the bottom 25% of university education schools take the courses they need to teach middle school math by international standards...

...but that bottom 25 percent of schools produces 60% of middle school math teachers.
Too few classroom hours on science

Classroom hours spent on science by 1st – 4th grade students

- 1994: 2.9
- 2012: 2.6

10% decrease over past two decades

How many 8th-graders spend 5 or more hours a week on science?

As of 2011, only 35%.
Overview

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Current STEM initiatives

National-Level Efforts

- Educate to Innovate
- 100K in 10
- Change the Equation
- National Math + Science Initiative

State-Level Efforts

- Common Core
- University Initiatives

Local Efforts with Corporate Partners

- Change the Equation – ‘Igniting Learning’
National Efforts: Educate to Innovate

• Launched in 2009 by President Obama

Goal—move U.S. students from the middle to the top of the world in science and math over the next decade

• Increase STEM literacy for students
• Improve the quality of STEM teaching
• Expand STEM education and career opportunities for under-represented groups, including women and minorities
National Efforts: 100K in 10

- Aims to prepare 100,000 STEM teachers in 10 years
- Backs the creation of next generation of innovators
- Led by the Carnegie Corporation of NY, more than 150 foundations and coalitions working in partnership to help improve the supply of excellent STEM teachers
Research Design Competition
Led by U. Chicago Urban Education Lab to generate evidence about which practices work in training and supporting STEM teachers. 2013’s winners, CSU and Mathalicious, work with school districts to analyze efforts to support teachers’ transitions to Common Core standards.

Shared Measures Annual Survey
Asks questions about partners’ work in each stage of a professional teacher’s life from recruitment to advancement. Goal—to find out what is working with STEM teachers, bringing to light the STEM successes.

Convenings
Collaborative learning opportunities that include regular forums for sharing key strategies, emerging research, and issues related to excellent STEM teaching and learning.

Notables
Series of case studies illustrating good practices. Includes programs from U. Chicago, U. Colorado, American Museum of Natural History and others.
National Efforts: Change the Equation

- CEO-led initiative launched in 2010 to motivate the business community to improve STEM learning quality.
- Created ‘Vital Signs’—an interactive tool providing a picture of the supply and demand of STEM skills in every state.
- Helps more than 100 members collaborate with philanthropic and advocacy efforts to motivate students in STEM learning and improve teacher quality in STEM subjects.

134 sites use 5 ‘Igniting Learning’ STEM programs
### National Efforts: Change the Equation

| ‘Igniting Learning’ Projects: Increasing interest in STEM subjects at schools |
|---------------------------------|-----------------------------------------------|
| **Eisenhower High School, Lawton, OK** | Grumman Corporation helped implement the APTIP program, expanding access and enrollment in AP courses for underrepresented groups |
| **Enos Garcia Elementary School, Taos, NM** | Intel funded “Math Progressions,” an innovative professional development program to improve math instruction |
| **Knox Elementary School, Chandler, AZ** | Intel launched ‘Engineering is Elementary’ integrating engineering into the elementary curriculum and allowing students to build their own engineering projects |
| **Rochester STEM High School, Rochester, NY** | With support from Motorola, a rigorous academic program integrates STEM focused project-based learning across all subjects for 9th- and 10th-graders |
National Efforts: National Math + Science Initiative

• Nonprofit organization provides increased instruction and teacher support for Advanced Placement courses
  – Training and mentoring teachers
  – Tutoring students
  – Holding study sessions
  – Providing access to videotaped lessons

• Results: The organization 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.

• Implications: Stronger and more frequent instruction in STEM is the key to better outcomes
Increased Focus on Higher-Order STEM Thinking

• MetLife survey of middle and high school teachers:
  – 56% said there is a great deal of focus in their school on application of math skills to solve everyday problems
  – 52% said there is focus on how to reason abstractly and quantitatively
  – These areas of focus are higher for teachers using the Common Core in their teaching

• Common Core Standards
  – Emphasize the importance of challenging content
  – Include trigonometry and calculus
  – Propose more advanced STEM standards
  – In math, overlap 90% with the content of standards in countries whose students perform best in math
University-Based Efforts: UTeach

• Began 1997 at University of Texas, Austin
• 88% UTeach graduates are math and science teachers
• 80% are still teaching after 5 years (compared with 65% non-UTeach graduates)
• 35 universities currently have UTeach programs
• Program attracts bright science and math majors into secondary teaching careers
• Offers an advanced curriculum and provides intensive field experiences and rigorous content area degrees
• Professional development and induction support encourage retention
University-Based Efforts: Stony Brook

• Making significant advances in boosting graduation rates of minorities
• “STEM SMART” provides support for disadvantaged high school and college graduates desiring to pursue degrees in hard sciences
• From 2004–10, graduation rates for Hispanic students increased from 42% to 58%.
• College students attend career prep workshops and many are offered internships or research opportunities.
• Other STEM Smart programs at SUNY Louis Stokes Alliance and Technology Entry Program (CSTEP) (both funded by the New York State Education Department)
Overview

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Teacher Effectiveness Varies

Two Years Ahead

Two students start 1st grade two years behind:

• One has excellent teachers every year, and achieves honors.
• The other has good, solid teachers every year—and stays behind.

Still Two Years Behind
Current Strategies: Not Enough

Recruiting STEM Teachers

Developing STEM Teachers

Retaining STEM Teachers

These strategies are important, but even if they are *dramatically* successful, they will, *if done alone*, still leave most classrooms without excellent STEM teaching.
Could New School Models Help?

Yes, if they:

• Extend the **reach** of excellent STEM teachers to more students
• Enable great STEM teachers—and eventually *all* teachers—to **earn more**, sustainably
• Make **development on the job** easier—e.g., via collaborative teams, led by excellent teachers
• Give great teachers **more authority to lead peers** and **clear accountability** for the students they reach
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
Teachers with leadership skills both teach and lead teams of teachers & assistants, sharing strategies and best practices.

The teacher-leader determines how students spend time and tailors teachers’ roles according to strengths. Accountable for the results of all students in her “pod,” she earns far more.

Based on [Models for Extending the Reach of Excellent Teachers](http://opportunityculture.org/models-for-extending-the-reach-of-excellent-teachers)
Model: Elementary Specialization

Excellent teachers specialize in high-priority subjects and the most crucial, challenging roles.

Teammates take care of students the rest of the time and cover administrative paperwork.

Specializing teachers instruct up to three times the students, earn more, and gain time for planning, development, and collaboration.

Based on Models for Extending the Reach of Excellent Teachers
Model: Time-Technology Swaps

Students spend part of the day engaged in age- and child-appropriate digital learning.

Digital instruction and offline homework-at-school—as little as an hour daily—replace enough teacher time that they can teach more students, plan more, and earn more.

Teachers use face-to-face teaching time for higher-order learning and personalized follow-up.

Based on Models for Extending the Reach of Excellent Teachers
Benefits of Combined Models

• *All* teachers who extend reach can **earn more**
  – Teacher-leaders *still* earn substantially more
• Naturally funded **career advancement** for great teacher who lead peers
• Rigorous, **job-embedded learning** for all—co-plan, co-teach, and co-learn in teams fully accountable for all students’ outcomes
• **Reach all students** with accountable, excellent teachers in charge of their learning

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# New Roles When Extending Reach

Summary of Teacher Career Paths and Roles in Opportunity Culture School Models

<table>
<thead>
<tr>
<th>Path</th>
<th>Direct-Reach Teacher</th>
<th>Multi-Classroom Leader</th>
<th>Support Teacher</th>
<th>District-Funded Teacher-Leader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roles</td>
<td>Elementary Specialized Teacher</td>
<td>Blended-Learning Teacher</td>
<td>Multi-Classroom Leader</td>
<td>Design Specialist* (Leadership Coach (of Multi-Classroom Leaders))</td>
</tr>
<tr>
<td></td>
<td>Expanded- Impact Teacher (low-tech)</td>
<td>Large-Class Teacher</td>
<td>Team Teacher</td>
<td>Video Teacher</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Professional Tutor</td>
<td>Digital Designer</td>
</tr>
<tr>
<td>How is reach extended?</td>
<td>Teaching best subject to more classes, while reducing other duties</td>
<td>Swapping portion of time with paraprofessional-supervised skills practice and projects—digital or offline—to teach more students</td>
<td>Increasing class sizes, within limits and by choice</td>
<td>Leading multiple classrooms’ worth of students with a teaching team for whom leader is responsible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supporting multi-classroom leader or efficient team, and/or addressing subject or teaching role(s) delegated by team leader</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Producing materials that reach students across schools in the district, or coaching multi-classroom leaders across schools</td>
</tr>
<tr>
<td>School Model</td>
<td>Subject Specialization (Elementary)</td>
<td>Time-Tech Swap Time-Time Swap</td>
<td>Class-Size Changes</td>
<td>Multi-Classroom Leadership</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All School Models</td>
</tr>
</tbody>
</table>

*Curriculum and assessment designers are common examples.
District-Level Teacher-Leaders

• Combine extended-reach roles at school level...

• With district-level functions, such as:
  – curriculum & assessment planning
  – coaching multi-classroom leaders
  – digital content development

• Keep great teachers teaching part time

• Keep district-level staff connected to classroom

• Provide another career path
## Potential to Increase Pay, within Budget

<table>
<thead>
<tr>
<th>Ways to Extend Reach</th>
<th>Multi-Classroom Leadership</th>
<th>Direct-Reach Models: Elementary Specialization, Time-Swaps, Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teacher-Leader Can Earn:</td>
<td>Specialized, Blended-Learning &amp; Expanded-Impact Teachers Can Earn:</td>
</tr>
<tr>
<td>Potential Pay Increase Percentages</td>
<td>Up to 100%+ More than average teacher pay</td>
<td>Up to 40%+ More than average teacher pay</td>
</tr>
</tbody>
</table>

- Teachers earn this sustainably, within budget—no grants needed.
- Sites conservatively paying up to 50% more to teacher-leaders; up to 25% more to teachers who extend reach directly.
How to Pay More, within Budget

Most common methods:

• Swap a team-teaching position with a paraprofessional (saves time & allows collaboration)
• Shift some non-classroom teaching specialists back into classrooms (except for ESL and special needs)

Other methods:

• Reallocate other spending to teachers (e.g., hybrids)
• Reduce new facilities costs by building fewer walls
• Offer some team-teaching roles with shorter hours
• Increase class sizes slightly (within limits, by choice)
Career Pathways when Extending Reach

Schools can pay larger supplements as teachers progress in their careers to reach more students.
Career Pathways when Extending Reach

Career Ladder Example for Highly Differentiated Structure

<table>
<thead>
<tr>
<th>SUPPORT</th>
<th>DIRECT REACH</th>
<th>TEACHER-LEADERSHIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Teacher II 6%</td>
<td>Advanced Reach Teacher 6%</td>
<td>Multi-Classroom Leader IV 75%</td>
</tr>
<tr>
<td>Team Teacher I 3%</td>
<td>Reach Teacher 3%</td>
<td>Multi-Classroom Leader III 65%</td>
</tr>
<tr>
<td>Effective Teachers</td>
<td>Upper 2 Levels: Highly Effective Teachers</td>
<td>Multi-Classroom Leader II 50%</td>
</tr>
<tr>
<td></td>
<td>Lower 2 Levels: Effective Teacher</td>
<td>Multi-Classroom Leader I 22%</td>
</tr>
</tbody>
</table>

Note: Pay supplements are examples only and are expressed as a percent of average pay.
# Overview of All Reach Models

## Opportunity Culture School Model Overview Table

**How do excellent teachers reach more students & help peers succeed?**

<table>
<thead>
<tr>
<th>Where is the Excellent Teacher?</th>
<th>In-Person</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-Classroom Leadership</strong></td>
<td>Multi-Classroom Leadership (In-Person Pods)</td>
<td>Multi-Teacher Leadership (Remote Pods)</td>
</tr>
<tr>
<td>Excellent teacher leads a teaching team and is accountable for all students.</td>
<td>The teacher accountable for learning is in the school, teaching face to face, and may lead peers.</td>
<td>in schools with shortages, the teacher accountable for learning uses technology to teach and connect with students, and may lead others. An in-person monitor is required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Specialization</strong></th>
<th>Subject Specialization</th>
<th>Subject Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent teachers specialize in high-priority subjects and roles, with new paraprofessional support.</td>
<td>Subject Specialization</td>
<td>Role Specialization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Class-Size Changes</strong></th>
<th>Class-Size Increases</th>
<th>Class-Size Increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent teachers teach larger classes, within limits and by choice, ideally without increasing instructional group size.</td>
<td>Class-Size Increases</td>
<td>Class-Size Shifting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Time-Technology Swaps</strong></th>
<th>In-Person Swaps</th>
<th>Remote Swaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital instruction or offline skill practice and projects save teachers time to teach more students and collaborate. Students spend an hour (elementary) or more (secondary) daily in paraprofessional-supervised learning.</td>
<td><strong>Rotation</strong> Alternating teacher and digital or other instruction on a fixed schedule.</td>
<td><strong>Rotation</strong> Alternating remote teacher and digital or other instruction on a fixed schedule.</td>
</tr>
<tr>
<td></td>
<td><strong>Flex</strong> Digital, small-group, and large-group learning time individualized</td>
<td><strong>Flex</strong> Digital, small-group, and large-group learning time individualized</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Combinations</strong></th>
<th>Multi-Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools committed to reaching every student in every valued subject with the excellent teachers will use</td>
<td></td>
</tr>
<tr>
<td>Combinations let schools optimize current students’ learning and teachers’ development on the job.</td>
<td></td>
</tr>
</tbody>
</table>

Note: Shaded items may require new technology. Students are in school buildings in all models in this table. *The terms Rotation and Flex are widely used to describe “blended learning” models.

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An Opportunity Culture for All

How to Reach Every Student with Excellent Teaching: A New Virtuous Cycle

Extend Excellent Teachers’ Reach to More Students Directly and Through On-the-Job Leadership

Opportunity

Extended Reach Allows:
- Career Advancement
- On-the-Job Learning for All

Selectivity

Increasingly Strong For:
- Who Enters
- Who Stays

Opportunity Culture FOR ALL

Pay

Sustainably Higher Through:
- Greater Reach
- Reallocated Funds
Additional Resources

For more information on school models that extend the reach of excellent teachers and teaching teams, please visit www.opportunityculture.org

- **Reaching All Students with Excellent STEM teachers: Education Leaders’ Brief**—companion brief to this slide deck
- **Teacher Pay and Career Paths in an Opportunity Culture**—design guide for districts
- **Two-pager for teachers**—just imagine a profession like this
- **Redesigning Schools**—summarizes reach model options
- **School Models**—model details and schedules
- **How to Pay Teachers More**—within budget while giving more students access to excellent teachers
- **Teacher Career Paths**—sustainable, paid career advancement using reach school models
- **Tools for School Design Teams**—regularly updated list of all OC materials
- **Selection, Development, & Evaluation Tools**

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