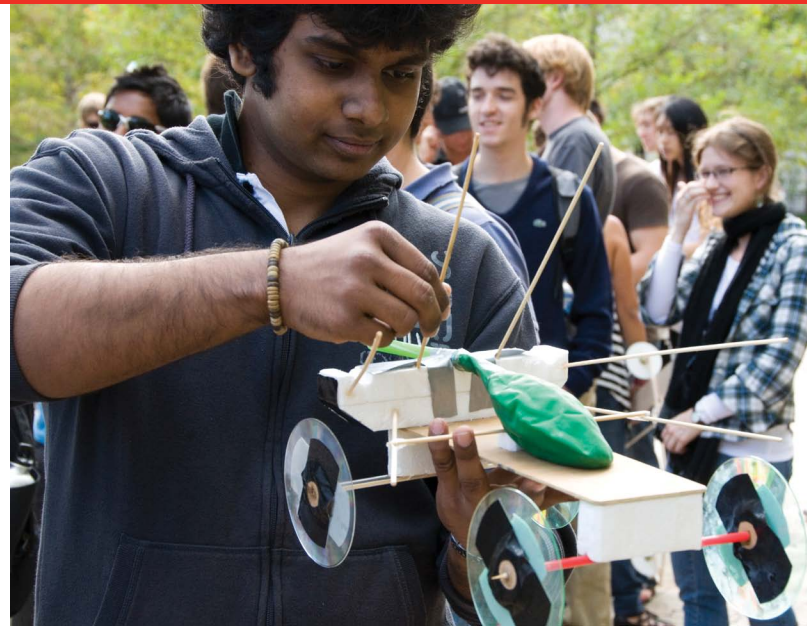


Advancing Equity through More and Better STEM Learning

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In releasing this report, our goals are to help raise awareness about the need to examine where and how we are losing so many children along the K-16 STEM pipeline and to accelerate progress in closing both opportunity and achievement gaps that persist.

The authors and publisher are solely responsible for the accuracy of statements and interpretations contained in this publication.



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Table of Contents

1	Introduction
2	Chapter I: A Broken System
4	Chapter II: A Segregated Majority
6	Chapter III: It's the Economy, Students
8	Chapter IV: A National Security Threat
9	Chapter V: The Difficulty of Coming From Behind
12	Chapter VI: An Opportunity Gap or No Opportunity?
14	Chapter VII: Low Expectations, Lower Quality
16	Chapter VIII: Bugs in Computer Science Education
18	Chapter IX: Odd Woman Out
20	Chapter X: Model Programs and Promising Practices
22	Chapter XI: Fixing Systems, Not Students
24	Conclusion and Recommendations
28	Endnotes

Introduction

When *Brown v. Board of Education* was decided more than 60 years ago, there were good paying, family supporting jobs for workers without formal educational credentials. But the era of pick and shovel jobs is long gone. Those who would support themselves and their families in the 21st century need a high school diploma and more: career training, an associate degree or, ideally, a four-year college degree.

Yet, right now, all across America, there are nearly 40 million adults—disproportionately people of color and those who grew up in poverty—who do not have a high school diploma or its equivalent. And they are effectively locked into the lowest rungs of the occupational ladder. Science, technology, engineering, and mathematics (STEM) education can provide these historically underrepresented populations with proven pathways for obtaining good jobs and a higher standard of living.

Today, only 2.2 percent of Latinos, 2.7 percent of African Americans, and 3.3 percent of Native Americans and Alaska Natives have earned a first university degree in the natural sciences or engineering by age 24. Women make up the majority of students on college campuses today and about 46 percent of the workforce, but they represent less than 20 percent of bachelor's degree recipients in fields like computer science and engineering, and hold less than 25 percent of STEM jobs.

It's time for the United States to examine where and how we are losing so many children along the K-16 STEM pipeline and to accelerate progress in closing both opportunity and achievement gaps that persist.

In May 2014, The Leadership Conference Education Fund joined with Educational Testing Service (ETS) to convene a symposium at the National Academy of Sciences on advancing equity in STEM education. There, a distinguished group of panelists discussed equal access

to STEM education as a critical civil rights concern and examined ways to address the disparities and ensure that STEM education is available to everyone.

STEM education isn't merely a new feel-good fad. It is now—and will continue to be—the backbone of our dynamic and constantly changing world. And it's critical that we make sure that it's equally available to every child. In the chapters that follow we'll examine several programs and initiatives that hold promise for changing the systems of delivering STEM education.

Chapter I: A Broken System

When Neil deGrasse Tyson was in elementary school, he already knew how he would spend his professional life.

“I’ve known that I wanted to do astrophysics since I was nine years old,” he told a sold out audience during a conference at the New York Academy of Sciences in 2007.¹

The director of the Hayden Planetarium and host of the new “Cosmos” television program succeeded in spite of the pernicious stereotypes of African-American children by the very people who should have been encouraging him.

According to Tyson, “The fact that I wanted to be a scientist and an astrophysicist was hands down the path of most resistance through the forces of society. Anytime I expressed this interest teachers would say, ‘don’t you want to be an athlete?’”

More than 20 years after earning his Ph.D., Tyson noted that the cultural expectations that colluded to hold him back haven’t gone away.

“Now here I am one, I think, of the most visible scientists in the land, and I want to look behind me and say where are the others who might have been this, and they’re not there,” he said.

Science, technology, engineering, or mathematics, known as the STEM fields, are the gateway to America’s continued economic competitiveness and national security, and the price of admission to higher education and higher standards of living for the country’s historically underrepresented populations.

Yet, access to the high-quality, rigorous math and science classes that are prerequisites for college STEM majors is still stacked against low-income students, women, and students of color. Their potential is neglected, sometimes discounted, when it should be a

national priority to develop their diverse talents, abilities, and skills.

U.S. Secretary of Education Arne Duncan acknowledged the extent of the problem when the department’s Office for Civil Rights released a massive data collection and analysis in March 2014, covering 14 years of information from all of the nation’s 97,000 public schools and representing 49 million students.

“This data collection shines a clear, unbiased light on places that are delivering on the promise of an equal education for every child and places where the largest gaps remain. In all, it is clear that the United States has a great distance to go to meet our goal of providing opportunities for every student to succeed,” Duncan said, in a press release accompanying the publication of the searchable database.²

The statistics are disheartening and shocking.

- Seventy-eight percent of high schools serving the lowest percentages of Black and Latino students offer high-level chemistry and 83 percent offer high-level math, while just 66 percent of high schools serving the highest percentages of Black and Latino students offer chemistry, and 74 percent offer Algebra II.³
- In 2013, there were 11 states where not one Black student took the Advanced Placement (AP) computer science exam, which allows high school students to earn college credit: Alaska, Idaho, Kansas, Maine, Mississippi, Montana, Nebraska, New Mexico, North Dakota, Utah, and Wyoming. No Latino students took the test in these eight states: Alaska, Idaho, Kansas, Mississippi, Montana, Nebraska, North Dakota, and Wyoming.⁴

- Black students are more than four times as likely as White students to attend schools where about one-fifth of the teachers haven't met all their state certification requirements; Latino students are twice as likely to be in these schools.⁵
- High schools with the largest population of low-income students offer, on average, half as many AP math and science courses as schools with wealthier students.⁶
- Nearly 20 percent of African-American high school students attend a high school that does not offer any AP courses.⁷
- At the top 40 college science and mathematics departments, Blacks, Hispanics, and Native Americans represent less than 5 percent of tenured faculty.⁸
- African-American and Hispanic students account for only 16 percent of college students majoring in computer science and mathematics, and women make up less than a third. And once they earn a degree, their median salaries average \$13,000-to-\$23,000 below those of White and Asian men.⁹
- Computer science is losing girls and women. Women hold about 20 percent of jobs in the industry today, down from 40 percent in the mid-1980s.¹⁰
- Concurrently, the number of women majoring in computer science in college is declining, down from 36 percent in the mid-1980s to less than 20 percent in 2010.¹¹
- Although women earned more than half of all bachelor's degrees in STEM fields overall in 2010, they represented just 18.4 percent of engineering baccalaureates. Minority women earned 10.6 percent of science and engineering bachelor's degrees.¹²
- The biggest correlation between schools that have enough bandwidth to use technology as a learning tool and those that don't is tied to the wealth of the school. According to the Education Superhighway, a nonprofit that advocates for all schools to have strong internet connections, among the wealthiest school districts—those with less than 1 percent of students eligible for the free and reduced lunch program—39 percent gave enough bandwidth to meet connectivity goals, compared to 14 percent of districts where three-quarters or more of their students are on the free and reduced price lunch program.¹³

nation's public schools. Of the more than 49 million students enrolled in public elementary and secondary schools, just over half—50.2 percent—are Latino, African American, Asian, and Native American, according to projections from the U.S. Department of Education.¹⁴

If the numbers weren't documented, they'd seem implausible, especially because this academic year, for the first time, minority students are the majority in our

Chapter II: A Segregated Majority

This demographic shift in enrollment occurred, coincidentally, during the 60th anniversary year of the U.S. Supreme Court’s landmark ruling in *Brown v. Board of Education*.¹⁵

By declaring, in a unanimous decision, that “In the field of public education, the doctrine of ‘separate but equal’ has no place,” Chief Justice Earl Warren established a path to desegregating the nation’s public schools and set in motion decades of civil rights legislation and legal action.

Congress laid the foundation for federal educational equity policy 11 years after *Brown*, with the Elementary and Secondary Education Act of 1965 (ESEA). As one of the defining elements of President Lyndon Johnson’s War on Poverty campaign, the heart of the ESEA was, and continues to be, Title I.¹⁶

“Today, we reach out to five-and-a-half million children held behind their more fortunate schoolmates by the dragging anchor of poverty,” said Johnson on September 23, 1965, after signing the ESEA, authorizing more than \$1 billion for the first Title I funding.

Then he issued a clarion call to state and local education officials, parents, and teachers that it was their responsibility to see that the funds were put to use quickly and appropriately:

*And so to you, I have this to say: Act now. Get your plans made. Open your schools to the promise of these new programs. I hope that not a single day will be lost. For in education, the time we waste today can mean a life wasted tomorrow.*¹⁷

For 50 years, Title I funds have been allocated to schools and school districts with high concentrations of poverty, based on the idea that these schools need extra resources

to ensure that children living in poverty have the support they need to succeed. Today, more than 56,000 schools receive Title I funds to provide additional academic support for 21 million students. Since 1980, Congress has appropriated more than \$285 billion for Title I programs, and the appropriation for FY 2015 alone was \$15.5 billion.¹⁸

Notwithstanding the aspirations of this signature Great Society program, Title I has had mixed success in narrowing achievement gaps between low-income students, who are disproportionately children of color, and their more advantaged classmates.¹⁹

The Center on Education Policy reviewed state test scores in grades four, eight and one year of high school for Title I and non-Title I students in 19 states. The analysis found that scores improved overall for both groups and, in some cases, the gains were higher for Title I students. But the achievement gap remained and even widened in a few states.

Massachusetts had a 33-point difference in the percentages of Title I and non-Title I fourth grade students scoring proficient on the state’s reading test. The gap was 29 points in California, 27 points in Pennsylvania, and 26 points in Maine.²⁰

The Obama administration has sought to address these shortcomings as a federal civil rights compliance matter. On October 1, 2014, the Department of Education issued detailed guidance in a 37-page letter from Catherine Lhamon, assistant secretary for civil rights, to states, school districts, and schools receiving federal aid.²¹ The letter informed education leaders that Title VI of the Civil Rights Act of 1964 prohibits discrimination on the basis of race and national origin in the allocation of educational resources and opportunities.

“Our data tells us that we have a problem and we have resegregation,” Lhamon acknowledged at The Education Fund/ETS’ STEM equity symposium a few months prior to releasing the letter. “When we look underneath the data and see the disparities, we are seeing justifications that are old style, baseless, groundless justifications that have no support in law but that we see too often in practice.”

The data give pause for how schools will address another looming challenge. In recent years, lawsuits have successfully overturned many of the desegregation plans put in place in the decades following the *Brown* decision and the nation’s schools are now on a reverse course toward resegregation.

Between 1954 and 1988, the percentage of Black students in the South attending majority white schools grew from virtually zero to 44 percent. They’ve been on a steady decline ever since, falling to about 23 percent, according to a study by The Civil Rights Project at the University of California, Los Angeles.²²

“One of the reasons that racial segregation is harmful is the strong connection between schools that concentrate Black and Latino students and schools that concentrate low-income students,” write the authors, and that helps “to explain why schools with high concentrations of Black and Latino students often have fewer educational resources and lower student outcomes.” Among the STEM-related resources frequently lacking in these schools are effective and qualified math and science teachers, fully equipped labs, and up-to-date technology.

Chapter III: *It's the Economy, Students*

By 2020, there will be nine million STEM-related jobs, according to the U.S. Bureau of Labor Statistics, a million more than at the start of the decade, making it one of the fastest growing sectors of the economy.²³ Between now and then, STEM industries will need to hire 2.6 million new workers due to that job growth as well as retirements.

At least half of those jobs will go to college graduates. The Georgetown University Center on Education and the Workforce estimates that 69 percent of STEM positions will require a bachelor's or master's degree by the end of the decade.²⁴ The Brookings Institution puts the figure closer to 50 percent, but notes that a majority of the STEM positions not requiring a four-year degree or higher still call for some postsecondary education.²⁵

The United States is not on track to fill those jobs. In a 2012 report, The President's Council of Advisors on Science and Technology (PCAST) warned that 300,000 or so college students graduating each year with bachelor's and associate's degrees in STEM fields is one million off the mark.²⁶

PCAST noted in an earlier report "that the problem is not just a lack of *proficiency* among American students; there is also a lack of *interest* in STEM fields among many students."²⁷

The interest and achievement gap is largest among African Americans, Hispanics, Native Americans, and women, notes the PCAST report, but it's not limited to them or to systemically failing schools.

Even the most successful schools, continues the report,

often lack teachers who know how to teach science and mathematics effectively—and who know and love their subject well enough to inspire their

students. Teachers lack adequate support, including appropriate professional development as well as interesting and intriguing curricula. School systems lack tools for assessing progress and rewarding success. The nation lacks clear, shared standards for science and math that would help all actors in the system set and achieve goals. As a result, too many American students conclude early in their education that STEM subjects are boring, too difficult, or unwelcoming, leaving them ill-prepared to meet the challenges that will face their generation, their country, and the world.

Something is clearly wrong with the way STEM is taught if even substantial financial rewards aren't a powerful enough incentive for students.

STEM jobs are among the highest paying positions, even without a four-year degree. Students graduating with associate's degrees or postsecondary certificates earn \$53,000 a year, on average, 10 percent higher than non-STEM jobs requiring similar levels of education.²⁸

At the high end, engineering, computer science, physics, economics, finance, biochemistry and molecular biology, mathematics, statistics, and chemistry all top a chart, compiled by The Hamilton Project, of the highest career wages. Median lifetime earnings for college STEM majors are double or more than for other majors.²⁹ The annual mean salary in computer and math occupations is \$82,000, according the U.S. Bureau of Labor Statistics.

Consider this: Georgia Tech computer science graduates had the highest starting salaries in their class, even at the low end of the industry pay scale, said Barbara Ericson, Director of Computing Outreach at the Georgia Tech College of Computing. In other words, she explained, "the person who got the highest offer who graduated from Georgia Tech was a computer science major, and

our lowest offer in computer science was higher than anybody's else's lowest offer.”

The openings aren't just in traditional tech companies; two-thirds of computing jobs are in industries as diverse as manufacturing, defense, health care, finance and government, weather forecasting, even digital arts and music. Among the 30 fastest-growing occupations, almost all will require at least some background in STEM, according to the Business Center for a College- and Career-Ready America.³⁰

But by failing to improve educational opportunities for the new majority of students of color, the United States is unable to prepare enough young people with the skills necessary for these jobs.

“Due to the lack of applicants with the right technical competencies, experience and soft skills, one out of three employers struggles to fill open roles. For nearly a decade skilled trades and STEM positions are among the top 10 hardest jobs to fill, both globally and in the U.S.,” said Jonas Prising, CEO of ManpowerGroup, in a talent shortage survey released in the spring of 2014.³¹

U.S. employers surveyed by ManpowerGroup reported a 40 percent shortage of skilled workers, just slightly above the global average of 36 percent. Many countries are much worse off, including Japan, Peru, India, Argentina, Brazil, and Turkey. But among the countries with the lowest shortfalls are those whose education systems have been rated among the best in the world—Finland, Canada, and Singapore.

“I'm trying to hire great engineers right now and I would hire them twice as fast if I could find them,” Kimber Lockhart, former director of engineering at cloud content management service Box, said in a video produced by undergraduate women majoring in computer science at Stanford University.³²

In addition, just improving math and science achievement by 10 percent would grow the nation's GDP (Gross Domestic Product) by 36 percent, according to the Business Center for a College- and Career-Ready America.

Chapter IV: A National Security Threat

Kimber Lockhart's is one of a multitude of voices warning that the U.S. cannot hope to meet the demands of the 21st century economy with its current unequal system of education and uneven provision of necessary accommodations and academic/social support for minority students who are now the majority in the nation's public schools.

The Council on Foreign Relations cautions that this failure of schools to work for all children has consequences far beyond the loss of potential earnings and fulfillment of millions of students—it also imperils national security.³³

On the most obvious measure of national security—military readiness—The Education Trust found that more than one in five young men and women between the ages of 17 and 20 didn't score high enough on the Army's qualifying test to be eligible for enlistment. More than twice as many Black applications failed as White applicants.³⁴

But a strong military is just one piece of national security, stressed an Independent Task Force on U.S. Education Reform and National Security created by the Council on Foreign Relations. The task force, headed by former U.S. Secretary of State Condoleezza Rice and Joel Klein, former chancellor of the New York City Department of Education, concluded in a 2012 report: "Without mastery of core academic subjects, students are not prepared to collaborate, compete, or interact locally or globally."

U.S. students are not especially competitive in this regard. On the 2012 Program for International Student Assessment (PISA), an international test covering math, science, and reading given to a sampling of 15-year-olds in 65 countries, American students ranked 26th in mathematics, 17th in reading, and 21st in science. Their baseline scores were slightly lower than in 2009, the last time PISA was administered. What's more, more than a quarter of U.S. students didn't score at the proficiency level in math.³⁵

They're not doing much better on homegrown assessments. Among graduating high school seniors in the class of 2013 who took the ACT college entrance exam, just 5 percent of African-American students, 10 percent of Native American students, and 14 percent of Latino students were ready for college-level work based on their scores. Their worst scores, across the board, were in science, with math right behind for African-American and Native American students.³⁶

Internationally, the United States has lost ground in higher education completion. It now ranks 12th in the percentage of 25 to 34 year-olds with a college education among 37 of the member and partner countries in the Organization for Economic Cooperation and Development (OECD). In South Korea, by comparison, 64 percent of 25 to 34 year-olds have a college degree. Japan, Canada, and Russia also have significantly higher rates of degree attainment than the United States for this age group.³⁷

It's not that the college graduation rate is declining in the United States; it's on the rise. But the increase is happening at a much slower pace than in other countries.

In language that reads more like a call to action than a rehashing of deficiencies, the task force report asserts that U.S. students

are not prepared to create the innovations that drive economic growth or to fill critical positions in the Foreign Service, intelligence agencies, and the armed services. Educational failure puts the United States' future economic prosperity, global position, and physical safety at risk. Leaving large swaths of the population unprepared also threatens to divide America and undermine the country's cohesion, confidence, and ability to serve as a global leader.

Chapter V: The Difficulty of Coming From Behind

Stanford education professor Prudence Carter cites three photos to illustrate the opportunity gap. The first is a picture of a high-speed elevator. Children with wealthy parents, who can afford to send them to the best preschools, take them to museums, and give them dance, music, and art lessons, ride these elevators to academic success.

The next photo shows a shiny escalator heading up. This is where middle-class children begin school. “Their parents must struggle to keep up,” explained Carter, in a commentary for the *New York Daily News*. “Their parents are able to put them on smoothly operating escalators toward academic attainment goals; but theirs is no express elevator.”³⁸

But that’s still a luxury ride compared to the third image—a steep stairwell with cracked and chipped steps representing the disadvantages that poor children bring when they start school, and the difficulties they face trying to succeed and graduate in the same amount of time as kids with the most resources.

The deficits begin from day one. Less than half of poor children and 59 percent of children with incomes just above the poverty line are ready to start kindergarten based on their vocabulary, understanding of basic math concepts, overall health, and behavior.³⁹

In a groundbreaking study published in 2003, researchers Betty Hart and Todd Risley developed an elaborate method to count how many words were spoken to young children in their homes based on income. The differences were more like a chasm than a gap. Children whose families were on welfare heard about 616 words per hour, children from working class families heard around 1,251 words per hour, and children from professional families heard 2,150 words. The poorest children heard 30 million fewer words than children from wealthier families before even walking through the kindergarten

doorway.⁴⁰

Numerous studies have found strong cognitive, social, and school readiness benefits for poor children who attend high-quality preschool. One of the most recognized is the Abbott Preschool Program. In its 1998 ruling in *Abbott v. Burke*⁴¹, the New Jersey Supreme Court ordered the state to provide free, all-day, high-quality preschool for three and four year-olds in New Jersey’s poorest school districts.

The Abbott Preschool Program Longitudinal Effect Study (APPLES) followed children who had completed the four-year-old Abbott program and found that they continued to show gains in math, science, reading, and writing through 4th and 5th grades, were less likely to repeat a grade of school, and had fewer special education referrals.⁴²

Most children don’t have access to Abbott-quality programs. Nationwide, 40 percent of school districts don’t offer preschool programs, and the majority of districts that do provide only half-day programs, according to the U.S. Department of Education.⁴³

When it comes to privately run childcare, a study by the National Institute for Early Education Research (NIEER) found that more than half the home-based programs that Black and Hispanic children attend were rated as low quality compared to 30 percent for White children. Black children were also less likely to attend high-quality childcare centers than either White or Hispanic youngsters. Even Head Start programs serving predominantly Black children were far more likely to be rated as low or medium quality.⁴⁴

As a result, African-American children and Hispanic children enter kindergarten significantly behind White and Asian children in reading and math.⁴⁵

“Research evidence is mounting for the importance of math and science school readiness for long-term achievement in these areas and in reading; yet, we leave behind so many children from low-resource communities. Children who are as curious, able, and eager to learn as their middle-class peers arrive at school behind in math and science knowledge and skills. These gaps are likely to widen during the school years,” wrote Kimberly Brenneman, assistant research professor at NIEER in a December 2013 article about STEM education in preschool.⁴⁶

Before- and after-school programs are also increasingly focused on providing engaging, hands-on activities in science, math, and computers. The federal government is one of the biggest supporters of giving under served children more access to STEM education after school through the 21st Century Community Learning Centers initiative.⁴⁷

Since 1998, the initiative has awarded more than \$15 billion⁴⁸ to schools and community organizations to create more than 11,000 afterschool centers for low-income students attending high-poverty, low-performing schools. All grantees are required to provide academic assistance that supports what the students are learning in school; art, music, and recreation programs; technology education; counseling services; and character education programs.

But, as with preschool programs, supply and demand are out of sync in afterschool programs, too. The most recent survey by the Afterschool Alliance found that low-income Black and Hispanic parents have a harder time than higher-income White families finding affordable, quality afterschool programs that provide academic tutoring and the type of enrichment activities that middle-class and wealthy children are exposed to by their parents, such as being read to, going to museums, attending plays and concerts, taking dance and art lessons, and playing sports.⁴⁹

On an international scale, “early childhood education (in the U.S.) is not as well-developed as in some other countries,” based on information gathered by the OECD. Although enrollment rates are rising for four-year-olds, the United States is behind 24 of the 37 OECD member and partner countries when it comes to preschool attendance.⁵⁰

If there’s any core value of our public schools, it’s that they are the great equalizer, the place where children are sheltered from stereotypes and held to the same expectations. But reality doesn’t often live up to that ideal.

“The bottom line is, everywhere you can make a choice

there is a difference. There is a disparity. It goes in many cases according to race. It often goes according to gender and it goes according to disability,” said Shirley Malcom, Ph.D., director of Education and Human Resources Programs at the American Association for the Advancement of Science (AAAS). At each of those decision points, Malcom said, the country is losing critical talent.⁵¹

Beginning in elementary school, students attending predominantly minority and low-income schools get less. Instead of being taught by experienced teachers with strong backgrounds in reading instruction, math, and science, Black, Latino, American Indian, and Native-Alaskan students attend schools with higher concentrations of first-year teachers (3 to 4 percent) than White students (1 percent). English learners also attend these schools at slightly higher rates (3 percent) than non-English learners (2 percent). Students of color are also more likely to have teachers who aren’t fully certified.⁵²

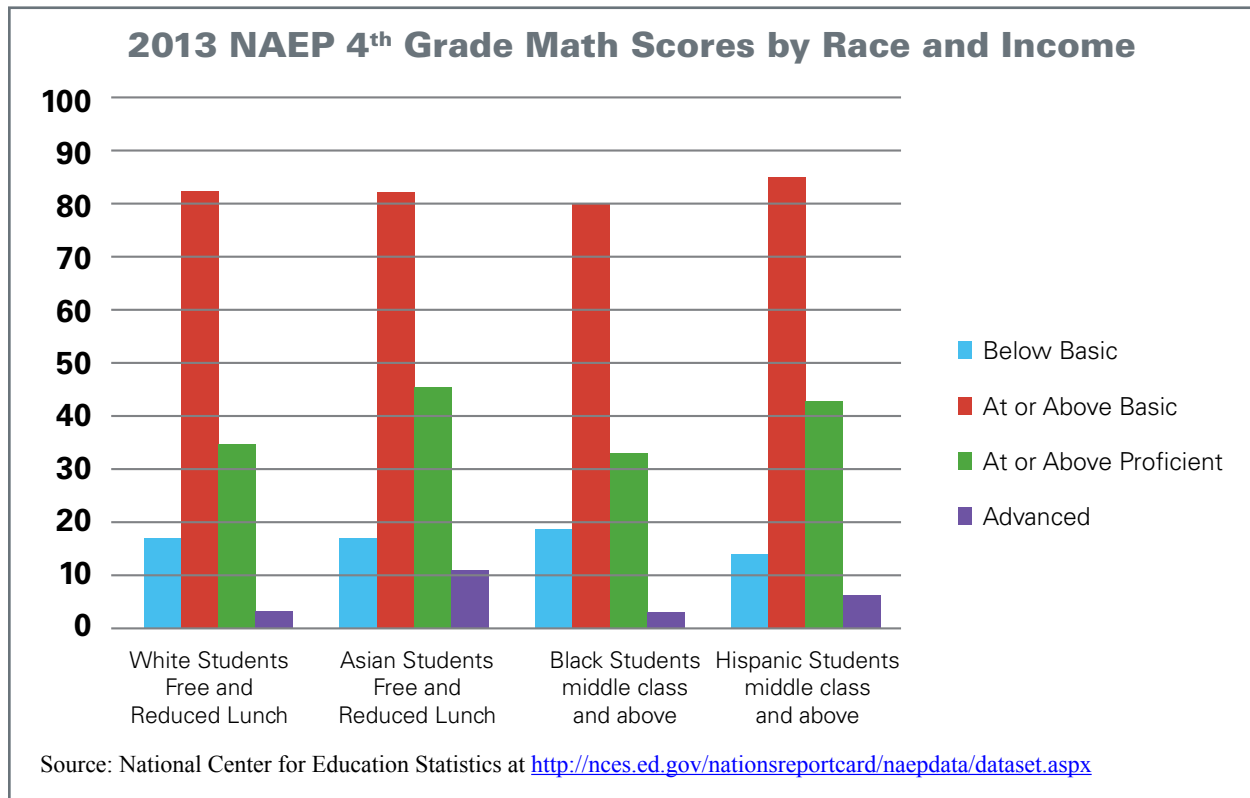
Those deficiencies show up in standardized test scores. On the 2013 National Assessment of Educational Progress, higher-income Black and Hispanic students in fourth grade scored about the same or below low-income White and Asian students, using the federal free and reduced price lunch program as a proxy for income.⁵³

When these students reach middle school, circumstances don’t change much. The National Science Foundation found that 36 percent of middle school science teachers and about 30 percent of middle school math teachers didn’t have enough training in their subjects.⁵⁴

That’s a problem because middle school algebra is a gateway course to higher-level math in high school and beyond, said Catherine Riegle-Crumb, an associate professor of STEM education at the University of Texas, Austin.

Taking algebra in eighth grade puts students on track to reach calculus by their senior year in high school. But because of the connection between math and science, says Riegle-Crumb, a student who isn’t on track for advanced math probably won’t be prepared for physics and other higher-level science classes. Additionally, a third of all Black students attend high schools that do not even offer calculus classes, compared with 19 percent of White students and 13 percent of Asian American students.⁵⁵

“All of that starts in eighth grade,” said Riegle-Crumb. “Yet, nationwide, Black and Hispanic students are much less likely to take or be placed in eighth grade algebra. That opportunity gap is a big part of the reason why we see so few African-American and Hispanic youth in STEM majors in college.”⁵⁶



Chapter VI: An Opportunity Gap or No Opportunity?

A school district in rural Alabama was cited by the Department of Education's Office for Civil Rights (OCR) for failing to offer any AP classes at the one high school out of four in the district that was 90 percent Black. The three other high schools had a "rich variety" of AP courses, said OCR Assistant Secretary Catherine Lhamon, and the Black students at those schools who enrolled in the classes were doing fine.

The schools are nearly 30 miles apart, making it impractical for students without AP courses on site to drive or bike over to one of the other campuses. An online version had no teacher.

Lhamon said when Department of Education investigators asked why the fourth school had no AP classes, a school official told them "he didn't think that the Black students could succeed, and he thought they needed remedial courses."

That answer fell on the wrong side of the law and the district has since signed an agreement with OCR to make changes.⁵⁷

AP courses, which allow students to earn college credit by passing an exam, offer insight into the scope of the opportunity gap in high schools.

AP classes are growing in popularity among all students. Slightly more than a third of last spring's three million high school graduates took at least one AP exam during high school. That's nearly double the number of AP students from the class of 2003. But the overall percentages are still lagging for minority students.⁵⁸

Just 9.2 percent of African-American students participated last year, 18.8 percent of Latino students, and less than 1 percent of Native American students, and they were less likely to pass than their White and Asian

classmates. Only half the Black students that took any AP test passed it.⁵⁹

A finer grained look at participation in AP STEM subjects among students of color shows physics and computer science had the fewest takers, but those courses were also offered by the fewest schools.

"These numbers, if left unchanged, will build an iron wall of inequality," warned David Coleman, president and CEO of the College Board. "If you are African American, Latino, if you are poor, rural White, a girl in computer science and you are ready to do more advanced work in those disciplines you must get the opportunity to take those disciplines."⁶⁰

The College Board estimates there are nearly 300,000 Black, Latino, and Native American students who have the potential to do well in AP classes based on their high school work and some standardized tests but enroll at significantly lower rates than White and Asian students with same same grades. In most cases, these students do attend schools where the classes are offered.

"The biggest part of the problem is barriers that exist within a school," said Amy Wilkins, senior fellow for social justice at the College Board, which administers the AP exams.

Wilkins said in some cases it's the teachers who look at students of color and assume that they're not AP material, and in other cases, it's the students themselves who don't feel they belong in those classes.

In an effort to gain a better understanding of what motivates students of color to either enroll in or abstain from AP courses, the College Board held focus groups with African-American students who had taken AP classes.

When asked what the most important factor was in deciding to take a class, the students said it was an adult in the school, whether a teacher, counselor, or principal, approaching them and saying, “I think you can do this,” said Wilkins.⁶¹

In response, the College Board launched the *All In* campaign⁶² to identify students who have AP potential and personally contact them, their parents, and their schools to encourage them to consider it.

But the focus groups raised another more sensitive issue that Wilkins said she’s still grappling with. There’s a sense of isolation that students of color feel in AP classes, because often they’re the only one. One young woman described how everyone in the class turned to look at her when they were reading *Huck Finn* and got to the N-word.

Wilkins also acknowledges that the *All In* program will reach only a small slice of minority students who

already excel in school. “The much larger problem is creating school systems that give kids from kindergarten forward the opportunity to do this, because there are lots of kids of color and lots of poor kids with intellectual gifts that are squandered between kindergarten and 10th grade, and that’s a nation’s work to fix.”

2014 AP STEM Exams by Race and Ethnicity

	Asian	Black	Hispanic	White	Total STEM Exams Taken (Including Other)
Biology	38,415	15,079	28,481	114,071	207,466
% of Test Takers	18.5	7.3	13.7	55	
Calculus AB	49,164	15,974	38,055	166,216	281,653
%	17.5	5.7	13.5	59	
Calculus BC	29,942	3,086	8,416	55,999	102,135
%	29.3	3	8.2	54.8	
Chemistry	32,501	7,461	14,729	78,715	140,358
%	23.2	5.3	10.5	56.1	
Computer Science A	11,060	1,469	3,720	19,520	37,327
%	29.6	3.9	10	52.3	
Environmental Science	16,569	9,954	20,798	74,517	128,829
%	12.9	7.7	16.1	57.8	
Physics (All levels)	35,936	5,780	16,143	84,573	149,587
%	24	3.9	10.8	56.6	
Statistics	31,741	10,935	21,117	105,963	178,014
%	17.8	6.1	11.9	59.5	

Source: College Board

Chapter VII: Low Expectations, Lower Quality

The reasons for these ongoing inequities are both systemic and personal, which include: cultural differences, community, peer groups, family income, family education, segregation, inadequate resources, less-experienced and less-qualified teachers, and low expectations.

“I’m a product of *de facto* segregation in Mississippi,” said Prudence Carter. The Stanford professor is also faculty director of a research center at the university focused on improving the lives of underserved children.

Both of her parents were math teachers, but as a young African-American girl attending school in the South, Carter said there were deficits in her education, especially in science.

“I remember this chemistry teacher I had who babysat us, gave us worksheets and never taught us,” she recalled. “If it weren’t for parents who had high aspirations for me, I don’t know what would have happened. I resent that that was the quality of teacher that I had.”

Carter went on to earn a Ph.D. at Columbia University, but many underserved students don’t have college educated parents who can fill in the gaps in their education. Even if they make it to college, they may find themselves out of their depth.

“We have a long and pretty undistinguished history of holding some kids to lower standards than others. They think they’re doing okay, and if they actually make it out they have a horrible shock, because they haven’t been given the preparation they really need,” said Claus von Zastrow, director of research at Change the Equation, a nonprofit organization dedicated to ensuring that all students have access to high quality STEM education.⁶³

In his 1998 book, *A Hope in the Unseen: An American Odyssey from the Inner City to the Ivy League*, Pulitzer Prize-winning journalist Ron Suskind tells the story of

Cedric Jennings, one of the smartest kids at one of the worst high schools in Washington, D.C. Jennings’ 4.02 grade point average and strong teacher recommendations got him into Brown University, and almost instantly he realized that his 4.02 did not equal that of his classmates.

Here, Suskind describes what happened when Jennings went to the university library to take a look at the books required for his classes.

“He waltzes onto the second floor, through long rows of books marked with yellow index cards noting course titles. With each step, his anxiety about gaps in his current level of learning seems to grow. He begins to wander, gazing at titles and authors: Sylvia Plath’s *The Bell Jar*, Hemingway’s *For Whom the Bell Tolls*, a biography of Theodore Roosevelt, another of Woodrow Wilson. All people from another country. Some of the names sound vaguely familiar. Most draw a blank.”⁶⁴

Jennings ultimately succeeded by sheer force of will, faith, and indefatigable tutors.

That was 20 years ago, but even now, passing grades set by schools, districts, and states are not comparable.

In one state, von Zastrow said, “you could be passed along as proficient even if you’re four grade levels behind another state.”

Arguably no college has done more to transform its entire culture and curriculum to increase the number of African Americans in STEM fields than the University of Maryland, Baltimore County (UMBC).

Between 2002 and 2011, 80 African-American graduates of UMBC went on to earn doctorates in science and engineering, more than any other school in the country that isn’t one of the historically black colleges and universities.⁶⁵

University of Maryland, Baltimore County: Teaching & Learning Come First

From its nascent days as an unremarkable commuter college, the University of Maryland, Baltimore County (UMBC) has been transformed into a national leader in undergraduate STEM education, especially for African-American students.

UMBC now has the distinction of sending more African-American graduates to Ph.D. programs in math and science than any university in the country, with the exception of the top 10 historically black colleges and universities, according to the National Science Foundation.

The metamorphosis began in 1987 with the arrival of Freeman Hrabowski, first as vice provost and, in 1992, as president, a position he still holds. Growing up Black in segregated Birmingham, Alabama, Hrabowski had an early, horrific experience that shaped his belief that African Americans must become successful and needed each other's support to make that happen.

In 1963, while participating in the Children's March, organized by Martin Luther King, Jr., Birmingham's devoutly segregationist commissioner of public safety, Eugene "Bull" Conner, picked up Hrabowski and spit in his face before sending him to jail with hundreds of other children. Hrabowski was 12 years old. Three years later he was in college, and at age 24, he earned a Ph.D. in mathematics.

The most important lesson he learned from that, Hrabowski said in a 2013 TED Talk, was "that children can be empowered to take ownership of their education, they can be taught to be passionate about wanting to learn and to love the idea of asking questions."

A year after coming to UMBC, Hrabowski teamed up with billionaire philanthropists Robert and Jane Meyerhoff and created the Meyerhoff Scholars program to counteract the social, economic, and political obstacles keeping African-American men from pursuing careers in math, science, and engineering.

Much of the credit of this achievement goes to Freeman Hrabowski. The longtime president of UMBC—since 1992—and chair of the President's Advisory Commission on Educational Excellence for African Americans is something of a superstar in the realm of closing the higher education achievement gap.

In 1988, Hrabowski and philanthropists Robert and Jane Meyerhoff co-founded the Meyerhoff Scholars Program, which provides academic support as well as scholarships

The Meyerhoff program, which has been expanded to include women and students of all races and ethnicities, is more than a financial aid program; it's a model of teaching and learning. Scholars attend a summer boot camp to immerse them in academics and in a set of values that places a strong emphasis on collaboration. Students live in the same dorms, study together, and are expected to help each other.

That philosophy extends to the entire faculty and staff and all 13,000 undergraduate and graduate students at UMBC. The campus has become a laboratory of innovations in teaching and learning, all built upon Hrabowski's four pillars of college success:

- Set high expectations for students
- Build a community of scholars among students
- Engage students in meaningful research by having them work in labs
- Hire faculty who are willing to get involved with and care about students

Of the more than 900 Meyerhoff Scholars who graduated with STEM degrees since 1993, about two-thirds have earned advanced degrees.

Yet, despite its success, no other universities have replicated the Meyerhoff program—until now. This year, the Howard Hughes Medical Institute funded a nearly \$8 million partnership to help UMBC develop similar programs at Penn State University and the University of North Carolina at Chapel Hill.

During those days in the Birmingham jail, Hrabowski wondered what his future could be. Becoming president of a university didn't seem possible. The mission of UMBC reflects his belief that a university can be a place "where students are not there just to survive. Where they love learning. Where they enjoy being the best. Where they will one day change the world," he told the TED Talk audience. "If a student has a sense of self, it is amazing how the dreams and the values can make all the difference in the world."

for the top 50 to 70 minority applicants who plan to major in a STEM field.

Since the Meyerhoff Scholars Program began, more than 1,200 have graduated from UMBC and many have earned Ph.D.'s from such leading universities as Harvard, Yale, NYU, Columbia, Duke, Stanford, Johns Hopkins, and the University of Michigan.

Chapter VIII: Bugs in Computer Science Education

Computer science is the field that put the “T” in STEM. There has been growth, but parity is years away.

Out of 27,320 public and private high schools in the United States,⁶⁶ 2,526 offered AP computer science during the 2013-14 school year, up from 2,253 the previous academic year.⁶⁷

The number of U.S. students taking the test also increased between those two years, from 29,555 to 37,327. Those gains occurred in every ethnic and racial group, with Hispanic students showing the biggest rate of growth at 35.8 percent from one year to the next, followed by Black students at 34.8 percent. But on a purely numerical basis, Black and Hispanic students still made up just 4 percent and 8.8 percent, respectively, of all AP computer science test takers in 2014.⁶⁸

One reason for the overall scarcity in AP or other higher-level computer sciences classes is that there aren’t enough qualified teachers. Indeed, it’s not clear what qualifications are necessary to teach computer science. There’s no standard and often no certification. Only Arizona, Wisconsin, and Washington, D.C., require any special licensing to teach computer science; another seven states require it only to teach AP computer science.

A survey by the Computer Science Teachers Association found that computer science teachers often make their way to the front of a high school technology classroom from within the math and science departments.⁶⁹

“It’s hard to find people who already have a computer science background. You basically have to take people who know nothing about computer science and bring them up to speed, which takes a lot of effort and time,” said Georgia Tech’s Barbara Ericson.

What’s more, only 14 states and the District of Columbia allow computer science to count toward high school

graduation requirements as a core academic subject. That creates a strong disincentive for students in most states to take a computer science course, and another reason for schools not to hire qualified computer science teachers.⁷⁰

That may be okay for now, because there is no standardization or even common understanding of what should be taught in computer science classes. There’s a lot of confusion between computer literacy (understanding how to use technology) and computer fluency (knowing how to use a computer to write and do basic searches), explained Ericson. At one school she visited, the AP computer science teacher didn’t know what was on the AP exam.

What passes as computer science in one school often bears little resemblance to a school down the street. While one may consider computer science to be teaching students how to use Microsoft Word, Excel, or PowerPoint, another may teach students to do programming. The distinctions usually break down along racial and economic lines.

“I think that (computer science) opportunity gap begins very early at home, just like everything,” said Jane Margolis, senior researcher at UCLA’s Institute for Democracy, Education and Access. “There are kids that their parents have the resources to send them to computer camp and buy them robotics under the Christmas Tree. ... By the time they get to school they have had a lot of hands-on experience.”

Those are the kids referred to in the “Preparatory Privilege” chapter of the 2008 book Margolis co-authored, *Stuck in the Shallow End: Education, Race, and Computing*, that examines access to computer science classes at three very different high schools in the Los Angeles Unified School District.

Studying the computer science programs in those schools, Margolis saw first-hand how the opportunity gap has been able to thrive in our society, revealing who gets the knowledge and who doesn't.

“We witnessed the structural constraints of a large, overcrowded school; we saw higher-level, more rigorous classes offered in a school with high numbers of White students, but not in schools with higher concentrations of students of color,” she wrote in the book’s conclusion. “We heard all sorts of rationales for the inequalities we were witnessing, and saw the extent to which these rationales become normalized in the minds of both teachers and students.”⁷¹

Chapter IX: *Odd Woman Out*

Girls and women are also seriously underrepresented in computer science, and their participation is actually shrinking. In the mid-1980s, women made up about 40 percent of the industry; today they're 26 percent and hold just 5 percent of tech leadership positions, according to the National Center for Women in Information Technology. Participation by Black women and Latinas is markedly lower: 3 percent and 2 percent, respectively.⁷²

"One of my early jobs, at Bell Communications Research, we were eight programmers in a group and we had one token guy," recalled Georgia Tech's Barbara Ericson. "So it's quite different these days than it was then."

Women simply aren't entering the field in any representative way. Between 2000 and 2009, the number of freshmen women interested in majoring in computer science fell by 79 percent.

Computer science experienced a dip in college for men and women in the mid-2000s, but while men are surging back into the major, women remain in the slump.

Although women earned 57 percent of all undergraduate degrees in 2012, they constituted only 18 percent of computer science degrees, down from 27 percent in 2001.⁷³

The largest rate of decline was among Asian/Pacific Islander women who earned 17 percent of all the computer science bachelor's received by women in 2000, but only 10 percent in 2012. Black women and Latinas increased by one percentage point each.⁷⁴

Ignoring, for a moment, the reasons behind these statistics, the undeniable reality is that by allowing this brain drain to continue, U.S. schools are ignoring half the population and more than half of all college students while concurrently facing a shortage of one million educated tech workers.

"I think this is actually a Rosie the Riveter moment and that is that women are the great untapped bench," said Jocelyn Goldfein, a startup investor and advisor and former director of engineering at Facebook.⁷⁵

Preconceptions, misconceptions, and discomfort on all sides factor into the downturn.

The Hollywood stereotype of computer scientists as unsocial, greasy-haired geeks probably isn't enticing to women. Neither is the more realistic prospect of being a woman in an overwhelmingly male college major.

Stanford University really did try to interest women in computer science, said Kimber Lockhart, who started her first company as a junior there, "but I was still the only girl in a couple of my classes. We're not talking classes of 20, we're talking classes of 120."⁷⁶

Women also encounter subtle messages questioning their very presence.

"I don't think I was ever treated differently by my professors at Stanford, but I did notice subtle cues from my TAs [teaching assistants] or fellow students, for example, showing up to office hours and being told by my appearance that I was in the wrong room," recalled she++ founder and Facebook employee Ellora Israni.

Senior researcher Catherine Ashcraft with the National Center for Women and Information Technology has a name for this: unconscious biases. They "include looks, gestures, or tone of voice, and often accumulate in ways that lead employees to underperform, withdraw from co-workers, and ultimately leave the workplace," writes Ashcraft.⁷⁷

Sometimes the messages are not so subtle. In a replay of then-Harvard President Lawrence Summers' 2005

remarks at a diversity conference that men might be innately better than women in science and math,⁷⁸ Microsoft CEO Satya Nadella suggested at a women in computing celebration in October 2014 that women shouldn't ask for raises but rather rely on "good karma" and have "faith that the system will actually give you the right raises as you go along."⁷⁹

Nadella has since reversed himself, apologized, and launched a diversity plan at Microsoft. That's all well and good, but as some researchers note, saying it means he's thinking it, and the thoughts are part of the problem. They are the underlying assumptions at play when White male job candidates are hired over women or men with "Black-sounding names," even though their resumes are identical.⁸⁰

Chapter X: Model Programs and Promising Practices

Nonprofits, private companies, and federal, state, and local governments have stepped in with a number of initiatives and strategies to try to remove these barriers in schools and the workplace.

- Code.org⁸¹ offers free professional development in computer science for teachers, online programming tutorials, and curriculum materials available at no charge through a Creative Commons License.
- Black Girls CODE⁸² runs programming workshops for young girls from underrepresented communities.
- Change the Equation⁸³ connects businesses with schools to collaborate on improving STEM education.
- The Algebra Project,⁸⁴ founded by civil rights leader and MacArthur genius award recipient Dr. Robert Moses, provides culturally sensitive professional development to teachers to break out of the ingrained attitudes that often prevent children of color from receiving the best math instruction.
- The Oracle Academy⁸⁵ is an international effort to expand access to computer science education in high schools and colleges by providing professional development, software, and curriculum materials.
- The UTeach program,⁸⁶ which began at the University of Texas, Austin and has expanded to dozens of universities, uses hands-on, project-based instruction through a partnership between colleges of education and STEM departments to prepare new STEM teachers.
- “There is no math brain,” proclaims Stanford University education professor Jo Boaler. Her project, YouCubed⁸⁷, is devoted to transforming math education and dispelling the belief that some people

just aren’t good at math by using research-based methods to prepare new math teachers in colleges of education and to retrain classroom teachers.

Recent years have also seen new government policies, programs, and voluntary initiatives established to expand educational opportunity in STEM, albeit with some challenges and shortcomings.

Common Core State Standards.

Perhaps the most promising reform taking root today is the result of a deliberate effort on the part of the nation’s governors and state education leaders to create a set of common, high standards for student academic achievement across the country. The Common Core State Standards (CCSS)⁸⁸ have been adopted by 45 states and the District of Columbia with the aim of both lifting the achievement of all students to better position the U.S. in the global economy, as well as to ensure that children consigned to even the most resource-deprived, segregated schools have an opportunity to prepare for college or a family-supporting career.

While the CCSS explicitly focus on English language arts and math, behind these two core subjects are opportunities to transform and improve instruction in other subjects, particularly the natural and social sciences. When effectively implemented, CCSS should result in greater use of technology by students and teachers alike through, for example, blended learning, online sources, and computerized assessments.

Next Generation Science Standards.

States have also taken the lead in pursuing new standards to prepare students for a future where extensive STEM knowledge and skills will be essential for the United States to remain globally competitive. The Next

Generation Science Standards (NGSS)⁸⁹ provide a new framework for science education designed to teach students about the natural world by engaging in research and understanding the connections among different branches of science instead of learning each in its own vacuum, as if biology, chemistry, physics, and environmental sciences were somehow unrelated to one another.

The final standards were light on computer science, however, including only basic concepts instead of treating it as a distinct discipline. Members of Computing in the Core, a coalition of organizations and companies advocating for stronger computer science education, expressed their concern in a letter to Achieve, which oversaw development of the NGSS, after the draft standards were released.⁹⁰ It said, in part:

“While the draft science standards include elements of computer science and computing concepts in the Engineering, Technology and Applications of Science topics, the attention paid to the discipline of computer science does not match its importance in terms of workforce demand and the opportunities it presents young people in the 21st century. The significant absence of core computing content is disappointing, as it demonstrates a lack of understanding of the ways in which computing is driving and supporting innovation and discovery in all sciences.”

ConnectEd.

ConnectEd is a U.S. Department of Education initiative to catalyze support from the private sector to help close the digital divide in low-wealth schools by providing broadband access to all students at home and in schools.⁹¹

My Brother’s Keeper.

In 2014, the White House launched My Brother’s Keeper,⁹² urging communities, foundations, and businesses to collaborate in developing mentorships and networks to help young men of color break down barriers to opportunity by giving them skills and support to pursue higher education and careers.

National Science Foundation Initiatives.

The National Science Foundation (NSF) funded development of two new courses to inspire more girls and students of color to study computer science. Margolis and her team at UCLA received one grant to design a course called Exploring Computer Science to introduce students to the fundamental concepts of computer science and coding through hands-on exploration and problem solving. After being piloted in Los Angeles Unified School

District, it’s now being taught in Chicago, New York, Boston, and Washington, D.C., public schools.⁹³ Margolis believes in “democratizing knowledge” by ensuring that every student, whether planning to attend college or not, has an opportunity to study computer science.

NSF is also seeking to broaden the appeal of computer science education with a new AP course under development with the College Board. The current Java programming AP class won’t go away, but starting in the 2016-17 school year, students who aren’t so-called “computer nerds” will have the option of enrolling in Computer Science Principles to learn more generally about programming as well as “the creative potential of computing for socially beneficial purposes, scientific advancement, and other ‘high impact’ uses not directly related to advancing the technology.”⁹⁴

Chapter XI: Fixing Systems, Not Students

These programs are all large, research-based, nationally scaled programs with ongoing evaluation and training. There are also thousands of smaller STEM programs around the country run by community organizations, after-school programs, area companies, school districts, or combinations of the above. Some of these are highly effective in reaching underserved students. In general, however, they're not closely monitored, reach a limited number of students, and even the best of them aren't likely to overcome all the deficiencies in schools serving the largest populations of low-income and minority students.

Closing the nation's STEM opportunity gap won't happen through one-off programs here or there, or by a slow, shaky ascent up the blighted steps depicted in Prudence Carter's photo. It has to be embedded in the culture and structure of schools. It must be galvanized with the right policies and resources.

"Change has to be systemic," said Dan Goldhaber, director of the Center for Education Data and Research at the University of Washington. "It's not a single thing; it's a variety of different things. It's the quality of the [teachers], the curriculum, the way that schools interact with parents," and providing more time for students to learn through longer school days.

According to Goldhaber, KIPP charter schools provide one example of a model that is helping disadvantaged students. An analysis of KIPP schools by Mathematica Policy Research found that the schools had "a statistically significant positive impact on student performance on state assessments in both reading and math."⁹⁵

But innovation isn't exclusive to charters. Goldhaber was a member of the Broad Prize review board this year, and says the winning districts employed similar strategies and raised student achievement.

Gwinnett County Public Schools in Georgia and Florida's Orange County Public Schools, the two large urban districts that tied for top honors, improved student performance and reduced achievement gaps.

Gwinnett County ranked in the top 10 percent of districts in Georgia in 2013 for the percentage of Black students scoring in the advanced level in reading, math, and science on state exams.⁹⁶ Orange County Public Schools in Florida were in the top fifth in the state.⁹⁷

They achieved these successes, said the Broad judges, by creating cultures that encourage teacher feedback and collaboration, welcoming new ideas, proactively seeking community input, using data to improve teaching and identify students who need help, and offering training programs for teachers who want to move into leadership positions.⁹⁸

These aren't new ideas, no one had to rediscover fire or reinvent the toaster, and more empirical research on what works in education is always underway.

"That's one thing about the United States; we actually know how to educate kids," said Wilkins of the College Board. "There are very good schools here; it's not about hand wringing and 'Oh no, we don't know what to do.' We do a fine job with some kids. It's about political will; it's not about know-how."

The way Shirley Malcom sees it, too many interventions for closing the opportunity gap are based on the backward belief that underrepresented students have a deficit that can be fixed by giving them the right tools and teaching them the right skills to enable them to fit into the system.

"The assumption is there's something wrong with the student. There was never any question raised about

maybe there was something wrong with the system,” explained Shirley Malcom of AAAS. “If you turn that on its head and say instead, ‘What would a system look like, what would an institution look like that was more supportive of these students? What would they do differently? What would the program be? What experiences would they provide?’ That’s really what we’re talking about.”

That’s what Uri Treisman did nearly four decades ago, when investigating why African-American students at the University of California, Berkeley, were failing calculus at a higher rate than their Asian American classmates. His findings led Treisman to design workshops for African-American students based on the autonomous social and academic groups organized by the Asian American students that served as safe spaces to help and support each other with school work while creating friendships. The workshops became a model for hundreds of other colleges and universities.⁹⁹

Success Vignette: The Emerging Scholars Program – Uri Treisman

In the mid-1970s, when Uri Treisman was a graduate student at the University of California, Berkeley, he led groundbreaking research on why African-American students who were at the top of their high school classes did so much worse in freshman calculus at Berkeley than their Chinese American classmates.¹

The findings refuted the conventional belief that Black students failed due to poor preparation, lack of parental support, and lack of motivation. Treisman, now a mathematics and public affairs professor at the University of Texas, Austin, found that starting on the first day of class, the Chinese American students organized academically focused social groups. They met regularly to study together, help each other with homework, discuss and critique each other’s schoolwork, and provide a support network for all other college questions and concerns.

By contrast, African-American students, accustomed to being among a small elite band of high achievers in high school, isolated themselves academically and kept their social lives and school lives separate. They studied by themselves, struggled on by themselves, and failed by themselves.

These observations led Treisman to establish the Mathematics Workshop Program, creating small science and math working groups for Black and Latino students. Minority students in the groups were more than twice as likely as those not in a working group to earn a B- or better in calculus, and four times more likely to graduate with a math-based major.

Treisman’s workshops became the model for the Emerging Scholars Program used by several hundred colleges and universities across the country.

1. Treisman, Uri, The Professional Development Program, University of California, Berkeley. <http://www.vccslitonline.cc.va.us/mrcte/treisman.htm>

Conclusion and Recommendations

The vast inequity in STEM education is pervasive and damaging. The combined efforts of government programs, private sector initiatives, and longstanding advocacy on behalf of women and minorities in the field have not yet broken down barriers based on stereotypes and structural inequalities from preschool through doctoral programs. It is clear that inequities in STEM education are damaging both to the economic and national security of the United States, as well as to the hopes and dreams of too many of our children and families. At the same time, our systems continue to work well by targeting resources and maintaining privilege for the few.

Only enduring and systemic changes will bring about the needed opportunities for all our children and young people. Below we offer some broad recommendations for consideration by policymakers, education leadership, community and advocacy organizations, and philanthropy. While it may not be possible in the current political climate to make all the progress that is needed, it is important that we take whatever steps are possible in the short-term, while acknowledging that real change and the elimination of systemic educational shortcomings and inequities will take a longer time to achieve. Nonetheless, the time to act is now.

Recommendations for National Policymakers

1. Congress should hold hearings on the nature and extent of STEM inequity with respect to underserved populations and to our nation's current and future well-being, and invite testimony from a broad cross-section of education, business, and civil rights experts. The evidence and testimony should be used to craft legislation aimed at eliminating disparities in both elementary and secondary as well as higher education.
2. Congress and the administration should undertake a review of the many federally sponsored programs and funding streams with a significant or primary focus on STEM education or training. These programs include, but are not limited to: the Elementary and Secondary Education Act (ESEA), the Higher Education Act, Workforce Investment Act, the Perkins Act, and STEM programs outside the U.S. Department of Education, including: the National Science Foundation, the U.S. Department of Energy, NASA, and others. Meaningful input should be solicited from communities most impacted by STEM inequity, including students, educators, and scientists from underrepresented groups; disability and civil rights organizations; minority-serving institutions; state public higher education systems including community colleges; both high- and low-wealth public school districts; and both labor and management in employment sectors with projected high STEM needs.
3. Following a thorough review, the federal government should improve and restructure its STEM programs to ensure greater equity and effectiveness. Priorities for funding should be given to institutional applicants that will use promising or validated approaches to improving the achievement and inclusion of traditionally underrepresented populations, including: members of disadvantaged racial and national origin minority groups, women and girls, people from communities with highly concentrated poverty, individuals with disabilities, returning veterans, and incarcerated persons preparing to rejoin their communities.
4. When the ESEA is reauthorized, Congress should add and strengthen provisions that will contribute to greater STEM equity and higher STEM achievement for all groups of students, including provisions for:

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- a. College and career-ready science standards, aligned to the Common Core State Standards where applicable, along with statewide science assessments aligned to the standards.
 - b. Annual improvement goals and accountability for subgroups in math and reading, and the addition of appropriate improvement goals for the sciences. The subgroups should include those in current law.
 - c. Public reporting on student outcomes, including in STEM subjects, with data disaggregated by major racial and ethnic groups, English learners, students with disabilities, and students from low-income families. Data should be further disaggregated for subgroups of Asian students, and cross-tabulated by gender.
 - d. A dedicated funding stream for low-income and low-achieving high school students that includes, for example: support for a college-preparatory course of study, including subsidies for AP/IB exams and dual enrollment, adequate college and career counseling, and dropout prevention, including approaches to reengage students in STEM learning through experiential learning, technology, and other effective teaching.
 - e. Substantial investment in teachers and school leaders, including provisions to ensure that poor and minority students are not taught at higher rates by inexperienced, unqualified or ineffective teachers.
5. Congress should reauthorize the Higher Education Act by: maintaining TRIO programs; strengthening support for women and underrepresented minorities in the STEM fields, including at minority-serving institutions and community colleges; maintaining college affordability for low- and middle-income students through Pell grants and low-interest student loans, requiring institutional transparency regarding costs, completion rates and other indicators; and safeguarding students against unscrupulous practices of for-profit programs.
 6. Congress should reauthorize the Perkins Act to align the program with job training needs for the modern workforce, e.g., jobs that pay a family-supporting wage in areas like STEM, green jobs, the building trades, transportation, and health professions. Resources should be targeted toward high-poverty communities. Executive branch departments and agencies must continue to enforce compliance with federal civil rights laws barring discrimination and inequality and focus on STEM inequality where data reveal significant disparities.
- a. At the elementary and secondary level, in access to high quality STEM curriculum, including core college-preparatory classes (such as chemistry, physics, and calculus), as well as college credit-bearing classes such as International Baccalaureate (IB) and Advanced Placement (AP), including computer science.
 - b. In student grouping and class placement, examining, e.g., how practices of tracking and ability grouping, particularly in the early grades, contribute to low achievement and limited access to rigorous STEM learning in middle and high school.
 - c. In resources connected to STEM learning (including up-to-date technology, laboratories, and materials) as well as in the assignment of highly qualified and effective math and science teachers to high-need schools.
 - d. At the postsecondary level, in admissions, the award of financial aid and scholarships, accessibility for students and faculty with disabilities, as well as in hiring, promotion, and tenure decisions.
7. The Department of Education should use its convening authority to bring together policy and assessment experts, representatives of students and teachers, and state and local leaders to address the needs for science standards, assessments, teacher preparation, and professional development.
 8. The Department of Education should also enforce provisions in the ESEA that could help ameliorate some of the worst disparities for children in grades K-12, including, e.g.:
 - a. The adoption and implementation of challenging academic standards in science, which were first required by Congress in the No Child Left Behind Act in 2001.
 - b. The development of science assessments that comply with Section 1111(b)(3) of Title I, assuring they meet nationally recognized professional standards for reliability and validity.
 - c. Undertaking monitoring activities under Titles I, II, and III, in particular, to ensure that all schools receiving federal assistance under ESEA have the capacity to, and in fact are,

teaching to the statewide standards in science, as well as the standards in reading and mathematics. Reviews should ascertain whether teachers in high-poverty schools have sufficient training and support, and whether the schools have the materials, curriculum guides, and other resources necessary to teach to the standards.

- d. The requirements in Sections 1111 and 1112 of Title I for both states and school districts to ensure that poor and minority students are not taught disproportionately by unqualified, inexperienced, or out-of-field teachers.
 - e. The requirements regarding the use of valid and reliable statewide assessments for English learners and students with disabilities, including the availability of appropriate accommodations, to determine academic proficiency in language arts, mathematics, and science, as well as English language proficiency levels and appropriate services for English learners.
9. The administration should hold all states to the promises they made in their applications for ESEA waivers to improve student achievement, including by closing achievement gaps, improving the numbers and percentages of students in all subgroups who graduate high school college- and career-ready, and turning around the state's lowest-performing schools.¹⁰⁰

Recommendations for State and Local Policymakers:

1. Governors, state legislators, state and local school board members, chief state school officers, school administrators, the business community, teachers, and parent and community organizations in each state and school district should assess—and develop budgets and plans to meet—current and projected STEM education needs in their all labor markets within each state.
2. States should consider the needs of low-wealth, high-minority schools and school districts to improve STEM instruction when crafting state foundation formulas, responding to calls for fiscal equity, and when setting high school graduation and school improvement goals.
3. Given that excellent STEM education often begins well before Kindergarten, states should consider following the lead of New Jersey and expand free, public preschool for all 3- and 4-year olds, beginning in the highest-poverty communities.
4. States and school districts should set ambitious but realistic goals for college and career readiness in the

STEM subjects, e.g., by teaching algebra in middle school; by providing extra time for students below grade level to catch up in math and science before they begin high school; by ensuring that *all* high schools in the state offer a full four-year sequence of classes in math and science, aligned with the expectations of the state's public colleges and universities; and by taking steps to eliminate race and gender bias in steering qualified students to AP and other challenging STEM courses.

5. States should reaffirm their support for Common Core State Standards and should also adopt a set of academic standards for the sciences, e.g., the Next Generation Science Standards, and should develop assessments aligned with the science standards, as required by ESEA. States should also work collaboratively with each other and with postsecondary educators to create standards for high school computer science classes, to design trainings and a certification program for computer science teachers, and to “count” computer science as a core academic subject.

Recommendations for the Private Sector and Philanthropy

6. The business community—including local chambers of commerce, major employers, as well as small businesses—should continue and expand efforts to ensure that the public education system is preparing each child for postsecondary education, career, and civic engagement. In the STEM fields, business leaders should work with parents and schools to encourage students, especially girls and under-represented minorities, to pursue STEM in middle school, high school, and college. Business leaders should also work with community colleges, job training programs, and school districts to identify their needs for workers with STEM proficiency. Finally, the business community could be helpful in promoting the federal and state policy recommendations in this report and others that will support systemic improvements.
7. Foundations should continue to invest in the important work of standard setting, improving the teaching profession, and promoting STEM education, research, and development that is best in the world. At the same time, however, addressing inequity in STEM is not only a moral imperative—the right thing to do—but it is clear that our country's economy and national security depend on expanding opportunity to groups historically shut out. Thus, we recommend that the philanthropic community support efforts to identify the practices, programs, laws, and policies most likely to lead to the sys-

temic changes needed to make STEM equity a reality. Once identified, foundations should provide support to organizations representing the full range of stakeholders—including students, civil rights organizations, and education advocates—to develop messages and organizing campaigns that promote legal, policy, and other effective solutions.

Recommendations of The Equity and Excellence Commission

Nearly two years ago, a distinguished panel of experts appointed by U.S. Secretary of Education Arne Duncan tackled the enduring problem of inequitable distribution of education resources and opportunities in the United States. The Equity and Excellence Commission’s report, “For Each and Every Child: A Strategy for Education Equity and Excellence,” released in February 2013, is a landmark document that identifies an urgent national problem and points the way forward, much like “A Nation at Risk” did over 30 years ago.

The Equity and Excellence Commission’s report lays out a thoughtful, five-part agenda to address these inequities. The Leadership Conference Education Fund recommends that all policymakers and stakeholders examine the recommendations and begin to take action as they are able.

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