

$$\sqrt{\left(\frac{g\lambda}{2\pi} + \frac{2\pi\lambda}{\rho\lambda}\right)\tan}$$
$$\int_{-\infty}^{\infty} (\alpha(k)e^{i(kx-\omega t)} + \beta(k)e^{i(kx+\omega t)}) \cos(kx) dk$$
$$E = mc^2$$



A LETTER ON STEM EDUCATION TO AMERICA'S PARENTS

FROM THE COMMITTEE ON
K-12 EDUCATION

CO-CHAIRS:
NORM AUGUSTINE, BILL BROCK, &
ROY ROMER



The Center for the Study of the Presidency and Congress, founded in 1965, is a nonprofit, nonpartisan 501(c)(3) organization. The Center's mission is to: promote leadership in the Presidency and the Congress to generate innovative solutions to current national challenges; preserve the historic memory of the Presidency by identifying lessons from the successes and failures of such leadership; draw on a wide range of talent to offer ways to better organize an increasingly compartmentalized federal government; and educate and inspire the next generation of America's leaders to incorporate civility, inclusiveness, and character into their public and private lives and discourse.

A LETTER ON STEM EDUCATION TO AMERICA'S PARENTS
FROM THE COMMITTEE ON K-12 EDUCATION

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A LETTER TO PARENTS

FROM

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**Committee on K-12 Education
Washington, DC**

December 6, 2012

Dear Parent,

The world has changed, but the overwhelming majority of American public schools have not. The knowledge and skills a highly competitive world requires are not being provided to your children, and their opportunity to thrive is at risk. It is time for you to take charge.

Our young men and women no longer compete only with other Americans for jobs. They also compete with often equally or better educated workers in Beijing, New Delhi, Tokyo, Rio, and thousands of other places. As Tom Friedman points out in *The New York Times*, "For politicians all their customers are 'here;' for CEO's (who decide where the jobs will go) 90 percent of their new customers are abroad." If the best jobs are going to go to American workers, those young men and women will need the knowledge and skills to earn them.

Today our children are losing the race for jobs and a high quality of life. Real income for the average family in the United States is lower than it was ten or twenty years ago. Statistics show that economic mobility in the United States has significantly slowed in recent decades, making it more difficult for lower income Americans to improve their quality of life. Such mobility was once the essence of the American Dream. Education is the key to reenergize it.

In this letter we focus on Science, Technology, Engineering and Mathematics (STEM) education, not because other fields are unimportant, but rather because excellence in STEM will to a large degree form the basis of our children's ability to obtain jobs; to defend themselves in a dangerous world; and to live healthy, happy, rewarding lives. It is becoming more and more difficult to succeed in the labor market or to make informed choices as citizens without STEM competency. But STEM alone will not be enough—a knowledge of such fields as economics, history and ethics, to name a few, will also be essential.

The reasons we take your time with this letter are threefold. First, your child needs a world class education to get a decent job and have a fulfilled life. Second, your

child may not be getting the world class education he or she deserves. And third, you—and perhaps only you—can do something about it.

The short pamphlet that accompanies this letter provides more details about the state of the education system that is serving your child. We hope you have a few moments to take a look. If you have limited time, as so many parents do, we ask that you review these ten suggestions, repeated in the booklet, for things you can do to improve the education of your child and children across the country. We hope you consider choosing at least two:

1. Forty-six states have agreed to a Common-Core Curriculum in at least some subjects. Demand that your state's leaders fully adopt that curriculum or a more rigorous one and expand it into other academic disciplines.
2. Use PTA and Board of Education meetings to insist that strenuous testing standards accompanying the Common-Core Curriculum be adopted and that they are not watered down. Illusions of progress lead to parental complacency and political lethargy.
3. Support the introduction of competition into our public school system through financial and other rewards for extraordinary teachers and through new and more effective ways of recognizing and replicating the best among our public schools, including public charter schools.
4. Insist that standards for new teachers are raised, that teachers meeting these standards are compensated as professionals, and that they are given the freedom to teach.
5. Write your Congressmen and Senators and tell them to implement the remainder of the National Academies' "Gathering Storm" recommendations.
6. Demand that your school district lengthen the number of high quality hours children spend in the classroom with their teachers. Time is important, but the quality of that time is even more so.
7. Don't leave your child's education up to the "establishment." Read with your children, turn off the TV and video games, and support extracurricular activities that focus on experiential education.
8. Discuss with your children the important connection between education and training and their lifelong standard of living. Help them to understand that hard work in the classroom and involvement in afterschool STEM programs will pay off in terms of greater career opportunities and higher pay.
9. Cut your political leaders no more slack. Demand action. Demand higher standards. Defeat those who make only hollow promises and excuses. Accept only tangible, demonstrable progress, quantified by actual results measured against the baseline of the best systems in the world.
10. Most of all, demand that every system, every program local or state, and every educator put our children first, not the adults – the students.

Sincerely,

Handwritten signature of Norman R. Augustine in black ink.

Norm Augustine

Handwritten signature of Bill Brock in black ink.

Bill Brock

Handwritten signature of Roy Romer in black ink.

Roy Romer

Co-chairs

Why the Center for the Study of the Presidency and Congress?

You might wonder why a Center dedicated to studying the lessons of past presidencies and congresses would undertake a project focused on STEM education, particularly in grades K-12. It is noteworthy in this regard that some of the most striking leadership lessons can be drawn from times when Presidents chose to make strategic investments in education and science even while under great duress from other more immediate challenges. For example, in the 1860's, in the midst of the Civil War, when it was not clear we would even have a nation, President Abraham Lincoln had the foresight to create the National Academy of Sciences and to establish the Land Grant Colleges system. In the 1940's, President Franklin D. Roosevelt created the G.I. Bill and mobilized U.S. science and business to bolster the war effort. In the 1950's, President Dwight Eisenhower knew that winning the Cold War would require more than military superiority and created the White House Science Advisor and the Advanced Research Projects Agency. Leaders such as these understood the importance of excellence in the STEM fields to our national strength and did not permit imminent pressures to justify ignoring that importance.

Knowledge, the Key to Survival

Today's job market demands a STEM-savvy workforce, a STEM-informed political leadership, and a cadre of STEM experts. STEM jobs were remarkably resilient during the recession following the 2008 financial crisis. In a period that saw general unemployment rise to 10 percent, unemployment in STEM fields peaked at 5.5

Highest unemployment rate since 2009

- Overall 10%
- STEM workers 5.5%

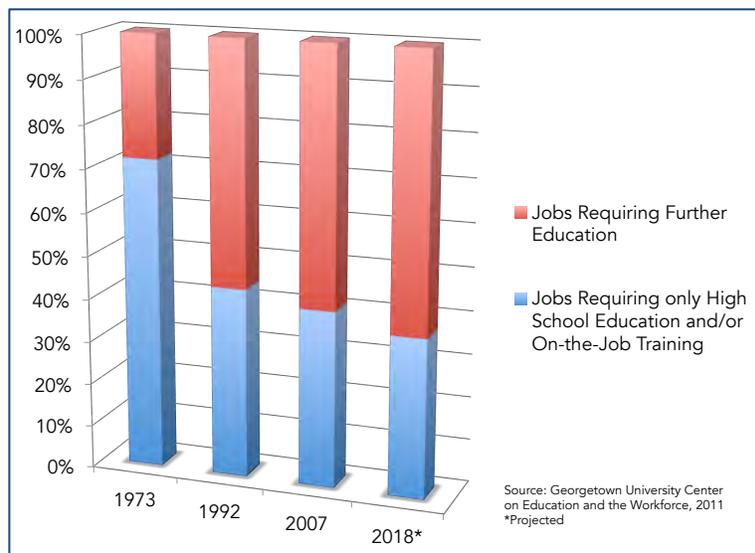
percent.^{iv} STEM workers on average earn 26 percent more than their non-STEM counterparts, and STEM degree holders earn higher wages whether they are employed in STEM or non-STEM occupations.^v Pay in STEM jobs is also more equitable across genders and ethnicities than in job "clusters" like finance, marketing, and health science.^{vi}

Various studies have shown that in recent decades between 50 and 85 percent of the growth in America's GDP and two-thirds of its growth in productivity is attributable to advancements in just two fields: science and engineering. Furthermore, whether your child wishes to pursue these fields or some other field, he or she will need to be prepared to live in a world of computers, green energy, advanced telecommunications, bio-engineering, robotic surgery, human-machine interaction, and much, much more. Failure to have at least a working understanding of modern STEM has become a one-way ticket to being left behind.

But there is a broader context to the STEM challenge: economic mobility, the ability of Americans to better their economic status. This characteristic has historically been viewed as a key factor that makes the American system of free enterprise and less government intrusion in the economy more effective than more socialized systems. However, America’s system simply does not work without quality education for all youth. Between 1979 and 2004, the real after-tax income of the poorest one-fifth of Americans rose by 9 percent; that of the richest one-fifth by 69 percent; and that of the top one percent by 176 percent.^{vii} American men in their thirties today are on average earning 12 percent less in real income than their fathers’ generation.^{viii}

If economically poor students receive poor educations and wealthy students receive good educations, then economic mobility is undermined. Today, family income is a staggeringly dominant predictor of college graduation rates, with 54 percent of students from affluent families graduating, compared to only 9 percent of students in lower income families.^{ix} Simply stated, the U.S. model of encouraging free enterprise and rewarding effort and merit simply doesn’t work if all students cannot receive a quality education.

The requirement for higher education in the workforce is gaining strength. A Georgetown University Workforce report states, “...the demand for postsecondary education will increase from 59 to 63 percent of all jobs by 2018.” It adds, “Jobs for workers with a high school diploma or less still exist but are quickly declining . . . [only] 37 percent of all jobs in 2018 will be for workers who have either a high school diploma or incomplete high school education with some on-the-job training. This number is down from 72 percent in 1973, 44 percent in 1992, and 41 percent in 2007.”^x



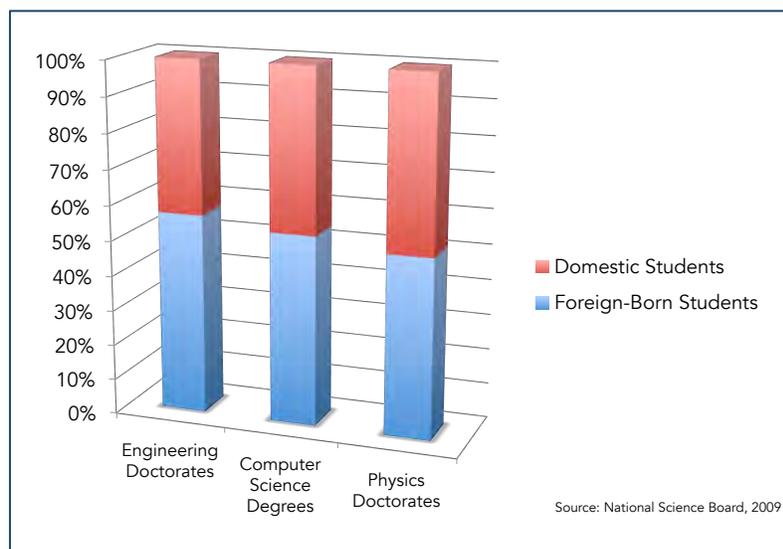
Sadly, it is harder and harder for children whose parents did not attend a higher educational institution to go into higher education themselves. According to the OECD, the United States “ranks 14th in the world in percentage of 25-34 year-olds with higher education.”^{xi} Moreover, the degree to which parents’ lack of higher education correlates to children not getting higher education is higher in the United States than all but two of the other nations measured (Canada and New Zealand).^{xii}

The Georgetown report notes that this trend is particularly ominous for women since, “The best opportunities for workers with (only) a high school diploma are in male-dominated fields. Over 80 percent of the workforce in manufacturing; architecture and construction; and transportation, distribution and logistics are men.”^{xiii} This means that in the current economic environment it is especially important for women to obtain education beyond a high school diploma.

The flow of qualified science and engineering-inclined, college bound youth through our economic pipeline is dangerously low. One reason is that only about 15 percent of U.S. high-school graduates have sufficient mathematics and science credentials to even begin pursuing an engineering degree^{xiv}—and more than half of those who do begin drop out.^{xv} Further, the current U.S. science and engineering workforce is aging. The National Science Board reports that 50 percent of the U.S. science and engineering workforce is older than 40, and a significant percentage is likely to retire in the next decade. This aging workforce is 82 percent white and three-quarters male. Young women represent only about 20 percent of degree seekers in engineering,^{xvi} and the U.S. minority population is underrepresented in this field by a factor of three.^{xvii}

In recent decades, while the role of technology has been rapidly expanding, because of these aforementioned factors, America’s educational system has actually been producing fewer mathematicians, scientists, and engineers. This is all occurring at a time when these same statistics for our nation’s economic competitors are heading in precisely the opposite direction. China, for example, graduates more *English-trained* engineers than the United States.^{xviii} In 2002, Asian countries as a whole awarded 636,000 first engineering degrees, European countries awarded 370,000, and North America awarded 122,000.^{xix}

Our failure to provide STEM-qualified youth has in the past been offset by our ability to attract highly talented, foreign-born individuals to our universities and to encourage them to remain here and build careers. According to the National Science Board, among degrees granted by U.S. universities in 2009, “foreign students earned 57% of all engineering doctorates, 54% of all computer science degrees, and 51% of physics



and 51% of physics

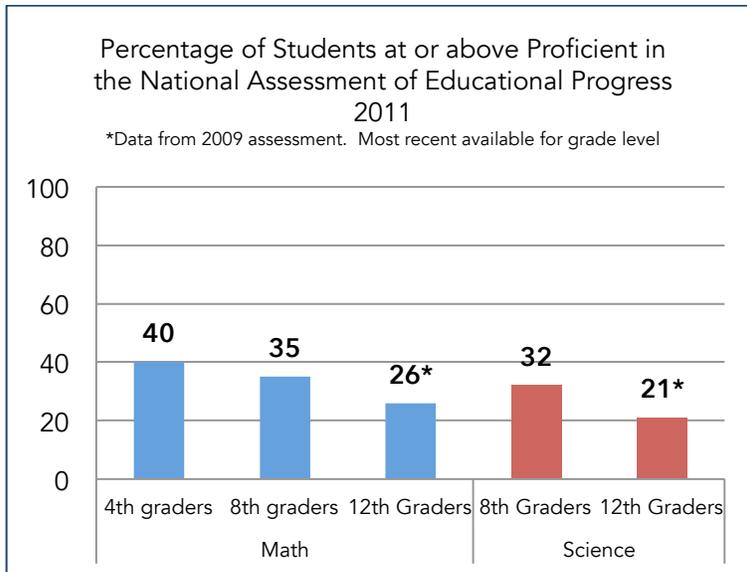
doctoral degrees.^{xx} Today, an increasing share of the individuals who elect to study in America are saying they will return home after gaining a few years of experience in the U.S.^{xxi} The 35 largest U.S. companies are creating nearly three times more jobs abroad than at home.^{xxii}

The Health of STEM Education

If we want to determine the condition of our own health, we look to vital signs and at the results of diagnostic tests, such as blood pressure, blood glucose level or cholesterol. We know how we feel, but rather than simply relying on that we test measurable indicators of our health. That way, we look beyond symptoms to more objective measures. Similarly, if we are to determine the health of STEM education in America, we would do well to look at objective indicators such as course-taking, student performance on national and international assessments, or student knowledge upon completion of a given level of education. By any of these measures, the health of STEM education in the United States should be on life support.

According to the most recent (2011) National Assessment of Educational Progress (NAEP), commonly referred to as “The Nation’s Report Card,” only 40 percent of U.S. 4th graders and 35 percent of 8th graders (note the trend) performed in mathematics at or above the “proficient” level.^{xxiii} In the science assessment, only 32 percent of eighth-grade students performed at or above the proficient level.^{xxiv*} Only 26 percent of 12th graders scored at or above the proficient level in mathematics^{xxv} and only 21 percent did the same in science in 2009.^{xxvi}

But the truth is that what really matters in the 21st century is how our children stack-up in comparison with their peers in other countries who will be seeking the same jobs and designing their own nation’s military systems. The well-regarded Programme for International Student Assessment (PISA) assesses the performance of 15-year-olds in mathematics and science, mostly from OECD (Organisation for Economic Co-operation and Development) countries. In 2009, the scores of U.S. students in both mathematics and science were below the average of all OECD countries (and also below some non-OECD countries). Specifically, U.S. students ranked 23rd in science and 31st in mathematics among the 65 participating countries. And in the most fundamental educational skill of all—reading—our nation’s children rank 17th.^{xxvii}



U.S. Ranking in 2009 Programme for International Student Assessment

Reading: tied for 17th (Poland, Iceland)

Science: 23rd

Mathematics: tied for 31st (Ireland, Portugal)

Even scores for top-performing U.S. students in mathematics (those at the 90th percentile and above) were lower than comparable top performers of 12 of 32 OECD nations. In science, scores of top U.S. performers were below those of their counterparts from seven of the OECD countries.

A contributing factor to these sobering statistics may be that teachers, by no fault of their own, are being forced to teach in subject areas beyond their area of expertise. Thirty six percent of middle school mathematics teachers (and 12 percent of high school mathematics teachers) are not even teaching in the field in which they are qualified. In the case of science, about 30 percent of middle school science teachers (and 19 percent of high school physical science teachers) are not teaching in their field. 'Out-of-field' teaching is much more prevalent in less affluent schools than in their wealthier counterparts.^{xxviii}

Let's be candid. There are many outstanding schools, many superb teachers and many excellent students in America. But, on average, by global standards, we are falling behind. Teaching should be the most respected profession in America. It is not. We can no longer afford to ineffectively recruit teachers; to pay them accordingly; to afford them little respect and few tools to improve their performance; and, frequently when job reductions are required, to lay off those who are the most effective.

Perhaps most disheartening of all is the misleading information being provided to parents in what has been called the "Race to the Bottom," a race wherein some states lower their standards in order to obscure the poor absolute performance of the students for whose education they bear responsibility. As the Vital Signs reports issued by Change the Equation, a group dedicated to mobilizing industry to improve STEM Education, note, "The least demanding state set the bar for proficient performance near 112 on the 300-point scale of the National Assessment of Educational Process

(NAEP), far below the 141 that is NAEP's cutoff for Basic performance. The most demanding state set the standard near 181, well above 170, where NAEP set the bar for proficiency . . . In all, 15 of the 37 states we examined set the bar for proficiency below NAEP's threshold for Basic. Only four states set the bar near or above NAEP's cutoff for Proficient."^{xxix} Actions like these distort reality and lead the state's citizens to believe that everything is fine in their own state, a recipe for inaction, when action is desperately needed.

Finally, and ironically, America already spends more per student on K-12 education than all but two other countries in the world. The problem is not what we spend...it is how we spend it. Simply put, though performance within the system varies, public education in America is, on balance, far too removed from the demands imposed by a highly competitive, knowledge-based global economy.

Doing Something about It

The good news is that you and your child are not alone in the crusade to improve his or her life. Many other individuals and organizations are working to help give your child a decent chance in life. One of these, the National Academies, with the nearly 200 Nobel Laureates among their membership, provided a list of 20 specific actions that our federal government can take.^{xxx} Although seven years have passed since the list was issued, many of their recommendations to keep America competitive have still not been implemented. It is notable, however, that several *other* nations have acted on many of the conclusions found in the report.

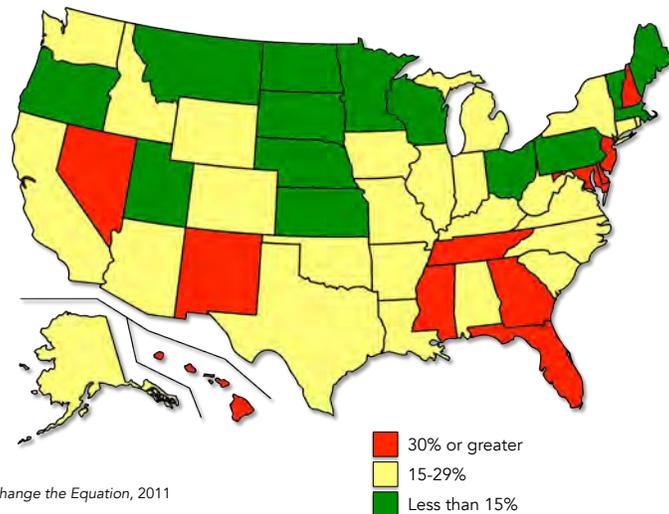
But education in America is primarily a state and local issue. This means that, by far, the most powerful group that can reverse the prevailing situation is America's citizens, especially parents. Our children do not have representation in Washington.

So what can *you* do? We ask that you consider taking at least two of the following actions:

1. Forty-six states have agreed to a Common-Core Curriculum in at least some subjects. Demand that your state's leaders fully adopt that curriculum or a more rigorous one and expand it into other academic disciplines.
2. Use PTA and Board of Education meetings to insist that strenuous testing standards accompanying the Common-Core Curriculum be adopted and that they are not watered down. Illusions of progress lead to parental complacency and political lethargy.
3. Support the introduction of competition into our public school system through financial and other rewards for extraordinary teachers and through new and more effective ways of recognizing and replicating the best among our public schools, including public charter schools.

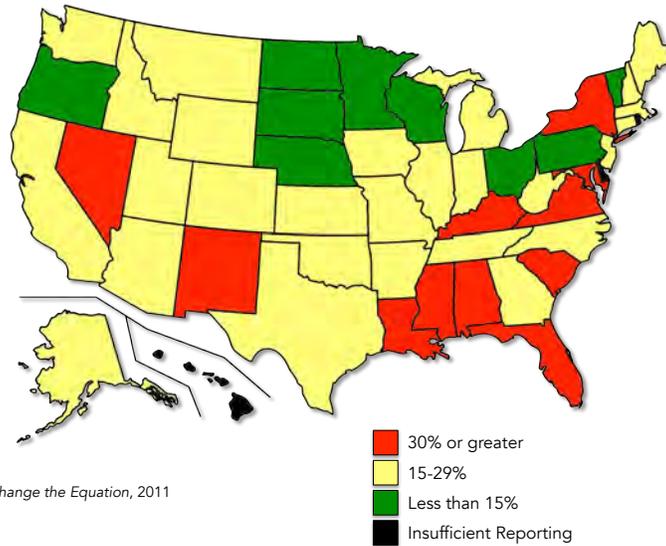
4. Insist that standards for new teachers are raised, that teachers meeting these standards are compensated as professionals, and that they are given the freedom to teach.
5. Write your Congressmen and Senators and tell them to implement the remainder of the National Academies' "Gathering Storm" recommendations.
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9. Cut your political leaders no more slack. Demand action. Demand higher standards. Defeat those who make only hollow promises and excuses. Accept only tangible, demonstrable progress, quantified by actual results measured against the baseline of the best systems in the world.
10. Most of all, demand that every system, every program local or state, and every educator put our children first, not the adults – the students.

TEACHERS WHO SAY LACK OF PARENTAL SUPPORT IS A SERIOUS PROBLEM IN MATHEMATICS EDUCATION



Source: *Change the Equation*, 2011

TEACHERS WHO SAY LACK OF PARENTAL SUPPORT IS A SERIOUS PROBLEM IN SCIENCE EDUCATION



Source: *Change the Equation*, 2011

A Final Word

America’s great middle class is rapidly disappearing. We are on a path to being a nation with a small, well-educated, prosperous group of citizens and a large, poorly educated, struggling group of citizens. This is not a formula for broadly shared prosperity.

It is not our international competitors that run the schools that educate our children. *We do*. The only issue at this point is how much we care . . . and what we are willing to do about it.

ⁱ Bureau of Labor Statistics, “College Enrollment and Work Activity of High School Graduates News Release,” April 19, 2012, <http://www.bls.gov/news.release/hsgsec.htm>.

ⁱⁱ Robert Balfranz, John M. Bidgeland, Mary Bruce and Joana Hornig Fox, *Building a Grad Nation: Progress and Challenge in Ending the High School Dropout Epidemic*, March 2012, pg. 5.

ⁱⁱⁱ Andrew Sum, Ishwar Khatiwada, and Joseph McLaughlin with Sheila Palma, “The Consequences of Dropping Out of High School: Joblessness and Jailings for High School Dropouts and the High Cost for Taxpayers,” October 2009, pg. 8, http://www.americaspromise.org/~media/Files/Resources/Consequences_of_Dropping_Out_of_High_School.ashx.

^{iv} Bureau of Labor Statistics data as cited in “STEM Education: Preparing for the Jobs of the Future,” Chairman’s staff of the Joint Economic Committee, April 2012, pg. 3.

^v Economics & Statistics Administration, “STEM: Good Jobs Now and For the Future,” July 14, 2011, <http://www.esa.doc.gov/Reports/stem-good-jobs-now-and-future>.

^{vi} Anthony P. Carnevale, Nicole Smith, James R. Stone, III, Pradeep Kotamraju, Bruce Steuernagel, Kimberly A. Green, “Career Clusters: Forecasting Demand for High School through College Jobs 2008-2018” Georgetown University Center on Education and the Workforce, 2011, pg. 72.

^{vii} Sawhill, Isabel and Morton, John E., “Economic Mobility: Is the American Dream Alive and Well?” 2007, pg. 3, http://www.brookings.edu/~media/research/files/papers/2007/5/useconomics%20morton/05useconomics_morton.pdf.

^{viii} Sawhill and Morton, pg. 5

^{ix} Martha J. Bailey and Susan M. Dynarski, “Inequality in Postsecondary Education,” *Wither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children*, September 2011, pp 117-132. Cited in Diane

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^x Carnevale et al, pg. 10.

^{xi} OECD, *Education at a Glance: OECD Indicators 2012*, "United States," 2012. pg. 1

^{xii} *Id.* at pg. 3

^{xiii} Carnevale et al, pg. 11.

^{xiv} Augustine, at pg. 45.

^{xv} *Id.*, at pg. 24.

^{xvi} Percentage derived from calculation based on data from Appendix 2-19 of National Science Board, *Science and Engineering Indicators 2012*, Arlington, VA, January 2012. <http://www.nsf.gov/statistics/seind12/c2/c2s2.htm>

^{xvii} National Academy of Sciences, *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*, 2011, National Academies Press, Washington, D.C. pg. 3.

^{xviii} *Id.*, at pg. 44.

^{xix} *Id.*, at pg. 43.

^{xx} National Science Board, *Science and Engineering Indicators 2012*, Arlington, VA, January 2012, <http://www.nsf.gov/statistics/seind12/c2/c2h.htm>.

^{xxi} Vivek Wadhwa, AnnaLee Saxenian, Richard Freeman, Alex Salkever, *Losing the World's Best and Brightest: America's New Immigrant Entrepreneurs, Part V, March 2009*, Ewing Marion Kauffman Foundation, pp 3-4, http://images.businessweek.com/extras/09/losing_the_worlds_best_brightest.pdf.

^{xxii} Scott Thrum, "U.S. Firms Add Jobs, but Mostly Overseas," Wall Street Journal, April 27, 2012, <http://online.wsj.com/article/SB10001424052702303990604577367881972648906.html>.

^{xxiii} National Center for Education Statistics, *Mathematics 2011: National Assessment of Educational Progress at Grades 4 and 8*, 2012. pg. 2.

^{xxiv} National Center for Education Statistics, *Science 2011: National Assessment of Educational Progress at Grade 8*, 2012, pg. 1.

* only 8th graders were tested in Science in the 2011 NAEP

^{xxv} National Center for Education Statistics, *Grade 12: Reading and Mathematics 2009 National Pilot State Results*, 2009, pg 1.

^{xxvi} National Center for Education Statistics, *Science 2009: National Assessment of Educational Progress at Grades 4, 8 and 12*, 2009, pg. 1.

<http://nces.ed.gov/nationsreportcard/pdf/main2009/2011455.pdf>

<http://nces.ed.gov/nationsreportcard/pdf/main2009/2011451.pdf>

^{xxvii} OECD, PISA 2009 Database "What Students Know and Can Do: Student Performance in Reading, Mathematics and Science," 2010, <http://www.oecd.org/pisa/46643496.pdf>.

^{xxviii} National Science Board, *Science and Engineering Indicators 2012*, "Appendix 1-19: Preparation of public middle and high school mathematics and science teachers for teaching in their field, by minority enrollment and school poverty level: Academic years 2003-04 and 2007-08," <http://www.nsf.gov/statistics/seind12/append/c1/at01-19.pdf>.

^{xxix} Change the Equation, "All Over the Map" September 2012, pg. 2

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^{xxx} National Academies, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, National Academies Press, 2005, pgs. 3-9.



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