Joint Economic Committee | Democrats
Senator Amy Klobuchar, Vice Chair

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STEM Education *for the* Innovation Economy

STEM EDUCATION FOR THE INNOVATION ECONOMY

Executive Summary

Innovation is a primary driver of American prosperity. A significant portion of economic growth in the United States has been attributed to improved productivity resulting in part from innovation. To ensure that innovation and productivity growth continue, more Americans than ever will need to be equipped with science, technology, engineering and math (STEM) skills.

Over the next decade, the economy will need nearly one million more STEM professionals than the United States will produce at the current rate. Due to the high demand for STEM-capable workers, wage and employment prospects for individuals with these skills are excellent. Even so, not enough Americans are studying STEM to meet the economy's needs. Fewer than one-in-five students obtain a bachelor's degree in STEM and the percentage of freshmen intending to study computer science dropped to 1.5 percent in 2010, down from 5.2 percent 10 years earlier.

Efforts to increase the number of STEM-capable workers must focus not only on higher education, but also on helping those who want to retrain and transition into STEM occupations. Certificate programs, for example, can help workers quickly acquire STEM skills they did not originally obtain in post-secondary programs. Increasing participation by veterans, women and minorities will also help provide additional STEM workers.

This report examines the growing number of STEM jobs in the United States and how to help American students take advantage of those opportunities. It also suggests policy changes that can be implemented to help the workforce become more STEM proficient. Policy suggestions include:

- Ensuring that schools and colleges have the resources to teach STEM skills;
- Assisting schools in attracting talented STEM graduates as teachers;
- Implementing partnerships between educational institutions and the business community;
- Encouraging women and minorities to enter STEM careers;
- Helping veterans transfer their STEM skills to the civilian workforce;
- Passing comprehensive immigration reform; and
- Encouraging and funding research and innovation.

JOINT ECONOMIC COMMITTEE
VICE CHAIR AMY KLOBUCHAR
UNITED STATES CONGRESS
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STEM EDUCATION FOR THE INNOVATION ECONOMY

The United States is a world leader in innovation and technology. According to a 2013 survey, 45 of the world's top 100 innovative companies are American.[1] A significant portion of economic growth in the United States has been attributed to improved productivity resulting in part from innovation.[2] To ensure that innovation and productivity growth continue, more Americans than ever will need to be equipped with science, technology, engineering and math (STEM) skills.[3] By driving innovation and boosting exports, a STEM-capable workforce spurs economic growth and supports high-quality jobs.[4]

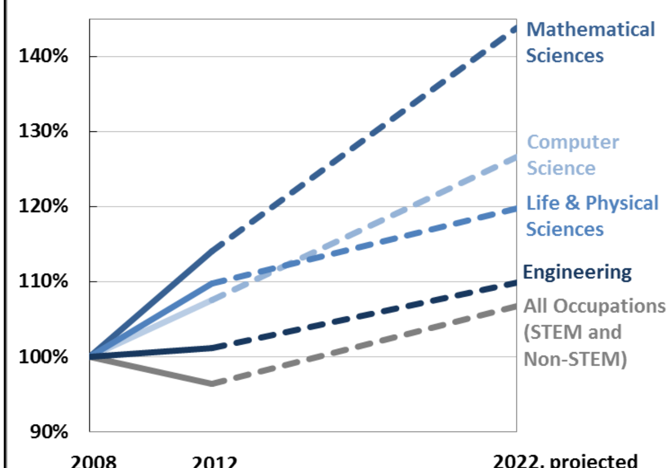
What is STEM?
The acronym STEM stands for science, technology, engineering and math. In general, STEM includes life sciences (except medical sciences), physical sciences, mathematics and statistics, computer science and engineering. The Department of Commerce also includes certain STEM-related managerial occupations in its definition of STEM, while the Organisation for Economic Co-operation and Development (OECD) includes manufacturing and processing, as well as architecture and building.

STEM skills are highly sought after by employers. STEM fields saw employment growth between 2008 and 2012, while as of 2012 non-STEM employment had not yet reached its pre-recession level.[5] In addition, STEM skills are in demand in a range of occupations not traditionally associated with STEM. The variety of opportunities for STEM-capable workers reflects the importance of these skills to employers and the overall economy.

Strong demand for STEM skills is expected to continue. Employment projections from the Bureau of Labor Statistics show a faster expansion in STEM occupations than non-STEM occupations from 2012 to 2022 (**Figure 1**). Computer science occupations, for example, are projected to provide an additional 651,000 jobs by 2022.[6]

This report examines the growth of STEM jobs in the United States and how to prepare American students to take advantage of those opportunities. It also suggests policy changes that would help the workforce become more STEM-proficient.

Figure 1. Sustained Growth is Projected for STEM Occupations
Employment as a percent of 2008 employment, by occupation



Source: JEC Democratic staff based on projections from the U.S. Department of Labor, Bureau of Labor Statistics (BLS). The BLS does not project employment for individual years from 2012 - 2022. For the purposes of this chart, Life Sciences excludes Medical Sciences.

The Future of STEM in the United States

The increase in demand for STEM skills means that there is likely to be a shortage of workers for STEM jobs. A 2013 report found almost two online job postings for every unemployed STEM worker.[7] The predicted shortage in STEM workers is amplified by the high concentration of baby boomers in STEM occupations and in jobs that require STEM skills. As those baby boomers begin to retire, more workers will be needed in STEM jobs to replace those who have left.[8]

These STEM opportunities will require more education and training than they did in previous decades. By 2018, 92 percent of STEM jobs will require some type of postsecondary education or training. That number will be even higher in several states, peaking at 96 percent in Hawaii.[9]

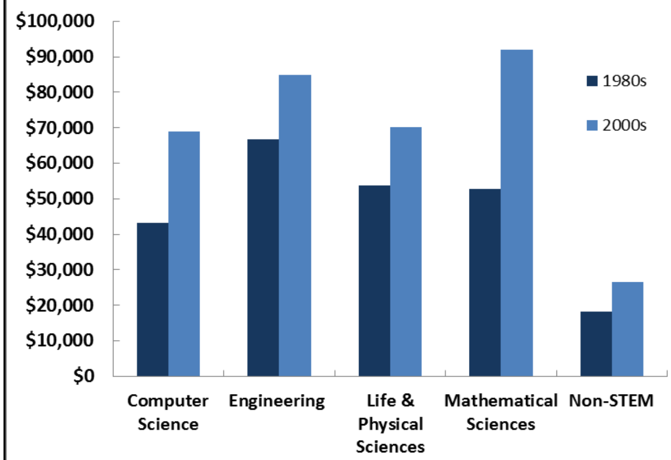
Although the federal government has directed significant resources toward STEM education (over $2.9 billion in fiscal year 2012)[10] and has supported investment in STEM education through legislation such as the America COMPETES Act, the United States is not on track to train enough STEM-capable workers to fill future job opportunities. Over the next decade, the economy will need approximately one million more STEM professionals than the United States will produce at the current rate.[11] At the bachelor's degree level, the United States would need to increase the number of students receiving STEM degrees by 34 percent annually over current rates to reach this goal.[12] Unfortunately, fewer than 40 percent of students who enter college intending to major in a STEM field actually complete a STEM degree.[13] Training students in STEM skills will give more workers access to the increasing number of job opportunities in STEM.

Wide Range of Opportunities for STEM-Capable Workers

Wages are higher and rising faster for most STEM workers than for most non-STEM workers (**Figure 2**).[14] However, those higher wages have not attracted enough people to keep up with the demand for workers with STEM skills.

Figure 2. Wages for STEM-Capable Workers Have Risen Faster Than for Non-STEM-Capable Workers

Average income over decade by occupational group, 1980s & 2000s



Note: All amounts are in 2012 dollars, adjusted for inflation using the CPI-U-RS.
Source: JEC Democratic staff calculations based on data from the U.S. Department of Commerce, Census Bureau, Current Population Survey. Original analysis from Anthony Carnevalle , Nicole Smith and Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011.

Due to the high demand for STEM-capable workers, STEM employers must compete with non-STEM employers, since both often value similar skills. For instance, a worker with a master's or doctorate degree can often get higher wages working as a health or managerial professional than in a STEM occupation.[15] Both of these career paths require proficiency in STEM skills, reflecting the high demand for STEM-capable workers across a spectrum of industries, particularly at high-education levels (**Figure 3**).[16]

Trends in Postsecondary STEM Degrees

Americans are currently not obtaining postsecondary degrees in STEM at a rate commensurate with the rising number of opportunities in STEM fields. Despite the increasing demand for STEM-capable graduates, the percentage of Americans receiving bachelor's or master's degrees in STEM fields has decreased since the late 1980s. The share of bachelor's degrees awarded in STEM fields peaked at 24 percent in 1985; by 2012, the share had fallen to 19 percent. The share of master's degrees in STEM fields dropped from 18 percent to 15 percent over the same period (**Figure 4**).[17]

In addition, while the percentage of doctoral students in STEM fields has remained constant, the percentage of American students compared to foreign students has declined over time.[18] Foreign students may be more likely to take their skills back to their native countries, especially given difficulties in obtaining visas to remain in the United States following graduation.

Why Aren't Students Obtaining STEM Degrees?

Students shy away from STEM majors for many reasons. One is a lack of math proficiency when entering college. Only 46 percent of students who take the ACT entrance examination for college achieve the ACT College Readiness Benchmark in math.[19] Higher education spends at least $2 billion per year to compensate for weaknesses in students' secondary education.[20] A recent study found that one reason for high diversion out of STEM majors in college was that students did not succeed as well in these majors as they expected and then switched to a major for which they felt better equipped.[21] Finally, many students who transfer out of STEM majors may be performing well, but they find the introductory STEM classes uninteresting.[22]

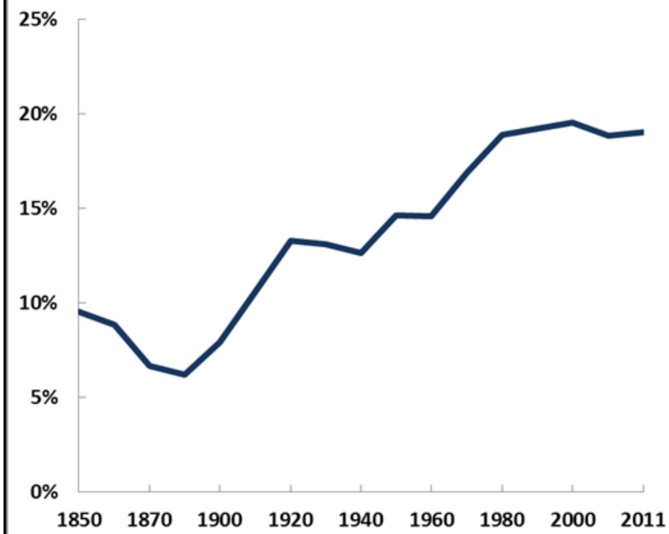
Although in 2010 a higher percentage of students intended to pursue science and engineering majors than in 1995, some STEM subjects have seen a decrease in students. For instance, the percentage of freshmen intending to study computer science dropped to 1.5 percent in 2010 from 5.2 percent in 2000.[23]

Once a student has embarked on a non-STEM major it can be difficult to switch to a STEM major. STEM majors often require more classes than non-STEM majors and have additional prerequisites. As a result, juniors deciding they want to major in engineering, for example, may have more difficulty completing the requirements on time than juniors deciding they want to major in English. Only five percent of those who start in a non-STEM major graduate with a STEM degree.[24]

It is often hard for those who graduate with a non-STEM degree to obtain the credentials necessary to work in a STEM field. STEM educational and career paths offer many opportunities to leave a STEM field, but fewer opportunities to enter or re-enter those fields. Only six percent of those who work in a STEM career did not graduate with a STEM major.[25] While some schools have implemented programs that allow non-engineers to obtain graduate degrees in engineering, such as Boston University's Late Entry Accelerated Program, these opportunities are rare.

Figure 3. STEM-Skill Jobs Are on the Rise

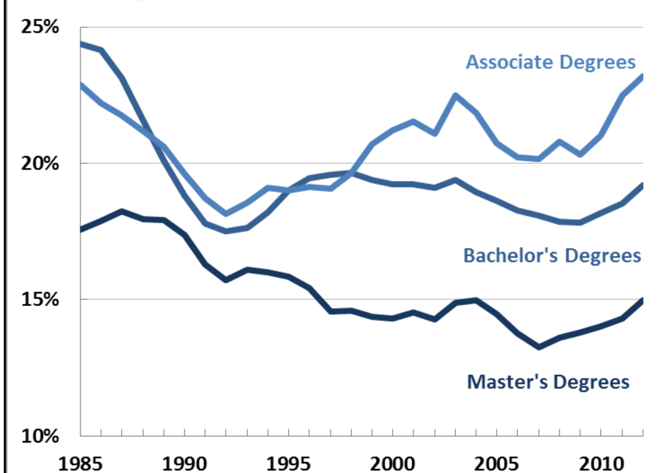
Percent of U.S. jobs requiring a high level of STEM skills, 1850 - 2011



Source: JEC Democratic staff calculations based on data from Jonathan Rothwell, *The Hidden STEM Economy*. Metropolitan Policy Program, The Brookings Institution. 2013.

Figure 4. A Smaller Percentage of Degrees Are in STEM Fields

STEM degrees as a percent of all degrees granted, 1985 - 2012



Note: STEM-degree majors include: Engineering, Physical Sciences, Geosciences, Math and Computer Sciences (excludes the categories "Medical Science" and "Other Life Science" as defined by the National Center for Education Statistics).
Source: JEC Democratic staff based on data from the Department of Education's National Center for Education Statistics: Integrated Postsecondary Education Data.

Associate Degrees and Certificates

STEM career paths can provide excellent opportunities for workers without a four-year college degree. Sixty-six percent of STEM workers with an associate degree earn more than the average worker at that education level, while 75 percent of STEM workers with only a high school degree earn more than the average worker at that education level.[26] Although 35 percent of all STEM jobs in 2018 will be open to individuals with less than a bachelor's degree, over 70 percent of those jobs will require some kind of postsecondary education.[27]

Associate degrees and certificates also allow the STEM workforce to respond more quickly to changing employer needs. In order to better adjust to changes in the labor market, those who initially obtained their education at a time when demand for STEM degrees was lower may need assistance in gaining new degrees and certificates that qualify them for STEM work today and in the future.

Brief training programs are the most accessible since those certifications can be obtained more quickly than other postsecondary degrees, allowing the workforce to obtain needed skills as the market changes. For instance, in response to the high demand for computer science-capable workers, many individuals have started attending programs that provide computer science training in a very short period of time. Such programs can be extremely successful: one saw 88 percent of its graduates receive job offers at an average annual salary of $79,000 after only 10 weeks of training.[28]

K-12 Education

Without a solid grounding in math and science, students often have difficulty obtaining degrees and certifications in STEM fields. Unfortunately at the K-12 level, American students are not competitive with many other countries' students in STEM fields. At age 15, American students are ranked 26th out of the 34 Organisation for Economic Co-operation and Development (OECD) countries in math.[29] In science, American 15-year-olds are ranked 21st.[30] While some states perform well compared to other industrialized countries (Massachusetts, Minnesota and North Carolina are particular stand-outs),[31] the country as a whole is falling behind on K-12 STEM education. One survey found that 84 percent of manufacturers believe that the public education system insufficiently prepares students with the skills necessary to succeed in the workplace. Over half specified a deficiency in math and science skills.[32]

One challenge is an inability to attract and retain strong STEM educators, partially because those with STEM skills often have many high-wage job opportunities. The average salary for a public school teacher is around $56,000,[33] whereas the average salary for an engineer is almost $100,000.[34] Currently, about 25,000 math and science teachers leave the profession annually, two-thirds of whom are leaving not due to retirement but because of job dissatisfaction.[35] This leaves behind a less well-trained STEM-teacher workforce. In 2007-2008, 28 percent of math teachers had not majored in math, whereas only 17 percent of all teachers had not majored in the subject they taught.[36]

In addition, career and technical education programs have not been widely implemented in high schools, despite their ability to reduce dropout rates and increase college attendance.[37] Programs like the Early College High School Initiative and the City Polytechnic High School of Engineering, Architecture, and Technology (which help students to graduate with both a high school diploma and an associate degree) prepare students for college work and provide them with a certification that is valued by employers.[38]

Women and Minorities in STEM

While women represent a growing share of college graduates, their share of the STEM workforce has not increased.[39] In 2012, women earned 57 percent of all bachelor's degrees awarded, up from 54 percent in 1993.[40] However, at the same time, the share of bachelor's degrees awarded to women in mathematics and statistics declined by four percentage points and in computer science by 10 percentage points.[41] Increasing women's participation in STEM would help provide the approximately one million new STEM workers that will be needed by 2022.[42]

Likewise, Hispanic and African-American workers are underrepresented in the STEM workforce. In 2011, both of these groups accounted for only six percent of STEM workers but 14 and 11 percent of overall employment, respectively.[43] In part, these lower numbers can be attributed to the lower college graduation rates among these groups and the education credentials required for many STEM jobs. However, among college graduates, Hispanics and African-Americans are less likely to major in STEM fields, and among STEM majors, individuals in these groups are less likely to end up in STEM jobs.[44] These differences persist despite the fact that racial and ethnic wage gaps are smaller in STEM jobs than in other occupations.[45]

Policy Solutions to Improve STEM Education and Training

Success in STEM education at all levels depends on providing adequate funding to help workers obtain the degrees, certifications and skills they need. Federal support for higher education, including Pell Grants, can ensure that the workforce has the skills to succeed in the 21st century economy.

In particular, policymakers should promote and fund flexible programs such as certificates or associate degrees that can be obtained easily and quickly. Ensuring that community colleges have the funding needed to educate the workforce is vital in preparing for the increased demand for STEM-capable workers.

Specific actions that would increase the size and capabilities of the STEM workforce include:

Ensuring that schools and colleges have the resources to teach STEM skills: Schools need support in attracting students to STEM fields and in developing their STEM skills. The Innovate America Act (S. 1777) would improve STEM education by doubling the number of STEM-focused high schools, promoting computer science training and expanding research opportunities for undergraduates in STEM majors.

Assisting schools in attracting talented STEM graduates as teachers: Congress is considering numerous bills that would help attract and retain skilled STEM teachers. The Strengthen our Schools and Students Act (S. 3) and STEM Master Teacher Corps Act (S. 358) would establish a STEM Master Teacher Corps, which would provide rewards and incentives to top teachers. The National STEM Education Tax Incentive for Teachers Act (HR. 118) would allow certain full-time elementary and secondary school teachers of math, science, engineering or technology courses a refundable tax credit for 10 percent of their undergraduate tuition, up to $1,000 in any taxable year ($1,500 for teachers in schools serving disadvantaged children).

Implementing partnerships between educational institutions and the business community: Public-private partnerships can help ensure that graduates obtain the skills needed for the STEM workforce. For example, New York State has embarked on a public-private partnership with IBM to provide students with the opportunity to earn associate degrees that the business community values while still in high school.[46] The Cisco Networking Academy partners with educational institutions, governments and others to train students in skills that Cisco and other technology companies value.[47]

Encouraging women and minorities to enter STEM careers: Women and minorities face barriers to entry into STEM occupations, such as a lack of peer mentorship and exposure to STEM opportunities. The Women and Minorities in STEM Booster Act (S. 288) would require the National Science Foundation to award competitive grants to programs aimed at increasing the participation of women and underrepresented minorities in STEM fields.

Helping veterans transfer their STEM skills to the civilian workforce: Providing veterans with the resources they need to transition to the civilian workforce improves their employment prospects and gives employers access to a greater number of

STEM-capable professionals. This allows employers to tap into an underutilized pool of talent. S. 514 (a veterans' STEM education program bill) would authorize the Secretary of Veterans Affairs to provide additional tuition benefits to those pursuing an education program with a STEM focus.

Passing comprehensive immigration reform: Increasing the number of non-immigrant visas would help provide employers with the STEM-capable workers they need. The Border Security, Economic Opportunity, and Immigration Modernization Act (S. 744) would increase the annual cap on H-1B visas to between 115,000 and 180,000, depending upon market conditions and existing demand.

Encouraging and funding research and innovation: Funding research and development projects provides STEM workers with the resources they need to be productive and innovate. Likewise, providing incentives for businesses to invest in innovation and research helps our economy grow. Policymakers should preserve funding for research and development and provide a full reauthorization of the America COMPETES Act.

Sources:

[1] Thomson Reuters, *2013 Top 100 Global Innovators*. October 2013. www.top100innovators.com/home.

[2] Jones, Charles, "Sources of U.S. Economic Growth in a World of Ideas," *The American Economic Review*, Volume 92(1), March 2002. stanford.edu/~chadj/SourcesAER2002.pdf; Bordoff, Jason E., Michael Deich, Rebecca Kahane and Peter R. Orszag, "Promoting Opportunity and Growth Through Science, Technology, and Innovation," The Hamilton Project at the Brookings Institution, December 2006. http://www.hamiltonproject.org/files/downloads_and_links/Promoting_Opportunity_and_Growth_through_Science_Technology_and_Innovation.pdf.

[3] See STEM as defined by the U.S. Department of Commerce's Economics and Statistics Administration report, *STEM: Good Jobs Now and for the Future*. ESA Issue Brief #03-11. July 2011. esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf. as cited in Joint Economic Committee (Chairman Bob Casey's staff), *STEM Education: Preparing for the Jobs of the Future*, April 2012.

[4] Freeman, Richard B., "Does Globalization of the Scientific/Engineering Workforce Threaten U.S. Economic Leadership?" National Bureau of Economic Research. August 2006. nber.org/chapters/c0207.pdf.

[5] JEC Democratic staff calculations based on data from the Bureau of Labor Statistics, "Employment Projections: 2012-22." Table 1.7 Occupational Employment and Job Openings Data, Projected 2012-22, December 2013. http://www.bls.gov/emp/ep_data_occupational_data.htm; and Lacey, Alan and Benjamin Wright, "Employment Outlook: 2008 – 2018," December 2010.

[6] *Ibid.* For the purposes of this calculation, STEM occupations are defined as in the U.S. Department of Commerce's Economics and Statistics Administration report, *STEM: Good Jobs Now and for the Future*. ESA Issue Brief #03-11. July 2011. esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf.

[7] Change the Equation, "STEM Help Wanted: Demand for Science, Technology, Engineering and Mathematics Weathers the Storm." 2013. http://changetheequation.org/sites/default/files/CTEq_VitalSigns_Supply%20%282%29.pdf.

[8] Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf.

[9] Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics State-Level Analysis.* Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-states-complete-update2.pdf.

[10] McNaull, Aline D., "FYI: The AIP Bulletin of Science Policy News – FY 2014 STEM Education Budget." American Institute of Physics. April 2013. http://www.aip.org/fyi/2013/069.html.

[11] President's Council of Advisors on Science and Technology, "Report to the President: Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics." Executive Office of the President. February 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf.

[12] *Ibid.*

[13] *Ibid.*

[14] Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf.

[15] *Ibid.*

[16] Rothwell, Jonathan, *The Hidden STEM Economy*. The Brookings Institution: Metropolitan Policy Program. June 2013. http://www.brookings.edu/~/media/research/files/reports/2013/06/10%20stem%20economy%20rothwell/thehiddenstemeconomy610.pdf; Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf.

[17] JEC Democratic staff calculations based on data from the U.S. Department of Education, National Center for Education Statistics: Integrated Postsecondary Education Data System. Available through the National Science Foundation's WebCASPAR data system. webcaspar.nsf.gov/.

[18] Joint Economic Committee (Chairman Bob Casey's staff), *STEM Education: Preparing for the Jobs of the Future*. April 2012.

[19] ACT, Inc., "ACT Profile Report – National – Graduating Class 2012." http://www.act.org/newsroom/data/2012/pdf/profile/National2012.pdf.

[20] President's Council of Advisors on Science and Technology, "Report to the President: Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics." Executive Office of the President. February 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf.

[21] Stinebrickner, Ralph and Todd Stinebrickner, "A Major in Science? Initial Beliefs and Final Outcomes for College Major and Dropout." University of Western Ontario: Social Sciences Centre. July 2013. http://economics.uwo.ca/people/stinebrickner_docs/amajorinscience_july13.pdf.

[22] Seymour, Elaine and Nancy M. Hewitt, *Talking About Leaving: Why Undergraduates Leave the Sciences*. 1997. Boulder, CO: Westview Press. Brainard, Suzanne and Linda Carlin, "A Six Year Longitudinal Study of Undergraduate Women in Engineering and Science." *Journal of Engineering Education*, Volume 87(4), p. 369-375, October 1998.

[23] National Science Foundation, National Center for Science and Engineering Statistics, S&E Indicators 2012: Chapter 2. Higher Education in Science and Engineering. http://www.nsf.gov/statistics/seind12/c2/c2s2.htm.

[24] Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf.

[25] *Ibid.*

[26] *Ibid.*

[27] *Ibid.*

[28]Empson, Rip, "Startups Court Dev Bootcamp's Ruby Grads: 88% Have Offers At Average of $79K." TechCrunch. May 2012. http://techcrunch.com/2012/05/10/dev-boot-camp-is-a-ruby-success/

[29] Organisation for Economic Co-operation and Development, "Programme for International Student Assessment (PISA) Results from Pisa 2012: United States." http://www.oecd.org/pisa/keyfindings/PISA-2012-results-US.pdf.

[30] *Ibid.*

[31] U.S. Department of Education, National Center for Education Statistics, Trends in International Mathematics and Science Study. Table 3: Average mathematics scores of 8th-grade students, by education system: 2011. http://nces.ed.gov/timss/table11_3.asp.

[32] Deloitte Consulting LLP and The Manufacturing Institute, "2005 Skills Gap Report – A Survey of the American Manufacturing Workforce." 2005. doleta.gov/wired/files/us_mfg_talent_management.pdf.

[33] U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 2011*: *Introduction*. 2012. http://nces.ed.gov/programs/digest/d11/index.asp.

[34] Sethi, Chitra, *Engineering Salary Survey: Your Value in Today's Economy*. American Society of Mechanical Engineers. August 2011. https://www.asme.org/career-education/articles/early-career-engineers/engineering-salary-survey-your-value.

[35] Ingersoll, Richard and David Perda, "Is the Supply of Mathematics and Science Teachers Sufficient?" *American Educational Research Journal*, Volume 47(3), p. 563-594, May 2010. http://aer.sagepub.com/content/early/2010/05/13/0002831210370711.

[36] Congressional Research Service, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*. April 2013. http://crs.gov/pages/Reports.aspx?PRODCODE=R42642&Source=search#Content.

[37] Plank, Stephen, Stefanie DeLuca, and Angela Estacion, "Dropping Out of High School and the Place of Career and Technical Education: A Survival Analysis of Surviving High School." National Research Center for Career and Technical Education. 2005; Plank, Stephen, "Career and Technical Education in the Balance: An Analysis of High School Persistence, Academic Achievement, and Postsecondary Destinations." National Dissemination Center for Career and Technical Education. 2001.

[38] Monahan, Rachel, "High schools go high-tech, offer associate degrees to make sure students are job- and college-ready." *NY Daily News*. December 2012. http://www.nydailynews.com/new-york/education/high-schools-offering-associate-degrees-ensure-students-job-college-ready-article-1.1213538. The Early College High School Initiative, "Overview and Facts." http://www.earlycolleges.org/overview.html.

[39] From 2000 to 2009, women as a share of all college-educated workers increased from 46 to 49 percent. *See* U.S. Department of Commerce, Economics and Statistics Administration, *Women in STEM: A Gender Gap to Innovation*. ESA Issue Brief #04-11. August 2011. esa.doc.gov/sites/default/files/reports/documents/womeninstemagaptoinnovation8311.pdf.

[40] JEC Democratic staff calculations based on data from the U.S. Department of Education, National Center for Education Statistics: Integrated Postsecondary Education Data System. Available through the National Science Foundation's WebCASPAR data system. webcaspar.nsf.gov/.

[41] *Ibid.*

[42] JEC Democratic staff calculations based on data from the Bureau of Labor Statistics, "Employment Projections: 2012-22." Table 1.7 Occupational Employment and Job Openings Data, Projected 2012-22, December 2013. http://www.bls.gov/emp/ep_data_occupational_data.htm; and Lacey, T. Alan and Benjamin Wright, "Employment Outlook: 2008 – 2018," December 2010. For the purposes of this calculation, STEM occupations are defined as in the U.S. Department of Commerce's Economics and Statistics Administration report, *STEM: Good Jobs Now and for the Future*. ESA Issue Brief #03-11. July 2011. esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf.

[43] U.S. Department of Commerce, Economics and Statistics Administration, *Education Supports Racial and Ethnic Equality in STEM*. ESA Issue Brief #05-11. September 2011. esa.doc.gov/sites/default/files/reports/documents/educationsupportsracialandethnicequalityinstem_0.pdf. The Department of Commerce uses the term African-American or black to refer to non-Hispanic blacks.

[44] *Ibid.*

[45] Carnevale, Anthony P., Nicole Smith, Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*. Georgetown Center on Education and the Workforce. 2011. http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/stem-complete.pdf.

[46] Governor Andrew M. Cuomo, "Governor Cuomo and IBM Announce Public-Private Partnership to Prepare NYS Students for High-Skills Jobs of the Future." 2013. http://www.governor.ny.gov/press/02262013-partnership-to-prepare-nys-students-for-high-skills-jobs.

[47] Cisco, "Program Overview: About Networking Academy." http://www.cisco.com/web/learning/netacad/academy/index.html.