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May 2014

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS EDUCATION

Assessing the Relationship between Education and the Workforce

GAO-14-374

GAO Highlights

Highlights of GAO-14-374, a report to congressional requesters

May 2014

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS EDUCATION

Assessing the Relationship between Education and the Workforce

Why GAO Did This Study

Federal STEM education programs help enhance the nation's global competitiveness by preparing students for STEM careers. Researchers disagree about whether there are enough STEM workers to meet employer demand. GAO was asked to study the extent to which STEM education programs are aligned with workforce needs.

GAO examined (1) recent trends in the number of degrees and jobs in STEM fields, (2) the extent to which federal postsecondary STEM education programs take workforce needs into consideration, and (3) the extent to which federal K-12 STEM education programs prepare students for postsecondary STEM education. GAO analyzed trends in STEM degrees and jobs since 2002 using 3 data sets—the Integrated Postsecondary Education Data System, American Community Survey, and Occupational Employment Statistics—and surveyed 158 federal STEM education programs. There were 154 survey respondents (97 percent): 124 postsecondary and 30 K-12 programs. In addition, GAO conducted in-depth reviews—including interviews with federal officials and grantees—of 13 programs chosen from among those with the highest reported obligations.

What GAO Recommends

GAO makes no recommendations in this report. GAO received technical comments from the Departments of Education, Energy, and Health and Human Services; National Science Foundation; and Office of Management and Budget.

View GAO-14-374. For more information, contact Melissa Emrey-Arras at (617) 788-0534 or EmreyArrasM@gao.gov.

What GAO Found

Both the number of science, technology, engineering, and mathematics (STEM) degrees awarded and the number of jobs in STEM fields increased in recent years. The number of degrees awarded in STEM fields grew 55 percent from 1.35 million in the 2002-2003 academic year to over 2 million in the 2011-2012 academic year, while degrees awarded in non-STEM fields increased 37 percent. Since 2004, the number of STEM jobs increased 16 percent from 14.2 million to 16.5 million jobs in 2012, and non-STEM jobs remained fairly steady. The trends in STEM degrees and jobs varied across STEM fields. It is difficult to know if the numbers of STEM graduates are aligned with workforce needs, in part because demand for STEM workers fluctuates. For example, the number of jobs in core STEM fields, including engineering and information technology, declined during the recession but has grown substantially since then.

Science, Technology, Engineering, and Mathematics (STEM) Fields

Core STEM
- Engineering
- Life sciences *e.g., Agricultural, environmental, and biological sciences*
- Physical sciences *e.g. chemistry, physics, and earth sciences*
- Computer and information technology
- Math and statistics

Healthcare STEM
- Health practitioners
- Health technologists and technicians

Other STEM
- Architecture and related *including urban planning and landscape architecture*
- Social sciences *e.g., economics, political science, and sociology*
- Psychology
- Multidisciplinary fields
- STEM teaching *e.g., elementary and secondary education*

Source: GAO categories based on Options for Defining STEM Occupations Under the 2010 Standard Occupational Classification (SOC) System: SOC Policy Committee Recommendation to the Office of Management and Budget (August 2012).

Almost all of the 124 federal postsecondary STEM education programs that responded to GAO's survey reported that they considered workforce needs in some way. For example, the most common program objective was to prepare students for STEM careers. Some of these programs focused on occupations they considered to be in demand and/or related to their agency's mission. Many postsecondary programs also aimed to increase the diversity of the STEM workforce or prepare students for innovation. Most STEM programs reported having some outcome measures in place, but GAO found that some programs did not measure an outcome directly related to their stated objectives. As GAO recommended in 2012, the National Science and Technology Council recently issued guidance to help agencies better incorporate STEM education outcomes into their performance plans and reports. As agencies follow the guidance and focus on the effectiveness of the programs, more programs may measure outcomes directly related to their objectives.

Of the 30 kindergarten through 12th grade (K-12) STEM education programs responding to GAO's survey, almost all reported that they either directly or indirectly prepared students for postsecondary STEM education. For example, one program worked closely with students to provide math and science instruction and supportive services to prepare them for postsecondary STEM education, while another supported research projects intended to enhance STEM learning.

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Abbreviations

ACS	American Community Survey
CIP	Classification of Instructional Program
IPEDS	Integrated Postsecondary Education Data System
IT	Information technology
K-12	Kindergarten-12th grade
OES	Occupational Employment Statistics
SOC	Standard Occupational Classification
STEM	Science, technology, engineering, and mathematics

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May 8, 2014

The Honorable John Kline
Chairman
Committee on Education and the Workforce
House of Representatives

The Honorable Richard Hanna
House of Representatives

The Honorable Joseph Heck
House of Representatives

The Honorable Duncan D. Hunter
House of Representatives

Science, technology, engineering, and mathematics (STEM) education programs can serve an important role both by helping to prepare students and teachers for careers in STEM fields and by enhancing the nation's global competitiveness. As part of this effort, many federal agencies administer STEM education programs. In addition to the federal effort, state and local governments, universities and colleges, and the private sector have also developed programs that provide opportunities for students to pursue STEM education and occupations.

The current administration maintains that a strong educational pipeline creating future STEM workers is important to ensure that the United States remains competitive with other highly technological nations. Researchers disagree about the sufficiency of the current supply of STEM workers. While some researchers have concluded that the United States has a sufficient supply of STEM workers,[1] others have found that the educational system is not producing enough STEM graduates to fill the jobs available in STEM occupations[2] or in the increasing number of jobs

[1] See, for example, Hal Salzman, Daniel Kuehn, and B. Lindsay Lowell, *Guestworkers In The High-Skill U.S. Labor Market: An Analysis Of Supply, Employment, and Wage Trends*, Economic Policy Institute Briefing Paper #359 (Washington, D.C.: April 24, 2013).

[2] See, for example, Microsoft, *A National Talent Strategy: Ideas for Securing U.S. Competitiveness and Economic Growth*. (September 2012).

in other fields that may require STEM competencies (such as analytical skills).[3] In light of this disagreement, we were asked to review the alignment between STEM and workforce needs. Specifically, we reviewed (1) recent trends in the number of degrees and jobs in STEM fields, (2) the extent to which federal postsecondary STEM education programs take workforce needs into consideration, and (3) the extent to which federal kindergarten-12th grade (K-12) STEM education programs prepare students for postsecondary STEM education.

To address our first objective, we analyzed three federal data sources to examine trends in STEM degrees and jobs over the past decade: (1) the Department of Education's Integrated Postsecondary Education Data System to examine trends in STEM degrees, (2) the Bureau of Labor Statistics' Occupational Employment Statistics data to examine employment and wage trends among STEM workers, and (3) the Census Bureau's American Community Survey data to examine unemployment rates of STEM workers and the relationships between educational background and occupation among STEM workers. We determined that these data were sufficiently reliable for the purposes of our report by reviewing relevant documentation and conducting electronic testing of the data. We also conducted a regression analysis with the American Community Survey data to examine differences in wages and unemployment rates between STEM and non-STEM workers, controlling for some demographic details.

To address our other objectives, we reviewed relevant federal laws and regulations and conducted and analyzed the results of a survey. We surveyed 158 K-12 and postsecondary STEM education programs about how they address STEM workforce needs and prepare students for future STEM education or careers. A total of 154 federal STEM education programs responded to our survey, representing a 97 percent response rate.[4] Among the respondents, we identified 124 programs—reporting

[3]See, for example, Anthony P. Carnevale, Nicole Smith, and Michelle Melton, *STEM: Science, Technology, Engineering, Mathematics*, Georgetown University Center on Education and the Workforce (October 20, 2011).

[4] See appendix I for more information about the four programs that did not respond to our survey. The survey also updated some of the descriptive data from our 2012 STEM report: GAO, *Science, Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Overlapping Programs across Multiple Agencies,* GAO-12-108 (Washington, D.C.: Jan. 20, 2012).

$1.9 billion in fiscal year 2012 obligations—that primarily served students and teachers at the postsecondary level, and 30 programs—reporting $685 million in fiscal year 2012 obligations—that primarily served students and teachers at the K-12 level.[5] To provide more details about some of the highest funded STEM education programs, we conducted a more in-depth review of 13 programs from three agencies: the National Science Foundation, the Department of Education, and the National Institutes of Health at the Department of Health and Human Services. We chose these programs because they were among the largest federal STEM education programs, collectively accounting for 54 percent of the fiscal year 2012 STEM education obligations reported by the 154 programs that responded to our survey. Seven of the selected programs served postsecondary students or institutions and six programs served K-12 students or teachers. We reviewed documentation from each program, interviewed agency officials, and conducted site visits with program grantees in Austin, Texas, and San Francisco, California, and phone interviews with grantees in Boston, Massachusetts.

We conducted this performance audit from January 2013 to April 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

STEM Education Definitions

The term "STEM education" refers to teaching and learning in the fields of science, technology, engineering, and mathematics. It includes educational activities across all grade levels—from pre-school to post-

[5] Amounts obligated for each program for fiscal year 2012 were reported to us by agency officials and we did not independently verify this information. An obligation is a definite commitment that creates a legal liability of the government for the payment of goods and services ordered or received, or a legal duty on the part of the United States that could mature into a legal liability. Payment on these obligations may be made immediately or in the future. An agency incurs an obligation, for example, when it places an order, signs a contract, awards a grant, or purchases a service. See GAO, *A Glossary of Terms Used in the Federal Budget Process,* GAO-05-734SP (Washington, D.C.: Sept. 2005).

doctorate—in both formal (e.g., classrooms) and informal (e.g., afterschool programs) settings.[6]

- In 2012, we reviewed the delivery and effectiveness of federal STEM education programs. As in our 2012 report, for this report we define a federally-funded STEM education program as a program funded in a designated fiscal year[7] by allocation or congressional appropriation that includes one or more of the following as a primary objective:[8]
- attract or prepare students to pursue classes or coursework in STEM areas through formal or informal education activities,
- attract students to pursue degrees (2-year, 4-year, graduate, or doctoral) in STEM fields through formal or informal education activities,
- provide training opportunities for undergraduate or graduate students in STEM fields (this can include grants, fellowships, internships, and traineeships that are targeted to students; we do not consider general research grants to researchers that may hire a student to work in the lab to be a STEM education program),
- attract graduates to pursue careers in STEM fields,
- improve teacher education in STEM areas for teachers and those studying to be teachers,
- improve or expand the capacity of K-12 schools or postsecondary institutions to promote or foster education in STEM fields, or
- conduct research to enhance the quality of STEM education programs provided to students.

There is no commonly used definition of fields that are considered STEM. For this report, we use a comprehensive definition of STEM that includes

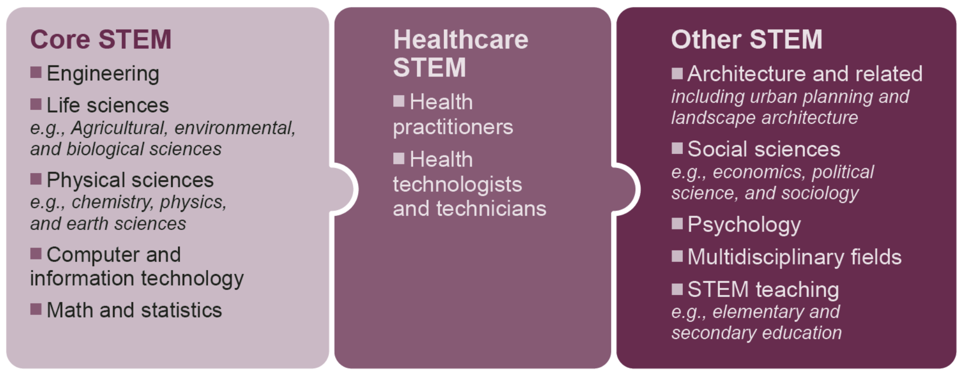
[6] Informal education programs support activities provided by a variety of organizations that offer students learning opportunities outside of formal schooling through contests, science fairs, summer programs, and other means. Outreach programs targeted to the general public (either adults or children) are not included.

[7] GAO-12-108. In our 2012 report, we considered federal STEM education programs funded in fiscal year 2010. In the current report, we consider those funded in fiscal year 2012.

[8] The current administration defines a STEM education investment (it does not use the word "program") as a federally funded STEM education activity that has a dedicated budget of $300,000 or above and staff to manage the budget. Our definition does not have a stated budget minimum. See Committee on STEM Education, National Science and Technology Council, *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* (Washington, D.C.: May 2013).

three STEM categories: Core STEM, Healthcare STEM, and Other STEM (see fig. 1).[9] We present our findings for the three categories combined and for each of three STEM categories. See our description of the relevant data sets in appendix I for an explanation of how we classified fields of study and occupations into these STEM categories in our data analysis.

Figure 1: Science, Technology, Engineering, and Mathematics (STEM) Fields



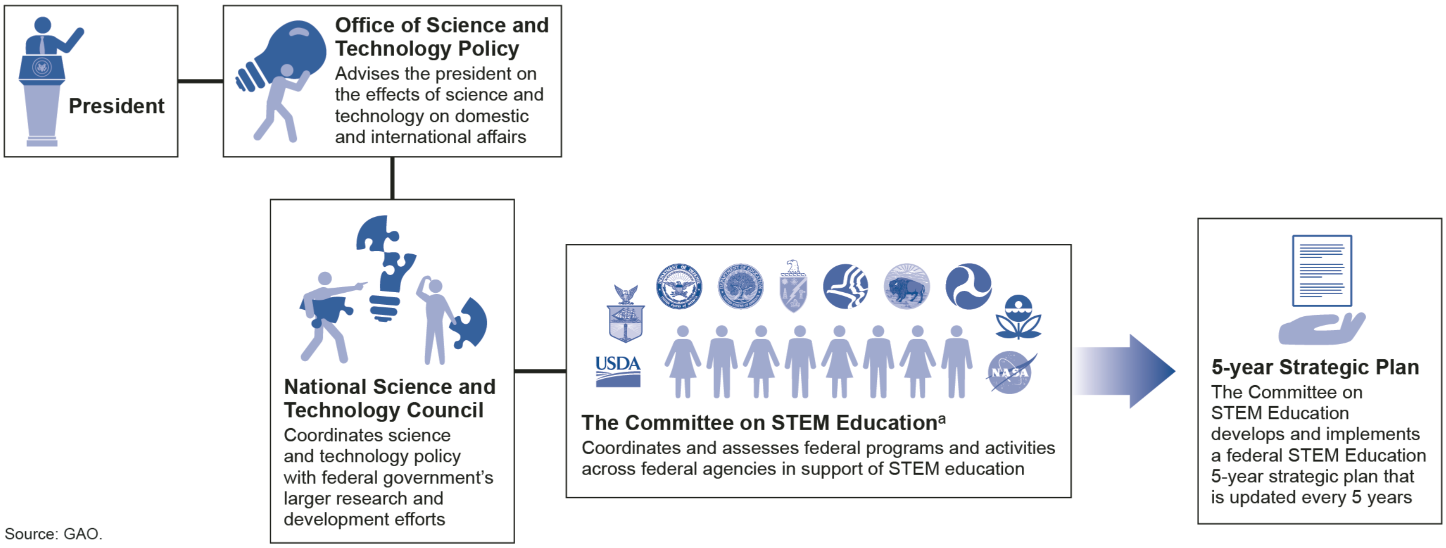
Source: GAO categories based on Options for Defining STEM Occupations Under the 2010 Standard Occupational Classification (SOC) System: SOC Policy Committee Recommendation to the Office of Management and Budget (August 2012).

Federal STEM Education Programs and Policy

The Committee on STEM Education is the interagency coordination body for STEM education in the federal government (see fig. 2).

[9] We based our categories on a categorization of STEM put forth by the Standard Occupational Classification Policy Committee presented in *Options for Defining STEM (Science, Technology, Engineering, and Mathematics) Occupations Under the Standard 2010 Occupation Classification System*, Standard Occupational Classification Policy Committee Recommendation to the Office of Management and Budget (August 2012). In 2011, the Standard Occupational Classification Policy Committee, a federal inter-agency committee responsible for recommending updates to the classification system used in occupational data, developed several options for defining STEM occupations. These included a categorization into the following four areas: (1) life and physical science, engineering, mathematics, and information technology occupations, (2) social science occupations, (3) architecture occupations, and (4) health occupations.

Figure 2: Science, Technology, Engineering, and Mathematics (STEM) Education Policy



Source: GAO.

[a]The Committee on STEM Education coordinates federal programs and activities in support of STEM education, as required by the America COMPETES Reauthorization Act of 2010 (Pub. L. No. 111-358, § 101(a), 124 Stat. 3982, 3984 (2011)). The Act also approved funding for some STEM education programs and addressed coordination and oversight issues, including those associated with the coordination and potential duplication of federal STEM education efforts. Specifically, the Act required the Director of Office of Science and Technology Policy to establish a committee under the National Science and Technology Council to inventory, review, and coordinate federal STEM education programs, among other things.

Federal STEM education programs have been created in two ways—directly by law or through agencies' broad statutory authority to carry out their missions. In our 2012 STEM report,[10] we reported that in fiscal year 2010, 13 federal agencies administered 209 programs to increase knowledge of STEM fields and attainment of STEM degrees. These agencies, listed below in Table 1, continued to administer federal STEM education programs in fiscal year 2014.

[10] GAO-12-108.

Table 1: Agencies Administering Science, Technology, Engineering, and Mathematics (STEM) Education Programs

Agency	Mission
Department of Agriculture	To provide leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management
Department of Commerce	To promote job creation, economic growth, sustainable development, and improved standards of living for all Americans by working in partnership with businesses, universities, communities, and our nation's workers
Department of Defense	To provide the military forces needed to deter war and to protect the security of our country
Department of Education	To promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access
Department of Energy	To ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions
Department of Health and Human Services	To enhance the health and well-being of Americans by providing for effective health and human services and by fostering sound, sustained advances in the sciences underlying medicine, public health, and social services
Department of Homeland Security	To ensure a homeland that is safe, secure, and resilient against terrorism and other hazards
Department of the Interior	To protect and manage the nation's natural resources and cultural heritage; to provide scientific and other information about those resources; and to honor its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities
Department of Transportation	To ensure a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future
Environmental Protection Agency	To protect human health and the environment
National Aeronautics and Space Administration	To drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth
National Science Foundation	To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes
Nuclear Regulatory Commission	To ensure the adequate protection of public health, safety, and the environment while promoting the common defense and security

Source: GAO review of agencies' websites and strategic plans.

In our 2012 report, we found that in fiscal year 2010, 83 percent of the programs we identified overlapped to some degree with at least 1 other program by offering similar services to similar target groups in similar STEM fields to achieve similar objectives. Although those programs may not be duplicative, we reported that they were similar enough that they needed to be well coordinated and guided by a robust strategic plan. We also found that federal agencies' limited use of performance measures and evaluations may have hampered their ability to assess the effectiveness of individual programs as well as the overall federal STEM education effort. We recommended that as the Office of Science and Technology Policy leads the government's STEM education strategic planning effort, it should work with agencies to better align their activities with a government-wide strategy, develop a plan for sustained coordination, identify programs for potential consolidation or elimination, and assist agencies in determining how to better evaluate their programs.

The Office of Science and Technology Policy has taken steps to address some of our recommendations. Regarding our recommendation on potential elimination or consolidation of programs, the Committee on STEM Education released its interim strategic planning progress report in February 2012, which noted that STEM education programs had been identified to be potentially overlapping and encouraged agencies to streamline programs where appropriate.[11] In addition, the President's fiscal year 2014 budget called for a major restructuring of federal STEM education programs through the consolidation of programs and the realignment of STEM education activities.[12] Since our prior report on STEM, the number of STEM education programs dropped from 209 in 2010 to158 in 2013. The President's fiscal year 2015 budget request seeks to continue these efforts and states that agencies should focus on internal consolidations and eliminations while funding their most effective programs.[13] Regarding our recommendation on evaluations, in May of 2013 the Committee on STEM Education released its 5-year Strategic Plan, which included guidance to agencies in developing evaluations for STEM education programs. The plan also laid out five broad priority areas: [14]

- Improve STEM instruction;
- Increase and sustain youth and public engagement in STEM;
- Enhance STEM experiences of undergraduate students;

[11] Committee on STEM Education, National Science and Technology Council, *Coordinating Federal Science, Technology, Engineering, And Mathematics (STEM) Education Investments: Progress Report* (Washington, D.C.: February 2012); Committee on STEM Education, National Science and Technology Council, *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan. (*Washington, D.C.: May 2013).

[12] Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2014* (Washington, D.C.: April 2013).

[13] Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2015* (Washington, D.C.: March 2014).

[14] We list these priority areas as stated in the 5-year Strategic Plan.

- Better serve groups historically under-represented in STEM fields; and
- Design graduate education for tomorrow's STEM workforce.

In addition, in July 2013, a joint Office of Science and Technology Policy/Office of Management and Budget memo included guidance to agencies on how to align their programs and budget submissions—beginning with the budget submission for 2015—with the goals of the STEM Education 5-Year Strategic Plan. The guidance includes language directing the agencies to prioritize programs that use evidence to guide program design and implementation and to define appropriate metrics and improve the measurement of outcomes. Furthermore, in the President's 2015 budget submission, the administration stated that improving STEM education by implementing the 5-year Strategic Plan is a cross-agency priority goal. As a result of this designation, the Office of Management and Budget must review on a quarterly basis agencies' progress in meeting this goal.

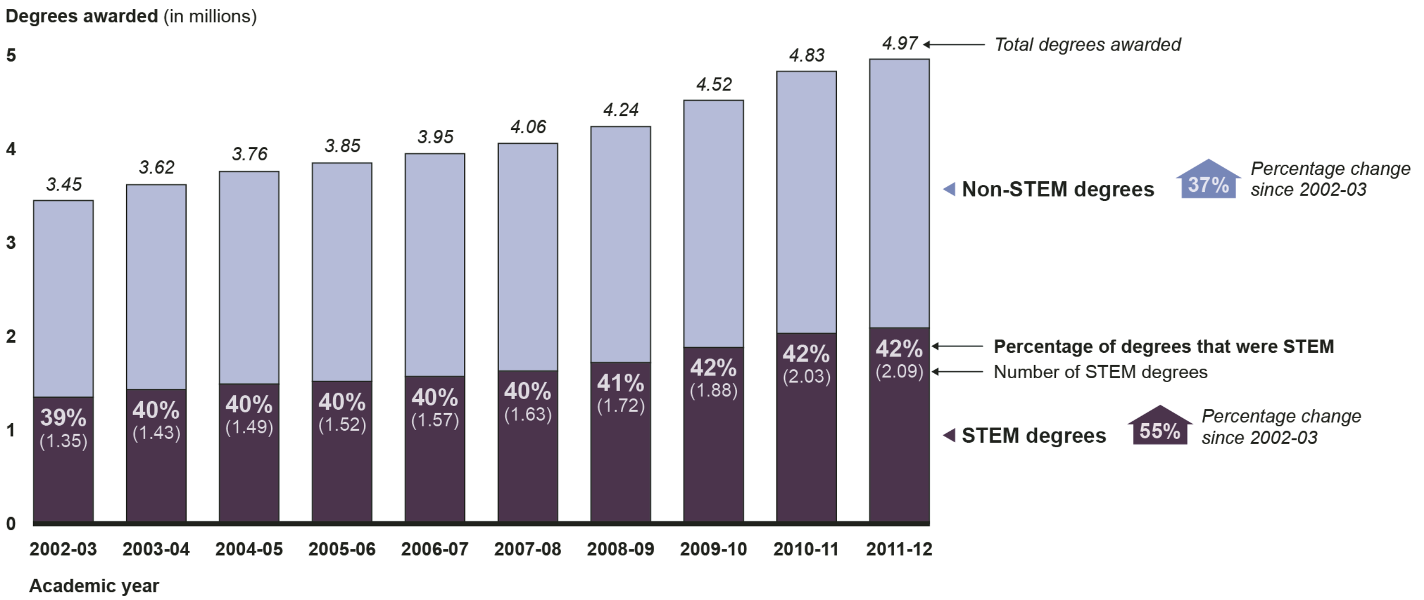
STEM Degrees and Jobs Are Increasing, but Their Alignment Is Difficult to Determine

While Degrees Have Increased in Most STEM Fields, Some Fields Have Grown More than Others

Overall, postsecondary degrees awarded in STEM fields have increased at a greater rate than in non-STEM fields during the past decade.[15] The number of STEM degrees awarded increased 55 percent, from 1.35 million degrees awarded in the 2002-2003 academic year to over 2 million in the 2011-2012 academic year. In comparison, degrees awarded in non-STEM fields increased 37 percent in the same time period (see fig. 3). STEM degrees now comprise a larger share of total postsecondary degrees awarded—42 percent in the 2011-2012 academic year, up from 39 percent in the 2002-2003 academic year.

[15] In this report, postsecondary degrees refers to and includes associate's and other degrees awarded below the bachelor's level, bachelor's, master's, postbaccalaureate and post-master's certificates, doctorate, and professional degrees. We include both degrees awarded for first and second majors in our analysis. Our results represent the number of degrees awarded, not the number of individuals who obtained degrees.

Figure 3: Trends in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Degrees Awarded



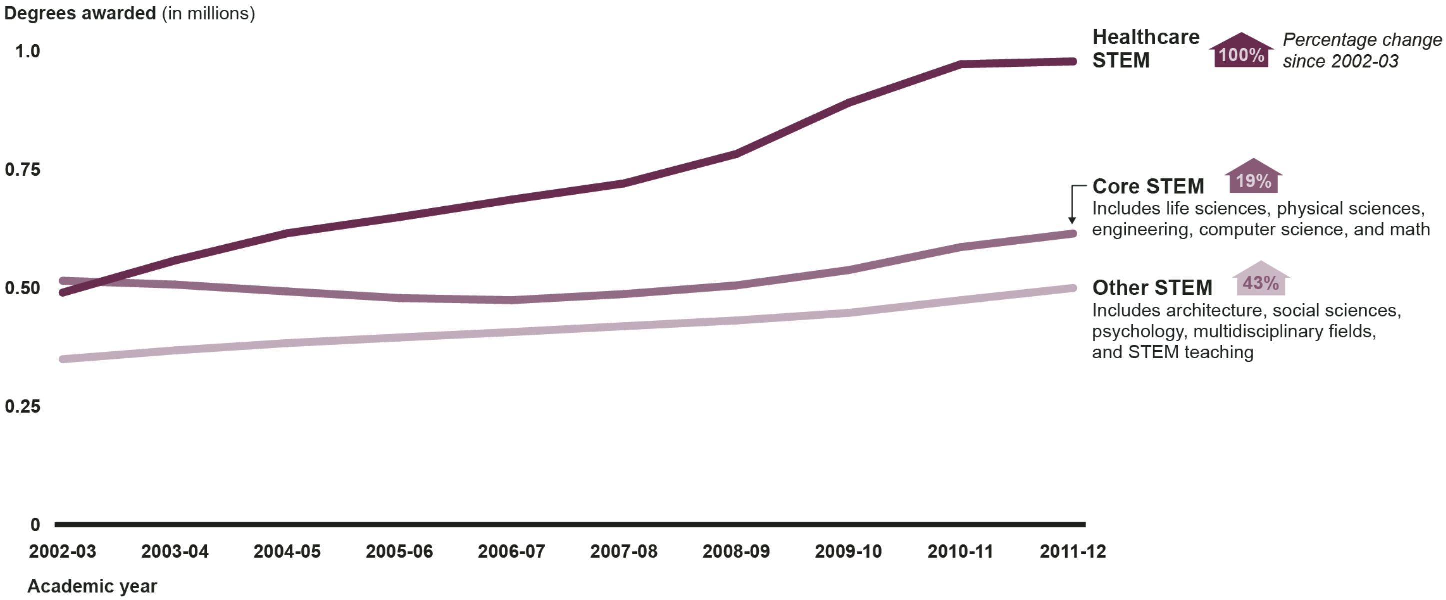
Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: This figure presents data on all degrees, including associate's and other degrees below the bachelor's level, bachelor's, master's, postbaccalaureate and post-master's certificates, doctorate, and professional degrees. The numbers shown in this figure include degrees awarded to citizens, non-resident aliens (students in the United States on a visa or temporary basis and do not have the right to remain indefinitely), and resident aliens.

However, much of the increase in STEM degrees came from growth in awards of Healthcare degrees, which have doubled over the past decade (see fig. 4). Degrees awarded in Core STEM fields increased at a substantially lower rate (19 percent) than non-STEM fields (37 percent).

Degrees awarded in Other STEM fields increased at a greater rate (43 percent) than non-STEM fields.[16]

Figure 4: Trends in Degrees Awarded in Science, Technology, Engineering, and Mathematics (STEM) Categories



Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: This figure presents data on all degrees, including associate's and other degrees below the bachelor's level, bachelor's, master's, postbaccalaureate and post-master's certificates, doctorate, and professional degrees. The numbers shown in this figure include degrees awarded to citizens, non-resident aliens (students in the United States on a visa or temporary basis and do not have the right to remain indefinitely), and resident aliens.

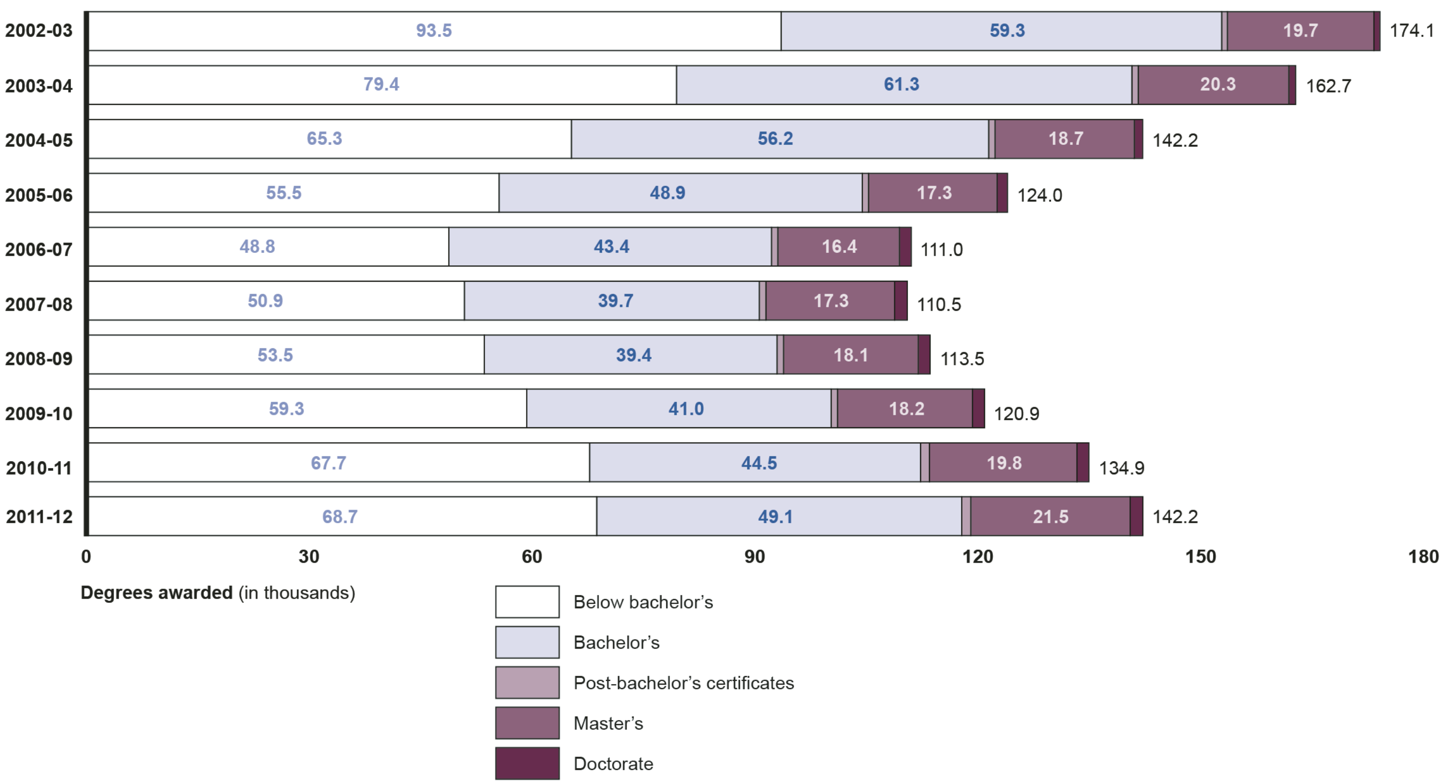
[16] When degrees awarded to non-resident aliens are excluded, degrees awarded in core STEM fields increased 18 percent between the 2002-2003 and 2011-2012 academic years, 100 percent in healthcare fields, and 44 percent in other STEM fields. Overall, degrees awarded to citizens and resident aliens increased 56 percent in STEM fields in this time period and 37 percent in non-STEM fields. Degrees awarded to non-resident alien students comprised 4 percent of all degrees awarded in the 2011-2012 school year. However, non-resident alien students were more heavily concentrated in core STEM fields, particularly at the graduate level—23 percent of non-resident alien degrees were in core STEM fields at the master's and the doctorate or professional level, compared to 2 percent of degrees awarded to U.S. citizens and residents. See appendix II for further information on STEM degrees awarded to various demographic groups.

The comparatively slower growth in Core STEM fields is due in large part to an 18 percent decline in the number of computer science and information technology (IT) degrees awarded in the past decade. Computer science and IT degrees decreased each year between the 2002-2003 and 2007-2008 academic years but then increased (see fig. 5).[17] A research association that has examined trends in computer science bachelor's degrees attributes the decline to the "dot-com crash."[18]

[17] Specifically, degrees at the below-bachelor's, bachelor's, and master's level in computer science/IT fields declined for 3 to 5 years from the 2002-2003 academic year and then increased. Computer science/IT degrees at the post-bachelor's certificate level was fairly stable (at about 800 to 900 degrees awarded) from 2002-2003 to 2009-2010 period but increased to about 1,200 degrees awarded in the 2010-2011 and 2011-2012 academic years. Computer science/IT degrees at the doctorate level steadily increased through the past decade, from about 800 degrees awarded in 2002-2003 to about 1,700 in the 2011-2012 academic year. Overall trends in computer science/IT degrees awarded were similar for non-resident alien students and citizens and residents—computer science/IT degrees declined 17 percent among non-resident aliens and 19 percent among citizens and residents from the 2002-2003 to 2011-2012 academic years. Citizens and residents received the large majority of computer science/IT degrees awarded at the less than bachelor's (99 percent), bachelor's (95 percent), and post-bachelor's certificate levels (84 percent) in the 2011-2012 academic year. At the graduate levels, sizable percentages of computer science/IT degrees were awarded to non-resident alien students (44 percent of master's degrees and 51 percent of doctorate degrees).

[18] Stuart Zweben, *Computing Degrees and Enrollment Trends from the 2009-2010 CRA Taulbee Survey*, Computing Research Association (Washington, D.C.).

Figure 5: Trends in Computer Science and Information Technology Degrees Awarded

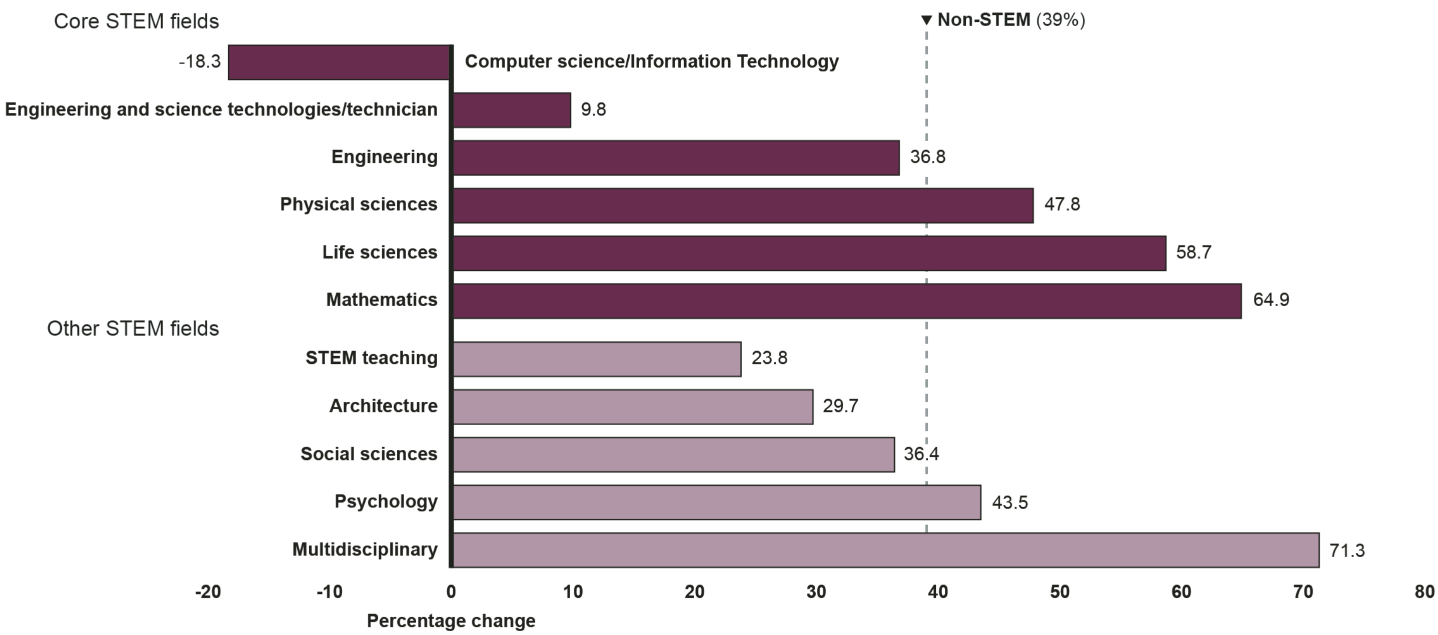


Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: Post-bachelor's certificates includes postbaccalaureate and post-master's certificates. The numbers shown in this figure include degrees awarded to citizens, non-resident aliens (students in the United States on a visa or temporary basis and do not have the right to remain indefinitely), and resident aliens.

Aside from degrees awarded in the computer science/IT field, degrees awarded in all of the other STEM fields have increased throughout the past decade. Among the Core STEM fields, degrees awarded in the physical sciences, life sciences, and mathematics have grown at a greater rate than non-STEM fields (see fig. 6). Degrees awarded in engineering have also increased, though at a slightly lower rate than non-STEM fields (37 percent compared to 39 percent).[19]

Figure 6: Percentage Change in Postsecondary Degrees Awarded from the 2002-2003 to 2011-2012 Academic Years for Select Science, Technology, Engineering, and Mathematics (STEM) Fields



Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: This figure presents data on all degrees, including associate's and other degrees below the bachelor's level, bachelor's, master's, postbaccalaureate and post-master's certificates, doctorate, and professional degrees. The numbers shown in this figure include degrees awarded to citizens, non-resident aliens (students in the United States on a visa or temporary basis and do not have the right to remain indefinitely), and resident aliens.

[19] Growth in degrees for the Core STEM field of engineering or science technician has been relatively slow. These degrees prepare students for jobs like industrial production technicians, telecommunications technicians, solar energy technicians, nuclear and industrial radiologic technicians. Degrees in these fields, which are largely at the below-bachelor's level, increased only 10 percent in the past decade (see fig 5). Similar to computer science/IT degrees, the number of technician degrees awarded declined from the 2002-2003 to 2007-2008 academic years, but has been increasing since then.

Employment Conditions Have Been More Favorable in STEM Occupations than Non-STEM, though They Vary across STEM Fields

Overall, employment trends have generally been more favorable in STEM occupations than in non-STEM occupations. The number of jobs in STEM occupations increased 16 percent from 14.2 million jobs in 2004 to 16.5 million in 2012, while jobs in non-STEM occupations remained fairly steady (with a decline of 0.1 percent). STEM occupations also had more wage growth on average and lower unemployment rates than non-STEM occupations (see table 2). However, employment conditions vary across STEM fields, with healthcare occupations generally having the most favorable conditions. (See also appendix III for more detailed information on recent trends in STEM and non-STEM occupations).

Table 2: Trends in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Occupations, 2004-2012

	Percent change, May 2004 to May 2012		
	Number of workers (2012 employment level)	Average annual wage, inflation-adjusted (2012 mean wage)	Unemployment rate, 2012
Non-STEM Occupations	- 0.1 (113.8 million workers)	+ 1.8 ($41,000)	8.4
STEM Occupations	+ 16 (16.5 million workers)	+ 6.2 ($79,000)	3.2
Core STEM	+ 11 (7.9 million workers)	+ 5.4 ($83,000)	3.9
Healthcare STEM	+ 21 (8.2 million workers)	+ 7.9 ($75,000)	2.6
Other STEM	+ 9 (0.5 million workers)	[a] ($74,000)	3.3

Source: GAO analysis of Occupational Employment Statistics data for the percentage change in number of workers and the average wage. GAO analysis of American Community Survey data for the unemployment rate in 2012.

[a]We do not report an estimate for Other STEM occupations because the margin of error at the 95 percent confidence level exceeds 30 percent of the estimate. The 95 percent confidence interval for the percentage change in average wage in other STEM occupations is 0.5 to 4.0 percent.

Note: With regard to the percentage change in number of workers between May 2004 and May 2012, the estimates shown in this table have margins of error within plus or minus 1.1 percentage points. Estimates of the number of workers employed in 2012 in each of the categories shown in the table have margins of error within plus or minus 1.5 percent of the estimate. With regard to the percentage change in average wage between May 2004 and May 2012, the estimates shown in this table have margins of error within plus or minus 0.8 percentage points. The estimates for the mean wage in 2012 have margins of error within plus or minus 2.1 percent of the estimate. With regard to the unemployment rates, estimates shown in this table have margins of error within plus or minus 0.2 percentage points, with the exception of other STEM occupations, which has a margin of error within plus or minus 0.6 percentage points. Differences between STEM and non-STEM occupations in the percentage change in employment level, percentage change in the average wage, and the unemployment rates are all statistically significant at the 95 percent confidence level. The differences between the three STEM categories in the percentage change in employment level and average wages were statistically significant at the 95 percent confidence level. With regard to unemployment rates, differences between healthcare STEM and the two other STEM categories were statistically significant at the 95 percent confidence level, but the difference between Core STEM and Other STEM was not statistically significant.

Comparison of Workers in STEM Occupations to Workers with Similar Characteristics in Non-STEM Occupations

After controlling for education levels, demographic characteristics, and type of job, we estimate that the unemployment rate among workers in STEM occupations overall was 1.2 percentage points lower than for similar workers in non-STEM occupations in 2012, and the average wage in STEM occupations was 17 percent higher (see table 3). Healthcare occupations had the largest differences, while workers in Other STEM occupations had unemployment rates and average wages that were similar to those in non-STEM occupations.

Table 3: Estimated Differences in Unemployment Rates and Annual Wages, Comparing Workers in Science, Technology, Engineering, and Mathematics (STEM) Occupations with Similar Workers in Non-STEM Occupations, 2012

Category	Estimated difference in unemployment rates, compared to similar workers in non-STEM occupations	Estimated difference in annual wages, compared to similar workers in non-STEM occupations
STEM Occupations	1.2 percentage points lower than non-STEM	17 percent higher than non-STEM
Core STEM	0.4 percentage points lower than non-STEM	16 percent higher than non-STEM
Healthcare STEM	2.0 percentage points lower than non-STEM	20 percent higher than non-STEM
Other STEM	similar to non-STEM	similar to non-STEM

Source: GAO analysis of American Community Survey data

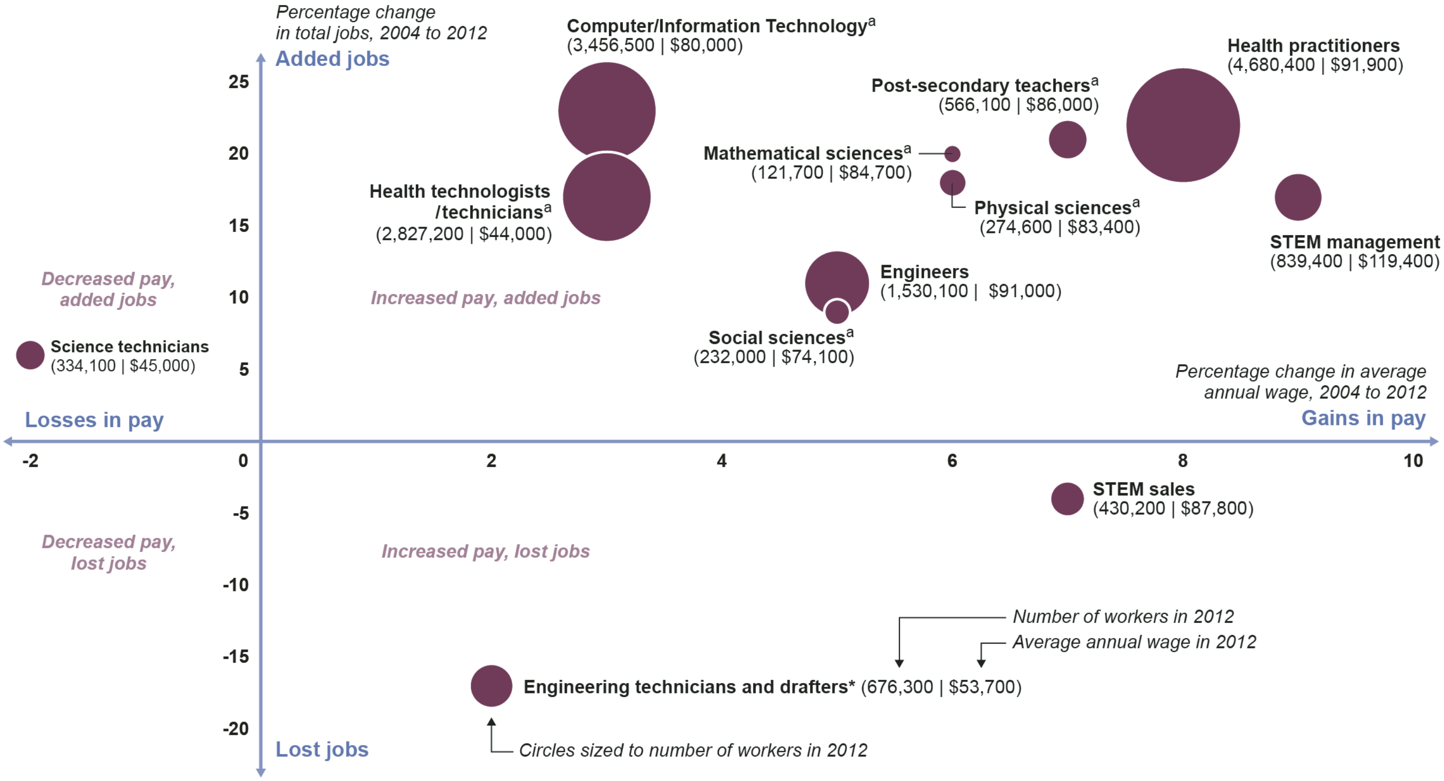
Note: Unemployment rate differences are measured in percentage points, while differences in wages are measured in percent of dollars. For example, a 2 percentage point increase in an unemployment rate of 10 percent would result in an unemployment rate of 12 percent. A 2 percent increase in a wage of $10 per hour would result in a wage of $10.20 per hour.

Employment Conditions across STEM Fields

While employment conditions have generally been more favorable in STEM occupations than in non-STEM occupations, conditions vary across specific STEM fields. Most STEM fields experienced both increases in employment levels and in average wages from 2004 to 2012, as well as relatively low unemployment rates when compared to non-STEM occupations. However, three fields— STEM sales occupations, engineering technician and drafting occupations, and science technician occupations—experienced either a decline in the number of jobs in this time period or a decline in the average wage (see fig. 7). Engineering technician and drafting occupations and science technician occupations are also among the STEM fields with the highest unemployment rates in recent years, though their unemployment rates have fallen since 2010 and were lower than non-STEM occupations in 2012 (see fig. 8).[20]

[20] We do not present unemployment rates for STEM sales occupations because the standard errors exceeded 30 percent of the estimates at the 95 percent confidence level.

Figure 7: Employment and Wage Trends across Science, Technology, Engineering, and Mathematics (STEM) Fields, 2004 to 2012

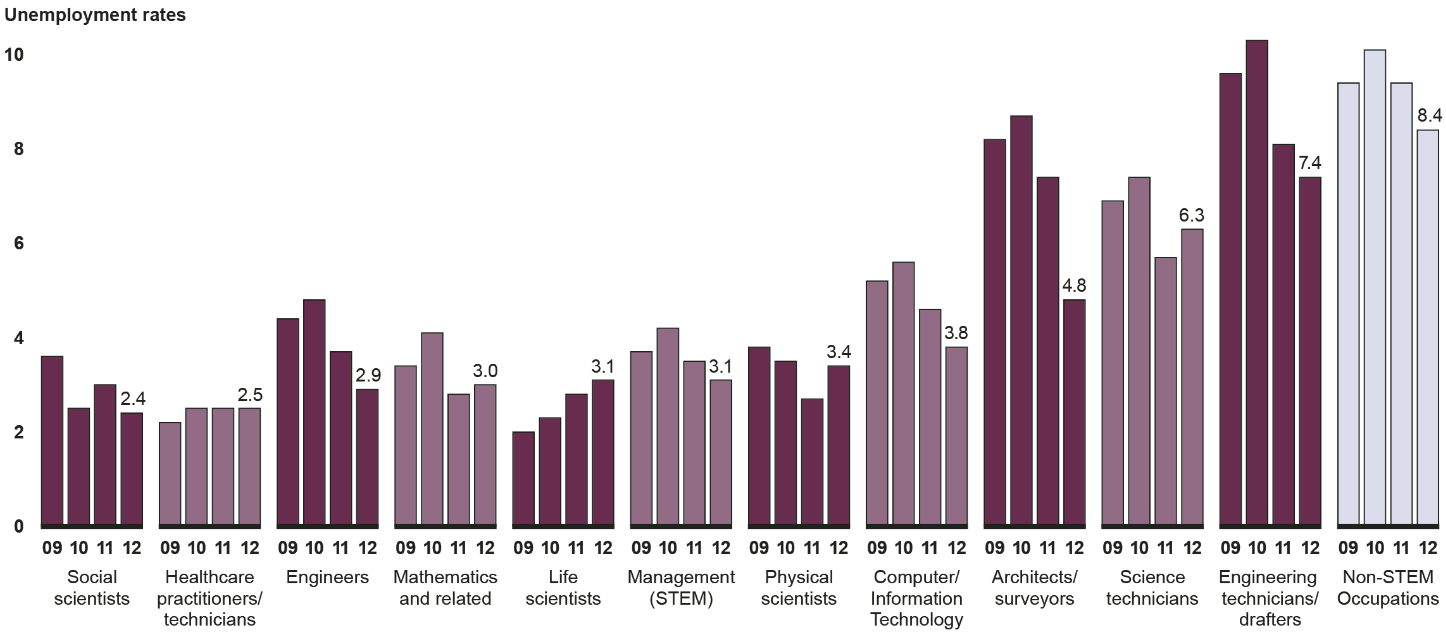


Source: GAO analysis of Occupational Employment Statistics data.

Note: Estimates of the percentage change in number of jobs between May 2004 and May 2012 have margins of error within plus or minus 3.1 percentage points. Estimates of the percentage change in average wages in this timeframe that do not have an asterisk have margins of error within plus or minus 1.9 percentage points. Estimates of the number of jobs in May 2012 have margins of error within plus or minus 2.7 percent of the estimate. Estimates of the average annual wage in May 2012 have margins of error within plus or minus 4.9 percent of the estimate.

[a]Indicates that the estimate of the percentage change in the average wage between May 2004 and May 2012 have margins of error greater than 30 percent of the estimate. The 95 percent confidence intervals for these estimates are: 1.2 to 3.9 percent increase in the average wage for computer science occupations, 3.5 to 7.9 percent for mathematical sciences occupations, 0.3 to 3.5 percent for engineering technicians and drafters, 4.0 to 8.2 percent for physical sciences occupations, 1.8 to 8.4 percent for social sciences occupations, 1.7 to 11.6 for postsecondary teachers, and 2.0 to 4.1 percent for health technologists and technicians.

Figure 8: Unemployment Rates in Selected Science, Technology, Engineering, and Mathematics (STEM) Occupations, 2009-2012



Source: GAO analysis of American Community Survey data.

Note: Estimates of the unemployment rate shown in this figure have margins of error within plus or minus 1.5 percentage points. For estimates that have a margin of error that exceeds 30 percent of the estimate, the 95 percent confidence intervals are: 1.3 to 2.7 for life sciences occupations in 2009, 1.6 to 3.0 for life sciences occupations in 2010, 1.3 to 2.5 for social science occupations in 2009, and 1.9 to 3.7 for mathematics occupations in 2011. Differences in the unemployment rates between STEM occupational groups and non-STEM occupations within each of the years are statistically significant at the 95 percent confidence level, except for the following: architects/surveyors in 2009 and engineering technicians/drafters in 2009 and 2010.

Several Factors, Including Fluctuations in the Economy, Make It Difficult to Determine Whether Supply of STEM Workers Is Aligned with Employer Demand

It is difficult to know whether the United States is producing enough STEM workers to meet employer needs for several reasons. First, estimating how many STEM workers employers need is a challenge, in part because demand for STEM workers can fluctuate with economic conditions. For example, the number of jobs in core STEM occupations declined by about 250,000 between 2008 and 2010 (from 7.74 million jobs in 2008 to 7.49 million in 2010), though it then increased (to 7.89 million jobs in 2012). Subject matter specialists and federal officials we interviewed also noted that employer needs in STEM fields are difficult to predict because they may change with technological or market developments.

Furthermore, the supply of STEM workers in the United States may not match the demand at any given point in time because of the time it takes to educate a STEM worker. Research suggests that students' decisions about which fields to study may be influenced by the economic conditions and future career prospects they perceive in those fields.[21] Favorable economic conditions in a STEM field may encourage students to pursue degrees in that field. However, it may take them several years to complete their degrees, so changes in the domestic supply of STEM workers may lag behind changes in the domestic demand.[22]

In addition, the number of students graduating with STEM degrees may not be a good measure of the supply of STEM workers because students often pursue careers in fields different from the ones they studied. Figure 9 shows the educational background of workers in selected STEM occupations in 2012 up to the bachelor's level. With the exception of engineering, most of those in STEM occupations did not receive a bachelor's degree in the same field in which they were working. They either majored in a different STEM field or a non-STEM field in their undergraduate education, or they did not receive a bachelor's degree.[23] As a result, it is difficult to estimate the supply of workers in a STEM occupation from information on the number of bachelor's degrees awarded in a STEM field.

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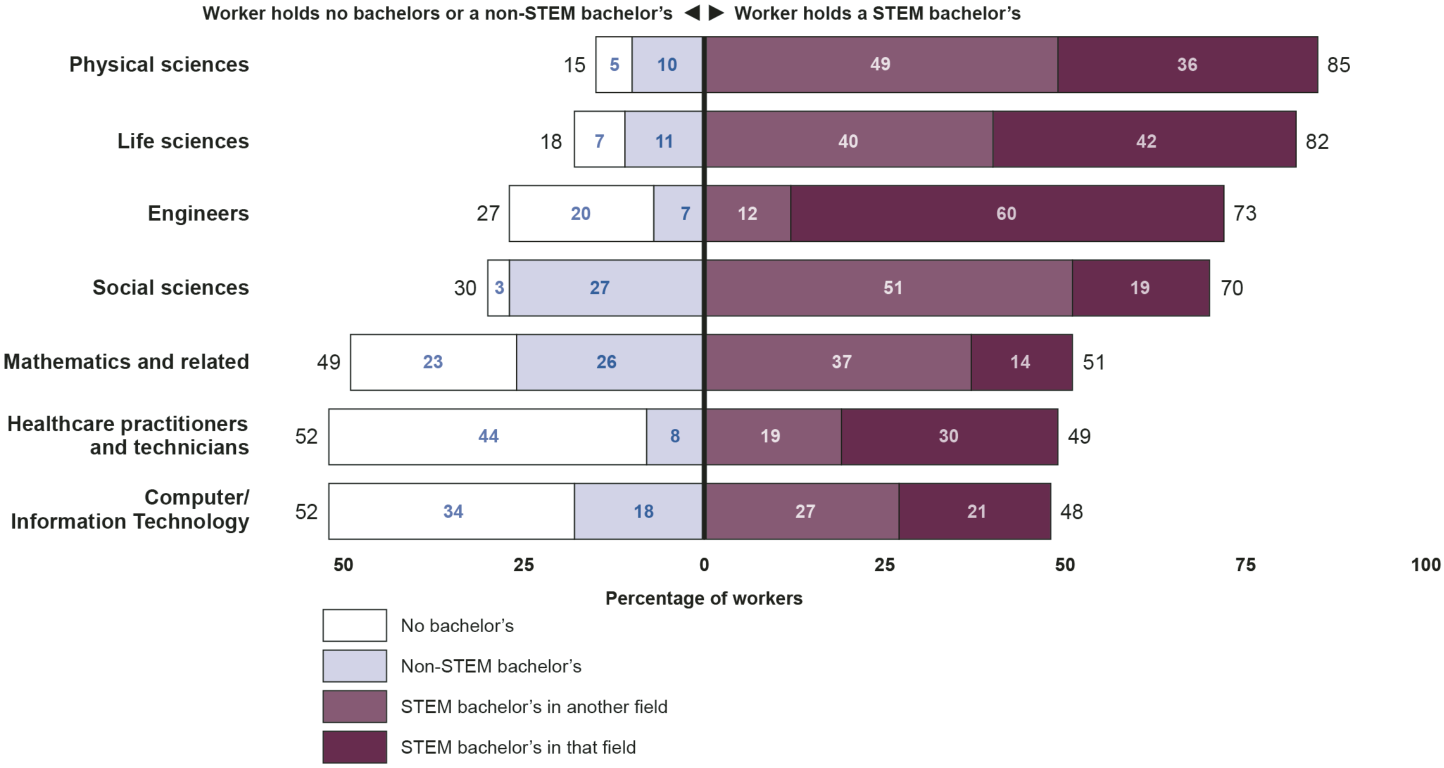
[21] See, for example, Richard B. Freeman, "A Cobweb Model of the Supply and Starting Salary of New Engineers, *Industrial and Labor Relations Review*, 29: 2 (January 1976), 236-248; Jaewoo Ryoo and Sherwin Rosen, "The Engineering Labor Market," *Journal of Political Economy*, 112: 1 pt. 2 (February 2004), 110-140.

[22] Supply and demand for STEM workers in the United States are also affected by global factors. The supply of STEM workers is affected by the number of foreign workers who relocate to the United States and work in STEM occupations. Demand for STEM workers in the United States is affected by global demand for American firms' products and services, as well as the presence of STEM workforces in other countries and the extent to which United States firms relocate activities or operations overseas to access those workers. For further information, see GAO, *H-1B Visa Program: Reforms Are Needed to Minimize the Risks and Costs of Current Program*, GAO-11-26 (Washington, D.C.: Jan. 14, 2011) and *Offshoring of Services: An Overview of the Issues*, GAO-06-5 (Washington, D.C.: Nov. 27, 2005).

[23] It is possible that these workers might have received another degree in the field in which they were working, but the American Community Survey data do not show this, since this survey only captures information on the field of study for degrees at the bachelor's level.

Figure 9: Educational Backgrounds of Workers Ages 22 or Older in Science, Technology, Engineering, and Mathematics (STEM) Occupations, 2012

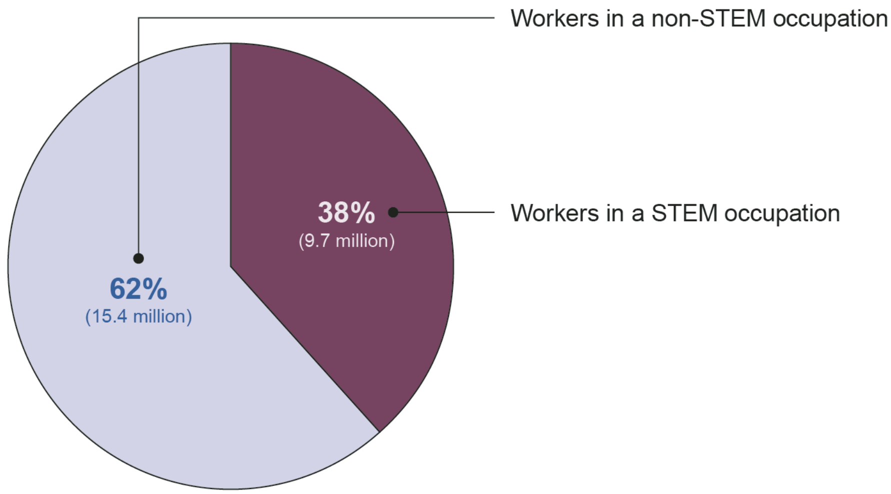


Source: GAO analysis of American Community Survey data.

Note: Estimates of the percentage of each occupational group in the education categories shown in this figure have margins of error that are within plus or minus 2.6 percentage points. In the estimates shown for engineers above, the percentages of workers with a STEM bachelor's degree in that field and a STEM bachelor's degree in another field does not sum to the numbers on the right of the bars due to rounding.

Further evidence of the difficulty in estimating the size of the STEM workforce from information on the number of STEM degrees is the substantial portion of workers with STEM bachelor's degrees who work in non-STEM occupations— 62 percent in 2012 (see fig. 10). The survey data cannot tell us how many of these STEM-educated workers are in a non-STEM occupation by choice and how many would prefer to work in a STEM occupation but cannot find a position suitable to them. However, these workers have had relatively low unemployment rates in recent years— 4.8 percent in 2012, suggesting that there is generally demand in the workplace for workers with STEM education, both in STEM and non-STEM occupations (see appendix III for further information on the educational backgrounds of workers in STEM and non-STEM occupations).

Figure 10: Percentage of Workers with Science, Technology, Engineering, and Mathematics (STEM) Bachelor's Degrees in STEM and Non-STEM Occupations, 2012



Source: GAO analysis of American Community Survey data.

Note: Estimates of the percentages have margins of error that are within plus or minus 0.2 percentage points. Population estimates shown in this figure have margins of error that are within plus or minus 0.01 percent of the estimate.

Most Federal Postsecondary STEM Education Programs Address Workforce Needs to Some Extent

Most Federal Postsecondary STEM Education Programs Consider Workforce Needs, Including Jobs, Diversity, and Innovation

Eighty-eight percent[24] of the 124 federal postsecondary STEM education programs[25] that responded to our survey indicated that meeting one or more of the workforce needs we identified, such as promoting a diverse workforce, was a stated objective of the program.[26] An additional 11 percent of postsecondary programs indicated that meeting at least one workforce need was a potential benefit of their program activities, even if it was not a stated objective.[27] The most common stated objective was to prepare postsecondary students for a career in a STEM field. See figure 11 for fiscal year 2012 obligations associated with the various workforce needs.

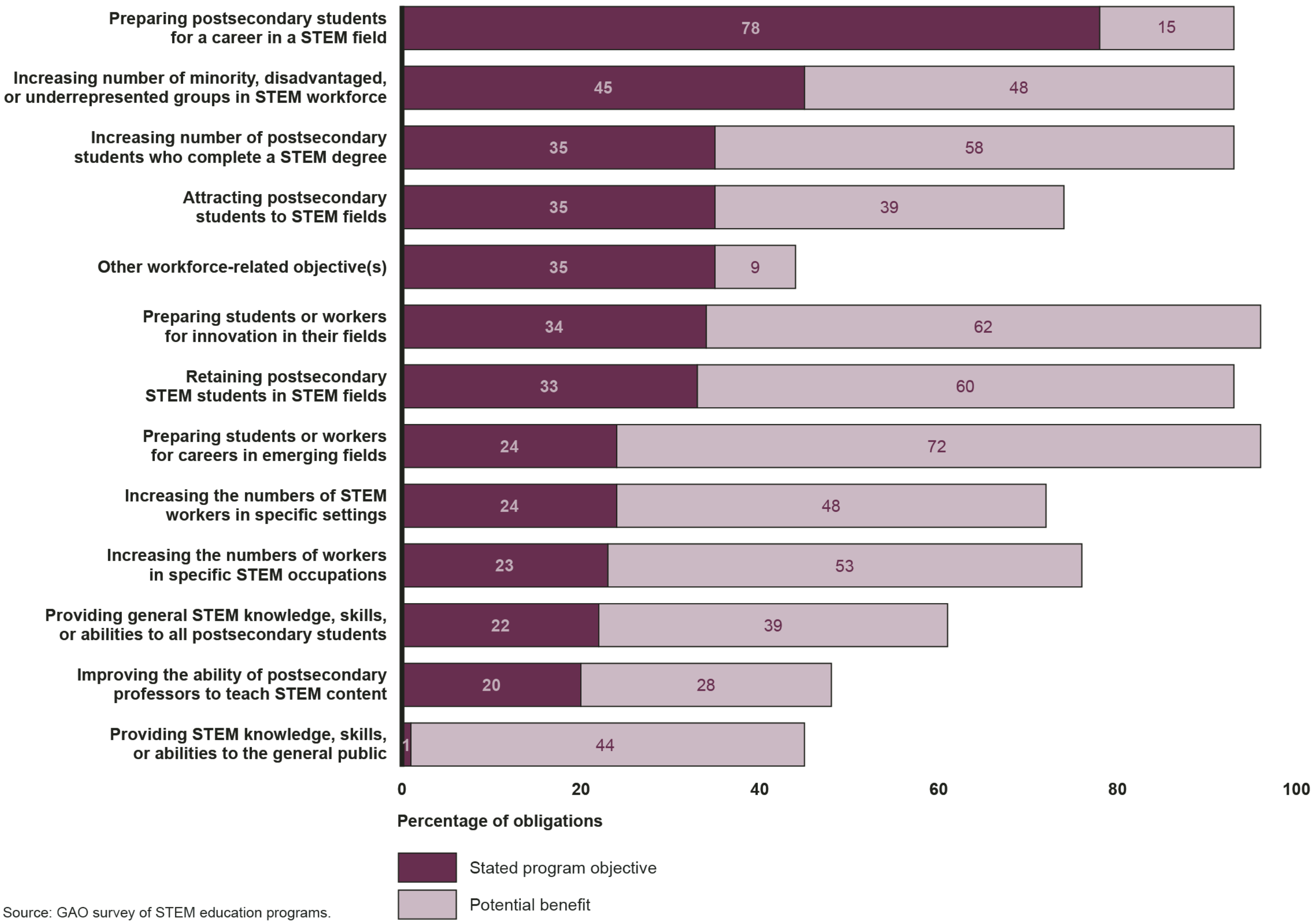
[24] These programs represented 95 percent of fiscal year 2012 obligations by federal postsecondary STEM education programs that responded to our survey.

[25] For purposes of this report, we consider federal postsecondary STEM education programs to also include programs with both a postsecondary and K-12 component.

[26] We created a list of possible workforce needs using input from experts, program officials, and grantees, and asked federal STEM education programs to indicate whether each possible workforce need was a stated program objective, a potential benefit of the program, or neither.

[27] We analyzed the proportions of both programs and obligations dedicated to a particular objective. See appendix I for a detailed explanation. Amounts obligated for each program for fiscal year 2012 were reported to us by agency officials in response to our survey. We did not independently verify this information.

Figure 11: Percent of Reported Fiscal Year 2012 Federal Postsecondary Science, Technology, Engineering, and Mathematics (STEM) Education Obligations Dedicated to Workforce Needs



Source: GAO survey of STEM education programs.

Note: For this figure, N=124 programs. Programs may have more than one stated objective or potential benefit, so total obligations cannot be summed across the various workforce needs.

Jobs

Eighty percent of the 124 federal postsecondary STEM programs that responded to our survey said that they focused on specific STEM occupations—41 percent as a stated objective and an additional 39 percent as a potential benefit of the program.[28] Almost three-quarters of obligations by grant-making programs with a stated objective to increase the numbers of workers in specific STEM occupations were made by programs that said they gave preference to applicants with the same goal.[29] Programs generally reported that they chose occupations according to market demand, their agency's mission, or both.

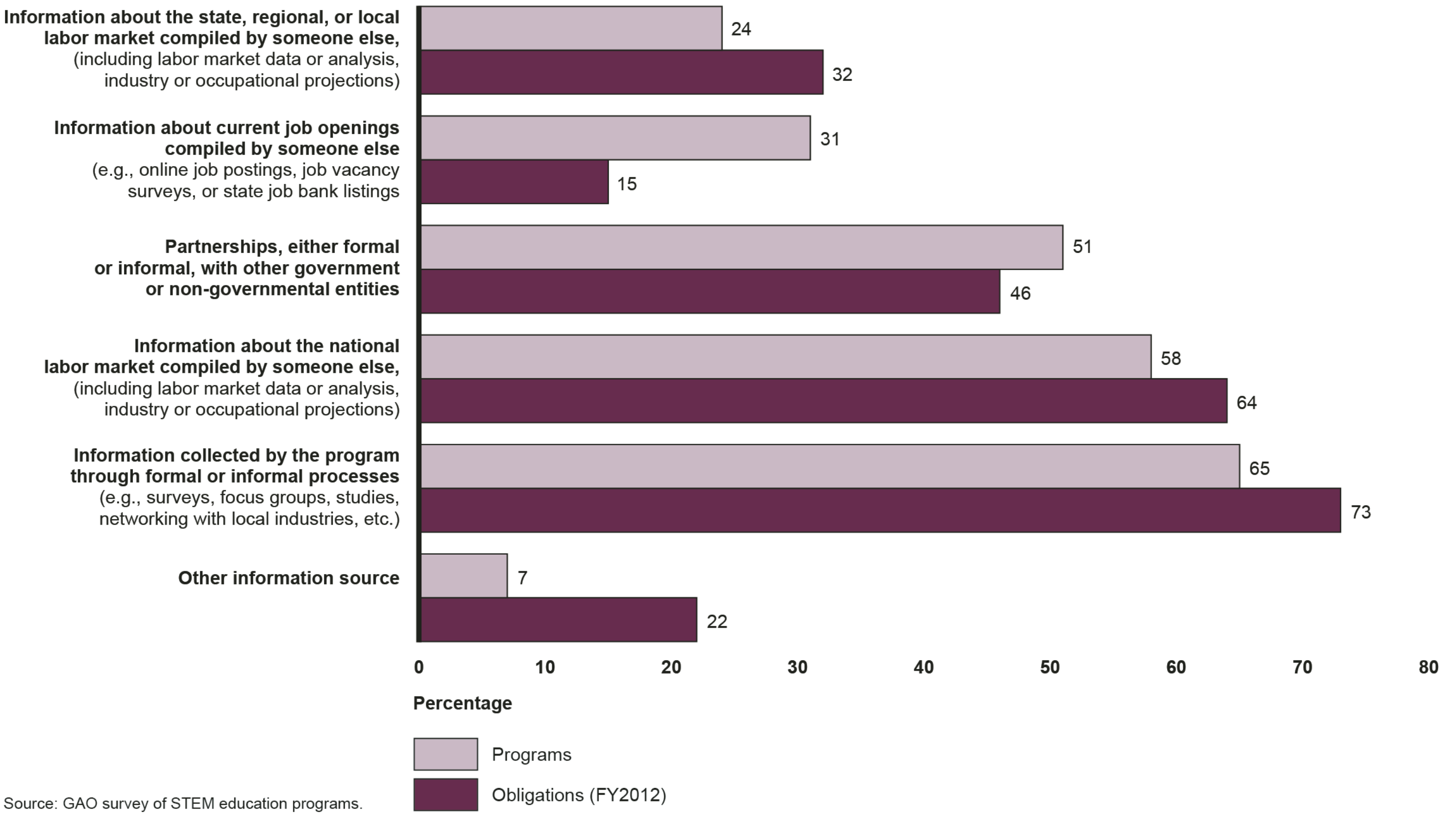
Fifty-six percent of the programs (25 percent of obligations) that focused on specific fields said that they chose occupations based on market demand.[30] Most of these programs reported that they identified high-demand occupations using national data and their own formal and informal research, such as networking with local industries. (See figure 12.) Some programs also indicated that they obtained information about high-demand occupations through partnerships with other organizations, such as industry groups that conduct national workforce needs assessments.

[28] While the number of programs with stated objectives and potential benefits related to specific occupations were roughly equal, much more money was obligated by the programs with potential benefits ($989 million, or 53 percent of postsecondary STEM obligations), compared to those with stated objectives (23 percent of obligations, or $429 million). This may indicate that the programs with stated objectives had smaller budgets, on average.

[29] Twenty-four grant-making programs, with obligations of $291 million, had a stated objective to focus on specific STEM occupations. Of these, 13, with $214 million in obligations, gave preference to grant applicants that focused on the same occupations.

[30] Ninety-nine federal postsecondary STEM programs ($1.4 billion in obligations) focused on specific occupations as either a stated program objective or potential benefit of their work. Of these, 55 programs ($349 million in obligations) identified occupations based on market demand. We defined high market demand to include STEM occupations with many job openings now, many predicted job openings in the future, or a shortage of qualified workers (e.g., there are not enough qualified workers available to fill job openings).

Figure 12: Information Sources Used by Science, Technology, Engineering, and Mathematics (STEM) Education Programs that Target Occupations Based on High Market Demand, Fiscal Year 2012



Source: GAO survey of STEM education programs.

Note: This figure includes only those 55 postsecondary STEM education programs (N=55 programs) that reported that they focused on high-demand occupations. Not included in this figure were 33 programs that focused only on occupations related to their missions, 11 programs that did not specify how they chose occupations, and 25 programs that indicated that they do not have a stated objective or potential benefit of increasing the number of workers in specific occupations.

Along with high-demand occupations, most of the STEM education programs (85 percent of programs, 65 percent of obligations) that focused on specific fields reported that they chose occupations related to the agency's mission.[31] For example, the Department of Energy's mission

[31] Ninety-nine federal postsecondary STEM programs ($1.4 billion in obligations) focused on specific occupations as either a stated program objective or potential benefit of their work. Of these, 84 programs ($919 million in obligations) chose occupations related to their agency's mission, including 51 programs that considered both market demand and mission.

corresponds to some specific STEM fields, such as energy science and nuclear physics, and the majority of programs from this agency said that they focus on mission-related occupations. Furthermore, one-third of the programs that target specific fields told us they focus solely on occupations related to their agency's mission instead of on high-demand occupations. One of the 13 programs we studied in depth—the National Institutes of Health's Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral Fellows program—aims to address needs for biomedical, behavioral, and clinical research in the country. For this reason, grant guidance states that applicants must propose projects in research areas that fall under the agency's scientific mission. Additionally, 60 percent of postsecondary STEM education programs, representing 59 percent of obligations, said that they prepared students for jobs at their own agencies. While this may meet some workforce needs, the agency creates its own closed loop of trainees, job openings, and employees, and does not necessarily try to provide STEM workers to the broader workforce.

Diversity

In addition to preparing students for STEM jobs, we identified several other workforce needs that federal STEM education programs reported addressing. For example, experts and agency officials told us that programs that increase the diversity of the STEM workforce, prepare students for innovation and emerging fields, or provide STEM skills to students who do not obtain STEM degrees can contribute to American competitiveness in other ways. Experts also said that federal STEM programs are uniquely positioned to meet some of these broader workforce needs, which may not be provided by the marketplace alone.

A majority of the postsecondary STEM education programs in our survey indicated that they focus on increasing the numbers of minority, disadvantaged, or under-represented groups in the STEM workforce: 38 percent (45 percent of obligations) as a stated program objective, and 54 percent (48 percent of obligations) as a potential benefit of the program. Programs with a stated objective to increase the diversity of the STEM workforce most frequently reported that they served one or more under-represented racial or ethnic groups and people from economically disadvantaged backgrounds, and least frequently reported serving women. [32] Additionally, 77 percent of obligations by grant-making programs that responded to our survey were made by programs that reported that they gave preference to grant applicants that intend to increase the number of STEM workers from minority, disadvantaged, or under-represented groups.[33]

Four of the thirteen programs we studied in depth reported that they were primarily intended to serve minority, disadvantaged, or under-represented groups in STEM fields. For example, the Department of Education's Hispanic-Serving Institutions STEM and Articulation Programs award grants to postsecondary institutions with undergraduate student bodies that are at least 25 percent Hispanic. Grantees may create new coursework, improve infrastructure, develop research opportunities for students, or provide outreach and support services to students in order to encourage their pursuit of STEM degrees. Additionally, the National Science Foundation's Louis Stokes Alliances for Minority Participation program seeks to increase the numbers and qualifications of STEM graduates from under-represented groups. Grantees are allowed wide latitude to design projects that improve the undergraduate educational experiences of students and facilitate their transfer from 2-year to 4-year postsecondary institutions.

Innovation

Innovation is another workforce need that most federal postsecondary STEM programs reported that they aim to meet. In fact, among postsecondary STEM programs responding to our survey, preparing students or workers for innovation in their field and for careers in emerging STEM fields were the workforce needs with the highest reported obligations. However, although 95 percent of the 124 STEM programs that responded to our survey (97 percent of obligations) indicated that they intended to prepare people for innovation in their fields or for emerging STEM fields, 59 percent (61 percent of obligations)

[32] Forty-seven programs indicated on our survey that they had a stated program objective to increase the numbers of minority, disadvantaged, or under-represented groups in the STEM workforce. Of these, 17 did not respond to questions asking which specific groups they focused on. The fairly high number of nonrespondents suggests that this information should be interpreted with caution.

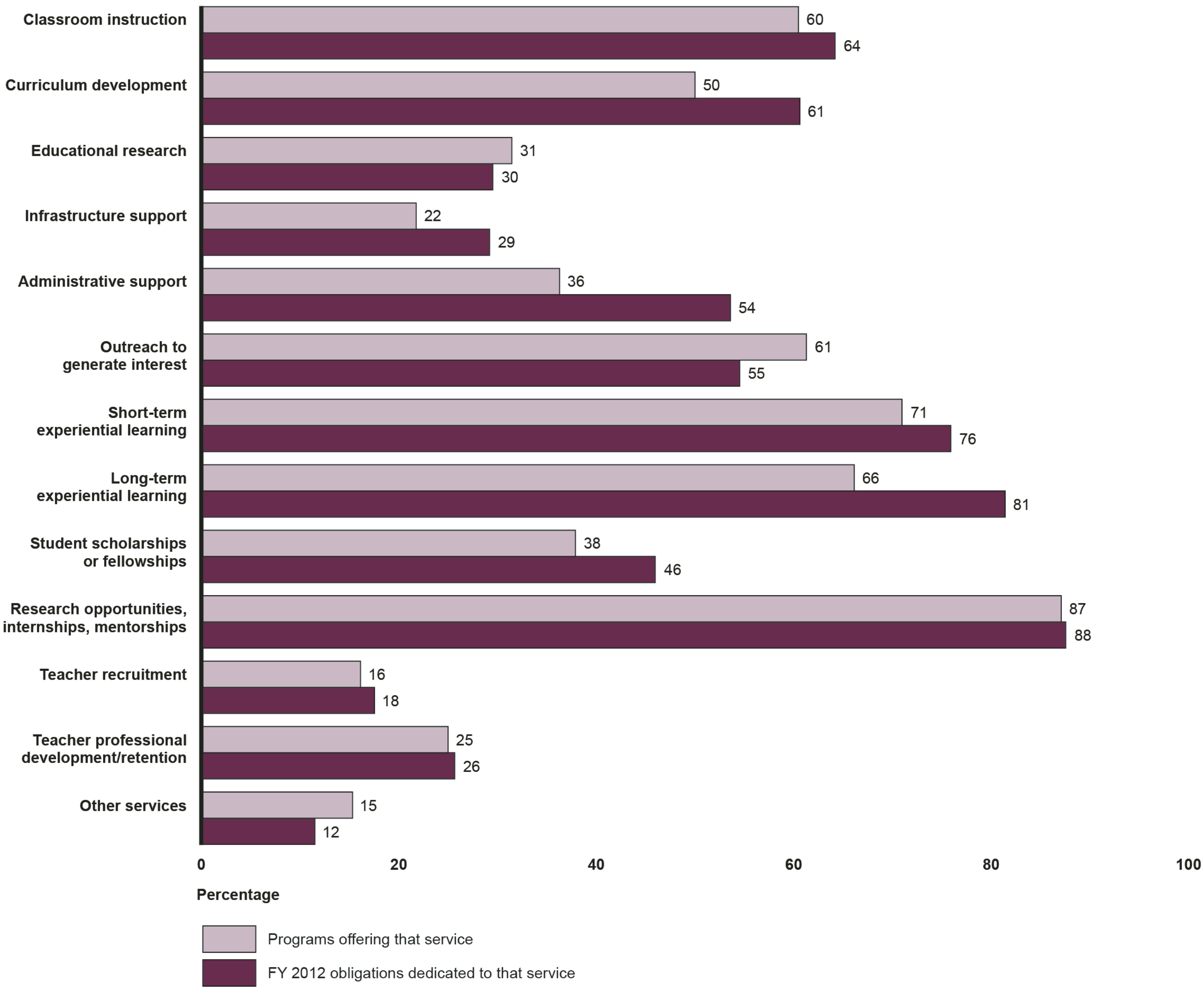
[33] Eighty postsecondary programs, with $1.396 billion in obligations in fiscal year 2012, indicated that they made grants for the purposes of STEM education. Of these, 39 programs, with $1.07 billion in obligations, gave preference to applicants that focused on minority, disadvantaged, or under-represented groups.

considered innovation to be a potential benefit rather than a stated objective. For example, the National Science Foundation and the National Institutes of Health both consider innovation in their agency-wide grant-making guidance. Additionally, the National Science Foundation sometimes creates agency-wide priorities for funding certain emerging fields, such as clean energy.

Programs Addressed Workforce Needs in Various Ways, and Some Measured Workforce-Related Outcomes

Federal postsecondary STEM education programs that responded to our survey indicated that they provided a range of services. The most common services they reported included research opportunities, internships, and mentorships. (See fig. 13.)

Figure 13: Services Provided by Federal Postsecondary Science, Technology, Engineering, and Mathematics (STEM) Education Programs in Fiscal Year 2012



Source: GAO survey of STEM education programs.

Eighty percent of the 124 postsecondary STEM education programs that responded to our survey, representing 88 percent of obligations, said they tracked their success at meeting workforce needs using at least one outcome-based measure. Degree attainment, number of students pursuing STEM coursework, number of students taking a STEM job, and participant satisfaction were the most commonly reported outcomes. For example, the National Institutes of Health produced a report focused on the workforce outcomes of biomedical students, the majority of whom receive support from the National Institutes of Health at some point in their graduate careers.[34]

However, some programs did not measure an outcome or output that directly related to their stated objectives. For example, of the 78 postsecondary programs with a stated program objective to prepare students for STEM careers, 53 percent (45 percent of obligations) reported that they did not track the number of their students who took a job in a STEM field. Similarly, of the 49 programs with a stated program objective to increase the numbers of STEM graduates, 39 percent (43 percent of obligations) reported that they did not measure the educational attainment of their program participants. These data are consistent with our 2012 STEM report, in which we found that STEM education programs' outcome measures were not clearly reflected in the performance planning documents of most agencies.[35] As we recommended in 2012, the National Science and Technology Council recently issued guidance to help agencies better incorporate their STEM education efforts and the goals from the government-wide STEM Education 5-Year Strategic Plan into their agency performance plans and reports. As agencies follow the guidance, improve their outcome measures, and focus on the effectiveness of the programs, more

[34] National Institutes of Health, *Biomedical Research Workforce Working Group Report: A Working Group of the Advisory Committee to the Director* (June 14, 2012). The National Institutes of Health has many programs that fund biomedical students. According to the report, the majority of biomedical graduate students receive National Institutes of Health support at some point in their graduate studies through training grants, fellowships or research project grants. It also found that although the agency primarily trained graduate students for careers in academic research, less than half of domestically trained biomedical PhD graduates in 2008 went into a career in academia, with many going into research or non research careers in government and industry. As a result, the report recommended that the National Institutes of Health create a program providing additional training and career development experiences to equip students for various career options.

[35] We also found that STEM programs varied in their ability to track reliable output measures, such as the number of students or teachers directly served by their program. We recommended that the National Science and Technology Council develop a monitoring framework to ensure that agencies collect data and report on the goals in the Strategic Plan. Work on this framework has begun, but our recommendation remains open because the framework has not been completed. See GAO-12-108.

programs may measure outcomes directly related to their stated program objectives, such as preparing students for STEM careers.

Most Federal K-12 STEM Education Programs Include Activities to Prepare Students for Future STEM Education

According to our survey, preparing students for postsecondary education in a STEM field is either a stated program objective or a potential secondary benefit of almost all federal K-12 STEM education programs.[36] Specifically, out of 30 federal K-12 STEM education program respondents to our survey, 13 programs (50 percent of K-12 program obligations)[37] reported that preparing students for postsecondary STEM education is a stated program objective, while 16 programs reported that it is a potential benefit of the program.[38]

Of the six federal K-12 STEM education programs we selected to review in more detail, four programs—Advanced Technological Education, Discovery Research K-12, Math and Science Partnership, and Upward Bound Math-Science—reported that preparing students for postsecondary STEM education is a stated objective of the program. Upward Bound Math-Science programs, which are based in institutions of higher education, work closely with students to strengthen their math and science skills in order to prepare and encourage them to pursue postsecondary degrees in math and science.[39] According to an official from an Upward Bound Math-Science program we visited in California, the program is not specifically intended to prepare students for the STEM workforce, but it emphasizes helping students understand the varied career opportunities available to them in math and science fields. Officials from another Upward Bound Math-Science program we visited said they try to connect their students with practitioners in the field, since it is

[36] For purposes of this report, we limited our category of federal K-12 STEM education programs to include only those STEM education programs that primarily serve students and teachers at the K-12 level. The category is not meant to be inclusive of all programs with a K-12 STEM education component.

[37] We analyzed the proportions of both programs and obligations for fiscal year 2012. Amounts obligated for each program for fiscal year 2012 were reported to us by agency officials in response to our survey. We did not independently verify this information.

[38] In addition to the 13 K-12 programs, 7 postsecondary programs noted that preparing students for postsecondary STEM education is a stated program objective.

[39] These programs are required to provide instruction in math and science—as well as laboratory experience, academic counseling, information on and assistance with applying for student aid, and mentorships opportunities.

important for students to have role models in STEM occupations who hail from similar backgrounds.

In our survey, 18 of the 30 federal K-12 STEM education programs (approximately 77 percent of K-12 program obligations) reported that improving the ability of K-12 teachers to teach STEM content is a stated program objective.[40] Several experts have noted that one challenge at the K-12 level is that STEM teachers sometimes do not have sufficient content knowledge to effectively teach these subjects, and that the federal government can play an important role by supporting professional development for STEM teachers and encouraging more college graduates in STEM fields to pursue teaching careers.

Four of the federal K-12 STEM education programs we reviewed in detail— Advanced Technological Education, Discovery Research K-12, Math and Science Partnership, and the Mathematics and Science Partnerships program[41]—reported that improving the ability of K-12 teachers to teach STEM content is a stated program objective. The Mathematics and Science Partnerships program provides formula grants to states, which in turn award competitive grants to partnerships that enhance the content knowledge and teaching skills of math and science teachers. A Mathematics and Science Partnerships grantee we met with in Texas established regional networks across the state in which mentor teachers provided professional development and mentoring to participating teachers. Similarly, the Discovery Research K-12 program supports research projects that address a need in STEM education at the pre-kindergarten through 12th grade levels, particularly programs that explore unconventional approaches to teaching and learning. Researchers we met with were exploring how computational models could be used to make decisions about resource allocation to optimize learning in STEM classes. For example, the model might be used to calculate optimal student-teacher ratios given other factors, such as grade level, subject, and class composition.

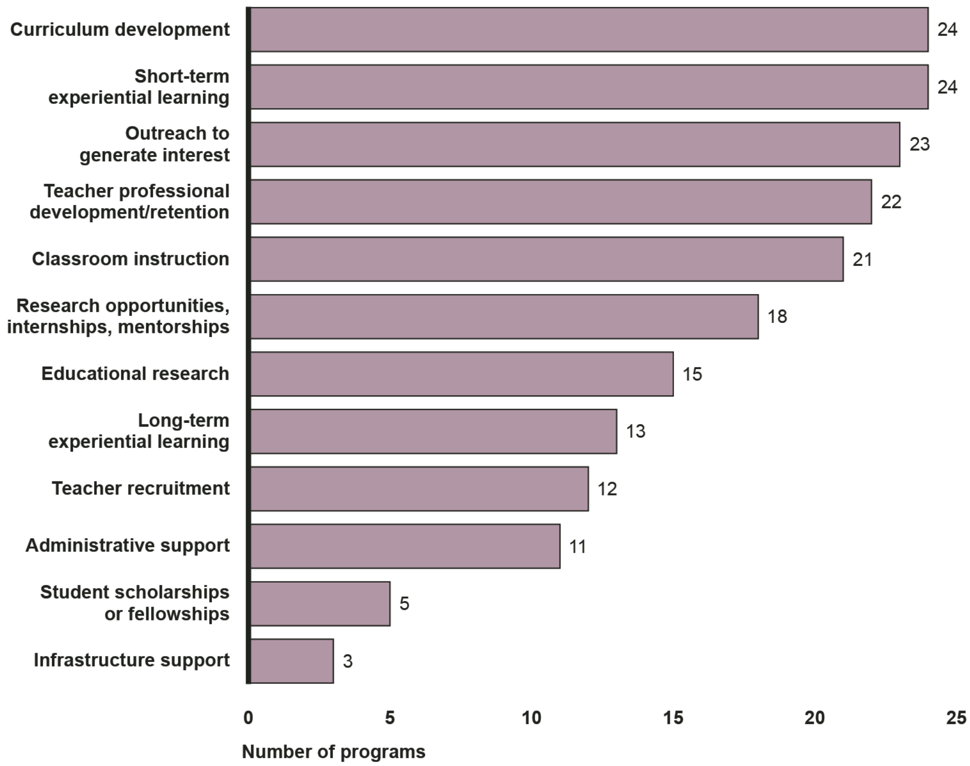
[40] In addition to the 18 K-12 programs, 4 postsecondary programs noted that improving the ability of K-12 teachers to teach STEM content is a stated program objective.

[41] NSF administers the Math and Science Partnership program, while Education administers the Mathematics and Science Partnerships program.

In our survey, 7 of the 30 federal K-12 STEM education programs (approximately 26 percent of K-12 program obligations) reported that providing students with STEM knowledge, skills, and abilities, without the explicit goal of preparing them for postsecondary STEM education or a STEM career, is a stated program objective. According to recent research, exposing students to STEM content and encouraging their interest in STEM disciplines at an early age is important in order to increase the likelihood that they remain engaged with STEM later in life. The National Science Foundation's Advancing Informal STEM Learning program provides grants to organizations working on innovative projects intended to expose students to STEM content outside the classroom. A museum we visited in California received an Advancing Informal STEM Learning grant to develop an outdoor bilingual science exhibit and related curriculum targeted towards Latino students in the San Francisco area. Officials told us the exhibit is geared towards students who may not generally visit the museum.

Federal K-12 STEM education programs provide a variety of educational services in order to achieve their objectives. The services identified most often in our survey included classroom instruction; curriculum development; outreach to generate student interest in STEM fields; short-term experiential learning activities; and teacher professional development or retention activities (see fig. 14).

Figure 14: Number of Kindergarten-12th grade Science, Technology, Engineering, and Mathematics (STEM) Education Programs Providing Various Services in Fiscal Year 2012



Source: GAO survey of STEM education programs.

In our survey, 25 of the 30 federal K-12 STEM education programs (approximately 89 percent of K-12 program obligations) reported that they tracked or monitored program outcome measures in 2012. However, as with the federal postsecondary STEM education programs some K-12 programs are not measuring outcomes directly related to their stated objectives. For example, of the 13 K-12 programs that reported having a stated program objective to prepare students for postsecondary STEM education, 10 programs said they did not track student educational attainment or the number of students who pursued coursework in STEM fields. Of the 18 programs that reported that improving the ability of K-12 teachers to teach STEM content was a stated program objective, 6 programs said they did not monitor teacher improvement and performance in STEM education instruction or the number of qualified teachers teaching STEM.

K-12 STEM education program grantees we met with monitored some programmatic outcomes. For example, an official from an Upward Bound Math-Science program we visited told us that each program is required to submit an annual report to Education, including data on performance outcomes such as the number of participants who graduate from high school, pursue postsecondary degrees in STEM fields, and graduate from college within 6 years.[42] The official said that all but one of the participants in the program's first cohort graduated from high school and enrolled in college. Further, officials from a Mathematics and Science Partnerships grantee told us that—in addition to mandatory reporting to Education on performance outcomes, such as the number of teachers trained through the program and the extent to which teachers' test scores showed statistically significant gains—they were implementing an initiative to correlate programmatic data with student outcomes across the state, as measured by teacher self-reporting and statewide assessments. The initial phase of the analysis, based on teacher self-reporting, found that the students whose teachers had participated in the program outperformed their peers in several STEM subjects. In addition, officials from the museum exhibit in California funded by the Advancing Informal STEM Learning program said assessments were planned for every stage of the project, including a summative evaluation to review the extent to which it may have influenced Latino youth awareness of and engagement with STEM content. Officials said the evaluation would be completed in January of 2015.

Concluding Observations

It is difficult to determine whether there has been a shortage or a sufficient supply of STEM workers in the United States and, consequently, to define the appropriate role the federal government should play in increasing the number of STEM-educated workers. There is not a one-to-one match between STEM graduates in a specific field and corresponding STEM jobs because not all people with STEM degrees pursue careers in their fields of study, whether by choice or because of limited employment opportunities in the field. Regardless of career choices, the rigor of a STEM education may help promote a workforce with transferable skills and the potential to fuel innovation and economic growth. Federal postsecondary STEM education programs may

[42] Education releases an annual performance report that aggregates results from all Upward Bound Math-Science programs and presents program-wide outcomes.

help develop a workforce that will address issues that affect the population as a whole, such as researching diseases or improving defense capabilities. Additionally, federal K-12 STEM education programs may generate interest in STEM fields early in life, which could usher more students into the STEM pipeline and increase the likelihood that they will pursue STEM education and careers.

Although the administration has taken steps to consolidate and coordinate STEM education programs, numerous programs—spread across 13 agencies—remain. As the administration continues to consolidate and eliminate STEM education programs, it risks making decisions without considering the efficacy of these programs because many federal STEM education programs are not measuring their outcomes. However, the guidance recently issued by the National Science and Technology Council could help agencies better incorporate their STEM education efforts and the goals from the government-wide 5-year STEM strategic plan into their agency performance plans and reports. This will enable agencies to better assess which STEM education efforts are successful in contributing to agency-wide performance goals and supporting the overall federal STEM effort.

Agency Comments and Our Evaluation

We provided a draft of this product for comment to the Departments of Defense, Education, Energy, and Health and Human Services; National Science Foundation; and Office of Management and Budget. All provided technical comments except the Department of Defense, which indicated that it had no comments. We incorporated the technical comments as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Department of Defense, Department of Education, Department of Energy, Department of Health and Human Services, National Science Foundation, and Office of Management and Budget. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (617) 788-0534 or emreyarrasm@gao.gov. Contact points for our

Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.

Melissa Emrey-Arras
Director, Education, Workforce, and Income Security Issues

Appendix I: Objectives, Scope, and Methodology

Our research objectives were to review (1) recent trends in the number of degrees and jobs in Science, Technology, Engineering, and Mathematics (STEM) fields, (2) the extent to which federal postsecondary STEM education programs take workforce needs into consideration, and (3) the extent to which federal kindergarten-12th grade (K-12) STEM education programs prepare students for postsecondary STEM education.

To inform all of our objectives, we reviewed relevant federal laws and regulations. We also reviewed relevant literature and past reports on STEM education, including our 2012 STEM report[1] and the National Science and Technology Council's Strategic Plan for federal STEM education programs. In addition, we interviewed STEM experts and officials from the Office of Science and Technology Policy and several other federal agencies that administer STEM education programs to gather information on their STEM education efforts. We attended a STEM education conference to gather additional perspectives about federal STEM education programs.

Analysis of Education and Workforce Data

Analysis of the Integrated Postsecondary Education Data System (IPEDS) Data

To examine recent trends in the number of STEM degrees awarded, we analyzed data from IPEDS from the Department of Education's National Center for Education Statistics. IPEDS is a system of interrelated surveys conducted annually to gather information from every college, university, and technical and vocational institution that participates in federal student financial aid programs. The Higher Education Act of 1965, as amended, requires institutions of higher education that participate in federal student aid programs to complete IPEDS surveys.[2] IPEDS provides institution-level data in such areas as enrollment, program completions, faculty, staff, and finances. Specifically, we analyzed 10 years of data from the IPEDS program completions component, from the July 2002-June 2003

[1] GAO, *Science, Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Multiple Programs Across Multiple Agencies*, GAO-12-108 (Washington, D.C.: Jan. 20, 2012).

[2] 20 U.S.C. §1094(a)(17).

academic year to the July 2011-June 2012 academic year. The program completions component provides data on the number of degrees awarded by each institution for each program of study. We analyzed the data to determine the number of degrees awarded nationally in STEM and non-STEM programs of study in this time period, the number awarded in our three STEM categories, and the number awarded in selected STEM fields. We included degrees awarded for both first and second majors in our analysis. Our results represent the number of degrees awarded, not the number of individuals who obtained degrees. We assessed the reliability of the IPEDS data we used by reviewing relevant documents and past GAO reviews of the data and conducting electronic testing. On the basis of this assessment, we concluded that the data were sufficiently reliable for our reporting purposes.

In conducting our analysis, we classified each program of study in the IPEDS data as STEM or non-STEM. We used as guidance work conducted by the Census Bureau to classify fields of study as science and engineering or science- and engineer-related in the American Community Survey (ACS) data. This helped to ensure that we were consistent with the fields we defined as STEM in both our IPEDS and ACS analyses. We further classified these STEM fields into our three STEM categories of Core STEM, Healthcare STEM, and Other STEM. See table 1 below for the fields of study we classified as STEM and how we classified them into our three STEM categories. We also aggregated detailed programs of study into broader STEM fields, generally based on the first two digits of the Classification of Instructional Programs code (the classification system that IPEDS uses to define programs of study). For example, Classification of Instructional Programs codes beginning with 11 represent programs of study under the category of “computer and information sciences and support services.” The information we present on numbers of computer science/information technology (IT) degrees comes from aggregating the number of degrees awarded for Classification of Instructional Programs codes that begin with 11. For life sciences, mathematics and statistics, and social sciences, we combined programs of study from multiple 2-digit Classification of Instructional Programs code categories (see table 4 for the fields we combined).

Table 4: Fields of Study We Classified as Science, Technology, Engineering, and Mathematics (STEM)

STEM Category	Programs of Study, based on the Classification of Instructional Programs 2010
Core STEM	Life sciences (includes biological and biomedical sciences; agricultural sciences, i.e., animal sciences, food science and technology plant sciences, and soil sciences; natural resources and conservation, i.e., environmental studies/science, fisheries science and management, forestry, wildlife and wildlands science and management)
	Computer and information sciences and support services
	Engineering
	Technician (includes engineering technologies and engineering-related fields, science technologies/technicians)
	Mathematics and statistics (including actuarial science)
	Physical sciences
Healthcare STEM	Health professions and related programs
Other STEM	Social sciences (includes natural resource economics and agricultural economics; area, ethnic, cultural, gender, and group studies; linguistics; public policy analysis; history and philosophy of science and technology; social sciences).
	Architecture and related services
	STEM teacher education
	Multi-/interdisciplinary studies (i.e., systems science, nutrition sciences, behavioral sciences, gerontology, international/global studies)
	Psychology

Source: GAO analysis of the Integrated Postsecondary Education Data System

Note: We did not include construction trades, mechanic and repair technologies/technicians, or precision production in our definition of STEM fields because they were not defined as STEM in the information sources that informed our categorization. We also did not include industry certifications or licenses. We note that Congress recently changed the name of the Office of Vocational and Adult Education to the Office of Career, Technical, and Adult Education.

Analysis of Occupational Employment Statistics (OES) Data

To examine trends in STEM occupations, we analyzed the Bureau of Labor Statistics' OES data from the May 2004 survey to the May 2012 survey. The OES program surveys establishments to produce estimates of employment and wages for specific occupations.[3] We began our analysis with the May 2004 data because that was the first year that all occupations in the OES were classified based on the Standard Occupational Classification (SOC) system. We conducted our analysis to identify trends in the number of jobs and the average wages in STEM and non-STEM occupations from 2004 to 2012. We assessed the reliability of

[3] The OES survey does not collect data from self-employed persons. As a result, our estimates from the OES data do not include data from self-employed persons.

the OES data by reviewing relevant documents, interviewing Bureau of Labor Statistics officials, and conducting electronic testing of the data. Based on our assessment, we concluded that the OES data were sufficiently reliable for our reporting purposes.

We classified occupations as STEM and non-STEM based on the SOC Policy Committee's *Options for Defining STEM (Science, Technology, Engineering, and Mathematics) Occupations Under the 2010 Standard Occupational Classification System*.[4] This document sets out several options for defining STEM occupations. Any occupation that was included in any of the SOC Policy Committee's options was classified as STEM in our analysis. All other occupations were classified as non-STEM. We also classified occupations into our three STEM categories of Core STEM, Healthcare STEM, and Other STEM based some of the options presented by the SOC Policy Committee. Specifically:

- Occupations categorized by the SOC Policy Committee as "Life and Physical Science, Engineering, Mathematics, and Information Technology Occupations" were classified as Core STEM occupations in our analysis. These include postsecondary teachers, managers, technicians, and scientists in these fields, as well as sales representatives for technical and scientific products and sales engineers.[5]

- Occupations categorized by the SOC Policy Committee as "Health Occupations" were classified as Healthcare STEM occupations in our analysis. These included health diagnosing and treating practitioners, health technologists and technicians, postsecondary health teachers, and medical and health services managers. It does not include healthcare support occupations (e.g., health aides, nursing assistants).

[4] *Options for Defining STEM (Science, Technology, Engineering, and Mathematics Occupations Under the 2010 Standard Occupational Classification (SOC) System,* SOC Policy Committee Recommendation to the Office of Management and Budget (OMB) (August 2012).

[5] Three occupations were classified by the SOC Policy Committee in multiple categories: architectural and engineering managers, architectural and civil drafters, and life, physical, and social science technicians, all other. We classified these occupations as Core STEM in our analysis.

- Occupations categorized by the SOC Policy Committee as “Social Science Occupations and “Architecture Occupations” were classified as Other STEM occupations in our analysis. These include scientists and researchers, architects and related professions, assistants, and postsecondary teachers in these fields.

The SOC Policy Committee’s *Options for Defining STEM Occupations* was based on occupations defined under the 2010 SOC, while the 2004 to 2009 OES data used a slightly different occupational classification system (the 2000 SOC). We used Bureau of Labor Statistics crosswalks between the 2000 SOC and the 2010 SOC to identify the appropriate STEM occupations throughout the period of our study.[6] We also combined detailed occupations into broader occupational groups based on the first two or three digits of the SOC codes and presented employment and wage trends for these occupational groups (e.g., computer/IT occupations). Specifically, our categories of STEM management and STEM sales in figure 6 of our report combine occupations under the two digit-SOC codes 11 (management occupations) and 41 (sales and related occupations). Other occupational categories presented in figure 6 combine occupations based on the first three digits of the SOC codes (e.g., our computer/IT category combines occupations beginning with SOC code 15-1, computer occupations).

To minimize respondent burden, the OES survey is conducted on a 3-year cycle that ensures that most establishments are surveyed at most once every three years. OES estimates are produced annually, but each year’s estimates are based on surveys conducted over a 3-year period. Following Bureau of Labor Statistics guidance for using OES data that are at least two or three years apart when examining trends over time, we present results for alternate years in appendix III (for May 2004, 2006, 2008, 2010, and 2012). We calculated standard errors for our estimates based on the relative standard errors that the Bureau of Labor Statistics provided for each employment and mean wage estimate for each occupation.

[6] The 2010 OES also used some temporary SOC codes for occupations where the estimates were based on some surveys that used the 2000 SOC and some surveys that used the 2010 SOC. We reviewed each of these temporary codes and classified them as STEM or non-STEM based on the SOC Policy Committee’s *Options for Defining STEM Occupations*.

Analysis of ACS Data

We analyzed the data from the Census Bureau's ACS to examine the unemployment rates of those in STEM and non-STEM occupations, as well as the educational backgrounds at the bachelor's degree level of those in STEM and non-STEM occupations. The ACS is an ongoing national survey which replaced the decennial census long-form questionnaire as a source for social, economic, demographic, and housing information. About 3 million households are selected for the ACS each year. The ACS questionnaire asks about the kind of work people in the household were doing in their most recent job if they worked in the last 5 years (i.e., their occupation). It also asks about the highest degree or level of school a person has completed. If the person has completed a bachelor's degree or higher, the ACS asks for the specific major(s) of any bachelor degree(s) the person has completed. The ACS also contains questions to produce estimates of the number of people who are employed, unemployed, and not in the labor force. We specifically analyzed data from the 1-year Public Use Microdata Samples for 2009 to 2012. We assessed the reliability of the data by reviewing relevant documentation and conducting electronic testing of the data. Based on our assessment, we concluded that the ACS data were sufficiently reliable for our reporting purposes.

The Census Bureau has its own system for coding occupations and fields of study in the ACS data, which are based on the SOC and the CIP, respectively. Census has also classified occupations as STEM and STEM-related (healthcare and architecture) and fields of study as science and engineering and science- and engineering-related. The Census Bureau's classifications of occupations are based on the SOC Policy Committee's *Options for Defining STEM Occupations*, though agency officials made some modifications due to their use of different coding systems. We considered any occupation that Census classified as STEM or STEM-related as STEM in our analysis of occupations, and any field of study they identified as science and engineering and science- and engineering-related as STEM in our analysis of degrees. As with our analysis of OES data, we classified occupations into our three STEM categories of Core STEM, Healthcare STEM, and Other STEM. We also combined detailed occupations and fields of study into broader categories. For example, we combined 11 specific occupations into our category of computer/IT occupations, and 6 different fields of study for the computer/IT major at the bachelor's degree level.

With regard to the unemployment rates we present, most of our estimates are for the civilian population in the labor force ages 16 and older. Our estimates of the educational background of those in STEM and non-

STEM occupations are based on the population ages 22 and older. Our estimates of the unemployment rates of those in STEM and non-STEM occupations by educational background (in figure 6 of appendix III) are for the civilian population in the labor force ages 22 and older. The Bureau of Labor Statistics has found that ACS estimates of the unemployment rate can differ from estimates produced by the Current Population Survey, a monthly survey of about 60,000 households that is the nation's source of official government statistics on employment and unemployment. The Bureau of Labor Statistics states that a number of factors may account for the differences, including overall questionnaire differences, differing requirements in the two surveys with regard to whether an individual is actively looking for work, and differences in reference periods, modes of collection, and population controls.

We calculated standard errors for our estimates using the replicate weight method. For some estimates of the unemployment rate for specific occupational categories, the margin of error exceeded 30 percent of the estimates. We note these instances in our report.

Regression Analysis

In order to compare the wages and unemployment rates of workers in STEM and non-STEM occupations with comparable personal characteristics, we ran a series of wage regressions and unemployment regressions in which we controlled for human capital characteristics (age and education) and demographic characteristics (race, ethnicity, gender, citizenship, and veterans status) as well as the worker's broad occupational category.

We used the ACS for our wage and unemployment regression analyses. We restricted our analysis to full-time, full-year workers. We restricted our analysis to full-time workers because the ACS does not collect data on whether people are salaried or hourly workers, making it difficult to use the "usual weekly hours" variable. We restricted our analysis to full-year workers because the ACS also does not collect data on weekly wages, but on earnings from wages or salary in the past year. Not all people work a full year, and people who have been unemployed for part of the year will have annual earnings that do not reflect their annual salary or hourly rate of pay. When constructing our dependent variable, we took the natural log of annual wages.

For the unemployment regressions, the outcome variable is current labor force status. People who are currently unemployed are defined as unemployed; people who are currently working or on paid leave from work are defined as not unemployed; and people who are not in the labor force are excluded from the universe. The universe is also restricted to people ages 16-64, and excludes people who have no work experience or have not worked in the past 5 years because the ACS does not collect occupation for these people.

Both sets of regressions use linear models and the same set of covariates.

Definition of STEM Education Program

For the purposes of our study, we applied the definition of a federally-funded STEM education program used in previous GAO work.[7] Specifically, we defined it as a program funded in fiscal year 2012 by allocation or congressional appropriation that had not been subsequently terminated and included one or more of the following as a primary objective:

- attract or prepare students to pursue classes or coursework in STEM areas through formal or informal education activities (informal education programs provide support for activities provided by a variety of organizations that offer students learning opportunities outside of formal schooling through contests, science fairs, summer programs, and other means; outreach programs targeted to the general public were not included),
- attract students to pursue degrees (2-year, 4-year, graduate, or doctoral degrees) in STEM fields through formal or informal education activities,
- provide training opportunities for undergraduate or graduate students in STEM fields (this could include grants, fellowships, internships, and traineeships that are targeted to students; general research grants that are targeted to researchers that may hire a student to work in the lab were not considered a STEM education program),
- attract graduates to pursue careers in STEM fields,
- improve teacher (pre-service or in-service) education in STEM areas,
- improve or expand the capacity of K-12 schools or postsecondary institutions to promote or foster education in STEM fields, or
- conduct research to enhance the quality of STEM education programs provided to students.

[7] GAO-12-108. In that report, we inventoried federal STEM education program funded in fiscal year 2010. In the current report, we inventoried those funded in fiscal year 2012.

In addition, STEM education programs may provide grants, fellowships, internships, and traineeships. While programs designed to retain current employees in STEM fields were not included, programs that fund retraining of workers to pursue a degree in a STEM field were included because these programs help increase the number of students and professionals in STEM fields by helping retrain non-STEM workers to work in STEM fields.

For the purposes of this study, we defined an organized set of activities as a single program even when its funds were allocated to other programs as well. Several programs had been eliminated or consolidated into new programs since our last inventory. We included programs that had been consolidated, but we did not include programs that had since been terminated. For a list of STEM education programs by agency, including consolidated programs, see appendix IV.

Program Selection

To identify federally-funded STEM education programs, first we developed a combined list of programs based on the findings of two previous STEM education inventories—one that we issued in 2012 and another completed by the National Science and Technology Council in 2011. Second, we shared our list with agency officials, along with our definition of STEM education program, and asked officials to make an initial determination about which programs should remain on the list and which programs should be added to the list. If agency officials indicated they wanted to remove a program from our list, we asked for additional information. For example, programs on our initial list may have been terminated or consolidated, or did not receive federal funds in fiscal year 2012.

We reviewed additional information on the programs that were not included in our 2012 inventory of STEM education programs, mainly through agency websites, program materials, or discussions with program officials. On the basis of this additional information, we excluded programs that we found did not meet our definition of a STEM education program. We also included screening questions in the survey to provide additional verification that the programs met our definition of a STEM education program. Of the 170 programs on our original survey distribution list, seven programs did not pass our screening questions because they had been eliminated since 2012, and we determined that another five did not meet our definition of a STEM education program.[8] In total, we identified 158 federal STEM education programs.

To provide more details about some of the STEM education programs with the highest reported obligations, we conducted a more in-depth review of 13 of the largest STEM education programs from three agencies: the National Science Foundation, the Department of Education, and the National Institutes of Health at the Department of Health and Human Services. [9] Seven of the selected programs served postsecondary students or institutions and six programs served K-12 students or teachers (see table 5). We reviewed documentation from each program, interviewed agency officials, and conducted site visits with grantees in Austin and San Francisco and phone interviews with grantees in Boston. We chose these sites based on geographic diversity and the prevalence of federal STEM grantees.

[8]After we had deployed our survey, program officials recommended that we exclude five programs from our review. After speaking with officials and reviewing program information, we determined that these five programs should be excluded from our list and should not complete the survey.

[9] We chose these programs because they were among the largest federal STEM education programs, collectively accounting for 54 percent of the fiscal year 2012 STEM education obligations reported by respondents to our survey.

Table 5: Science, Technology, Engineering, and Mathematics (STEM) Education Programs Reviewed In Depth

Department of Education	
Postsecondary programs	Hispanic Serving Institutions STEM and Articulation Programs
K-12 programs	Upward Bound Math-Science
	Mathematics and Science Partnerships
Department of Health and Human Services (National Institutes of Health)	
Postsecondary programs	Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants
	Ruth L. Kirschstein NRSA for Individual Predoctoral Fellows, including Under-represented Racial/Ethnic Groups, Students from Disadvantaged Backgrounds, and Predoctoral Students with Disabilities
National Science Foundation	
Postsecondary programs	Graduate Research Fellowship Program
	Integrative Graduate Education and Research Traineeship Program
	Louis Stokes Alliances for Minority Participation
	Research Experiences for Undergraduates
K-12 programs	Advancing Technological Education
	Discovery Research K-12
	Advanced Informal Science Learning
	Math and Science Partnership

Source: GAO.

Survey

Design and Implementation

We developed a web-based survey to collect information on federal STEM education programs. The survey included questions on program objectives, occupations targeted, methods used to identify targeted occupations, and factors considered when selecting grantees. We created a list of possible workforce needs using input from experts, program officials, and grantees, and asked federal STEM education programs to indicate whether each possible workforce need was a stated program objective, a potential benefit of the program, or neither. The survey also asked programs to update information provided in our survey for the 2012 report on target groups served, services provided, outcome measures, and obligations. To minimize errors arising from differences in how questions might be interpreted and to reduce variability in responses that should be qualitatively the same, we conducted pretests with six different programs in August and September 2013. To ensure that we obtained a variety of perspectives on our survey, we selected programs from six different agencies that differed in program scope, objectives, services provided, and target groups served. An independent GAO reviewer also reviewed a draft of the survey prior to its administration. On the basis of feedback from these pretests and independent review, we revised the survey in order to improve its clarity.

After completing the pretests, we administered the survey. On October 29 or November 13, 2013, we sent an e-mail message to the officials responsible for the 158 programs selected for our review that informed them that the survey was available online. In that e-mail message, we also provided them with unique passwords and usernames. We made telephone calls to officials and sent them follow-up e-mail messages, as necessary, to clarify their responses or obtain additional information. We received completed surveys from 154 programs, for a 97 percent response rate.[10] We collected survey responses through February 14, 2014.

Of the 154 federal STEM education programs that responded to our survey, 124 programs in 13 agencies primarily served students and teachers at the postsecondary level.[11] According to our survey, these programs' reported fiscal year 2012 obligations ranged from zero to $348 million and totaled $1.9 billion. We identified 30 programs in 10 agencies that primarily serve students and teachers at the K-12 level.[12] According to our survey, these programs reported obligations totaling approximately $685 million in fiscal year 2012 in amounts ranging from $1,200 to $148 million.

[10] Four programs did not respond to our survey, all from the National Oceanic and Atmospheric Administration. They were the education programs housed in the National Marine Sanctuaries; National Environmental Satellite, Data, and Information Service; National Ocean Service; and National Weather Service.

[11] These agencies are the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Nuclear Regulatory Commission, and the U.S. Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Homeland Security, Interior, and Transportation.

[12] These agencies are the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, and the U.S. Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, and Transportation.

Analysis of Responses and Data Quality

We used standard descriptive statistics to analyze survey responses. The STEM education programs in our survey received widely varying amounts of federal funding. This introduced the possibility that a few very large programs—accounting for the majority of obligations—could pursue one activity, while many small programs—accounting for the majority of programs but a small proportion of obligations—could pursue another activity. To accurately capture the survey data, we analyzed it both in terms of the percentage of programs answering each question and the corresponding percentage of obligations. In cases where these proportions differed, we presented both. Amounts obligated for each program for fiscal year 2012 were reported to us by agency officials in response to our survey. We did not independently verify this information.

Because this was not a sample survey, there are no sampling errors. To minimize other types of errors—commonly referred to as nonsampling errors—and to enhance data quality, we employed recognized survey design practices in the development of the survey and in the collection, processing, and analysis of the survey data. For instance, as previously mentioned, we pretested the survey with federal officials to minimize errors arising from differences in how questions might be interpreted and to reduce variability in responses that should be qualitatively the same. We further reviewed the survey to ensure the ordering of survey sections was appropriate and that the questions within each section were clearly stated and easy to comprehend. To reduce nonresponse, another source of nonsampling error, we sent out e-mail reminder messages to encourage officials to complete the survey. To assess the reliability of data provided in our survey, we performed automated checks to identify inappropriate answers. We further reviewed the data for missing or ambiguous responses and followed up with agency officials when necessary to clarify their responses. While we did not verify all responses, on the basis of our application of recognized survey design practices and follow-up procedures, we determined that the data used in this report were of sufficient quality for our purposes.

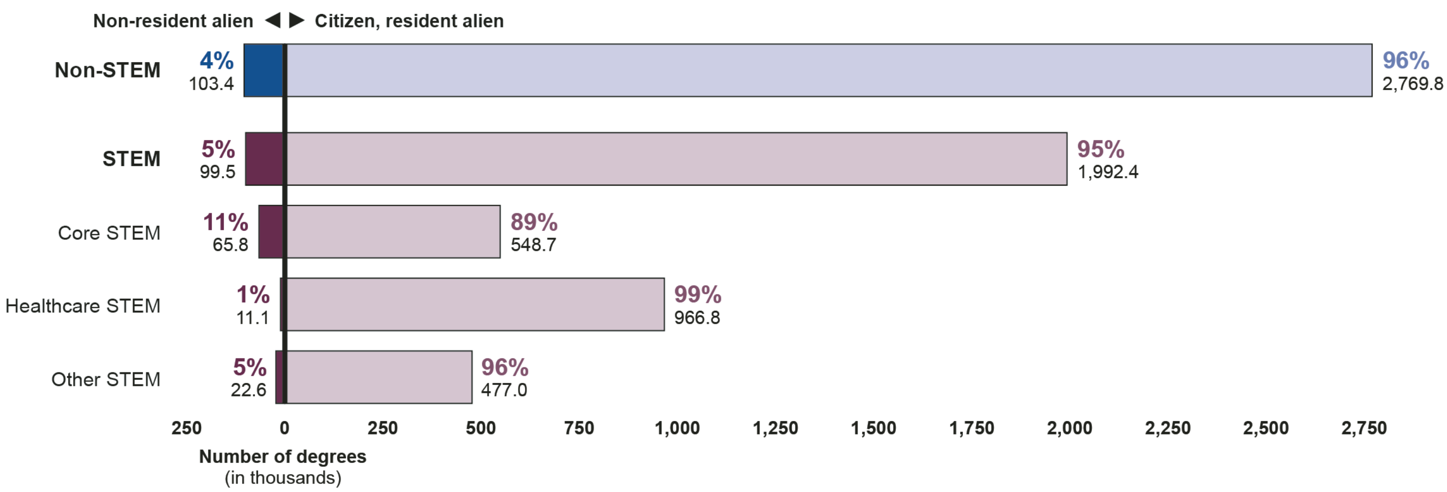
Appendix II: Demographics of Science, Technology, Engineering, and Mathematics (STEM) Degree Recipients

The figures below show demographic information for students who received STEM degrees in the 2011-2012 academic year.

STEM Degrees Awarded to Non-Resident Alien Students

Overall, degrees awarded to non-resident alien students—students in the United States on temporary visas—comprised 5 percent of all STEM degrees and 4 percent of all non-STEM degrees awarded in the 2011-2012 academic year (see fig. 15). However, degrees awarded to non-resident alien students represented a larger share of Core STEM degrees (11 percent) and a smaller share of Healthcare degrees (1 percent).

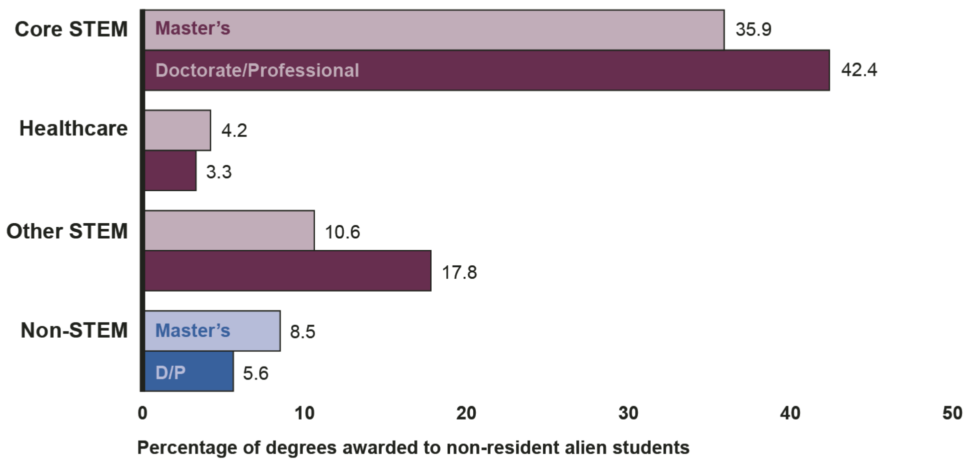
Figure 15: Degrees Awarded to Non-Resident Alien Students and to Citizens and Resident Aliens, 2011-2012 Academic Year



Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Non-resident alien students were particularly concentrated at the graduate degree levels in Core STEM fields, receiving 36 percent of master's degrees awarded and 42 percent of doctorate or professional degrees in Core STEM fields in the 2011-2012 academic year (see fig. 16).

Figure 16: Percent of Master's and Doctorate/Professional Degrees Awarded to Non-Resident Alien Students, 2011-2012 Academic Year



Source: GAO analysis of Integrated Postsecondary Education Data System (IPEDS) data.

Table 6 lists the STEM fields of study and degree levels in which non-resident alien students comprised more than 30 percent of the degrees awarded.

Table 6: Science, Technology, Engineering, and Mathematics (STEM) Fields of Study in which Non-Resident Alien Students Received Over 30 Percent of the Degrees Awarded in the 2011-2012 Academic Year

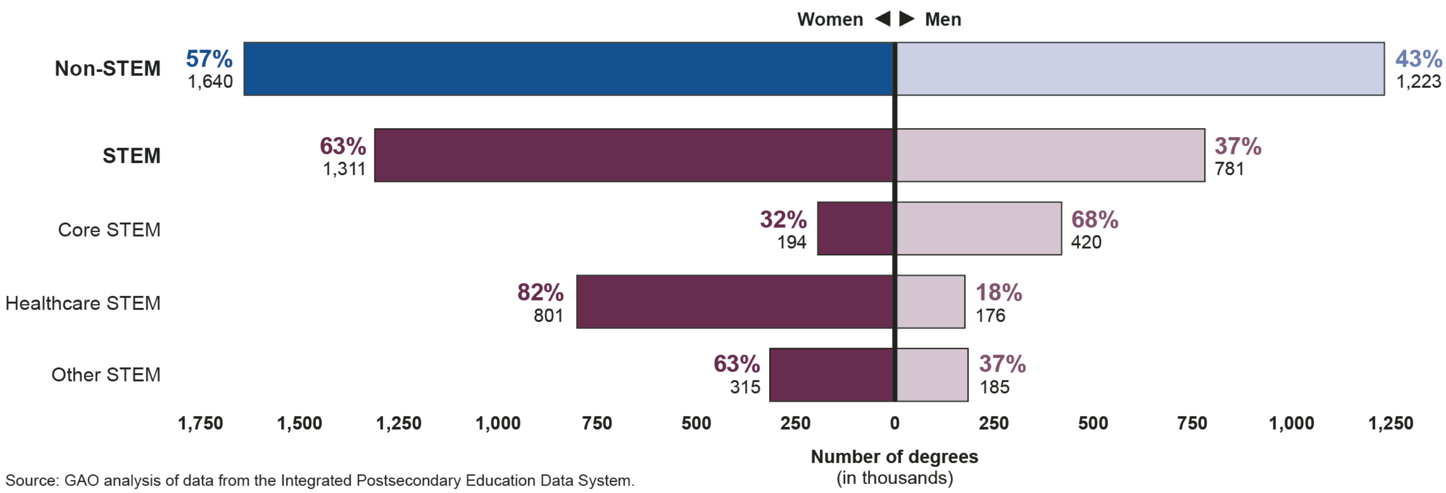
STEM Field	Award Level	Degrees Awarded to Non-Resident Alien Students	Degrees Awarded to Citizens and Resident Aliens	Percentage of Degrees Awarded to Non-Resident Alien Students
Core STEM Fields				
Computer science/IT	Master's	9,402	12,068	44
	Doctorate	873	826	51
Engineering	Master's	17,192	24.316	41
	Doctorate	4,892	3,877	56
Mathematics	Master's	2,712	3,935	41
	Doctorate	820	854	49
Physical sciences	Doctorate	2,155	3,244	40
Other STEM Fields				
Architecture	Doctorate	102	106	49
Social sciences	Doctorate	1,526	3,271	32

Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

STEM Degrees by Gender

Overall, most (63 percent) of the STEM degrees awarded in the 2011-2012 academic year were awarded to women. However, as figure 17 shows, while women received the large majority (82 percent) of Healthcare STEM degrees that year, men received the majority of Core STEM degrees (68 percent).[1]

Figure 17: Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Degrees Awarded, by Gender, 2011-2012 Academic Year



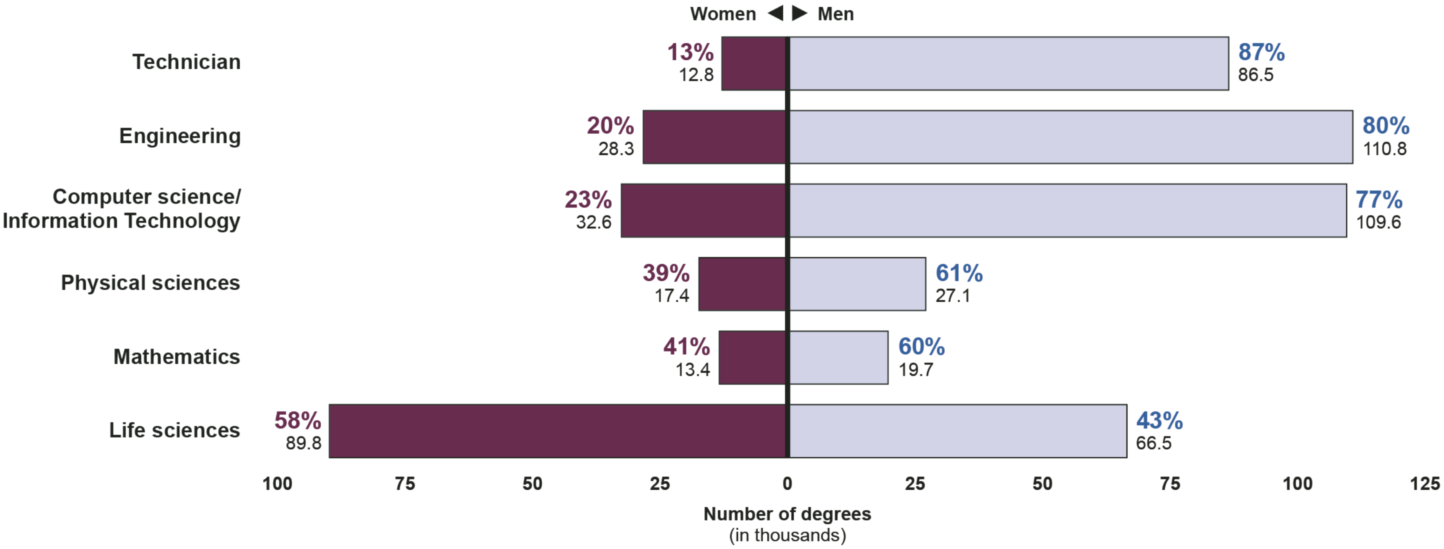
Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Among the Core STEM fields, men received the majority of degrees in computer science/information technology, engineering, technician, mathematics, and physical science fields. [2] Women received the majority of life sciences degrees (see fig. 18).

[1] Men received the majority of Core STEM degrees at all levels (less than bachelor's, bachelor's, post-bachelor's certificates, master's, and doctorate/professional). Women received the majority of Healthcare degrees at all levels. At the doctorate/professional level, women's share of Healthcare STEM degrees awarded has increased from 51 percent in the 2002-2003 academic year to 58 percent in the 2011-2012 academic year.

[2] Men received the majority of postsecondary degrees in these fields at all degree levels. Women received the majority of life sciences degrees at all degree levels.

Figure 18: Degrees Awarded in Core Science, Technology, Engineering, and Mathematics (STEM) Fields, by Gender, 2011-2012 Academic Year



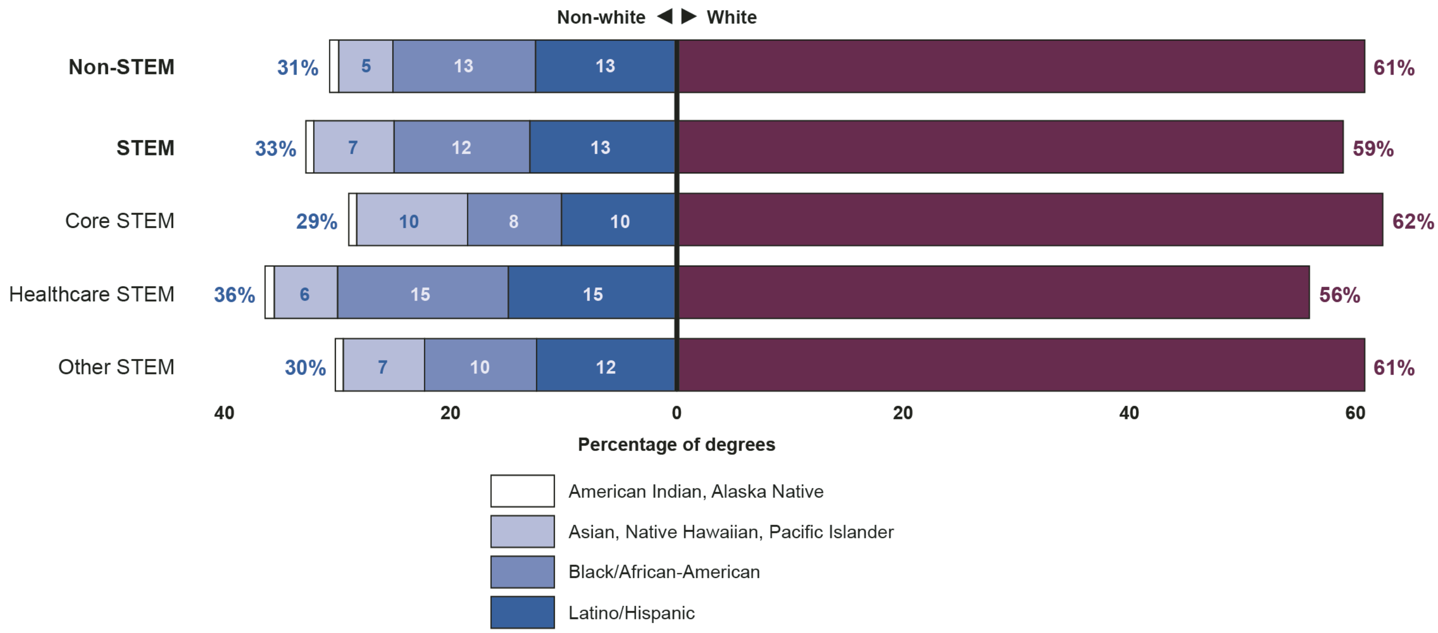
Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: Percentages may not total 100 due to rounding.

STEM Degrees by Race/Ethnicity

Among U.S. citizens and resident aliens, Asians and Pacific Islanders received a larger share of STEM degrees (7.1 percent), compared to their share of the non-STEM degrees (4.8 percent) (see fig. 19). Other groups' share of STEM degrees was about the same as or less than their share of non-STEM degrees. Examining the data by STEM categories, however, African-Americans received a larger share of Healthcare degrees (15.1 percent), compared to their share of non-STEM degrees (12.6 percent).

Figure 19: Racial and Ethnic Composition of Postsecondary Degrees Awarded in the 2011-2012 Academic Year

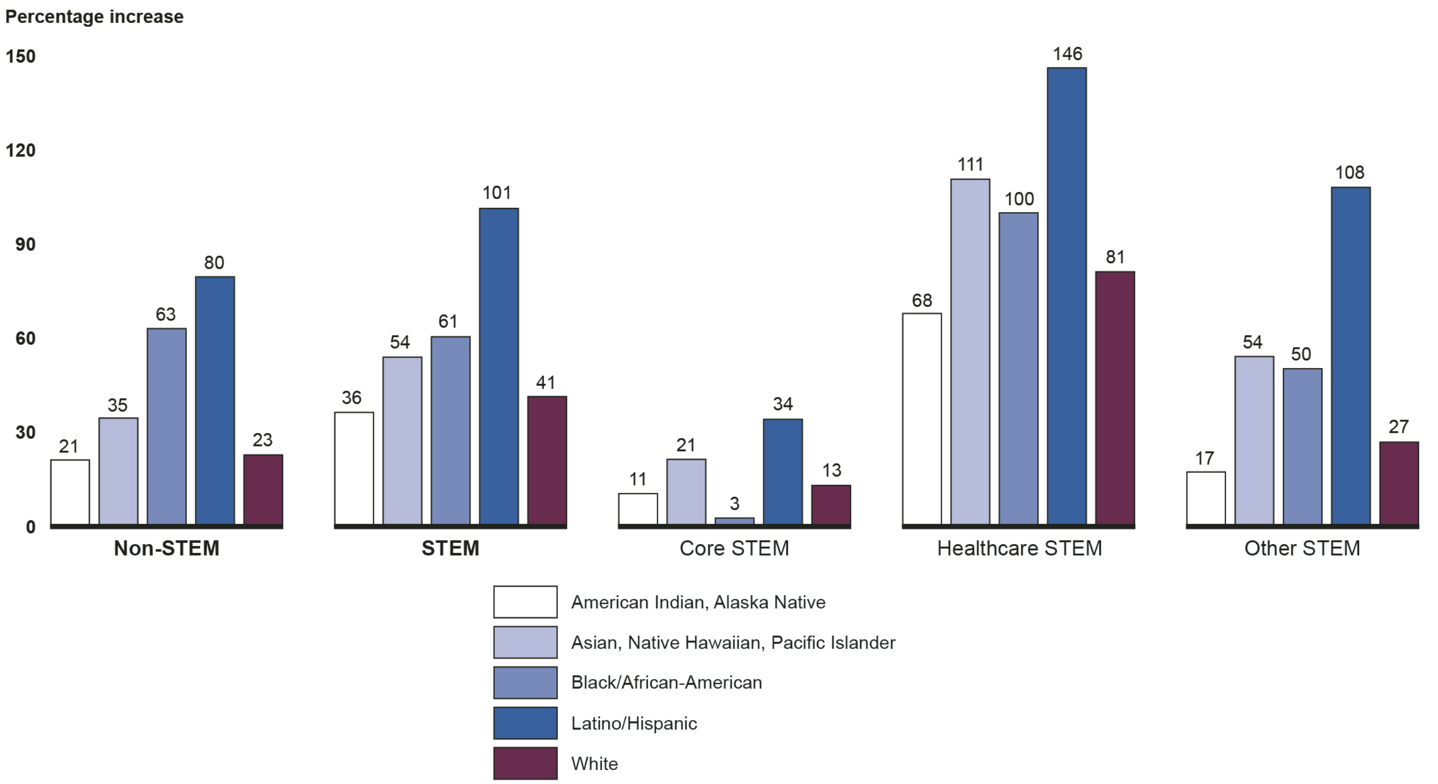


Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

Note: This figure presents information on degrees awarded to citizens and resident aliens only. It does not include degrees awarded to non-resident aliens. Percentages for the non-white demographic groups may not total the percentages on the left of each bar due to rounding. The percentages for degrees awarded to American Indian, Alaska Native students are: 0.8 percent for non-STEM, 0.7 percent for STEM, 0.7 percent for Other STEM and Core STEM, and 0.8 percent for Healthcare. Not shown in the figure are degrees awarded to citizens and resident aliens of more than one race or of unknown race. As a result, the percentages on the left of each bar and the percentages on the right of each bar do not total 100. In the 2011-2012 academic year, degrees received by students of more than one race comprised: 1.3 percent of STEM degrees awarded to citizens and residents, 1.4 percent of non-STEM degrees, 1.4 percent of Core STEM degrees, 1.3 percent of Healthcare degrees, and 1.8 percent of Other STEM degrees. Degrees received by students whose race is unknown comprised 6.9 percent of STEM degrees awarded to citizens and resident aliens, 7.3 percent of non-STEM degrees, 7.2 percent of Core STEM degrees, 6.5 percent of Healthcare degrees, and 7.2 percent of Other STEM degrees.

Overall, STEM degrees awarded to Latino/Hispanic students increased more than other groups from the 2002-2003 to 2010-2011 academic years. STEM degrees have also increased at a higher rate among Asians and African-Americans, compared to whites. The increase among African-Americans was primarily in Healthcare and Other STEM fields (see fig. 20).

Figure 20: Percentage Increase in Postsecondary Degrees from the 2002-2003 to 2010-2011 Academic Years



Source: GAO analysis of data from the Integrated Postsecondary Education Data System.

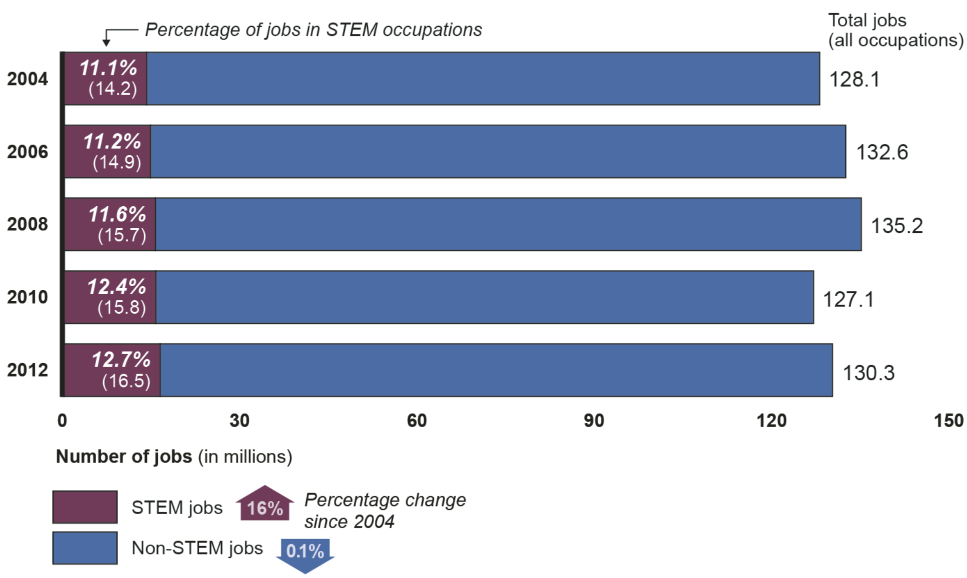
Appendix III: Employment and Wage Trends in STEM and non-STEM Occupations

This appendix provides more detailed information about recent trends in STEM and non-STEM occupations.

Trends in STEM and Non-STEM Employment Levels

Figure 21 shows the number of jobs in STEM and non-STEM occupations from 2004 to 2012. While the overall number of jobs in STEM occupations increased throughout this time period, the number of jobs in non-STEM occupations declined during the recession.[1]

Figure 21: Employment in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Occupations, 2004 to 2012



Source: GAO analysis of Occupational Employment Statistics data.

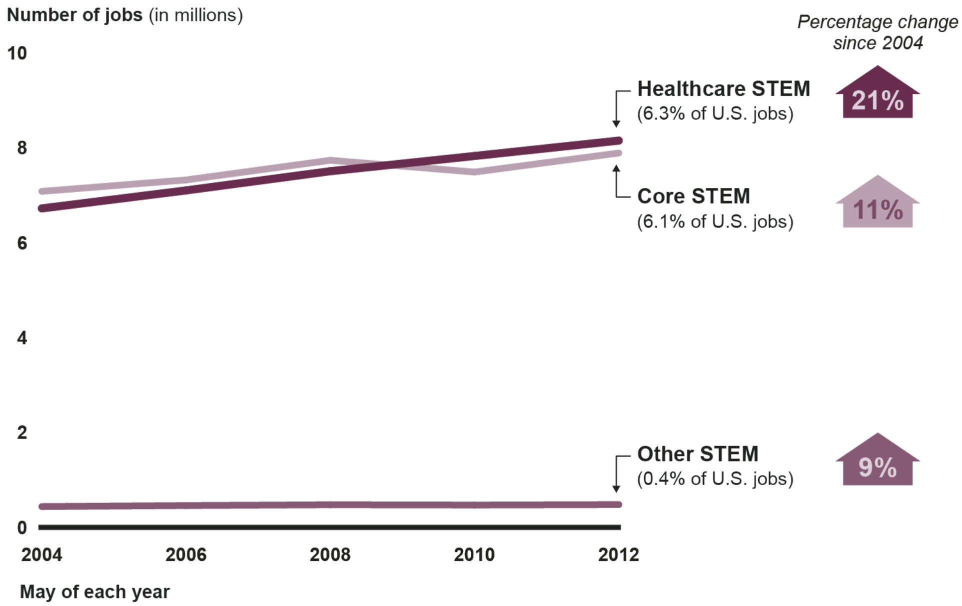
Note: Estimates of the number of jobs in STEM occupations shown in this figure have margins of error within plus or minus 0.5 percent of the estimate. Estimates of the number of jobs in non-STEM occupations have margins of error within plus or minus 0.2 percent of the estimate. With regard to the share of jobs in STEM occupations, the estimates have margins of error within plus or minus 0.1 percentage points. With regard to the percentage change in employment levels between May 2004 and May 2012, the estimates shown in this figure have margins of error within 0.3 percentage points. The difference between STEM and non-STEM occupations in the percentage change in employment levels between May 2004 and May 2012 is statistically significant at the 95 percent confidence level.

However, the trends vary by STEM categories. The number of jobs in Healthcare occupations steadily increased from 2004 to 2012, even

[1] The recent recession officially began in December 2007 and ended in June 2009.

during the recession (see fig. 22). The number of jobs in Core STEM occupations, however, declined during the recession years, though it has increased since then.

Figure 22: Employment in Science, Technology, Engineering, and Mathematics (STEM) Occupations, 2004-2012



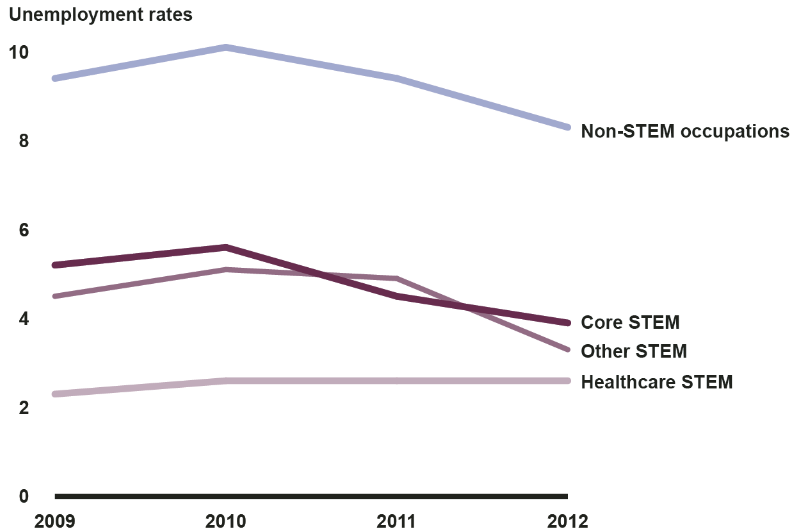
Source: GAO analysis of Occupational Employment Statistics data.

Note: Estimates of the number of jobs in Core STEM and Healthcare occupations have margins of error within plus or minus 0.7 percent. Estimates of the number of jobs in Other STEM occupations have margins of error within 2 percent of the estimate. With regard to the share of jobs in each category, the estimates have margins of error within plus or minus 0.03 percentage points. With regard to the percentage change in employment between May 2004 and May 2012, the estimates for Core STEM and Healthcare occupations shown in this figure have margins or error within plus or minus 0.4 percentage points. The estimate for the percentage change in jobs in Other STEM occupations between May 2004 and May 2012 has a margin of error within plus or minus 1.1 percentage points. The differences between the three STEM categories in the percentage change in employment levels between May 2004 and May 2012 are statistically significant at the 95 percent confidence level.

Trends in STEM and Non-STEM Unemployment Rates

Unemployment rates in all three STEM categories have been relatively low from 2009 to 2012— about 5 percent or less—while rates in non-STEM occupations have been about 8 percent or higher. Unemployment rates in Healthcare occupations have been the lowest among the STEM categories, at less than 3 percent (see fig. 23).

Figure 23: Unemployment Rates in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Occupations, 2009 to 2012



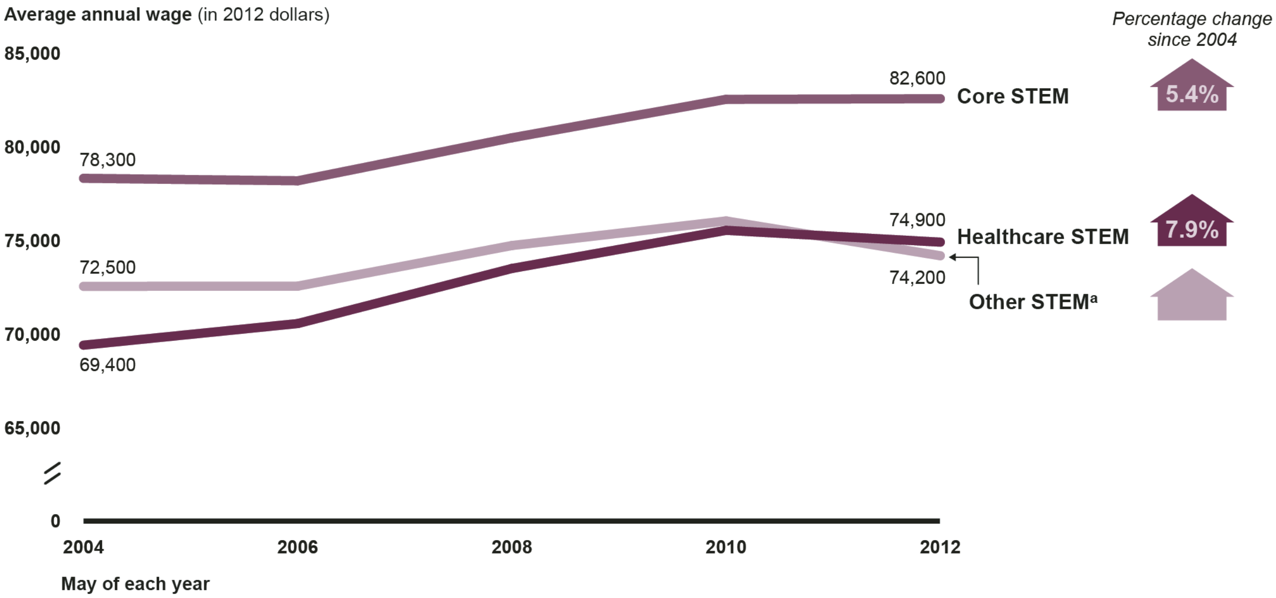
Source: GAO analysis of American Community Survey data.

Note: Estimates of unemployment rates for non-STEM, Core STEM and Healthcare STEM occupations shown in this figure have margins of error that are within plus or minus 0.2 percentage points. Estimates of unemployment rates for Other STEM occupations shown in this figure have margins of error that are within plus or minus 0.8 percentage points.

Trends in STEM Average Wages

Figure 24 shows trends in the average wage in the three STEM categories. The average wage was highest in core STEM occupations, but the greatest increase in wages occurred in healthcare occupations.

Figure 24: Average Annual Wage in Science, Technology, Engineering, and Mathematics (STEM) Occupations, 2004 to 2012



Source: GAO analysis of Occupational Employment Statistics data.

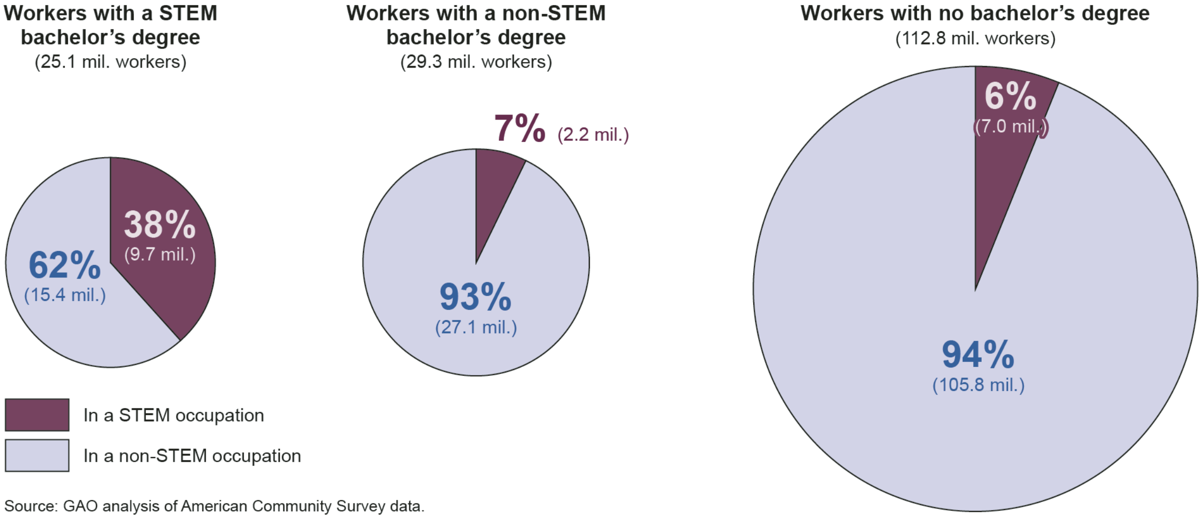
Note: Estimates shown in this figure of the average wage in Core STEM and Healthcare occupations have margins of errors within plus or minus 1.2 percent of the estimate. Estimates of the average wage in Other STEM occupations have margins of error within plus or minus 2.8 percent of the estimate. With regard to the percentage change in average wage between May 2004 and May 2012, the estimates for Core STEM and Healthcare occupations have margins of error within plus or minus 0.8 percentage points. The differences between the three STEM categories in the percentage change in the average wage between May 2004 and May 2012 are all statistically significant at the 95 percent confidence level.

[a]We do not report an estimate for this value because the margin of error at the 95 percent confidence level exceeds 30 percent of the estimate. The 95 percent confidence interval for the percentage change in average wage in Other STEM occupations is 0.5 to 4.0 percent.

Education and Occupation

Thirty-eight percent of people with STEM bachelor's degree were working in STEM occupations in 2012, and the majority worked in non-STEM occupations. Figure 25 shows that much smaller percentages of workers with non-STEM bachelor's degrees or without a bachelor's degree worked in STEM occupations. However, they represented about half of workers in STEM occupations.

Figure 25: Percentage of Workers in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Occupations by Educational Background, 2012

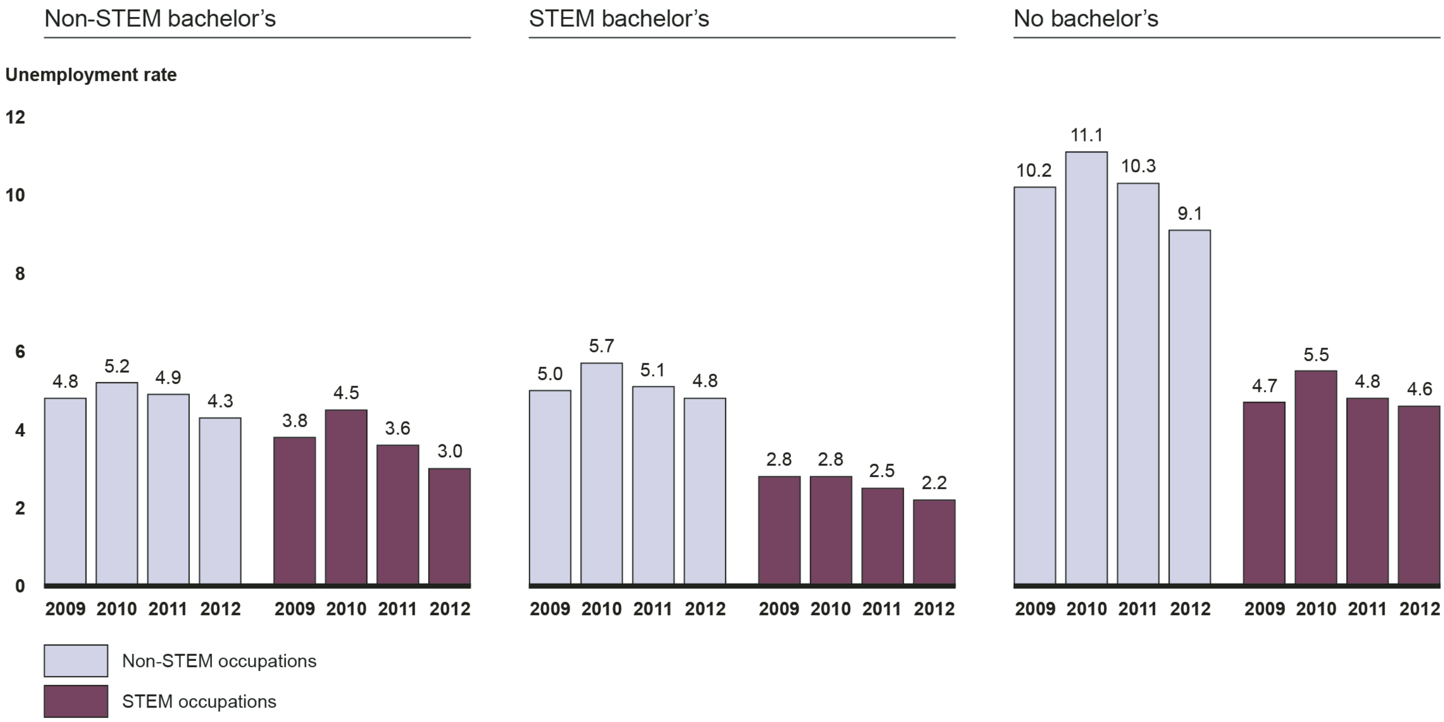


Source: GAO analysis of American Community Survey data.

Note: Estimates of the percentages in STEM and non-STEM occupations have margins of error that are within plus or minus 0.2 percentage points. Population estimates shown in this figure in parentheses have margins of error that are within plus or minus 0.02 percent of the estimate.

Figure 26 shows the unemployment rates for the groups of workers shown in figure 25.

Figure 26: Unemployment Rates in Science, Technology, Engineering, and Mathematics (STEM) and Non-STEM Occupations, by Educational Background, 2009 to 2012

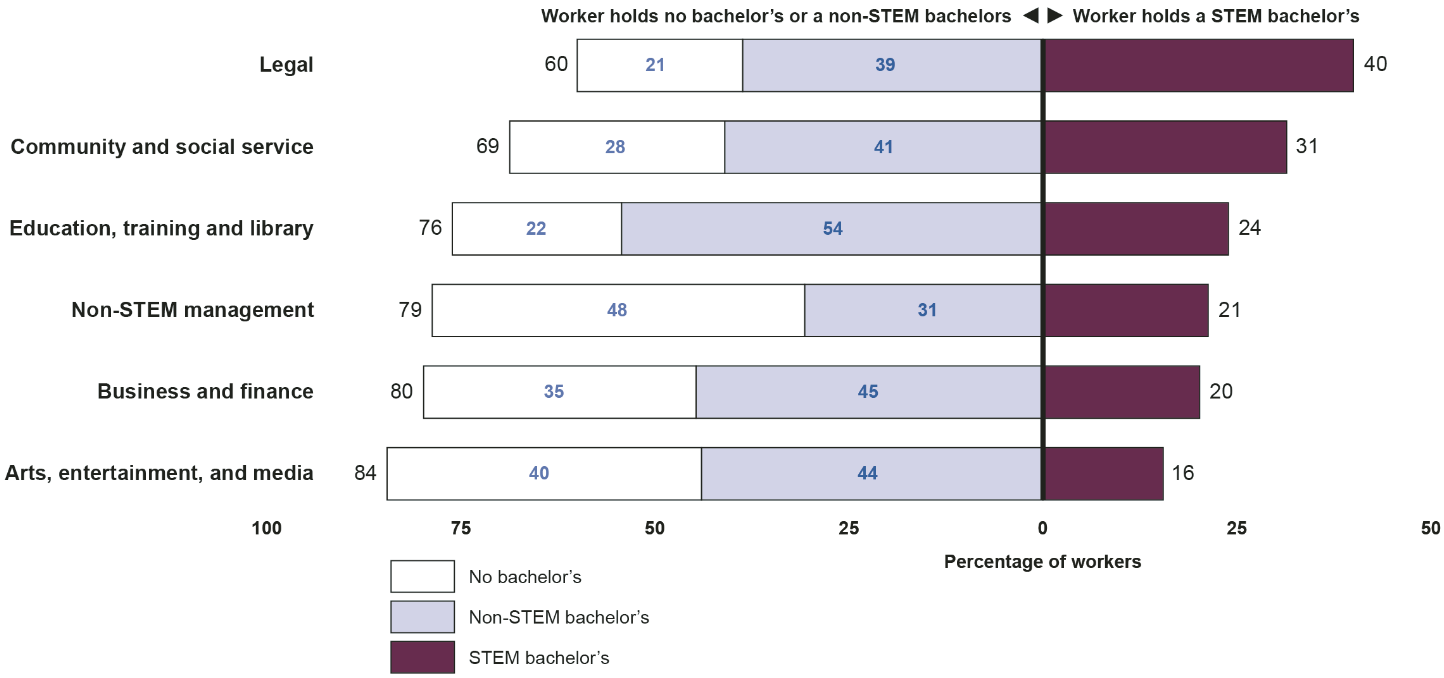


Source: GAO analysis of American Community Survey data.

Note: Estimates of the unemployment rate shown in this figure have margins of error that are within plus or minus 0.3 percentage points. Within each of the categories of STEM and non-STEM occupations, the differences between the non-STEM bachelor's, STEM bachelor's, and no bachelor's categories are statistically significant at the 95 percent confidence level in each of the years shown.

Figure 27 shows some non-STEM occupations with sizable populations of workers with STEM bachelor's degrees.

Figure 27: Educational Backgrounds of Workers Ages 22 or Older in Selected Non-Science, Technology, Engineering, and Mathematics (STEM) Occupations, 2012



Source: GAO analysis of American Community Survey data.

Note: Estimates of the percentage of each occupational group in the education categories shown in this figure have margins of error that are within plus or minus 0.9 percentage points.

Appendix IV: Science, Technology, Engineering, and Mathematics (STEM) Programs and Reported FY 2012 Obligations

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
NASA	Aeronautics Research Directorate - STEM Education activities	$3,300,000
	Aerospace Research and Career Development (ARCD) Program	$58,000,000
	Informal Education	$10,000,000
	Minority University Research and Education Project (MUREP)	$30,000,000
	Science Directorate - STEM Education activities	$41,000,000
	STEM Education and Accountability Projects — Higher Education	$21,000,000
	STEM Education and Accountability - Formal and Informal Education	$21,000,000
	Human Exploration and Operations (HEO) Mission Directorate -STEM Education Activities	$4,300,000
National Science Foundation	Advanced Technological Education (ATE)	$64,070,000
	Advancing Informal STEM Learning	$62,430,000
	Alliances for Graduate Education and the Professoriate (AGEP)	$7,840,000
	Discovery Research K-12 (DR-K12)	$99,570,000
	East Asia & Pacific Summer Institutes for U.S. Graduate Students (EAPSI)	$2,000,000
	Research in Engineering Education	$11,810,000
	Ethics Education in Science & Engineering (EESE)	$3,060,000
	CyberCorps(R): Scholarship for Service (SFS)	$44,980,000
	Graduate Research Fellowship (GRF) Program	$197,930,000
	Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	$31,850,000
	Integrative Graduate Education and Research Traineeship (IGERT) Program	$65,430,000
	International Research Experiences for Students (IRES)	$100,000
	Louis Stokes Alliances for Minority Participation (LSAMP)	$45,480,000
	Math and Science Partnership Program (MSP)[b]	$57,070,000
	Nanotechnology Undergraduate Education in Engineering	$1,880,000
	Research Experiences for Teachers (RET) in Engineering and Computer Science	$7,870,000
	Research Experiences for Undergraduates (REU)	$79,550,000
	Research on Education and Learning (REAL)[c]	$54,160,000
	Robert Noyce Scholarship (Noyce) Program	$54,890,000
	Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)	$25,300,000
	Transforming Undergrad Education in STEM (TUES)	$39,060,000
	Tribal Colleges and Universities Program (TCUP)	$13,390,000

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
Nuclear Regulatory Commission	Grants to Universities/Curriculum Development	$4,021,989
	Integrated University Program	$14,682,692
	Minority Serving Institutions Program	$2,800,000
Department of Agriculture		
Animal and Plant Health Inspection Service	AgDiscovery Program	$766,493
National Institute of Food and Agriculture	1890 Institution Teaching, Research and Extension Capacity Building Grants Program	$22,456,532
	Agriculture in the Classroom	$430,000
	Distance Education Grants Program for Institutions of Higher Education in Insular Areas	$7,500,000
	Food and Agricultural Sciences National Needs Graduate and Postdoctoral Fellowships Grants Program	$2,849,063
	Higher Education Challenge Grants Program	$4,500,000
	Higher Education Multicultural Scholars Program	$875,670
	Hispanic-Serving Institutions Education Grants Program	$9,000,000
	Resident Instruction Grants Program for Institutions of Higher Education in Insular Areas	$900,000
	Secondary Education, Two-Year Postsecondary Education and Agriculture in the K-12 Classroom Grants	$800,000
Office of the Assistant Secretary for Departmental Management	1890 National Scholars Program	$3,014,685
Department of Commerce		
National Institute of Standards and Technology	NIST Summer Institute for Middle School Science Teachers	$300,000
	Summer Undergraduate Research Fellowship (SURF) Program	$880,190
National Oceanic and Atmospheric Administration (NOAA)	Bay Watershed Education and Training (B-WET) Program	$5,490,619
	Environmental Literacy Grants	$2,626,990
	Dr. Nancy Foster Scholarship Program	$453,657
	Educational Partnership Program with Minority Serving Institutions	$12,500,000
	Ernest F. Hollings Undergraduate Scholarship Program	$4,959,273
	National Environmental Satellite, Data, and Information Service (NESDIS) Education	[d]
	National Marine Sanctuaries Education Program	[d]
	National Ocean Service (NOS) Education	[d]
	National Sea Grant College Program	$1,118,000
	National Weather Service (NWS) Education	[d]

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
	Teacher at Sea Program	$600,000
Department of Defense		
Air Force	National Defense Science and Engineering Graduate (NDSEG) Fellowship	$38,739,774
Army	Army Educational Outreach Program (AEOP)	$7,724,000
Navy	Navy STEM2Stern	$11,170,000
Department of Education	Developing Hispanic-Serving Institutions: STEM and Articulation Programs	$100,000,000
	Graduate Assistance in Areas of National Need	$30,873,072[e]
	Mathematics and Science Partnerships	$148,353,872[f]
	Minority Science and Engineering Improvement Program	$9,466,075
	Research in Special Education	$3,300,000
	Research, Development, and Dissemination	$31,200,000
	Strengthening Predominantly Black Institutions[g]	$15,000,000
	Upward Bound Math-Science	$44,141,410
Department of Energy[h]	Advanced Vehicle Competitions	$1,991,000[i]
	American Chemical Society Summer School in Nuclear and Radiochemistry	$561,000
	ASCR-ORNL Research Alliance in Math and Science	$250,000
	Community College Internships	$599,000[j]
	Computational Science Graduate Fellowship	$6,000,000
	Diversity in Science and Technology Advances National Clear Energy (DISTANCE)-Solar[k]	$365,000[l]
	Industrial Assessment Centers	$6,000,000
	Hampton University Graduate Studies	$46,000
	HBCU Mathematics, Science and Technology, Engineering and Research Workforce Development Program	$8,000,000
	Integrated University Program	$5,000,000
	Laboratory Equipment Donation Program	$124,000[m]
	Mickey Leland Energy	$655,000
	Minority Educational Institution Student Partnership Program (MEISPP)	$700,000
	National Science Bowl	$1,854,000[n]
	National Undergraduate Fellowship Program in Plasma Physics and Fusion Energy Sciences	$370,000
	Pan American Advanced Studies Institute	$200,000
	Plasma/Fusion Science Educator Programs	$209,000[o]
	QuarkNet	$610,000
	Science Undergraduate Laboratory Internships	$6,387,000[p]
	Solar Decathlon	$4,200,000[q]
	Summer Applied Geophysical Experience (SAGE)	$0[r]

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
	Visiting Faculty Program	$1,179,000[s]
Department of Health and Human Services		
Health Resources and Services Administration	Health Careers Opportunity Program	$14,779,000
National Institutes of Health	Bridges to the Baccalaureate Program	$8,200,000
	Bridges to the Doctorate	$3,600,000
	Cancer Education Grants Program (R25)	$12,473,029
	CCR/JHU Master of Science in Biotechnology Concentration in Molecular Targets and Drug Discovery Technologies	$301,400
	Center for Cancer Research Cancer Research Interns	$206,604
	Community College Summer Enrichment Program	$92,000
	Educational Programs for Demography and Population Science, Family Planning and Contraception, and Reproductive Research	$0[t]
	Graduate Program Partnerships	$11,121,000
	Initiative for Maximizing Student Development	$23,300,000
	Initiative to Maximize Research Education in Genomics	$1,336,000
	Intramural NIAID Research Opportunities	$935,429
	MARC U-STAR NRSA Program	$21,300,000
	Medical Infomatics Training Program	$6,074,705
	Medical Research Scholars Program	$1,100,000
	National Cancer Institute Cancer Education and Career Development Program (R25)	$18,285,877
	NIH Science Education Partnership Award (SEPA)	$18,616,000
	NIA MSTEM: Advancing Diversity in Aging Research (ADAR) through Undergraduate Education	$356,667
	NIAID Science Education Awards	$1,230,000
	Educational Programs for Population Research (R25)	$586,486
	NIDDK Education Program Grants	$322,529
	NIH Academy	$224,000
	NIH Summer Research Experience Programs	$1,951,274
	NIMH Mentoring Networks for Mental Health Research Education	$0[u]
	NIMH Research Education Programs for HIV/AIDS Research	$4,550,000
	NIMH Short Courses for Mental Health-Related Research Education	$0[v]
	NINR Summer Genetics Institute	$62,000
	Post-baccalaureate Intramural Research Training Award Program	$24,400,000
	Postbaccalaureate Research Education Program (PREP)	$7,700,000

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
	Research Education Grants for Statistical Training in the Genetics of Addiction	$683,058
	Research Supplements to Promote Diversity in Health-Related Research	$31,190,209
	RISE (Research Initiative for Scientific Enhancement)	$28,600,000
	Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants (T32, T35)	$348,287,734
National Institutes of Health	Ruth L. Kirschstein NRSA for Individual Predoctoral Fellows, including Fellowships to Promote Diversity in Health-Related Research	$58,784,787
	Science Education Drug Abuse Partnership Award	$1,189,795
	Short Courses on Mathematical, Statistical, and Computational Tools for Studying Biological Systems	$1,200,000
	Short-Term Research Education Program to Increase Diversity in Health-Related Research	$4,706,540
	Student Intramural Research Training Award Program	$4,500,000
	Summer Institute for Training in Biostatistics	$0[w]
	Team-Based Design in Biomedical Engineering Education	$530,397
	Technical Intramural Research Training Award	$2,209,000
	Training in Computational Neuroscience: From Biology to Model and Back Again	$2,022,614
	Training in Neuroimaging: Integrating First Principles and Applications	$1,225,649
	Undergraduate Scholarship Program for Individuals from Disadvantaged Backgrounds	$2,400,000
Department of Homeland Security		
Science and Technology Directorate	Education - Career Development Grant Awards	$2,700,000
	HS-STEM Summer Internship Program	$350,000
	Minority Serving Institutions - Scientific Leadership Awards	$2,850,000
	Minority Serving Institutions - Summer Research Team	$600,000
Department of the Interior		
United States Geological Survey	EDMAP Component of the National Cooperative Geologic Mapping Program	$492,493
	National Association of Geoscience Teachers (NAGT)-USGS Cooperative Summer Field Training Program	$0
	Student Intern in Support of Native American Relations (SISNAR)	$0
Bureau of Land Management	Conservation and Land Management Internship Program	$2,500,000
National Park Service	Geoscientists-in-the-Parks Program	$596,090
Department of Transportation		
Federal Aviation Administration	Joint University Program	$450,000
	National Center of Excellence for Aviation Operations Research (NEXTOR)	$6,740,000

Agency	Program	Fiscal Year 2012 STEM education program obligations[a]
Federal Highway Administration	Garrett A. Morgan Technology and Transportation Education Program	$1,161,862
	National Summer Transportation Institute Program	$3,000,000
	Summer Transportation Internship Program for Diverse Groups	$1,100,000
Research and Innovative Technology Administration	University Transportation Centers Program	$72,000,000
Environmental Protection Agency	Cooperative Agreements for Training Cooperative Partnerships	$655,210
	Environmental Education Grants	$2,160,000
	EPA Marshall Scholars Program	$150,000
	Greater Research Opportunities Undergraduate Fellowship Program	$1,900,000
	National Environmental Education and Training Partnership	$2,259,500
	P3 Award: National Student Design Competition for Sustainability	$2,711,000
	President's Environmental Youth Awards	$1,200
	Science to Achieve Results Graduate Fellowship Program	$15,600,000
	Environmental Research Training Program	$1,391,069

Source: GAO survey of STEM education programs.

Note: Amounts obligated for each program for fiscal year 2012 were reported to us by agency officials in response to our survey. We did not independently verify this information.

[a]A few programs had zero obligations for fiscal year 2012. We determined that these programs still fit our definition of a STEM education program because they received federal funding and had not been terminated.

[b]The Math and Science Partnership program was consolidated with other programs into the Science, Technology, Engineering, Mathematics, including Computing Partnerships (STEM-C Partnerships) program in FY 2014.

[c]REAL combines three programs: Research and Evaluation on Education in Science and Engineering, Research in Disabilities Education, and Research on Gender in Science and Engineering.

[d]This program existed in fiscal year 2012, but did not respond to our survey.

[e]In response to our survey, Education reported $30,973,072 in obligations for the Graduate Assistance in Areas of National Need program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Education, they reported that the actual obligations for fiscal year 2012 were $30,873,072. This represents a decrease of 0.32 percent from the reported program obligations and a decrease of 0.01 percent of total reported post-secondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission. In addition, Education noted that funds for this program could be used to support non-STEM fields, such as area studies, foreign languages and literature, and educational evaluation also were allowable activities.

[f]In response to our survey, Education reported $148,000,000 in obligations for the Mathematics and Science Partnerships program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Education, they reported that the actual obligations for fiscal year 2012 were $148,353,872. This represents an increase of 0.24 percent in reported program obligations and a 0.05 percent increase in total reported K-12 STEM education program obligations. We determined that this change would not materially affect our

overall results and findings and therefore we present our overall report analysis with the original survey submission.

[g]Obligations for Strengthening Predominantly Black Institutions were not exclusive to STEM activities. STEM is one of five allowable activities, and grantees can choose to focus their projects on any of these five activities.

[h]After our survey analysis was completed and the draft report was shared with Energy, officials reported changes to the fiscal year 2012 obligations for many of their programs. The changes to Energy's postsecondary programs summed to zero percent of total reported postsecondary obligations, and the changes to Energy's K-12 programs summed to zero percent of total reported K-12 obligations. We determined that these changes would not materially affect our overall results or findings. Individual changes are noted in table notes below.

[i]In response to our survey, Energy reported $1,992,000 in obligations for the Advanced Vehicle Competitions program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $1,991,000. This represents a 0.00 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[j]In response to our survey, Energy reported $700,000 in obligations for the Community College Internships program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $599,000. This represents a 0.01 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[k]In response to our survey, Energy reported $455,000 in obligations for the DISTANCE-Solar program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $365,000. This represents a 0.00 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[l]In fiscal year 2012, the DISTANCE-Solar program was called the Minority University Research Associates program.

[m]In response to our survey, Energy reported $50,000 in obligations for the Laboratory Equipment Donation program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $124,000. This represents a 0.00 percent increase in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[n]In response to our survey, Energy reported $2,800,000 in obligations for the National Science Bowl program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $1,854,000. This represents a 0.14 percent decrease in total reported K-12 STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[o]In response to our survey, Energy reported $774,000 in obligations for the Plasma/Fusion Science Educator Programs, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $209,000. This represents a 0.08 percent decrease in total reported K-12 STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[p]In response to our survey, Energy reported $7,300,000 in obligations for the Science Undergraduate Laboratory Internships program, and we used that number for the analysis throughout the report.

After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $6,387,000. This represents a 0.05 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[q]In response to our survey, Energy reported $2,250,000 in obligations for the Solar Decathlon program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $4,200,000. This represents a 0.10 percent increase in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[r]In response to our survey, Energy reported $65,000 in obligations for the SAGE program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $0. This represents a 0.00 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[s]In response to our survey, Energy reported $1,300,000 in obligations for the Visiting Faculty program, and we used that number for the analysis throughout the report. After our analysis was completed and the draft report was shared with Energy, they reported that the actual obligations for fiscal year 2012 were $1,179,000. This represents a 0.01 percent decrease in total reported postsecondary STEM education program obligations. We determined that this change would not materially affect our overall results and findings and therefore we present our overall report analysis with the original survey submission.

[t]No awards were made in response to program solicitations in fiscal year 2012.

[u]No funds were awarded in fiscal year 2012 because the first applications were due shortly before the end of the fiscal year.

[v]This program was not active in fiscal year 2012 and thus no funds were obligated in that fiscal year.

[w]Funds were obligated in fiscal year 2011 through fiscal year 2013 for grantees. Hence the obligation in fiscal year 2012 is $0.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

Melissa Emrey-Arras, (617) 788-0534 or emreyarrasm@gao.gov.

Staff Acknowledgments:

The following staff members made key contributions to this report: George Scott, Director; Nagla'a El-Hodiri, Assistant Director; Divya Bali; James Bennett; Melinda Cordero; Keira Dembowski; Bill Keller; Jill Lacey; Brittni Milam; Rhiannon Patterson; Timothy Persons; Kathleen Peyman; James Rebbe; Ryan Siegel; Yunsian Tai; Kathleen Van Gelder; and Walter Vance.

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