The U.S. Science and Engineering Workforce: Recent, Current, and Projected Employment, Wages, and Unemployment

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Summary

The adequacy of the U.S. science and engineering workforce has been an ongoing concern of Congress for more than 60 years. Scientists and engineers are widely believed to be essential to U.S. technological leadership, innovation, manufacturing, and services, and thus vital to U.S. economic strength, national defense, and other societal needs. Congress has enacted many programs to support the education and development of scientists and engineers. Congress has also undertaken broad efforts to improve science, technology, engineering, and math (STEM) skills to prepare a greater number of students to pursue science and engineering (S&E) degrees. In addition, some policy makers have sought to increase the number of foreign scientists and engineers working in the United States through changes in visa and immigration policies.

Policy makers, business leaders, academicians, S&E professional society analysts, economists, and others hold diverse views with respect to the adequacy of the S&E workforce and related policy issues. These issues include whether a shortage of scientists and engineers exists in the United States, what the nature of such a shortage might be (e.g., too few people with S&E degrees, mismatched skills and needs), and whether the federal government should undertake policy interventions to address such a putative shortage or to allow market forces to work in this labor market. Among the key indicators used by labor economists to assess occupational labor shortages are employment growth, wage growth, and unemployment rates.

In 2012, there were 6.2 million scientists and engineers (as defined in this report) employed in the United States, accounting for 4.8% of total U.S. employment. Science and engineering employment was concentrated in two S&E occupational groups, computer occupations (56%) and engineers (25%), with the rest accounted for by S&E managers (9%), physical scientists (4%), life scientists (4%), and those in mathematical occupations (2%). From 2008 to 2012, S&E employment increased by 352,370, a compound annual growth rate (CAGR) of 1.5%, while overall U.S. employment contracted at 0.9% CAGR. Viewed only in aggregate, the increase in S&E employment masks the varied degrees of growth and decline in detailed S&E occupations.

In 2012, the mean wage for all scientists and engineers was $87,330, while the mean wage for all other occupations was $45,790. Between 2008 and 2012, the nominal mean wages of the S&E occupational groups grew between 1.4% CAGR (life scientists) and 2.2% CAGR (physical scientists, S&E managers, mathematicians). Inflation-adjusted wage growth for each of the S&E occupational groups was less than 0.6% CAGR, and in the case of life scientists was negative. Nominal wage growth for all occupations in the economy was 1.1%; real wages declined 0.5%.

Compared to the overall workforce, the S&E occupational groups had significantly lower unemployment rates for the 2008-2012 period. In general, though, the professional occupations (of which the S&E occupations are a part) historically have had lower unemployment rates than the workforce as a whole. In 2012, the overall S&E unemployment rate of 3.6% was higher than for other selected professional occupations, including lawyers (1.4%), physicians and surgeons (0.8%), dentists (1.5%), and registered nurses (2.6%).

The Bureau of Labor Statistics (BLS) projects that the number of S&E jobs will grow by 953,200 between 2012 and 2022, a growth rate (1.3% CAGR) that is somewhat faster than that of the overall workforce (1.0%). In addition, BLS projects that 1.3 million scientists and engineers will be needed to replace those projected to exit S&E occupations. The number of scientists and engineers needed to meet growth and net replacement needs between 2012 and 2022 is 2.3 million, including 1.2 million in the computer occupations and 544,300 engineers.

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Overview

Many congressional policy makers have an ongoing interest in whether the number of U.S. scientists and engineers is sufficient to meet the needs of U.S. employers, to spur economic growth and job creation through innovation, to maintain U.S. global technological leadership and industrial competitiveness, and to address other important national and societal needs.

To help ensure an adequate science and engineering (S&E) workforce, Congress has established and funded a variety of federal programs. These programs are intended to foster improved science, technology, engineering, and mathematics (STEM) skills among students; to incentivize students to pursue degrees in science and engineering through tools such as fellowships, assistantships, and traineeships; and to provide graduate and post-graduate research experiences at U.S. colleges and universities through the financing of university-based research. The 113th Congress is considering legislation to create, reform, and provide funding for STEM education efforts, and may seek to reauthorize the America COMPETES Act of 2007 (P.L. 110-69) and the America COMPETES Reauthorization Act of 2010 (P.L. 111-358).[1] In addition, Congress is considering changes to immigration policies, among them the number of visas and processes associated with F-1 visas, H-1B visas, L1 visas, and legal permanent residency ("green cards"), to address U.S. S&E workforce needs.[2]

As Congress develops policies and programs and makes appropriations to help address the nation's needs for scientists and engineers, it may wish to consider past, current, and projected S&E workforce trends. Among the key factors that labor economists examine for evidence of labor shortages are employment growth, wage growth, and unemployment rates relative to other occupations.[3] This report provides employment, wage, and unemployment information for the computer occupations, mathematical occupations, engineers, life scientists, physical scientists, and S&E management occupations, as follows:

- The section on "Current Employment, Wages, and Unemployment" provides a statistical snapshot of occupational employment, wage, and unemployment data for the S&E workforce in 2012 (the latest year for which data are available).
- The section on "Recent Trends in Employment, Wages, and Unemployment" provides a perspective on how S&E employment, wages, and unemployment changed during the period 2008-2012.
- The section on "Employment Projections, 2012-2022" provides an analysis of projections by the Bureau of Labor Statistics for how the number employed in S&E occupations is expected to change during the 2012-2022 period, as well as how many openings will be created by workers exiting each occupation (replacement needs).

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[1] For additional information about P.L. 110-69 and P.L. 111-358, see CRS Report R42430, *America COMPETES 2010 and the FY2013 Budget*, by (name redacted).

[2] For additional information, see CRS Report R42530, *Immigration of Foreign Nationals with Science, Technology, Engineering, and Mathematics (STEM) Degrees* , by (name redacted).

[3] See, for example, Carolyn M. Veneri, "Can Occupational Labor Shortages Be Identified Using Available Data?," *Monthly Labor Review*, March 1999, p. 18.

A final section, "Concluding Observations," provides stakeholder perspectives that Congress may wish to consider as it seeks to ensure that the United States has an adequate S&E workforce to meet the demands of the 21st century.

Methodology

Occupational Taxonomy

Most experts agree that there is no authoritative definition of which occupations comprise the science and engineering (S&E) workforce. Rather, the selection of occupations included in any particular analysis of the S&E workforce may vary. Some analysts, policy makers, and organizations may refer to the group in different ways (e.g., the scientific and technical workforce, the STEM workforce) and include varying sets of occupations. In 2001, the Bureau of Labor Statistics (BLS), in defining the STEM occupations for a particular analysis, stated, "This is only one possible definition of STEM occupations; other definitions exist that may be better suited for other uses."[4]

The size of the S&E workforce varies substantially depending on which occupations are included in the definition. In its 2012 Science and Engineering Indicators report, the National Science Board (NSB) stated, "In the most recent estimates, the U.S. S&E workforce (defined by occupation) totaled between 4.8 million and 6.4 million people."[5] Previously, the NSB asserted that the S&E workforce could be as large as 21 million people if the definition included those with either an S&E degree or a degree in an S&E-related field such as health or technology.[6]

The policy debate about the adequacy of the U.S. S&E workforce has focused largely on the computer occupations, mathematical occupations, engineers, and physical scientists. For purposes of this report, these occupations, along with life scientists (a part of the natural sciences, with physics and chemistry) and S&E management occupations, are collectively referred to as the S&E workforce. Notably, this group does not include social scientists (e.g., economists, survey researchers, psychologists, sociologists, urban and regional planners, anthropologists, archeologists, geographers, historians, political scientists) or S&E-related technicians. As defined this way, the size of the S&E workforce in 2012 was approximately 6.2 million.

This report uses a modified version of the Standard Occupation Classification (SOC) system[7] to categorize scientists and engineers. The report taxonomy includes six S&E occupational groups, each composed of closely related detailed occupations:

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[4] For purposes of the BLS analysis, the authors defined the STEM occupation group as consisting of 97 occupations, including computer and math sciences, architecture and engineering, life and physical sciences, managerial and post-secondary teaching occupations associated with these functional areas, and two sales occupations that require scientific or technical education at the postsecondary level—sales engineers and wholesale and engineering manufacturing sales representatives of technical and scientific products. Ben Cover, John Jones, and Audrey Watson, "Science, Technology, Engineering, and Mathematics (STEM) Occupations: A Visual Essay," *Monthly Labor Review*, May 2011, p. 3.

[5] National Science Board, *Science and Engineering Indicators 2012*, January 2012, p. 3-10.

[6] National Science Board, *Science and Engineering Indicators 2008*, January 2008, p. 3-8.

[7] The Standard Occupational Classification system is a federal system that defines over 840 detailed occupations, and groups them into 461 broad occupations, 97 minor groups, and 23 major groups. Detailed occupations in the SOC with similar job duties, and in some cases skills, education, and/or training, are grouped together. The system is used by (continued...)

- **Computer occupations—**computer and information research scientists; computer systems analysts; computer programmers; software developers, applications; software developers, systems software; database administrators; network and computer systems administrators; computer user support specialists; computer network support specialists; information security analysts; web developers; computer network architects; and computer occupations, all other.
- **Mathematical occupations—**actuaries; mathematicians; operations research analysts; statisticians; and mathematical science occupations, all other.
- **Engineers—**aerospace, agricultural, biomedical, chemical, civil, computer hardware, electrical, electronics (except computer), environmental, health and safety (except mining safety engineers and inspectors), industrial, materials, mechanical, mining and geological (including mining safety engineers), nuclear, and petroleum engineers; engineers, all other; and marine engineers and naval architects.
- **Life scientists—**animal scientists; food scientists and technologists; soil and plant scientists; biochemists and biophysicists; microbiologists; zoologists and wildlife biologists; biological scientists, all other; conservation scientists; foresters; epidemiologists; medical scientists (except epidemiologists); and life scientists, all other.
- **Physical scientists—**astronomers; physicists; atmospheric and space scientists; chemists; materials scientists; environmental scientists and specialists (including health); geoscientists (except hydrologists and geographers); hydrologists; and physical scientists, all other.
- **Science and engineering managers—**computer and information systems managers, architectural and engineering managers,[8] and natural sciences managers.

A description of the detailed occupations is provided in the **Appendix**.

Data Sources

This report relies on federal government employment, wage, and unemployment data from the following sources:

- The **Occupational Employment Statistics (OES)**,[9] a survey of non-farm establishments conducted by the U.S. Department of Labor's Bureau of Labor Statistics and state workforce agencies, is the source of employment and wage data for the 2008-2012 period. The survey provides employment and wage

(...continued)

federal statistical agencies for the purpose of collecting, calculating, and disseminating data. First established in 1977, the SOC system has been revised periodically; the latest revision is the 2010 SOC.

[8] Occupational Employment Statistics (OES) employment figures for the occupation group "architectural and engineering managers" are reported as a single number, thus the architectural managers are included in this group, though data on architect and other architectural-related occupations are not otherwise included in this report.

[9] Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes.

estimates annually for over 800 occupations. According to BLS, "employees" are all part-time and full-time workers who are paid a wage or salary. The survey does not cover the self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers. For this report, the wage statistic used is the occupational "mean wage," an average wage calculated by summing the wages of all the employees in a given occupation and then dividing the total wages by the number of employees.

- The **Current Population Survey (CPS)**,[10] a monthly survey of households conducted for BLS by the Department of Commerce's Bureau of the Census, is the source of the unemployment data in this report. CPS data are also used to supplement OES data in BLS employment projections (discussed below).
- BLS's **Employment Projections**,[11] a biennial product of BLS, provide occupational employment and industry employment projection data for 10-year periods. The latest projections, covering the 2012-2022 period, were published in December 2013. According to BLS, for most industries, the OES survey provides data for the occupational staffing patterns—the distribution of wage and salary employment by occupation in each industry—and Current Employment Statistics (CES)[12] data provide information on total wage and salary employment in each non-farm industry. While OES data include only wage and salary, non-farm employment, the employment data in the projections also include agricultural industry employment and the self-employed (derived from CPS data) to arrive at base year employment levels for each occupation.[13]

Timeframe

The "Current Trends in Employment, Wages, and Unemployment" section provides information on changes in employment, wages, and unemployment for the period 2008 to 2012. The "Employment Projections, 2012-2022" section relies entirely on the most recent Bureau of Labor Statistics biennial employment projections for the 2012-2022 timeframe.

Methodological Limitations

It is important to note that a wide range of factors can affect the size and occupational composition of the U.S. S&E workforce. Among these factors are global and domestic economic conditions; the development and market adoption of new technologies; capital cost and availability; the level of public and private funding for research and development; changes in scientific, technological, and market opportunities; the size, knowledge, and skills of the U.S.-born labor force; the size, knowledge, and skills of the foreign-born labor force in the United States; and changes in business practices regarding the use of foreign-based science and

[10] Current Population Survey, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/cps.

[11] Employment Projections, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/emp.

[12] The Current Employment Statistics survey provides industry employment data used by BLS in making its biennial 10-year projections. The CES survey does not collect occupational information.

[13] Telephone conversation with Michael Wolf, economist, Division of Occupational Outlook, Office of Occupational Statistics and Employment Projections, Bureau of Labor Statistics, Department of Labor, March 4, 2013.

engineering capabilities. This report does not attempt to attribute changes in the U.S. S&E workforce to any of these factors specifically.

In addition, a variety of factors may affect the comparability of OES data over time:

> Although the OES survey methodology is designed to create detailed cross-sectional employment and wage estimates for the U.S., States, metropolitan and nonmetropolitan areas, across industry and by industry, it is less useful for comparisons of two or more points in time. Challenges in using OES data as a time series include changes in the occupational, industrial, and geographical classification systems, changes in the way data are collected, changes in the survey reference period, and changes in mean wage estimation methodology, as well as permanent features of the methodology.[14]

In its examination of current trends, CRS chose the 2008-2012 time period to enhance comparability of data across the period by reducing inconsistencies resulting from changes in the OES occupational classification system. The OES survey used the same occupational categories throughout the 2008-2012 period.

The Bureau of Labor Statistics makes a number of estimates in developing its employment projections. These estimates include "the future size and composition of the population, as well as on the trends in labor force participation rates of different age, gender, race, and ethnic groups, a total of 136 separate categories," "the rate of growth and demand composition of real GDP, the labor productivity growth rate, and the inflation rate," expectations regarding the federal budget surplus or deficit, historical staffing patterns, shifts in product mix, changes in technology and business practices, and retirement rates.[15] If these estimates do not accurately reflect future performance, occupational employment projections may be over- or underestimated. Other factors may affect occupational projections as well, including changes to immigration laws and patterns, trade laws and practices, regulatory regimes, and social and educational patterns; wars and disasters; revolutionary advances in technology; and shifts in consumer tastes. The BLS evaluates the accuracy of its projections regularly and publishes these evaluations in its *Monthly Labor Review*.[16]

[14] BLS website, Occupational Employment Statistics, Frequently Asked Questions, http://www.bls.gov/oes/oes_ques.htm.

[15] BLS website, Employment Projections, Projections Methodology, http://www.bls.gov/emp/ep_projections_methods.htm.

[16] For links to past evaluations of BLS projections, see http://www.bls.gov/emp/ep_pub_projections_eval.htm. For the latest evaluation, see "Evaluating the 1996–2006 employment projections," by Ian D. Wyatt, *Monthly Labor Review*, September 2010, http://www.bls.gov/opub/mlr/2010/09/art3full.pdf.

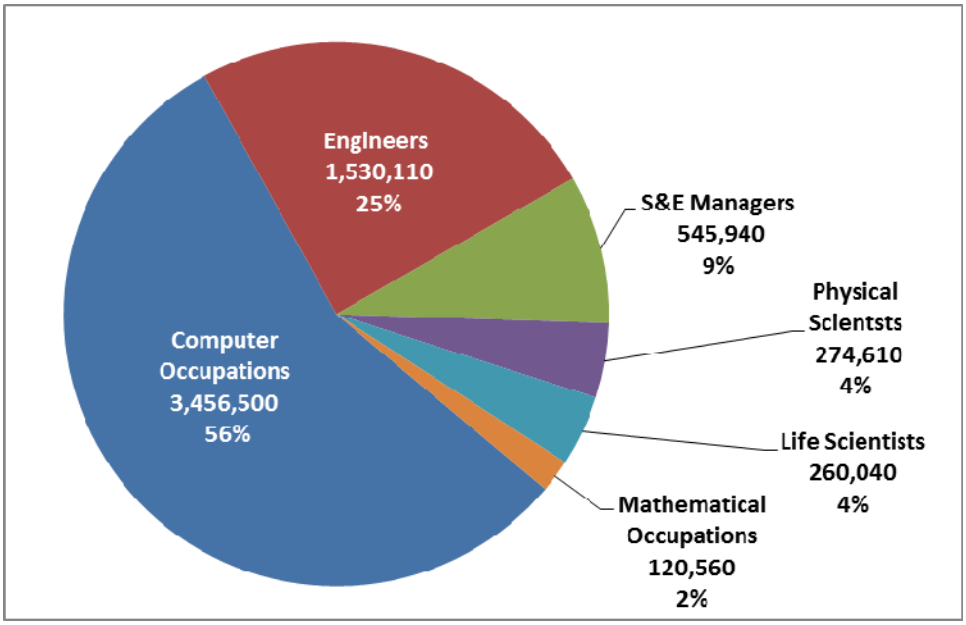
Selected S&E Occupational Data

Current Employment, Wages, and Unemployment

This section provides a snapshot of the S&E workforce in 2012, using employment, wages, and unemployment data.

Employment

Figure 1. Compilation of S&E Occupational Employment, 2012



Source: CRS analysis of Occupational Employment Statistics survey data, May 2012, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

Notes: Chart does not include social scientists or S&E-related technicians. For additional information about which detailed occupations are included, see "Occupational Taxonomy."

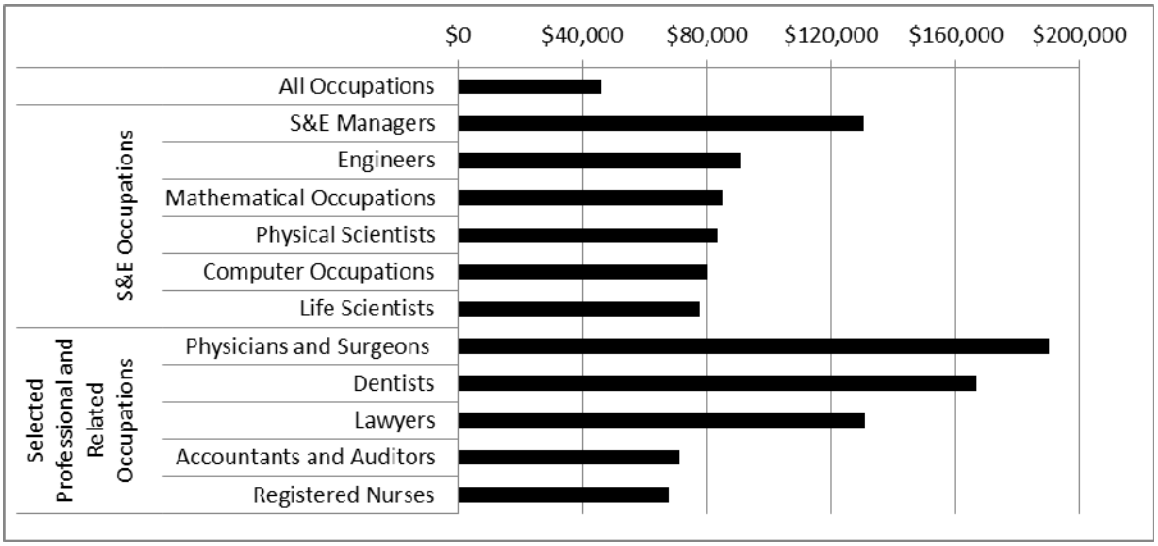
In 2012, the latest year for which Occupational Employment Statistics survey data are available, 6.2 million people were employed in the United States as scientists and engineers, accounting for 4.7% of total U.S. employment. Science and engineering employment was concentrated in two occupational groups—computer occupations and engineers—which together accounted for 81% of S&E jobs, with 56% and 25%, respectively. The remainder of S&E employment was accounted for by science and engineering managers (9%), physical scientists (4%), life scientists (4%), and mathematical occupations (2%). Employment totals and share of S&E occupational employment are presented in **Figure 1**.

(See **Table 4** for more detailed 2012 employment data on specific S&E occupations.)

Wages

Scientists and engineers have a mean annual wage that exceeds the mean annual wage for all occupations in the United States. In 2012, the mean annual wage for all scientists and engineers was $87,330; the mean annual wage for all occupations—professional and non-professional—was $45,790. S&E managers had the highest mean annual wage of all S&E occupational groups at $130,660, followed by engineers, $90,960; mathematical occupations, $84,940; physical scientists, $83,360; computer occupations, $80,020; and life scientists, $77,620. Scientists and engineers have lower mean annual wages than some other professionals, such as physicians and surgeons ($190,060), dentists ($166,910), and lawyers ($130,880). (See **Figure 2**.)

Figure 2. Mean Annual Wages of S&E Occupational Groups and Other Selected Professional Occupations, 2012



Source: CRS analysis of Occupational Employment Statistics survey data, May 2012 Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

Table 1 shows the 2012 mean annual wage for each of the S&E occupational groups and individual S&E occupations, organized by S&E occupational group.

Table 1. Mean Annual Wages of S&E Occupations, 2012

Occupational Group	Mean Annual Wage
Science and Engineering Managers	$130,660
Computer and Information Systems Managers	129,130
Architectural and Engineering Managers	133,240
Natural Sciences Managers	130,400
Computer Occupations	$80,020
Computer and Information Research Scientists	103,670
Computer Systems Analysts	83,800
Information Security Analysts	89,290
Computer Programmers	78,260

Occupational Group	Mean Annual Wage
Software Developers, Applications	93,280
Software Developers, Systems Software	102,550
Web Developers	66,100
Database Administrators	79,120
Network and Computer Systems Administrators	76,320
Computer Network Architects	94,000
Computer User Support Specialists	50,130
Computer Network Support Specialists	62,690
Computer Occupations, All Other	81,860
Mathematical Occupations	$84,940
Actuaries	106,680
Mathematicians	101,280
Operations Research Analysts	79,830
Statisticians	79,570
Mathematical Science Occupations, All Other	63,250
Engineers	$90,690
Aerospace Engineers	104,810
Agricultural Engineers	77,370
Biomedical Engineers	91,200
Chemical Engineers	102,270
Civil Engineers	84,140
Computer Hardware Engineers	103,980
Electrical Engineers	91,810
Electronics Engineers, except Computer	95,250
Environmental Engineers	85,140
Health and Safety Engineers, except Mining Safety Engineers and Inspectors	79,760
Industrial Engineers	82,100
Marine Engineers and Naval Architects	96,140
Materials Engineers	87,490
Mechanical Engineers	84,770
Mining and Geological Engineers, Including Mining Safety Engineers	91,250
Nuclear Engineers	107,140
Petroleum Engineers	147,470
Engineers, All Other	93,330
Life Scientists	$77,620
Animal Scientists	73,400

Occupational Group	Mean Annual Wage
Food Scientists and Technologists	64,140
Soil and Plant Scientists	63,290
Biochemists and Biophysicists	89,470
Microbiologists	73,250
Zoologists and Wildlife Biologists	62,500
Biological Scientists, All Other	76,220
Conservation Scientists	63,590
Foresters	57,140
Epidemiologists	71,400
Medical Scientists, except Epidemiologists	87,830
Life Scientists, All Other	74,740
Physical Scientists	$83,360
Astronomers	102,550
Physicists	114,150
Atmospheric and Space Scientists	90,010
Chemists	76,870
Materials Scientists	89,740
Environmental Scientists and Specialists, Including Health	68,970
Geoscientists, except Hydrologists and Geographers	106,780
Hydrologists	78,920
Physical Scientists, All Other	93,720

Source: CRS analysis of Occupational Employment Statistics survey data, May 2012, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

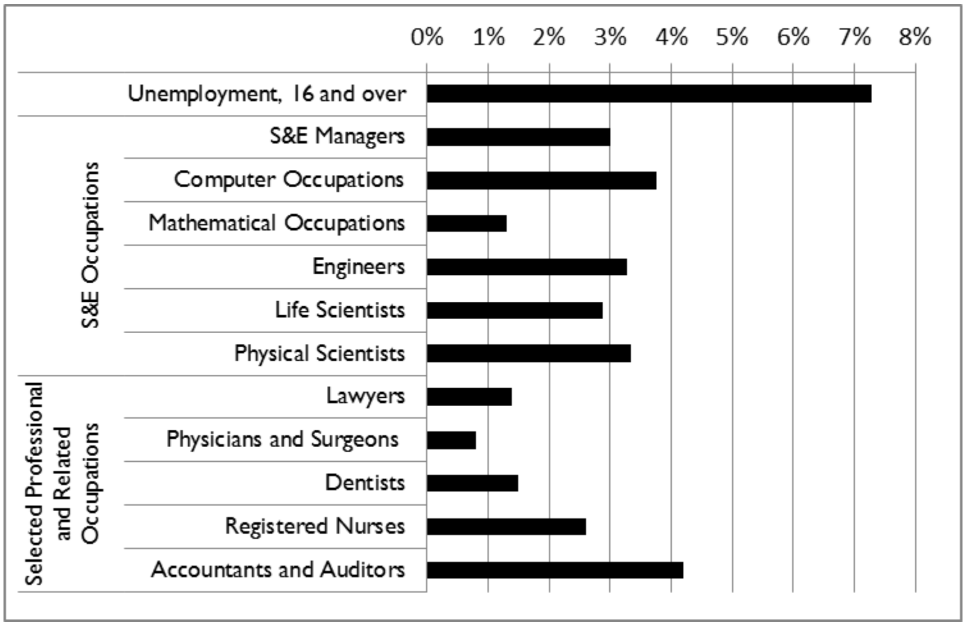
Unemployment

The 2012 annual average unemployment rates for S&E occupational groups are shown in **Figure 3**, together with the annual average unemployment rates of other selected professional and related occupations.[17] The annual average unemployment rates for the S&E occupations overall (3.6%) and for each of the S&E occupational groups (which range from 1.3% to 3.8%) were lower than the overall annual average unemployment rate for those 16 and over (7.3%) and lower than the annual average unemployment rate for the professional and related occupations group (4.2%).[18] However, the annual average unemployment rates for most of the S&E occupational groups were higher than the rates for some other professional occupations—including lawyers (1.4%), physicians and surgeons (0.8%), dentists (1.5%), and registered nurses (2.6%)—but lower in general than some, such as accountants and auditors (4.2%).

[17] Science and engineering occupations are part of the larger category of "Professional and Related Occupations" used in the Current Population Survey.

[18] Mathematical occupations was the only S&E occupational group with a higher unemployment rate (5.3%) than the professional and related occupations group (4.3%).

Figure 3. Annual Average Unemployment Rates for S&E Occupational Groups and Selected Professional and Related Occupations, 2012



Source: CRS analysis of unpublished 2012 data from the Current Population Survey, Bureau of Labor Statistics.

The unemployment rate for each detailed S&E occupation is provided in **Table 2**.[19] The unemployment rates for S&E occupations range from 0.3% for astronomers and physicists to 18.5% for mining and geological engineers (including mine safety engineers). The unemployment rate for mining and geological engineers is more than twice the rate of any other detailed S&E occupation.[20]

Table 2. Annual Average Unemployment Rate for S&E Occupational Groups and Detailed S&E Occupations, 2012

Occupation	Unemployment Rate (Percentage)
Total, all occupations, 16 years and over	**7.3**
Science and Engineering Managers	**3.0**
Computer and information systems managers	3.2
Architectural and engineering managers	2.3
Natural sciences managers	2.1
Computer Occupations	**3.8**
Computer and information research scientists	2.2
Computer systems analysts	3.6
Information security analysts	0.9
Computer programmers	4.5

19 The occupational classification system used in the Current Population Survey is based on the 2010 Standard Occupational Classification System but differs somewhat from those used by in the Occupational Employment Statistics survey.

20 CPS does not publish unemployment rates for occupations with an employment base of less than 50,000.

Occupation	Unemployment Rate (Percentage)
Software developers, applications and systems software	2.8
Web developers	4.2
Computer support specialists	6.6
Database administrators	3.6
Network and computer systems administrators	4.1
Computer network architects	2.2
Computer occupations, all other	3.2
Mathematical Occupations	**1.3**
Actuaries	—
Mathematicians	—
Operations research analysts	1.3
Statisticians	—
Miscellaneous mathematical science occupations	1.3
Engineers	**3.3**
Aerospace engineers	3.7
Agricultural engineers	—
Biomedical engineers	0.4
Chemical engineers	2.7
Civil engineers	3.4
Computer hardware engineers	1.9
Electrical and electronics engineers	3.4
Environmental engineers	2.7
Industrial engineers, including health and safety	2.7
Marine engineers and naval architects	8.2
Materials engineers	4.4
Mechanical engineers	3.1
Mining and geological engineers, incl. mining safety engineers	18.5
Nuclear engineers	1.7
Petroleum engineers	0.6
Engineers, all other	3.4
Life Scientists	**2.9**
Agricultural and food scientists	3.7
Biological scientists	3.0
Conservation scientists and foresters	2.1
Medical scientists	2.2
Life scientists, all other	—
Physical Scientists	**3.3**
Astronomers and physicists	0.3
Atmospheric and space scientists	—
Chemists and materials scientists	5.5
Environmental scientists and geoscientists	2.6
Physical scientists, all other	3.1

Source: Current Population Survey, 2012, Bureau of Labor Statistics, U.S. Department of Labor.

Notes: Unemployment for occupations refers to the experienced unemployed (those with prior work experience), classified according to their last job. For occupations in which the total number of employed and unemployed totals less than 50,000 the unemployment rate is not shown;— indicate data are not available.

Recent Trends in Employment, Wages, and Unemployment

This section provides information on changes in employment, wages, and unemployment for the period 2008 to 2012.

Employment Trends

Aggregate S&E Employment

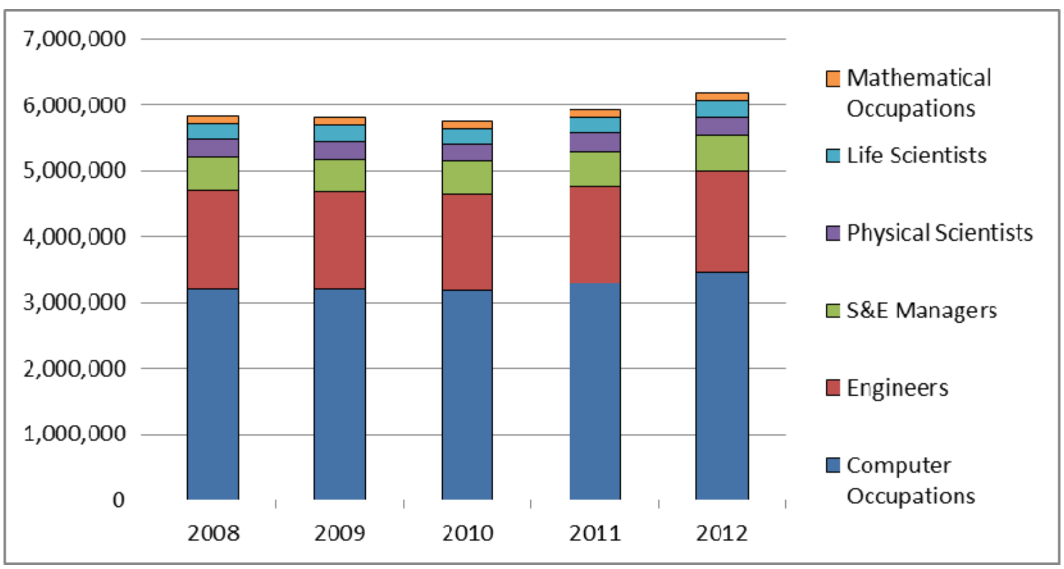
During the 2008-2012 period, aggregate S&E employment increased by 353,520 jobs, rising from 5.8 million to 6.2 million, a compound annual growth rate of 1.5%.[21] The growth in the S&E occupations ran counter to overall U.S. employment, which contracted at 0.9% CAGR during this same period. Growth rates for the S&E occupational groups and detailed occupations are provided in the following sections.

Science and Engineering Occupational Groups

Figure 4 illustrates the aggregate size and occupational composition of the S&E workforce from 2008 to 2012. Aggregate employment decreased somewhat from 2008 to 2010, led by reductions in the number of engineers employed. Modest growth in aggregate S&E employment returned in 2011 and 2012, led by increases in computer occupations.

Figure 4. Aggregate S&E Employment, 2008-2012

by S&E Occupational Group Composition



Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

21 A compound annual growth rate (CAGR) is a calculated growth rate which, if applied year after year to a beginning amount reaches a specified final amount.

Table 3 provides employment data—2008 employment, 2012 employment, and changes in number employed and the compound annual growth rates during the 2008 to 2012 period—for each S&E occupational group. The fastest growth rate among S&E occupational groups during this period was in mathematical occupations which grew at 2.8%% CAGR, while the largest increase in the number employed was in computer occupations which added 258,450 jobs. The slowest growth rate among S&E occupational groups during this period was in engineers which grew at 0.2% CAGR.

Table 3. Employment Change in S&E Occupational Groups, 2008-2012

Occupation	Employment, 2008	Employment, 2012	Employment Change, Number	Employment Change, Compound Annual Growth Rate
All occupations	135,185,230	130,287,700	-4,897,530	-0.9%
All S&E occupations	5,835,390	6,188,910	353,520	1.5%
S&E managers	502,180	545,940	43,760	2.1%
Computer occupations	3,198,050	3,456,500	258,450	2.0%
Mathematical occupations	109,130	121,710	12,580	2.8%
Engineers	1,516,230	1,530,110	13,880	0.2%
Life scientists	250,250	260,040	9,790	1.0%
Physical scientists	259,550	274,610	15,060	1.4%

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

Detailed S&E Occupations

Table 4 provides 2008-2012 employment data for each of the S&E occupations, organized by S&E group. The data indicate that there was substantial variation in the number of jobs gained and lost among the S&E occupations, as well as in their growth rates. With respect to the number employed, the occupation with the largest gain was software developers, applications, which added 92,180 jobs, while the occupation experiencing the largest decrease was computer programmers, which lost 77,440 jobs. Some have speculated that some of the losses in computer programmers may be due to reclassification of these positions as other computer occupations (e.g., software developers). The S&E occupation with the fastest growth rate was petroleum engineers with a 14.9% CAGR, adding 15,530 new jobs, while the occupation with the fastest decline was mathematical science occupations, all other, which experienced a -34.43% CAGR and a loss of 5,380 jobs. The three fastest declining occupations were all "other" categories—mathematical science occupations, all other; engineers, all other; and life scientists, all other. These declines may be due, in part, to assignation by employers of jobs previously classified in these residual classifications to other detailed and specific S&E occupations; if so, consequentially, some growth in the detailed occupations may be due, in part, to such re-assignations.

Among the computer occupations with comparable data across the 2008-2012 period,[22] those with the fastest growth rates were software developers, applications (4.4% CAGR); network and computer systems administrators (1.7% CAGR); and software developers, systems software (0.6% CAGR). Nevertheless, it appears that the vast majority of job growth occurred in the occupational areas that were separated into more detailed occupational classifications in the 2012 survey. Comparing the aggregate of two 2012 detailed occupations—computer user support specialists and computer network support specialists—to the previously used classification, "computer support specialists," shows job growth of 148,090 (6.2% CAGR).[23] Similarly, comparing three 2012 detailed occupations—information security analysts, web developers, and computer network architects—to the previously used classification, "information security analysts, web developers, and computer network architects," shows job growth of 148,090 (8.0% CAGR).[24] Within the computer occupations group, these gains offset losses in other computer occupations, including computer programmers (-77,440, -5.3% CAGR); database administrators (4,180, -0.9% CAGR); and computer occupations, all other (-6,050, -0.8% CAGR).

Eleven engineering occupations increased employment during this period, with the largest growth in mechanical engineers (18,930, 2.0% CAGR), petroleum engineers (15,530, 14.9% CAGR), and aerospace engineers (12,620, 4.4% CAGR). Employment gains in these engineering occupations were offset by declines in seven engineering occupations, including engineers, all other (-46,830, -7.8% CAGR); electronics engineers (-4,970, -0.9% CAGR); and civil engineers (-3,260, -0.3% CAGR).

Growth in the mathematical occupations was led by operations research analysts (8,320, 3.3% CAGR), statisticians (4,890, 5.4%), actuaries (3,120, 4.0% CAGR), and mathematicians (480, 4.1% CAGR). Mathematical science occupations, all other, declined (-5,380, -34.4% CAGR).

Among life scientists, the occupation biochemists and biophysicists had the largest employment growth (4,180, 4.4% CAGR), followed by food scientists and technologists (3,170, 6.8% CAGR), which also had the fastest growth rate. Employment declined in four life science occupations: medical scientists (-4,330, -1.1% CAGR); life scientists, all other (-3,090, -7.2% CAGR); foresters (-690, -1.7% CAGR); and animal scientists (-640, -6.4% CAGR).

The physical sciences occupations with the largest growth were environmental scientists and specialists (4,120, 1.3% CAGR); geoscientists (3,920, 3.0% CAGR), and physicists (3,010, 4.7% CAGR). Employment in two physical sciences occupations declined: material scientists (-1,680, -4.7% CAGR), and hydrologists (-710, -2.4% CAGR).

Employment grew in each of the S&E managers occupations. The largest growth was in computer and information systems managers (32,920, 2.8% CAGR). Natural science managers had the

[22] Several changes were made in the occupational classifications used in the Occupational Employment Statistics survey over the 2008-2012 period in the computer occupations. For the most part, these changes involved minor changes in titles and definitions, and the splitting of some occupations into two or more occupations. According to BLS, these changes could have both direct and indirect effects on the way that employers classify particular jobs. For a more detailed explanation of these effects, please contact the author of this report.

[23] The definitions for computer user support specialists and computer network support specialists are broadly comparable to the previously used occupational classification "computer support specialists."

[24] The definitions for information security analysts, web developers, and computer network architects are broadly comparable to the previously used occupational classification "information security analysts, web developers, and computer network architects."

fastest growth rate (3.1%), adding 5,500 jobs. Architectural and engineering managers grew by 5,340, with a growth rate of 0.7%.

Table 4. Employment in Detailed S&E Occupations, 2008-2012

Occupational Group	Employ-ment, 2008	Employ-ment, 2012	Employ-ment Change, Number	Employ-ment Change, CAGR
Science and Engineering Managers				
Computer and Information Systems Managers	276,820	309,740	32,920	2.8%
Architectural and Engineering Managers	182,300	187,640	5,340	0.7%
Natural Sciences Managers	43,060	48,560	5,500	3.1%
Computer Occupations				
Computer and Information Research Scientists	26,610	24,880	-1,730	-1.7%
Computer Systems Analysts	489,890	482,040	-7,850	-0.4%
Computer Programmers	394,230	316,790	-77,440	-5.3%
Software Developers, Applications	494,160	586,340	92,180	4.4%
Software Developers, Systems Software	381,830	391,700	9,870	0.6%
Database Administrators	115,770	111,590	-4,180	-0.9%
Network and Computer Systems Administrators	327,850	350,320	22,470	1.7%
Computer Support Specialists[a]	545,520			
Computer User Support Specialists		525,630		
Computer Network Support Specialists		167,980		
Information Security Analysts, Web Developers, and Computer Network Architects[b]	230,410			
Information Security Analysts		72,670		
Web Developers		102,940		
Computer Network Architects		137,890		
Computer Occupations, All Other	191,780	185,730	-6,050	-0.8%
Mathematical Occupations				
Actuaries	18,220	21,340	3,120	4.0%
Mathematicians	2,770	3,250	480	4.1%
Operations Research Analysts	60,860	69,180	8,320	3.3%
Statisticians	20,680	25,570	4,890	5.4%
Mathematical Science Occupations, All Other	6,600	1,220	-5,380	-34.4%
Engineers				
Aerospace Engineers	67,800	80,420	12,620	4.4%
Agricultural Engineers	2,640	2,470	-170	-1.7%
Biomedical Engineers	15,220	18,810	3,590	5.4%
Chemical Engineers	30,970	32,190	1,220	1.0%
Civil Engineers	261,360	258,100	-3,260	-0.3%
Computer Hardware Engineers	73,370	79,580	6,210	2.1%
Electrical Engineers	154,670	160,560	5,890	0.9%
Electronics Engineers, except Computer	139,930	134,960	-4,970	-0.9%

Occupational Group	Employ-ment, 2008	Employ-ment, 2012	Employ-ment Change, Number	Employ-ment Change, CAGR
Environmental Engineers	52,590	50,850	-1,740	-0.8%
Health and Safety Engineers, except Mining Safety Engineers and Inspectors	25,190	23,490	-1,700	-1.7%
Industrial Engineers	214,580	220,130	5,550	0.6%
Marine Engineers and Naval Architects	6,480	6,880	400	1.5%
Materials Engineers	24,160	22,740	-1,420	-1.5%
Mechanical Engineers	233,610	252,540	18,930	2.0%
Mining and Geological Engrs., incl. Mining Safety Engrs.	6,900	7,640	740	2.6%
Nuclear Engineers	16,640	19,930	3,290	4.6%
Petroleum Engineers	20,880	36,410	15,530	14.9%
Engineers, All Other	169,240	122,410	-46,830	-7.8%
Life Scientists				
Animal Scientists	2,760	2,120	-640	-6.4%
Food Scientists and Technologists	10,510	13,680	3,170	6.8%
Soil and Plant Scientists	10,790	12,410	1,620	3.6%
Biochemists and Biophysicists	22,230	26,410	4,180	4.4%
Microbiologists	15,750	18,550	2,800	4.2%
Zoologists and Wildlife Biologists	17,780	18,650	870	1.2%
Biological Scientists, All Other	28,290	31,080	2,790	2.4%
Conservation Scientists	15,830	18,460	2,630	3.9%
Foresters	10,160	9,470	-690	-1.7%
Epidemiologists	4,370	4,850	480	2.6%
Medical Scientists, except Epidemiologists	99,750	95,420	-4,330	-1.1%
Life Scientists, All Other	12,030	8,940	-3,090	-7.2%
Physical Scientists				
Astronomers	1,280	2,150	870	13.8%
Physicists	14,810	17,820	3,010	4.7%
Atmospheric and Space Scientists	8,860	10,190	1,330	3.6%
Chemists	83,080	84,950	1,870	0.6%
Materials Scientists	9,650	7,970	-1,680	-4.7%
Environmental Scientists and Specialists, including Health	80,120	84,240	4,120	1.3%
Geoscientists, except Hydrologists and Geographers	31,260	35,180	3,920	3.0%
Hydrologists	7,590	6,880	-710	-2.4%
Physical Scientists, All Other	22,900	25,230	2,330	2.5%

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/tables.htm.

a. See footnote 23.

b. See footnote 24.

Table 5 shows the 10 S&E occupations with the largest employment growth from 2008 to 2012. The list includes six engineering occupations, three computer occupations, and one mathematics occupation.

Table 5. S&E Occupations with the Largest Employment Growth, 2008-2012

Rank	S&E Occupation	Employment Growth
1	Software Developers, Applications	92,180
2	Network and Computer Systems Administrators	22,470
3	Mechanical Engineers	18,930
4	Petroleum Engineers	15,530
5	Aerospace Engineers	12,620
6	Software Developers, Systems Software	9,870
7	Operations Research Analysts	8,320
8	Computer Hardware Engineers	6,210
9	Electrical Engineers	5,890
10	Industrial Engineers	5,550

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, BLS, U.S. Department of Labor.

Table 6 shows the 10 S&E occupations with the largest employment losses. The occupation with the greatest employment loss is computer programmers. As mentioned earlier, some have speculated that some of the losses in computer programmers may be due to reclassification of these positions as other computer occupations (e.g., software developers).

Table 6. S&E Occupations with the Largest Employment Losses, 2008-2012

Rank	S&E Occupation	Employment Growth
1	Computer Programmers	-77,440
2	Engineers, All Other	-46,830
3	Computer Systems Analysts	-7,850
4	Computer Occupations, All Other	-6,050
5	Mathematical Science Occupations, All Other	-5,380
6	Electronics Engineers, except Computer	-4,970
7	Medical Scientists, except Epidemiologists	-4,330
8	Database Administrators	-4,180
9	Civil Engineers	-3,260
10	Life Scientists, All Other	-3,090

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, BLS, U.S. Department of Labor.

Table 7 shows the 10 S&E occupations with the fastest growth rates. The occupation with the fastest growth rate was petroleum engineers (14.9% CAGR), adding 15,530 jobs from 2008 to 2012, followed by astronomers (13.8% CAGR), and food scientists and technologists (6.8% CAGR).

Table 7. S&E Occupations with the Fastest Growth Rates, 2008-2012

Rank	S&E Occupation	Employment Growth rate
1	Petroleum Engineers	14.9%
2	Astronomers	13.8%
3	Food Scientists and Technologists	6.8%
4	Statisticians	5.4%
5	Biomedical Engineers	5.4%
6	Physicists	4.7%
7	Nuclear Engineers	4.6%
8	Biochemists and Biophysicists	4.4%
9	Software Developers, Applications	4.4%
10	Aerospace Engineers	4.4%

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, BLS, U.S. Department of Labor.

Table 8 shows the 10 S&E occupations with the slowest growth rates. All 10 of these occupations have negative growth rates. This group includes at least one occupation from each of the engineering, physical sciences, life sciences, mathematics, and computer occupational groups.

Table 8. S&E Occupations with the Slowest Growth Rates, 2008-2012

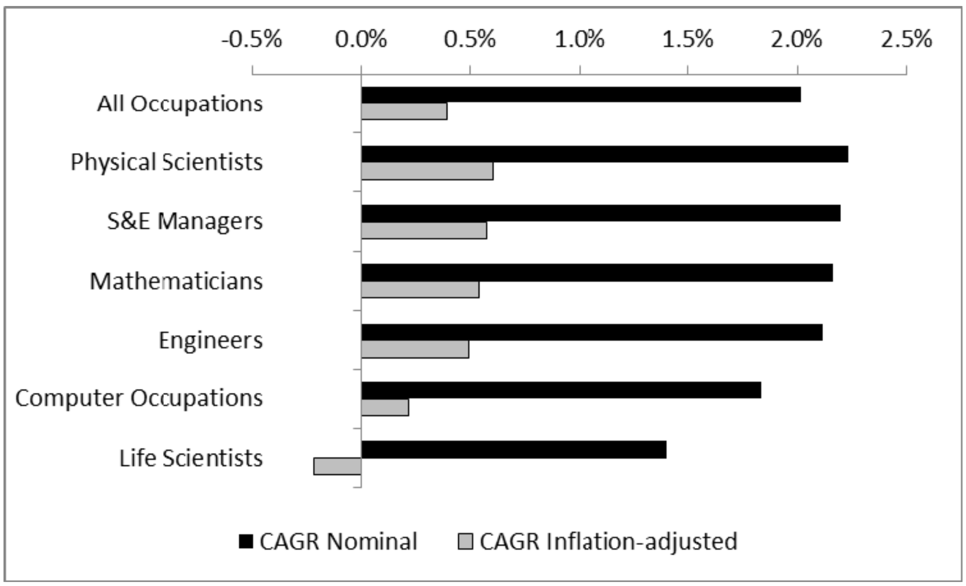
Rank	S&E Occupation	Employment Growth Rate
1	Mathematical Science Occupations, All Other	-34.4
2	Engineers, All Other	-7.8
3	Life Scientists, All Other	-7.2
4	Animal Scientists	-6.4
5	Computer Programmers	-5.3
6	Materials Scientists	-4.7
7	Hydrologists	-2.4
8	Foresters	-1.7
9	Health and Safety Engineers, except Mining Safety Engineers and Inspectors	-1.7
10	Computer and Information Research Scientists	-1.7

Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, BLS, Department of Labor.

Wage Trends

Between 2008 and 2012, mean wages for each S&E occupational group grew at about the same pace as the overall mean wage for all occupations, and only somewhat faster than inflation. **Figure 5** illustrates the nominal and inflation-adjusted compound annual growth rates for each S&E occupational group, as well as for all occupations. The nominal growth rate of mean wages for all occupations during this period was 2.0% CAGR, while the fastest growth rate in the S&E occupational groups was for physical scientists (2.23% CAGR), followed by S&E managers (2.20% CAGR), and mathematical occupations (2.16% CAGR), engineers (2.12% CAGR), computer occupations (1.84% CAGR), and life scientists (1.4% CAGR). Adjusting for inflation, life scientists experienced a small decline (-0.2% CAGR) in mean wages between 2008 and 2012, while the other S&E occupational categories grew by less than 1%.

Figure 5. Nominal and Inflation-adjusted Compound Annual Growth Rates of Mean Wages in S&E Occupational Groups, 2008-2012



Source: CRS analysis of Occupational Employment Statistics survey data, 2008-2012, http://www.bls.gov/oes/tables.htm, using BLS Consumer Price Index Inflation Calculator, http://data.bls.gov/cgi-bin/cpicalc.pl.

Unemployment Trends

Table 9 provides unemployment rates for the S&E occupational groups, as well as all for all workers (16 years and over) and selected professional and related occupations for the years 2008-2012. This table provides a perspective on how the unemployment rates of S&E occupational groups compare to the overall unemployment rate and other selected professional and related occupations, as well as how these rates changed during this period.

Professional occupations (of which the S&E occupations are a part) historically have had lower unemployment rates than the overall workforce. As shown in **Table 9**, S&E occupational groups had significantly lower unemployment rates than those of the overall workforce for the 2008-2012 period. Nevertheless, during this period the S&E occupational groups generally had unemployment rates that were comparable or higher than the rates for many other selected professional occupations (e.g., lawyers, dentists, physicians and surgeons, registered nurses, accountants and auditors).

In 2008, the unemployment rates for each S&E occupational group and each selected professional occupation were below 3%. However, from 2008 to 2011, the unemployment rates for the S&E occupational groups grew faster than did the other selected professional occupations. Consequently, the separation between the unemployment rates of the S&E occupational groups and the other selected professional occupations grew during this period (see **Table 9**). In 2011, the unemployment rates for each of the selected professional occupations remained around or below 2% while the unemployment rates for each of the S&E occupational groups were above 3%. In 2012, the unemployment rate for all of the S&E occupational groups fell, some dropping below 3%.

Table 9. Unemployment Rates for S&E Occupational Groups, the Overall Workforce, and Other Selected Professional and Related Occupations, 2008-2012

	2008	2009	2010	2011	2012
S&E Occupations					
Computer Occupations	2.6%	5.3%	5.4%	4.1%	3.8%
Mathematical Occupations	1.6%	2.6%	1.4%	5.3%	1.3%
Engineers	2.6%	5.1%	4.5%	3.6%	3.3%
Life Scientists	1.0%	3.9%	4.2%	3.4%	2.9%
Physical Scientists	2.1%	3.3%	2.3%	3.7%	3.3%
Selected Non-S&E Occupations					
Lawyers	1.9%	2.3%	1.5%	2.1%	1.4%
Dentists	0.4%	1.2%	0.8%	0.7%	1.5%
Physicians and surgeons	0.8%	0.8%	0.9%	0.6%	0.8%
Registered nurses	1.2%	2.1%	2.1%	2.0%	2.6%
Accountants and auditors	2.5%	5.0%	5.0%	4.2%	4.2%

Source: CRS analysis of unpublished data from the Current Population Survey, BLS.

Employment Projections, 2012-2022

This section provides an analysis of the Bureau of Labor Statistics occupational employment projections for the 2012-2022 period.

Scientists and Engineers in Aggregate

An analysis of Bureau of Labor Statistics employment projections indicates that the science and engineering workforce will grow by 953,200 (14.3%) jobs between 2012 and 2022, a CAGR of

1.3%. This growth rate is somewhat higher than the growth rate projected for all occupations (1.0%) during this period.[25]

In addition to the job openings created by growth in the number of jobs in S&E occupations, BLS projects that an additional 1.3 million scientists and engineers will be needed to replace those who are expected to exit the S&E occupations during this period due to retirement, death, career change, etc. (i.e., net replacements). BLS projects a total of 2.3 million job openings in S&E occupations due to growth and net replacements during this period.

Science and Engineering Occupational Groups

Employment projections for science and engineering occupational groups are provided in **Table 10**, which includes the following for each group: 2012 actual employment, 2022 projected employment, the change in the number of jobs between 2012 and 2022, the total percentage increase in the number of jobs, the compound annual growth rate in the number of jobs, and the total job openings due to growth and net replacements.

Among the S&E occupational groups, computer occupations are projected to see the largest increase in the number employed (651,500) and the largest number of job openings (1,240,100). Computer occupations, which accounted for 55.2% of all S&E jobs in 2012, are projected to account for 68.3% of the total growth in S&E occupations between 2012 and 2022. (See **Figure 6**.) As a result, the share of all S&E jobs accounted for by computer occupations is projected to rise from 55.2% in 2012 to 56.9% in 2022.

Mathematical occupations are projected to have the fastest employment growth (2.4% CAGR), increasing their projected share of total S&E employment slightly to 2.2% in 2022.

The occupational groups that are projected to account for a smaller share of total S&E job growth than their share of total 2012 S&E employment are:

- **Engineers**—projected to account for 14.4% of total S&E job growth during the 2012-2022 period, below their 23.8% share of S&E employment in 2012, thus reducing their projected share of 2020 S&E employment to 22.7%;
- **Physical scientists**—projected to account for 3.8% of total S&E job growth during the 2012-2022 period, below their 5.9% share of S&E employment in 2012, thus reducing their projected share of 2022 S&E employment to 5.6%; and
- **Life scientists**—projected to account for 2.9% of total S&E job growth during the 2012-2022 period, below their 4.4% share of S&E employment in 2012, thus reducing their projected share of 2022 S&E employment to 4.2%; and
- **S&E managers**—projected to account for 7.0% of total S&E job growth during the 2012-2022 period, below their 8.7% share of S&E employment in 2012, thus reducing their projected share of 2022 S&E employment to 8.5%.

[25] CRS analysis of BLS 2012-2022 employment projections, http://www.bls.gov/emp.

Table 10. 2012-2022 Employment Projections for S&E Occupational Groups

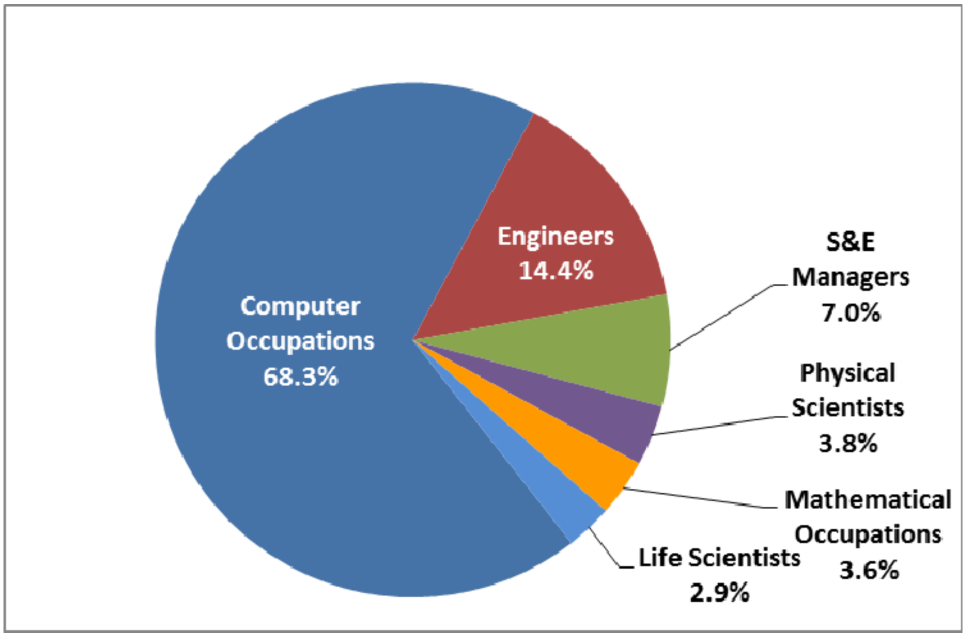
Numbers in thousands, except percent and CAGR

Occupations	Employment 2012	Employment 2022	Change, 2012-2022 Number	Change, 2012-2022 %	Change, 2012-2022 CAGR	Job Openings Due to Growth and Net Replacements
Computer Occupations	3,682.1	4,333.6	651.5	17.7%	1.6%	1,240.1
Mathematical Occupations	130.5	164.7	34.2	26.2%	2.4%	67.7
Engineers	1,589.6	1,726.4	136.8	8.6%	0.8%	544.3
Life Scientists	294.3	322.0	27.7	9.4%	0.9%	104.7
Physical Scientists	393.6	429.7	36.1	9.2%	0.9%	140.9
S&E Managers	578.1	645.0	66.9	11.6%	1.1%	171.4
S&E Occupations, Total	**6,668.2**	**7,621.4**	**953.2**	**14.3%**	**1.3%**	**2,269.1**
Selected Other Professional and Related Occupations						
Lawyers	759.8	834.7	74.8	9.8%	0.9%	196.5
Dentists	146.8	170.2	23.3	15.9%	1.5%	59.1
Physicians and Surgeons	691.4	814.7	123.3	17.8%	1.7%	296.4
Registered Nurses	2,711.5	3,238.4	526.8	19.4%	1.8%	1,052.6
Accountants and auditors	1,275.4	1,442.2	166.7	13.1%	1.2%	544.2
Total, All Occupations	**145,355.8**	**160,983.7**	**15,628.0**	**10.8%**	**1.0%**	**50,557.3**

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

Notes: Numbers for S&E occupational groups may not add due to rounding of component occupations.

Figure 6. Share of Total Projected S&E Occupational Job Growth, 2012-2022, by S&E Occupational Group

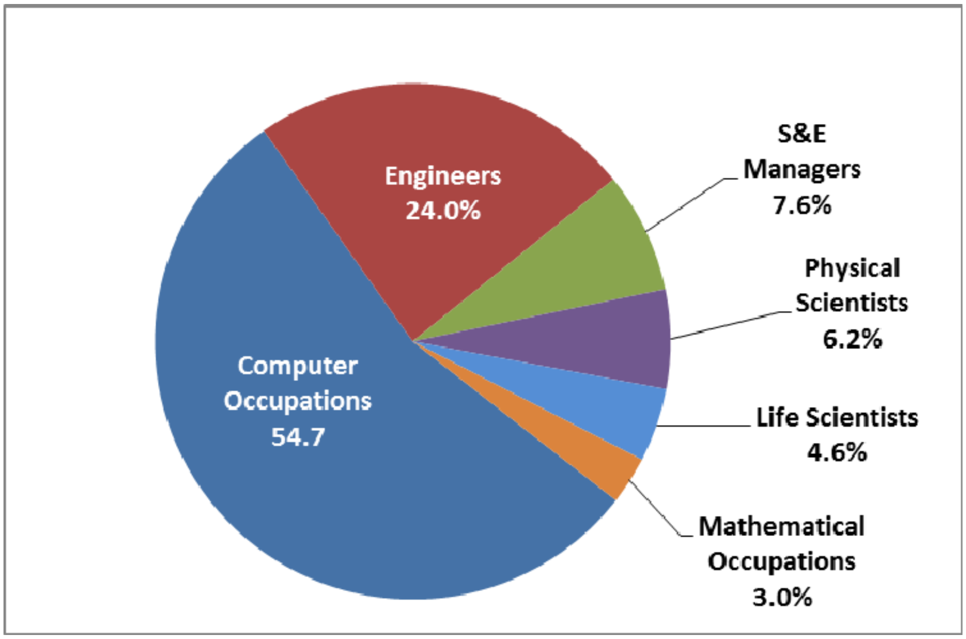


Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

Notes: Numbers are rounded and may not add to 100%.

Across all occupations (not just S&E occupations) the number needed to replace those exiting the workforce (34.9 million) is expected to be more than twice the number of new jobs created (15.6 million). For certain S&E occupational groups, in contrast, the number of openings resulting from growth in the number employed is expected to exceed the number of openings resulting from those exiting the occupations (net replacements). For example, BLS projects an increase of 651,500 jobs in the computer occupations between 2012 and 2022. During the same period, BLS projects that there will be 588,600 job openings in computer occupations due to net replacement needs. Similarly, for the mathematics occupations, the increase in jobs (34,200) exceeds the number needed to replace those exiting the field (33,500). For certain other S&E occupational groups, however, net replacement needs greatly exceed the number of projected new jobs in the occupation as for the workforce as a whole. For engineering occupations, BLS projects that 75% of job openings in the 2012 to 2022 period will result from the need to replace those exiting the occupations (407,500 job openings due to net replacement needs and 136,800 due to increases in the number of engineering jobs). **Figure 7** illustrates the composition of total projected S&E job openings (due to growth and net replacements) by S&E occupational group.

Figure 7. Share of Total Projected S&E Occupational Job Openings (Job Growth plus Net Replacement Needs), 2012-2022, by S&E Occupational Group



Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

Notes: Numbers are rounded and may not add to 100%.

Detailed Science and Engineering Occupations

The Bureau of Labor Statistics' projected job growth and projected total job openings (job growth plus net replacements) for the S&E occupations vary substantially during the 2012-2022 projection period. **Table 11-Table 16** show the top 10 S&E occupations in terms of job growth, job losses, and job openings.

Table 11 shows the 10 S&E occupations with the highest projected growth in jobs. Eight of the ten S&E occupations on this list are in the computer occupations. One of the remaining two occupations is computer and information systems managers. The only non-IT occupation in the top 10 is civil engineers.

Table 11. S&E Occupations with the Highest Projected Growth in Jobs and Other Selected Occupations, 2012-2022

Rank	S&E Occupation	Projected Average Annual Job Growth[a]
1	Software developers, applications	13,990
2	Computer systems analysts	12,770
3	Computer user support specialists	11,080
4	Software developers, systems software	8,280
5	Civil engineers	5,370

Rank	S&E Occupation	Projected Average Annual Job Growth[a]
6	Computer and information systems managers	5,090
7	Network and computer systems administrators	4,290
8	Web developers	2,850
9	Computer programmers	2,840
10	Information security analysts	2,740
Non S&E Selected Occupations with Highest Projected Growth		
	Personal Care Aides	58,080
	Registered Nurses	52,680
	Retail Salespersons	43,470
	Home Health Aides	42,420
	Combined food preparation/serving workers, incl. fast food	42,190

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Table 12 shows the 10 S&E occupations with the smallest projected growth in jobs. The list includes occupations from physical and life sciences, mathematics, and engineering occupations. The number of new jobs projected to be created in these 10 occupations total less than 300 per year.

Table 12. S&E Occupations with the Smallest Projected Growth in Jobs, 2012-2022

Rank	S&E Occupation	Projected Average Annual Job Growth[a]
1	Biological scientists, all other	-20
2	Conservation scientists	10
3	Agricultural engineers	10
4	Animal scientists	20
5	Materials engineers	20
6	Astronomers	30
7	Mathematical science occupations, all other	30
8	Materials scientists	40
9	Epidemiologists	50
10	Foresters	70

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Table 13 shows the 10 S&E occupations with the fastest projected job growth rates. Information security analysts (3.2%) and biomedical engineers (2.4% CAGR) are the fastest growing S&E occupations. The remaining occupations on the list range from 1.9% to 2.4% CAGR, faster than the overall projected job growth rate for all occupations (1.0% CAGR). The list includes four computer occupations, four mathematical occupations, and two engineering occupations.

Table 13. S&E Occupations with the Fastest Projected Job Growth Rates, 2012-2022

Rank	S&E Occupation	Projected Job Growth Rate (CAGR)	Projected Average Annual Job Growth[a]
1	Information security analysts	3.2%	2,740
2	Biomedical engineers	2.4%	520
3	Operation research analysts	2.4%	1,950
4	Statisticians	2.4%	740
5	Actuaries	2.3%	630
6	Petroleum engineers	2.3%	980
7	Computer systems analysts	2.2%	12,770
8	Mathematicians	2.1%	80
9	Software developers, applications	2.1%	13,990
10	Software developers, systems software	1.9%	8,280
Non S&E Occupations with Fastest Projected Growth			
	Industrial-organizational psychologists	4.6%	90
	Personal care aides	4.1%	58,080
	Home health aides	4.0%	42,420
	Insulation workers, mechanical	3.9%	1,350
	Interpreters and translators	3.9%	2,930
All Occupations		1.0%	1,562,800

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Table 14 shows the 10 S&E occupations with the slowest projected job growth rates, ranging from -0.1% to 0.4% CAGR, well below the overall projected job growth rate of 1.0% CAGR. The list includes seven engineering occupations, two biological sciences occupations, and one computer occupation.

Table 14. S&E Occupations with the Slowest Projected Job Growth Rates, 2012-2022

Rank	S&E Occupation	Projected Job Growth Rate (CAGR)	Projected Average Annual Job Growth[a]
1	Biological scientists, all other	-0.1%	-20
2	Materials engineers	0.1%	20
3	Conservation scientists	0.1%	10
4	Electronics engineers, except computer	0.3%	480

Rank	S&E Occupation	Projected Job Growth Rate (CAGR)	Projected Average Annual Job Growth[a]
5	Computer occupations, all others	0.4%	780
6	Engineers, all others	0.4%	510
7	Agricultural engineers	0.4%	10
8	Mechanical engineers	0.4%	1,160
9	Chemical engineers	0.4%	150
10	Industrial engineers	0.4%	1,010

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Table 15 shows the 10 S&E occupations with the most projected job openings (jobs growth plus net replacements). This category shows where the most job opportunities are projected to be. Six of the ten occupations are computer occupations and another is computer and information systems managers. The other three occupations on the list are engineering occupations—civil, mechanical, and industrial engineering.

Table 15. S&E Occupations with the Most Projected Job Openings, 2012-2022

Rank	S&E Occupation	Projected Average Annual Job Openings[a]
1	Software developers, applications	21,850
2	Computer systems analysts	20,960
3	Computer user support specialists	19,690
4	Software developers, systems software	13,470
5	Civil engineers	12,010
6	Computer programmers	11,810
7	Network and computer systems administrators	10,050
8	Mechanical engineers	9,970
9	Computer and information systems managers	9,710
10	Industrial engineers	7,540

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Table 16 shows the 10 S&E occupations with the fewest projected job openings. This list includes occupations from the life sciences, engineering, physical sciences, and mathematical fields.

Table 16. S&E Occupations with the Fewest Projected Job Openings, 2012-2022

Rank	S&E Occupation	Projected Average Annual Job Openings[a]
1	Mathematical science occupations, all other	70
2	Agricultural engineers	80
3	Astronomers	90
4	Animal scientists	120
5	Epidemiologists	160
6	Mathematicians	170
7	Materials scientists	260
8	Marine engineers and naval architects	260
9	Hydrologists	290
10	Mining and geological engineers, incl. mining safety engineers	300

Source: CRS analysis of Employment Projections, 2012-2022, Bureau of Labor Statistics, U.S. Department of Labor.

a. The numbers in this column are derived by dividing the net job creation during the 2012-2022 projection period for each occupation by 10 to get the average annual number of net new jobs created.

Concluding Observations

Scientists and engineers are widely believed to be essential to U.S. technological leadership, innovation, manufacturing, and services, and thus vital to U.S. economic strength, national defense, and other societal needs (e.g., treating and preventing diseases, ensuring access to affordable energy, protecting and restoring the environment). The adequacy of the U.S. science and engineering workforce has been an ongoing concern of Congress for more than 60 years. Congress has enacted many programs to support the education and development of scientists and engineers. Congress has also undertaken broad efforts improve science, technology, engineering, and math (STEM) skills to prepare a greater number of students to pursue science and engineering (S&E) degrees. Some policy makers have sought to increase the number of foreign scientists and engineers working in the United States through changes in visa and immigration policies.

While there is a broad consensus on the important role of scientists and engineers to the United States, policy makers, business leaders, academicians, S&E professional society analysts, economists, and others hold diverse views with respect to the adequacy of the S&E workforce and related policy issues. In particular, there are varying perspectives about whether a shortage of scientists and engineers exists in the United States, what the nature of such a shortage might be (e.g., too few people with S&E degrees, a mismatch of worker skills and employer needs), and whether the federal government should undertake policy interventions to address a putative shortage or allow market forces to work in this labor market.

Perspectives on the Adequacy of the U.S. S&E Workforce

Here are some general ways in which their views may be expressed:

- **There is a shortage.** There is a shortage (or a looming shortage) of scientists and engineers (or alternatively, an inadequate supply of workers with degrees in science and engineering fields), and this may result in the loss of U.S. scientific, engineering, technological, and industrial leadership, with consequent effects on areas such as economic growth, job creation, standard of living, and national security.[26]
- **There is not a shortage.** Assertions of a broad shortage of scientists and engineers are not supported by the data when considering indicators such as employment growth, wage growth, and unemployment rates.[27]
- **More scientists and engineers are needed regardless of the existence of a shortage.** Historically, federal policies, programs, and investments have contributed to the development of the United States' scientific and engineering workforce. Regardless of whether demand currently exceeds supply, increasing the number of U.S. scientists and engineers will increase U.S. innovation, economic performance, and job creation. Even if there is not a shortage of scientists and engineers, jobs in many occupations require a higher level of STEM knowledge than ever before.[28] Students who earn S&E degrees gain thinking skills, problem-solving skills, and STEM knowledge that will enable them to be successful not only in S&E occupations, but also in S&E-related careers and in non-S&E fields where they can apply their S&E knowledge and skills.[29]

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[26] See, for example, National Research Council, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, 2007, http://www.nap.edu/catalog.php?record_id=11463; U.S. Department of Energy, *Secretary Chu, Intel President Discuss Need for More U.S. Engineers*, September 1, 2011, http://energy.gov/articles/secretary-chu-intel-president-discuss-need-more-us-engineers; Shirley Ann Jackson, President, Rensselaer Polytechnic Institute, *The Quite Crisis: Falling Short in Producing American Scientific and Technical Talent,* Building Engineering and Science Talent (BEST), 2002; and Vinton G. Cerf, "How to Fire Up U.S. Innovation," *Wall Street Journal*, April 12, 2011, http://online.wsj.com/article/SB10001424052748704461304576216911954533514.html; and Rodney C. Atkins, Senior Vice President, Systems and Technology Group, IBM, "America Desperately Needs More STEM Students. Here's How to Get Them," *Forbes*, July 9, 2012, http://www.forbes.com/sites/forbesleadershipforum/2012/07/09/america-desperately-needs-more-stem-students-heres-how-to-get-them.

[27] See, for example, testimony of Ralph Gomory, President, Alfred P. Sloan Foundation, before the U.S. Congress, House Committee on Science and Technology, *The Globalization of R&D and Innovation, Part I*, 110th Cong., June 12, 2007 (Washington: GPO, 2008); testimony of Michael Teitelbaum, Vice President, Alfred P. Sloan Foundation and Harold Salzman, Senior Research Associate, The Urban Institute, before the U.S. Congress, House Committee on Science and Technology, *The Globalization of R&D and Innovation, Part IV*, 110th Cong., November 6, 2007 (Washington: GPO, 2008); Robert J. Samuelson, "Sputnik Scare, Updated" *Washington Post*, August 26, 2005, p. A27, http://www.washingtonpost.com/wp-dyn/content/article/2005/05/25/AR2005052501812.html; and Michael Teitelbaum, "The U.S. Science and Engineering Workforce: An Unconventional Portrait," *Pan-Organizational Summit on the U.S. Science and Engineering Workforce*, Government-Industry-University Research Roundtable, National Research Council, 2003, pp. 1-7, http://www.nap.edu/catalog.php?record_id=10727.

[28] See, for example, U.S. Congress Joint Economic Committee, Chairman's Staff, *STEM Education: Preparing for the Jobs of the Future*, April 2012, http://www.jec.senate.gov/public/index.cfm?a=Files.Serve&File_id=6aaa7e1f-9586-47be-82e7-326f47658320.

[29] See, for example, Vern Ehlers, before the U.S. Congress, House Committee on Science and Technology, *The Globalization of R&D and Innovation, Part IV*, 110th Cong., November 6, 2007 (Washington: GPO, 2008).

- **Government interventions in the S&E labor market to address perceived shortages may introduce inefficiencies.** Federal government efforts to increase the number of scientists and engineers by incentivizing the pursuit of degrees in S&E disciplines and/or increasing immigration quotas may result in less efficient operation of the S&E labor market. For example, too many students may be educated in S&E for the number of jobs available and graduates who find S&E jobs may receive lower salaries.[30]
- **Workforce projections are unreliable for predicting shortages.** Long-term projections for S&E occupations are unreliable.[31] Relying on such projections may result in the preparation of too many or too few students with S&E degrees or in mismatches between the students' education and market needs. Among the difficulties in making long-term projections are unexpected changes in the mix of industrial output or employment due to technological or market changes, factor substitution (e.g., substitution of capital for labor) due to changes in prices, changes in retirement behavior, the availability of foreign labor, labor market demographics, and government policies.[32]
- **There may be shortages in certain industries, occupations, or fields.** Shortages may exist in some S&E occupations or for certain employers, for example in new and emerging S&E fields (e.g., nanotechnology); cyclical industries (e.g., aerospace); in fields where foreign scientists and engineers may not be employed due to export control laws; and for employers otherwise limited, in general or for specific purposes, to using only U.S. citizens.
    - **The labor market will resolve such needs.** If markets are allowed to operate freely (i.e., without government interventions), any short-term "shortages" will be resolved as wages equilibrate demand and supply, as the labor supply increases (e.g., as more students earn S&E degrees) in response to market signals, or through substitution of alternative inputs.[33]
    - **The potential adverse consequences of even discrete shortages require government interventions.** These shortages should be met with federal efforts to increase supply or the United States may face the loss of technological leadership in new and emerging fields, lower economic performance, and diminished national security.[34]

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[30] See, for example, Leonard Lynn, Case Western Reserve University, and Hal Salzman, Rutgers University, "Dynamics of Engineering Labor Markets: Petroleum Engineering and Responsive Supply," presentation at "U.S. Engineering in the Global Economy," sponsored by the Alfred P. Sloan Foundation, Cambridge, MA, September 26, 2011, http://policy.rutgers.edu/faculty/salzman/dynamics.pdf.

[31] See, for example, Office of Technology Assessment, *Demographic Trends and the Scientific and Engineering Workforce*, OTA-TM-SET-35, December 1985, http://www.princeton.edu/~ota/disk2/1985/8507/8507.PDF.

[32] See, for example, Richard B. Freeman, *Is a Great Labor Shortage Coming? Replacement Demand in the Global Economy*, National Bureau of Economic Research, Working Paper 12541, Cambridge, MA, September 2006, http://www.nber.org/papers/w12541.

[33] See, for example, Richard B. Freeman, *Does Globalization of the Scientific/Engineering Workforce Threaten U.S. Economic Leadership?*, National Bureau of Economic Research, Working Paper 11457, Cambridge, MA, June 2005, http://www.nber.org/papers/w11457.pdf.

[34] See, for example, National Research Council, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, 2007.

- **Industry assertions of shortages are driven by a desire to reduce costs and/or increase current knowledge.** Industry assertions of S&E shortages are driven primarily by a desire to lower their labor costs through increased supply by providing a continuous stream of young, lower-cost recent college graduates through education, training, and immigration. These new hires can replace older, higher-cost workers with less current knowledge.[35]
- **The real issue is a skills mismatch, not a shortage of people.** The difficulty employers have in meeting their S&E workforce needs (in particular their information technology workforce needs) results primarily from a mismatch between the specific skills—or combinations of knowledge, skills, and experience—needed by employers and those held by S&E workers.[36]
- **Expanding immigration can help address the shortage.** Immigration policies directed at increasing the number of foreign scientists and engineers in the United States puts the creativity of the world's best and brightest to work for the U.S. economy and reduces the loss of U.S.-educated foreign nationals with S&E degrees (i.e., returning to their countries of origin, working in countries other than the United States or their countries of origin).[37]
- **Expanding immigration will dampen the market signals that would otherwise drive more U.S. students into science and engineering.** Visa and immigration policies directed at increasing the number of foreign scientists and engineers in the United States may, by increasing the overall supply of scientists and engineers, depress wages, increase unemployment, and reduce career opportunities for U.S. scientists and engineers; discourage American students from pursuing S&E degrees and careers; and cloud labor market signals (e.g., wage growth, unemployment rates) to students considering pursing S&E degrees and careers.[38]
- **U.S. students lag those of other nations in STEM knowledge; federal efforts to improve STEM education are needed.** U.S. students lag foreign students in

[35] See, for example, various writings of Norm Matloff, Professor of Computer Science, University of California at Davis, http://heather.cs.ucdavis.edu/matloff.html.

[36] See, for example, Tom Kucharvy, *Solutions to STEM Skills Mismatch*, Beyond IT, February 25, 2012, http://beyond-it-inc.com/GKEblog/solutions-to-stem-skills-mismatch.html; and "Statistic of the Month: Investigating the Skills Mismatch," Center on International Education Benchmarking, July 31, 2012, http://www.ncee.org/2012/07/statistic-of-the-month-investigating-the-skills-mismatch.

[37] See, for example, Vivek Wadhwa, Anna Lee Saxenian, Richard Freeman, and Alex Salever, *Losing the World's Best and Brightest: America's New Immigrant Entrepreneurs*, Ewing Marion Kauffman Foundation, March 2009, http://www.kauffman.org/uploadedFiles/ResearchAndPolicy/Losing_the_World%27s_Best_and_Brightest.pdf; The White House, "Fact Sheet: Fixing Our Broken Immigration System So Everyone Plays by the Rules," press release, January 29, 2013, http://www.whitehouse.gov/the-press-office/2013/01/29/fact-sheet-fixing-our-broken-immigration-system-so-everyone-plays-rules; and Robert D. Atkinson, *Eight Ideas for Improving the America COMPETES Act*, Information Technology and Innovation Foundation, March 2010, http://www.itif.org/files/2010-america-competes.pdf.

[38] See, for example, Ross Eisenbrey, Vice President, Economic Policy Institute, "Op-Ed: America's Genius Glut," *New York Times*, February 7, 2013; Remarks of Brian Keane, Founder and CEO, Ameritas Technologies, and Neeraj Gupta, Founder and CEO, Systems in Motion, at Senate briefing on "Understanding the Impact of the H-1B Program: On the Economy, Employers and Workers," March 14, 2013, http://www.epi.org/files/2013/Keane_H-1B_briefing_14_March_2013.pdf; and Stan Sorscher, Labor Representative, Society of Professional Engineering Employees in Aerospace, *Flooding the STEM Labor Market*, March 3, 2013, http://www.ifpte.org/downloads/issues/2013-3-3%20Flooding%20the%20STEM%20labor%20market.pdf.

STEM knowledge, and this may result in fewer and/or less-talented U.S. scientists and engineers, lower economic growth, and reduced economic competitiveness.[39] Federal policies and programs can help to build a stronger K-12 STEM education system.

- **International assessments do not reflect the adequacy of U.S. student STEM knowledge.** Standardized tests used to compare the STEM knowledge of U.S. K-12 students to those of other nations do not appropriately reflect the STEM knowledge of U.S. students, the adequacy of their preparation to pursue S&E degrees and occupations, or their future capabilities as scientists and engineers.[40]

Perspectives on Ways to Foster Development of the S&E Workforce

These disparate perspectives contribute to a variety of opinions on the roles the federal government should play in fostering the development of the S&E workforce, including the merits of federal policies focused on:

- increasing the number of students pursuing S&E degrees;
- increasing the number of foreign scientists and engineers admitted to the United States;
- increasing the number and share of underrepresented minorities and women in science and engineering;
- improving K-12 STEM education; and
- improving career information and counseling for high school students.

As Congress considers approaches to bolstering U.S. competitiveness and scientific, engineering, technological, and industrial leadership, it may wish to consider these perspectives and opinions.

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[39] U.S. Department of Education, "Secretary Arne Duncan's Remarks at OECD's Release of the Program for International Student Assessment (PISA) 2009 Results," press release, December 7, 2010, http://www.ed.gov/news/speeches/secretary-arne-duncans-remarks-oecds-release-program-international-student-assessment; Paul E. Peterson, Ludger Woessmann, Eric A. Hanushek, and Carlos X. Lastra-Anadon, *Globally Challenged: Are U.S. Students Ready to Compete*, Harvard Kennedy School, Harvard University, PEPG Report No. 11-03, August 2011, http://www.hks.harvard.edu/pepg/PDF/Papers/PEPG11-03_GloballyChallenged.pdf; and Brandon Wright, "What do International Tests Really Show About U.S. Student Performance," Thomas B. Fordham Institute, January 24, 2013, http://www.edexcellence.net/commentary/education-gadfly-weekly/2013/january-24/what-do-international-tests-really-show-about-us-performance.html.

[40] Martin Carnoy and Richard Rothstein, *What Do International Tests Really Show About U.S. Student Performance*, Economic Policy Institute, January 15, 2013, http://www.epi.org/publication/us-student-performance-testing.

Appendix. S&E Occupational Descriptions and Entry-Level Education Requirements

Occupation	Description	Entry-level Education
Computer Occupations		
Computer and Information Research Scientists	Conduct research into fundamental computer and information science as theorists, designers, or inventors. Develop solutions to problems in the field of computer hardware and software.	Doctoral or professional degree
Computer Programmers	Create, modify, and test the code, forms, and script that allow computer applications to run. Work from specifications drawn up by software developers or other individuals. May assist software developers by analyzing user needs and designing software solutions. May develop and write computer programs to store, locate, and retrieve specific documents, data, and information.	Bachelor's degree
Computer User Support Specialists	Provide technical assistance to computer users. Answer questions or resolve computer problems for clients in person, or via telephone or electronically. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems.	Some college, no degree
Computer Network Support Specialists	Analyze, test, troubleshoot, and evaluate existing network systems, such as local area network (LAN), wide area network (WAN), and Internet systems or a segment of a network system. Perform network maintenance to ensure networks operate correctly with minimal interruption.	Associate's degree
Computer Systems Analysts	Analyze science, engineering, business, and other data processing problems to implement and improve computer systems. Analyze user requirements, procedures, and problems to automate or improve existing systems and review computer system capabilities, workflow, and scheduling limitations. May analyze or recommend commercially available software.	Bachelor's degree
Database Administrators	Administer, test, and implement computer databases, applying knowledge of database management systems. Coordinate changes to computer databases. May plan, coordinate, and implement security measures to safeguard computer databases.	Bachelor's degree
Information Security Analysts	Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information. May ensure appropriate security controls are in place that will safeguard digital files and vital electronic infrastructure. May respond to computer security breaches and viruses.	Bachelor's degree
Web Developers	Design, create, and modify websites. Analyze user needs to implement website content, graphics, performance, and capacity. May integrate Web sites with other computer applications. May convert written, graphic, audio, and video components to compatible Web formats by using software designed to facilitate the creation of Web and multimedia content.	Associate's degree
Computer Network Architects	Design and implement computer and information networks, such as local area networks (LAN), wide area networks (WAN), intranets, extranets, and other data communications networks. Perform network modeling, analysis, and planning. May also design network and computer security measures. May research and recommend network and data communications hardware and software.	Bachelor's degree

Occupation	Description	Entry-level Education
Network and Computer Systems Administrators	Install, configure, and support an organization's local area network (LAN), wide area network (WAN), and Internet systems or a segment of a network system. Monitor network to ensure network availability to all system users and may perform necessary maintenance to support network availability. May monitor and test website performance to ensure Web sites operate correctly and without interruption. May assist in network modeling, analysis, planning, and coordination between network and data communications hardware and software. May supervise computer user support specialists and computer network support specialists. May administer network security measures.	Bachelor's degree
Software Developers, Applications	Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team. May supervise computer programmers.	Bachelor's degree
Software Developers, Systems Software	Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. May design embedded systems software. Apply principles and techniques of computer science, engineering, and mathematical analysis.	Bachelor's degree
Computer Occupations, All Other	All computer occupations not listed separately. Excludes Computer and Information Systems Managers; Computer Hardware Engineers; Electrical and Electronics Engineers; Computer Science Teachers, Postsecondary; Multimedia Artists and Animators; Graphic Designers; Computer Operators; and Computer, Automated Teller, and Office Machine Repairs.	Bachelor's degree
Mathematical Occupations		
Actuaries	Analyze statistical data, such as mortality, accident, sickness, disability, and retirement rates and construct probability tables to forecast risk and liability for payment of future benefits. May ascertain insurance rates required and cash reserves necessary to ensure payment of future benefits.	Bachelor's degree
Mathematicians	Conduct research in fundamental mathematics or in application of mathematical techniques to science, management, and other fields. Solve problems in various fields using mathematical methods.	Master's degree
Operations Research Analysts	Formulate and apply mathematical modeling and other optimizing methods to develop and interpret information that assists management with decision making, policy formulation, or other managerial functions. May collect and analyze data and develop decision support software, service, or products. May develop and supply optimal time, cost, or logistics networks for program evaluation, review, or implementation.	Bachelor's degree
Statisticians	Develop or apply mathematical or statistical theory and methods to collect, organize, interpret, and summarize numerical data to provide usable information. May specialize in fields such as bio-statistics, agricultural statistics, business statistics, or economic statistics. Includes mathematical and survey statisticians.	Master's degree
Mathematical Science Occupations, All Other	All mathematical scientists not listed separately.	Bachelor's degree

Occupation	Description	Entry-level Education
Engineers		
Aerospace Engineers	Perform engineering duties in designing, constructing, and testing aircraft, missiles, and spacecraft. May conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture. May recommend improvements in testing equipment and techniques.	Bachelor's degree
Agricultural Engineers	Apply knowledge of engineering technology and biological science to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation, and processing of agricultural products.	Bachelor's degree
Biomedical Engineers	Apply knowledge of engineering, biology, and biomechanical principles to the design, development, and evaluation of biological and health systems and products, such as artificial organs, prostheses, instrumentation, medical information systems, and heath management and care delivery systems.	Bachelor's degree
Chemical Engineers	Design chemical plant equipment and devise processes for manufacturing chemicals and products, such as gasoline, synthetic rubber, plastics, detergents, cement, paper, and pulp, by applying principles and technology of chemistry, physics, and engineering.	Bachelor's degree
Civil Engineers	Perform engineering duties in planning, designing, and overseeing construction and maintenance of building structures, and facilities, such as roads, railroads, airports, bridges, harbors, channels, dams, irrigation projects, pipelines, power plants, and water and sewage systems. Includes architectural, structural, traffic, ocean, and geo-technical engineers.	Bachelor's degree
Computer Hardware Engineers	Research, design, develop, or test computer or computer-related equipment for commercial, industrial, military, or scientific use. May supervise the manufacturing and installation of computer or computer-related equipment and components.	Bachelor's degree
Electrical Engineers	Research, design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use.	Bachelor's degree
Electronics Engineers, Except Computers	Research, design, develop, or test electronic components and systems for commercial, industrial, military, or scientific use employing knowledge of electronic theory and materials properties. Design electronic circuits and components for use in fields such as telecommunications, aerospace guidance and propulsion control, acoustics, or instruments and controls.	Bachelor's degree
Environmental Engineers	Research, design, plan, or perform engineering duties in the prevention, control, and remediation of environmental hazards using various engineering disciplines. Work may include waste treatment, site remediation, or pollution control technology.	Bachelor's degree
Health and Safety Engineers, except Mining Safety Engineers and Inspectors	Promote worksite or product safety by applying knowledge of industrial processes, mechanics, chemistry, psychology, and industrial health and safety laws. Includes industrial product safety engineers.	Bachelor's degree
Industrial Engineers	Design, develop, test, and evaluate integrated systems for managing industrial production processes, including human work factors, quality control, inventory control, logistics and material flow, cost analysis, and production coordination.	Bachelor's degree
Marine Engineers and Naval Architects	Design, develop, and evaluate the operation of marine vessels, ship machinery, and related equipment, such as power supply and propulsion systems.	Bachelor's degree

Occupation	Description	Entry-level Education
Materials Engineers	Evaluate materials and develop machinery and processes to manufacture materials for use in products that must meet specialized design and performance specifications. Develop new uses for known materials. Includes those engineers working with composite materials or specializing in one type of material, such as graphite, metal and metal alloys, ceramics and glass, plastics and polymers, and naturally occurring materials. Includes metallurgists and metallurgical engineers, ceramic engineers, and welding engineers.	Bachelor's degree
Mechanical Engineers	Perform engineering duties in planning and designing tools, engines, machines, and other mechanically functioning equipment. Oversee installation, operation, maintenance, and repair of equipment such as centralized heat, gas, water, and steam systems.	Bachelor's degree
Mining and Geological Engineers	Conduct sub-surface surveys to identify the characteristics of potential land or mining development sites. May specify the ground support systems, processes and equipment for safe, economical, and environmentally sound extraction or underground construction activities. May inspect areas for unsafe geological conditions, equipment, and working conditions. May design, implement, and coordinate mine safety programs.	Bachelor's degree
Nuclear Engineers	Conduct research on nuclear engineering projects or apply principles and theory of nuclear science to problems concerned with release, control, and use of nuclear energy and nuclear waste disposal.	Bachelor's degree
Petroleum Engineers	Devise methods to improve oil and gas extraction and production and determine the need for new or modified tool designs. Oversee drilling and offer technical advice.	Bachelor's degree
Engineers, All Other	All engineers not listed separately.	Bachelor's degree
Life Scientists		
Animal Scientists	Conduct research in the genetics, nutrition, reproduction, growth, and development of domestic farm animals.	Doctoral or professional degree
Food Scientists and Technologists	Use chemistry, microbiology, engineering, and other sciences to study the principles underlying the processing and deterioration of foods; analyze food content to determine levels of vitamins, fat, sugar, and protein; discover new food sources; research ways to make processed foods safe, palatable, and healthful; and apply food science knowledge to determine best ways to process, package, preserve, store, and distribute food.	Bachelor's degree
Soil and Plant Scientists	Conduct research in breeding, physiology, production, yield, and management of crops and agricultural plants or trees, shrubs, and nursery stock, their growth in soils, and control of pests; or study the chemical, physical, biological, and mineralogical composition of soils as they relate to plant or crop growth. May classify and map soils and investigate effects of alternative practices on soil and crop productivity.	Bachelor's degree
Biochemists and Biophysicists	Study the chemical composition or physical principles of living cells and organisms, their electrical and mechanical energy, and related phenomena. May conduct research to further understanding of the complex chemical combinations and reactions involved in metabolism, reproduction, growth, and heredity. May determine the effects of foods, drugs, serums, hormones, and other substances on tissues and vital processes of living organisms.	Doctoral or professional degree
Microbiologists	Investigate the growth, structure, development, and other characteristics of microscopic organisms, such as bacteria, algae, or fungi. Includes medical microbiologists who study the relationship between organisms and disease or the effects of antibiotics on microorganisms.	Bachelor's degree

Occupation	Description	Entry-level Education
Zoologists and Wildlife Biologists	Study the origins, behavior, diseases, genetics, and life processes of animals and wildlife. May specialize in wildlife research and management. May collect and analyze biological data to determine the environmental effects of present and potential use of land and water habitats.	Bachelor's degree
Biological Scientists, All Other	All biological scientists not listed separately.	Bachelor's degree
Conservation Scientists	Manage, improve, and protect natural resources to maximize their use without damaging the environment. May conduct soil surveys and develop plans to eliminate soil erosion or to protect rangelands. May instruct farmers, agricultural production managers, or ranchers in best ways to use crop rotation, contour plowing, or terracing to conserve soil and water; in the number and kind of livestock and forage plants best suited to particular ranges; and in range and farm improvements, such as fencing and reservoirs for stock watering.	Bachelor's degree
Foresters	Manage public and private forested lands for economic, recreational, and conservation purposes. May inventory the type, amount, and location of standing timber, appraise the timber's worth, negotiate the purchase, and draw up contracts for procurement. May determine how to conserve wildlife habitats, creek beds, water quality, and soil stability, and how best to comply with environmental regulations. May devise plans for planting and growing new trees, monitor trees for healthy growth, and determine optimal harvesting schedules.	Bachelor's degree
Epidemiologists	Investigate and describe the determinants and distribution of disease, disability, or health outcomes. May develop the means for prevention and control.	Master's degree
Medical Scientists, except Epidemiologists	Conduct research dealing with the understanding of human diseases and the improvement of human health. Engage in clinical investigation, research and development, or other related activities. Includes physicians, dentists, public health specialists, pharmacologists, and medical pathologists who primarily conduct research.	Doctoral or professional degree
Life Scientists, All Other	All life scientists not listed separately.	Bachelor's degree
Physical Scientists		
Astronomers	Observe, research, and interpret astronomical phenomena to increase basic knowledge or apply such information to practical problems.	Doctoral or professional degree
Physicists	Conduct research into physical phenomena, develop theories on the basis of observation and experiments, and devise methods to apply physical laws and theories.	Doctoral or professional degree
Atmospheric and Space Scientists	Investigate atmospheric phenomena and interpret meteorological data, gathered by surface and air stations, satellites, and radar to prepare reports and forecasts for public and other uses. Includes weather analysts and forecasters whose functions require the detailed knowledge of meteorology.	Bachelor's degree
Chemists	Conduct qualitative and quantitative chemical analyses or experiments in laboratories for quality or process control or to develop new products or knowledge.	Bachelor's degree
Materials Scientists	Research and study the structures and chemical properties of various natural and synthetic or composite materials, including metals, alloys, rubber, ceramics, semiconductors, polymers, and glass. Determine ways to strengthen or combine materials or develop new materials with new or specific properties for use in a variety of products and applications. Includes glass scientists, ceramic scientists, metallurgical scientists, and polymer scientists.	Bachelor's degree

Occupation	Description	Entry-level Education
Environmental Scientists and Specialists, including Health	Conduct research or perform investigation for the purpose of identifying, abating, or eliminating sources of pollutants or hazards that affect either the environment or the health of the population. Using knowledge of various scientific disciplines, may collect, synthesize, study, report, and recommend action based on data derived from measurements or observations of air, food, soil, water, and other sources.	Bachelor's degree
Geoscientists, except Hydrologists and Geographers	Study the composition, structure, and other physical aspects of the Earth. May use geological, physics, and mathematics knowledge in exploration for oil, gas, minerals, or underground water; or in waste disposal, land reclamation, or other environmental problems. May study the Earth's internal composition, atmospheres, oceans, and its magnetic, electrical, and gravitational forces. Includes mineralogists, crystallographers, paleontologists, stratigraphers, geodesists, and seismologists.	Bachelor's degree
Hydrologists	Research the distribution, circulation, and physical properties of underground and surface waters; and study the form and intensity of precipitation, its rate of infiltration into the soil, movement through the earth, and its return to the ocean and atmosphere.	Master's degree
Physical Scientists, All Other	All physical scientists not listed separately.	Bachelor's degree
S&E Managers		
Architectural and Engineering Managers	Plan, direct, or coordinate activities in such fields as architecture and engineering or research and development in these fields.	Bachelor's degree
Computer and Information Systems Managers	Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming.	Bachelor's degree
Natural Sciences Managers	Plan, direct, or coordinate activities in such fields as life sciences, physical sciences, mathematics, statistics, and research and development in these fields.	Bachelor's degree

Source: *Occupational Employment Statistics*, Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/oes/current/oes_stru.htm; Employment Projections, BLS, U.S. Department of Labor, http://data.bls.gov/projections/occupationProj.

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