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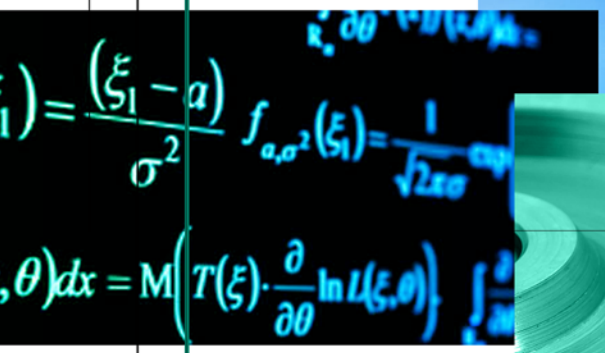
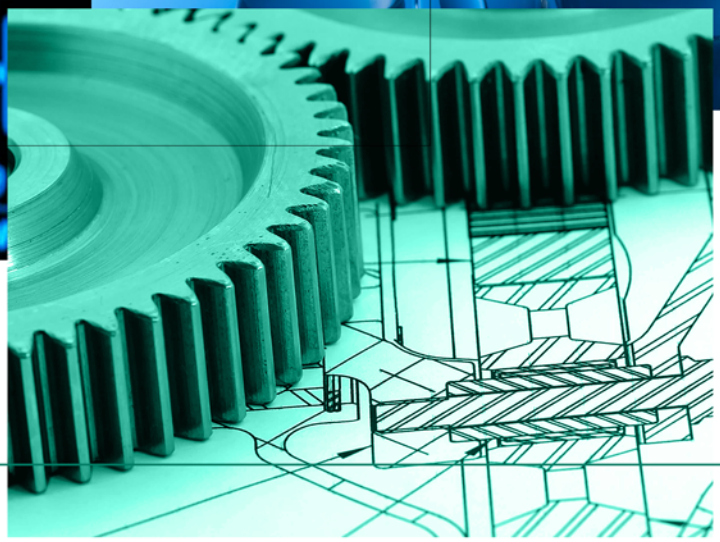
STEM in New Hampshire: A Labor Supply-Demand Analysis





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STEM in New Hampshire:

A Labor Demand-Supply Analysis

State of New Hampshire

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Executive Summary

There has been a renewed emphasis on the need for both education and jobs in Science, Technology, Engineering and Mathematics (STEM) among political stakeholders, educators, and employers. With the variety of stakeholders involved with this one topic, this analysis is an attempt to bridge the differences between the business demand for qualified workers in STEM occupations and educational institutions providing programs in STEM subjects.

To analyze supply and demand, STEM occupations were grouped into three clusters based on the Bureau of Labor Statistics definition of STEM occupations:

- *Life/Physical Science, Engineering, Architecture, Math, and Information Technology cluster*
- *Social Science cluster*
- *Health cluster*

The *Health cluster*, which is excluded from some definitions of STEM, was included here because analysis shows that workers in health care are required to have many of the same skills and knowledge areas as workers in other STEM occupations, as well as needing advanced educational preparation and occupational licensure to practice.

Demand for STEM Workers

In New Hampshire, occupations identified as STEM are projected to have a stronger demand than the average for all occupations between 2010 and 2020, according to the latest occupational employment projections.

- STEM occupations are expected to grow by 17.3 percent, compared to 10.4 percent for the state as a whole.
- STEM occupations are expected to account for 3,180 of the 22,759 projected annual job openings in New Hampshire, or about 14 percent.
  - *Life/Physical Science, Engineering, Architecture, Math, and Information Technology* occupations are projected to have 1,507 annual job openings.
  - *Social Science* occupations are projected to have 71 annual job openings.
  - *Health* occupations are projected to have 1,602 annual job openings.
- Among the workers' occupations, four out of five are in occupations with "very favorable" employment opportunities expected, compared to two out of five among all occupations.
- Of the estimated annual job openings for STEM occupations, more than half are *Research, Development, Design, or Practitioner* occupations, and just over a quarter are *Technologist and Technician* occupations.
- About 27 percent of projected STEM job openings are in occupations requiring an Associate's degree, about 42 percent are in occupations requiring a Bachelor's degree, and about 16 percent are in occupations requiring an advanced degree (beyond a baccalaureate).
- Among the STEM occupations, approximately 35 percent must be licensed, certified, or registered in New Hampshire, compared to 20 percent of all occupations.

Supply of STEM Workers

In 2011, about 4,600 New Hampshire students were awarded degrees in educational programs corresponding to entry-level qualifications for STEM occupations. Of those:

- 2,150 completers were awarded a degree in an instructional program that corresponded to entry-level employment requirements for *Life/Physical Science, Engineering, Architecture, Math, and Information Technology* occupations;
- 530 completers were awarded a degree in an instructional program that corresponded to entry-level employment requirements for *Social Science* occupations; and
- 1,920 completers were awarded a degree in an instructional program that corresponded

to entry-level employment requirements for *Health* occupations.

To estimate the pipeline of workers into the labor market, postsecondary educational program completers at New Hampshire colleges and universities were used as a proxy for labor market entrants. Program completers were matched to occupations based on academic major, using a crosswalk that identifies the specific educational program(s) that prepare students to become employed in an occupation. In addition, for a completer to be considered available as labor supply, the award level needed to correspond to or be higher than the entry-level educational qualification for each occupation, as defined by the Bureau of Labor Statistics.

Not all of the STEM occupations in New Hampshire had corresponding program completers with the degree needed for entry-level employment. In some cases, the program was offered, but at lower educational level than the entry-level requirement. In other cases, a program meeting the requirement was offered, but there were no New Hampshire completers in 2011.

Also contributing to meeting the demand for workers in STEM occupations are those already in the labor force. The supply of experienced STEM workers was examined using the unemployment rates of workers in four occupational groups: *Computer and mathematical science* occupations, *Architecture and engineering* occupations, *Life, physical, and social service* occupations, and *Healthcare practitioner and technical* occupations. New Hampshire's average annual unemployment rate in 2012 among these occupations was 2.7 percent, well below the statewide average rate of 5.6 percent for all occupations.

Translating Occupational Demand into Industry Demand

The final step in the analysis of supply and demand was to determine the economic impact of STEM workers on the New Hampshire economy. First, industry staffing patterns were used to identify the industries most likely to employ workers in STEM occupations. Annual openings for STEM occupations were distributed across employing industries.

- 39.8 percent of STEM annual openings were in the *Health care and social assistance* sector
- 17.3 percent of STEM annual openings were in the *Professional and business services* sector
- 9.5 percent of STEM annual openings were in the *Manufacturing* sector.

Then, the REMI econometric model was used to develop a counterfactual simulation to estimate the multiplier effect of not filling a STEM job opening on the economy. In this counterfactual scenario, annual average job openings for STEM occupational employment by industry were removed from the REMI model baseline. For each STEM job opening not filled, the impact on New Hampshire's economy averaged 1.77 jobs (including the STEM job opening) over the ten-year period. *

Conclusion

In New Hampshire, workers in STEM occupations:

- are more likely to have higher levels of education,
- have the skills and knowledge most in demand, and
- are expected to have very favorable employment opportunities between 2010 and 2020.

* This multiplier is a conservative estimate. The multiplier effect is likely higher as the model's baseline employment was reduced by industry, and not occupation. The majority of STEM occupations are paid wages higher than the average, whereas the REMI policy employment variable is based on average pay in each industry.

The supply of labor, measured by postsecondary educational program completers from New Hampshire educational institutions, was also positive. Supply exceeded demand in each of the three STEM clusters — *Life/Physical Science, Architecture, Engineering, Math and IT* occupations; *Social Science* occupations, and *Health* occupations. This was not the case for the individual occupations, where some had an over-supply of entrants and others had no supply.

However, these program completers are not all expected to seek employment here in New Hampshire. In addition, there is a lack of population growth among the state's primary and secondary school-age students, impacting the future supply pipeline into the labor force.

New Hampshire faces a potential labor shortage in the future, and STEM occupations are no exception. This problem cannot be addressed from just one perspective. The business community must ensure that the education community understands expectations for worker skills and abilities, and be willing to hire graduates with little or no experience. The education community must understand the skills and abilities expected by business, and be prepared to adjust curricula to meet those expectations, as well as provide students opportunities to gain work experience. Both sides of the labor equation — demand and supply — will have to work together to achieve success.

Introduction

As far back as the first Congressional address given by President George Washington,[1] emphasis has been placed on an American population highly educated in math and science because it was considered the path to new innovations and prosperity. Americans invented products such as the typewriter, the revolver, the telegraph, vulcanized rubber, and the telephone. In the first half of the 20th century, demands of two world wars brought forth the continued need for excellence in math and science disciplines.[2] As the United States entered the race to space with the Soviet Union in the late 1950s, astronauts became American heroes, and the National Defense Education Act appropriated funding to improve science, mathematics, and foreign language instruction in elementary and secondary schools.[3]

New Hampshire has been the home of many inventors, including Samuel Morey (internal combustion engine), Sylvester Marsh (cog rail mechanism), David Goodell (apple-parer), Benjamin Palmer (artificial leg), Neil Tillotson (latex balloon), and Dean Kamen (ambulatory infusion pump, portable dialysis machine, the Segway, and more).[4] Earl Silas Tupper (Tupperware) was born in New Hampshire.[5]

As technology has advanced more quickly, so has the expansion and evolution within science and mathematics education disciplines. The emphasis on science and mathematics education has evolved, merging with theory, practical application, and instructional methodology. Today, there is a renewed emphasis on the need for people educated in the fields of Science, Technology, Engineering, and Mathematics, known as STEM. Workers with advanced skills and knowledge in STEM fields are vital to keeping America's workforce competitive.

This study is an assessment of the current status of STEM in New Hampshire from a labor force perspective, comparing the supply of and demand for workers with STEM knowledge and abilities. First, STEM occupations are defined. Then, demand for workers in STEM occupations for New Hampshire is estimated, using projections of occupational employment for 2010 to 2020. These data are measured against a proxy of worker supply, a measurement of students at New Hampshire institutions completing postsecondary education programs that prepare them for employment in STEM occupations. Finally, these data will be used to estimate the contribution of STEM workers to the New Hampshire economy.

The goal of this assessment is to provide a point-in-time picture of the supply and demand for STEM workers in New Hampshire — to determine if supply exceeds demand, or if there is more demand than supply. This study is not intended as a critique of the education community, nor of business practices. It is, however, hoped that by identifying labor supply and demand, educational institutions and employers will develop a common understanding and be encouraged to work together to fill labor force gaps, making New Hampshire more competitive in a global economy.

1. U.S. President George Washington, First Annual Message to Congress on the State of the Union, January 8, 1790. The American Presidency Project. <www.presidency.ucsb.edu/ws/index.php?pid=29431>.
2. Roosevelt, F.D. (1945) Science The Endless Frontier A Report to the President. Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945. United States Government Printing Office, Washington: 1945. <www.nsf.gov/od/lpa/nsf50/vbush1945.htm>.
3. US Department of Education. The Federal Role in Education. <www2.ed.gov/about/overview/fed/role.html>.
4. Karlon, Marty, "Invented Here." NHMagazine.com. January 1, 2011. <www.nhmagazine.com/people/903944-113/invented-here.html>.
5. PBS. "American Experience." <www.pbs.org/wgbh/americanexperience/features/biography/tupperware-tupper/>.

Defining STEM Occupations

STEM has re-emerged as a prominent issue among the political stakeholders, educators, and employers. Yet those discussing, promoting, or analyzing the demand for and supply of workers in STEM are not always using the same definitions. Some STEM definitions are quite broad, while others are very specific. STEM has been used in reference to secondary students' level of science, technological, and math expertise (or lack thereof) prior to entering postsecondary institutions. It has also been used to refer to the number of postsecondary graduates with degrees in science, technology, engineering, or math. At other times, STEM refers to the apparent insufficient number of workers with necessary experience in engineering to meet employer needs.

To analyze supply and demand, a labor market definition of STEM is most appropriate. The STEM definition published by the Bureau of Labor Statistics was selected,[6] as this definition provides a broad range of occupations covering a measurable portion of the New Hampshire economy, and is based on standard occupational coding methodology. The 2012 STEM definition was developed upon request from the Office of Management and Budget to the Standard Occupational Classification Policy Committee (SOCPC). A STEM workgroup was established, representing members from federal agencies related to workforce and economic development as well as national stakeholders such as the National Center for Education Statistics, the National Science Foundation, and the National Center for Science and Engineering Statistics.[7]

The STEM workgroup developed a framework to identify STEM occupations using two major STEM domains, or areas of expertise, with each domain including two sub-domains. Then, five types of

Data Sources and Classification Systems

To evaluate an estimate of demand for and supply of workers in STEM occupations, data were drawn from three sources, each of which uses a different taxonomy. Demand data are from projections of occupational demand for New Hampshire, 2010 – 2020. Projections of industry and occupational employment are developed biennially by New Hampshire Employment Security's Economic and Labor Market Information Bureau. Supply data are based on postsecondary educational program completers for 2011 at New Hampshire colleges and universities. These data are reported to and compiled by the Integrated Postsecondary Educational Data System (IPEDS), National Center for Education Statistics, US Department of Education. Finally, economic impact is assessed by industry using the North American Industry Classification System (NAICS).

The first hurdle for such an analysis is that labor demand — occupational data — is classified using the 2010 Standard Occupational Classification (SOC), while new labor supply — educational program completers — is classified using the 2010 Classification of Instructional Programs (CIP). To determine if the supply of new labor (educational completers) is adequate for worker demand (projected job openings), the *CIP-SOC crosswalk* was used.[a]

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a. The CIP-SOC crosswalk used was jointly developed by the Bureau of Labor Statistics and the National Center for Education Statistics. For more information, visit the NCES website: nces.ed.gov/ipeds/cipcode/resources.aspx?y=55.

6. US Bureau of Labor Statistics, Standard Occupational Classification Crosswalks. <www.bls.gov/soc/#crosswalks>.
7. SOC Policy Committee, Options for Defining STEM (Science, Technology, Engineering, and Mathematics) occupations under the 2010 Standard Occupational Classification (SOC) system, Attachment A. <www.bls.gov/soc/Attachment_A_STEM.pdf>.

occupations were identified, based on educational attainment and method of work.[8]

The framework used the same guidelines as those for structuring the Standard Occupational Classification (SOC) System. Most significantly, STEM occupations were selected based on SOC Classification Principle 2, which states, *"Occupations are classified based on the **work performed** and, in some cases on the skills, education, and/or training needed to perform the work at a competent level."* [9]

The STEM domains and sub-domains in this classification are:

Science, Engineering, Mathematics, and Information Technology Domain

1. Life and Physical Science, Engineering, Mathematics, and Information Technology Occupations
2. Social Science Occupations

Science- and Engineering-Related Domain

3. Architecture Occupations
4. Health Occupations

In addition to being divided by domain, STEM occupations were further classified by type of occupation:

A. Research, Development, Design, or Practitioner Occupations
B. Technologist and Technician Occupations
C. Postsecondary Teaching Occupations
D. Managerial Occupations
E. Sales Occupations

The STEM workgroup identified 184 SOC occupations as STEM, and identified a domain, sub-domain, and type for each occupation.[10] There were three detailed SOC occupations that fit equally well in multiple sub-domain and occupational type groups: *Architectural and engineering managers*, *Architectural and civil drafters*, and *Life, physical, and social science technicians, all other*. The framework assigned

continued from page 2

According to the *Guidelines for Using the CIP-SOC Crosswalk*:

> A CIP-SOC relationship must indicate a 'direct' relationship, that is, programs in the CIP category are preparation … for entry into and performance in jobs in the SOC category. The programs satisfy requirements for entry and/or prepare individuals to meet licensure or certification requirements to work in the occupation.
>
> It is possible that there may be no direct correspondence between a CIP Code and a SOC code. This may occur because the occupation does not require any postsecondary education, because the CIP program is not career related, or because an insufficient number of institutions offer the program, to justify having a CIP Code.
>
> Relationships between CIP and SOC may be one-to-one, one-to-many, many-to-one, or many-to-many. Since SOC codes tend to be more specific than CIP codes, it is likely that one CIP code will map to multiple SOC codes. This is in part because the CIP codes describe instructional programs that will often provide training that can be applied to multiple occupations.[b]

Thus, the measure of labor supply is based on a count of students completing postsecondary education who majored in an instructional program that has prepared the student to enter an occupation identified as STEM in the definition selected for this analysis. For example, a student attaining a degree in Physical therapy is most likely

continued on page 4

b. National Center for Education Statistics, CIP User Site. <nces.ed.gov/ipeds/cipcode/resources.aspx?y=55>.

8. Ibid.
9. US Bureau of Labor Statistics, 2010 SOC User Guide. <www.bls.gov/soc/soc_2010_user_guide.pdf>.
10. For a complete list of the STEM occupations as identified by the STEM workgroup, see Appendix A.

"part" of the employment in these occupations into multiple groups.

New Hampshire demand data were available for 130 STEM occupations, which were organized into the following three groups:

- **Life/Physical Science, Architecture, Engineering, Mathematics, and Information Technology Occupations**
- **Social Science Occupations**
- **Health Occupations**

Because the Architecture sub-domain includes just five occupations, it was combined with *Life/Physical Science, Engineering, Mathematics, and Information Technology occupations*. There were several reasons for making this combination. First, two of the five Architecture occupations (*Architectural and engineering managers*, and *Architectural and civil drafters*) are included in part with *Life/Physical Science, Engineering, Mathematics, and Information Technology occupations*. Second, three of the five Architecture occupations are classified in the *Architecture and Engineering occupations* SOC job family (17-0000), a major occupational group having similar educational requirements, and dominated by engineering occupations. Finally, due to the fact that the majority of STEM occupations have a relatively low employment level in New Hampshire, combining STEM occupations into fewer groups provides a larger employment base for analysis, and helps avoid potential data confidentiality issues.

In many STEM definitions, *Health occupations* are excluded, however, *Health occupations* are included in this analysis for two reasons. First, workers in *Healthcare Practitioner and Technical occupations* (SOC job family 29-000) are required to have an educational background in sciences, technology, engineering, and mathematics similar to that of many engineers or life and physical scientists. Second, health care represents a significant portion of employment in New Hampshire — in 2011, the *Health care and social assistance* industry sector was the second-largest private employment sector in the state, after *Retail trade*. The majority of this analysis examines the three occupational groups separately, to inform both those who consider Healthcare a part of STEM, and those who do not.

continued from page 3

to be employed as a Physical therapist (a one-to-one relationship). On the other hand, a student attaining a degree in Biology may find employment as a Biological scientist, a Secondary school teacher, or a Natural sciences manager (a one-to-many relationship).

The next hurdle in this analysis was that STEM employment by occupation had to be translated into industry data to assess the economic impact of STEM workers. Industry data are classified in a third taxonomy, the North American Industrial Classification System, or NAICS. The connection between occupation and industry is determined by occupational staffing patterns.

The Occupational Employment Statistics (OES) Program, conducted in New Hampshire under cooperative agreement with the US Bureau of Labor Statistics, collects information from New Hampshire employers, who have been identified by industry, on the occupations of workers employed there. These data are compiled to create an occupational staffing pattern for all non-farm industries, measuring the share of each industry's total employment held by each occupation. These data can then be inverted to show the industries in which workers engaged in each occupation are usually employed. These inverse staffing patterns may indicate numerous industries employing workers in an occupation, or a small number of industries employing workers in another occupation. For example, Accountants and auditors are employed by businesses in nearly 70 different industries, while Audiologists are employed by businesses in just two industries.

Demand for Workers in STEM Occupations

To determine the level of demand, long-term projections of New Hampshire employment by occupation for 2010 to 2020 were used.[11] Among all occupations in New Hampshire in 2010, there were about 662,150 workers. This number is expected to grow to 730,700 by 2020, a ten-year growth rate of 10.4 percent, and an increase of 68,500 workers. On average, 22,760 workers will be needed to fill available job openings annually. New job growth will create an estimated annual 7,100 openings, while the need to replace workers who leave jobs, either to retire or for other reasons, will create an estimated 15,650 job openings annually.

Among the defined STEM occupations, there were about 84,800 workers in 2010, and that number is expected to increase to 99,500 by 2020. This is a ten-year growth rate of a little over 17 percent, an increase of 14,660 workers. An average of 3,180 workers will be needed annually to fill available job openings. Of those, about 1,500 will be new job openings and 1,700 will be replacement job openings. [12]

In this assessment, total projected annual job openings are used to estimate labor demand for STEM workers. Among the three defined STEM occupational clusters, *Health occupations* are expected to have 1,600 job openings annually. *Life/Physical Sciences, Architecture, Engineering, Math, and IT occupations* are expected to have almost the same number, with 1,500 job openings, while *Social Science occupations* are expected to have fewer than 100 job openings annually. *Life/Physical Sciences, Architecture, Engineering, Math, and IT occupations* are expected to have more openings from replacements (870) than from growth (640), while *Health occupations* are expected to have about an equal number of openings from replacements and growth (800).

To gain a perspective of how the demand for workers in STEM occupations compares to other parts of the labor market, projections data for STEM occupations and all occupations were compiled. The comparisons were based on projected employment opportunity (occupational descriptors); projected annual job openings by job family; and projected annual job openings for STEM by entry-level educational requirement.[13]

New Hampshire Long-term Occupational Projections, 2010 to 2020

Occupational categories	2010 Base	2020 Projected	Total Change	Percent	Average Annual Openings		
					Growth	Replacements	Total
Life/Physical Sciences, Architecture, Engineering, Math, and IT occupations	43,037	49,396	6,359	14.8%	636	871	1,507
Social Science Occupations	1,895	2,139	244	12.9%	23	48	71
Health Occupations	39,901	47,962	8,061	20.2%	804	798	1,602
STEM Occupations, Total	**84,833**	**99,497**	**14,664**	**17.3%**	**1,463**	**1,717**	**3,180**
Total, All Occupations	662,146	730,710	68,564	10.4%	7,109	15,650	22,759

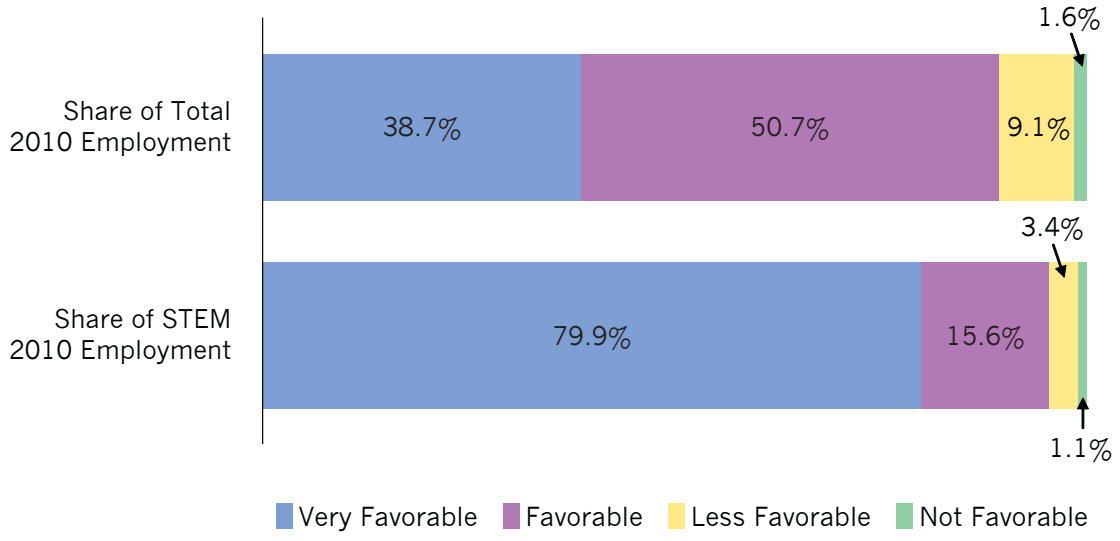
11. Occupational projections data include the self-employed.
12. A detailed listing of projected demand for workers in individual STEM occupations is available in Appendix B.
13. Total annual openings are an estimated number of new workers needed annually for each occupation. The total estimate is the sum of openings due to new job growth and openings due to replacement needs. A replacement is a job opening created by a worker who permanently leaves an occupation because of retirement, death, or exiting the workforce. This estimate does not include turnover, or workers moving from one job to another within the same occupation. Annual openings are also not the same as job postings, which are advertisements for jobs.

Projected Employment Opportunity for STEM Occupations

As part of the projections process, occupations are assigned a measure of employment opportunity known as "occupational descriptors," based on the projected growth rate and the average number of annual openings. Five ranges of projected growth are combined with five ranges of annual openings into four categories of favorability for employment opportunity. These categories are *Very favorable*, *Favorable*, *Less favorable*, and *Not favorable*.[14]

Occupations with *Very favorable* job opportunities are expected to have higher than the average growth rate for all occupations and more job openings than the average for all occupations from 2010 to 2020. Among the 130 STEM occupations in New Hampshire, four out of five workers were in occupations with a *Very favorable* outlook. Among all occupations, only two out of five workers were in occupations with a *Very favorable* outlook. All of the three STEM clusters are expected to grow at a faster rate than the growth rate for *Very favorable* occupations (11.1 percent). But there are some specific STEM occupations within each cluster that have low levels of employment. As a result, these individual occupations will not produce many job openings despite a high rate of growth, and so are not considered *Very favorable* occupations.

Employment opportunities for STEM occupations are expected to be more favorable than opportunities for all occupations.



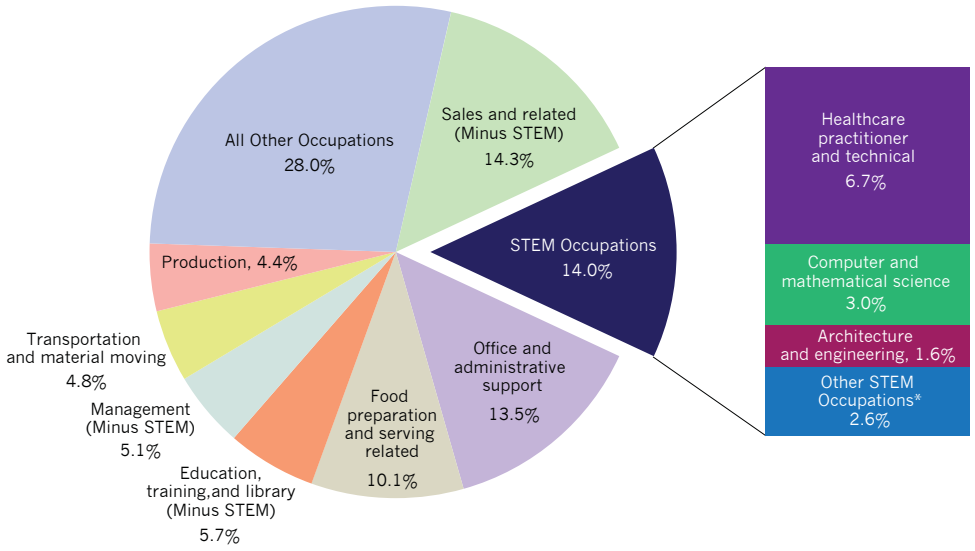
14. Additional information about the Occupational Descriptors can be found in *New Hampshire Employment Projections by Industry and Occupation, Base Year 2010 to Projected Year 2020*, <www.nhes.nh.gov/elmi/products/documents/projections.pdf>, page 8.

Projected Annual Openings by Job Family

The Standard Occupational Classification (SOC) hierarchical structure organizes occupations into 23 major groups, also known as job families. Using the BLS definition of STEM, all occupations in three of these job families — *Healthcare practitioner and technical occupations*, *Computer and mathematical science occupations*, and *Architecture and engineering occupations* — are considered STEM occupations. All but one occupation *(Historians)* in the *Life, physical, and social science occupations* job family are also considered STEM occupations. In addition, STEM includes two occupations from the *Sales and related occupations* job family. The remaining STEM occupations are classified in the *Management occupations* and *Education, training and library occupations* job families, as these are occupations that either manage workers in STEM occupations or are responsible for teaching STEM subjects at postsecondary institutions.

By job family, the highest number of annual openings for all occupations is projected to be in *Sales and related occupations* (excepting two STEM occupations),[15] *Office and administrative support occupations*, and *Food preparation and serving related occupations*, representing 14.3 percent, 13.5 percent, and 10.1 percent, respectively. Projected annual openings for all STEM occupations represent 14.0 percent of projected annual openings in New Hampshire. All together, these STEM occupations are projected to generate the second-highest average number of annual openings over the next ten years.

Projected Annual Openings by Major Occupational Groups and STEM Occupations

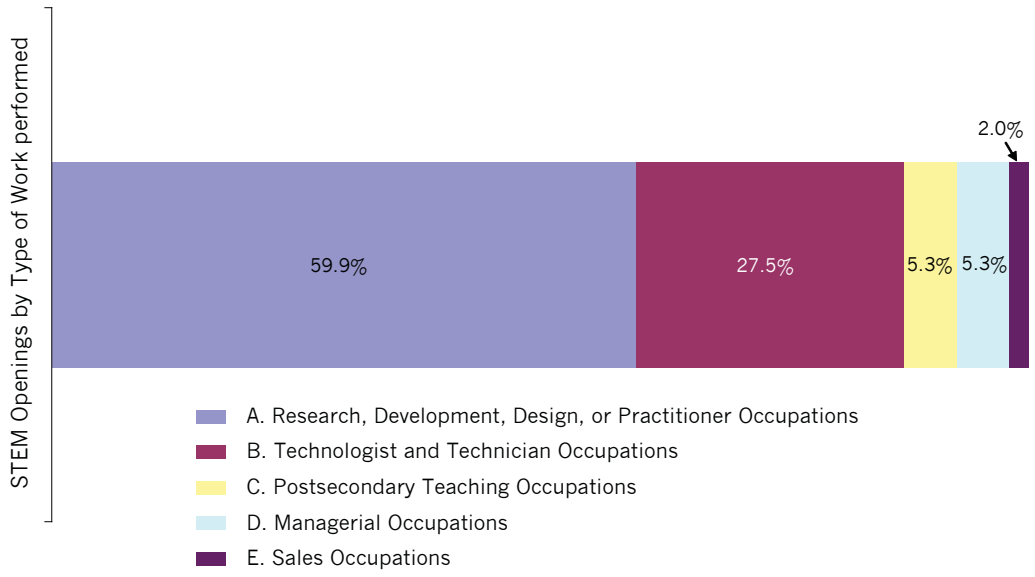


Numbers may not add to 100% due to rounding

* Other STEM occupations include the *Life, physical, and social science occupations* job family (except *Historians*); Managers of workers in STEM occupations; Postsecondary teachers of STEM fields of study; and two sales occupations.

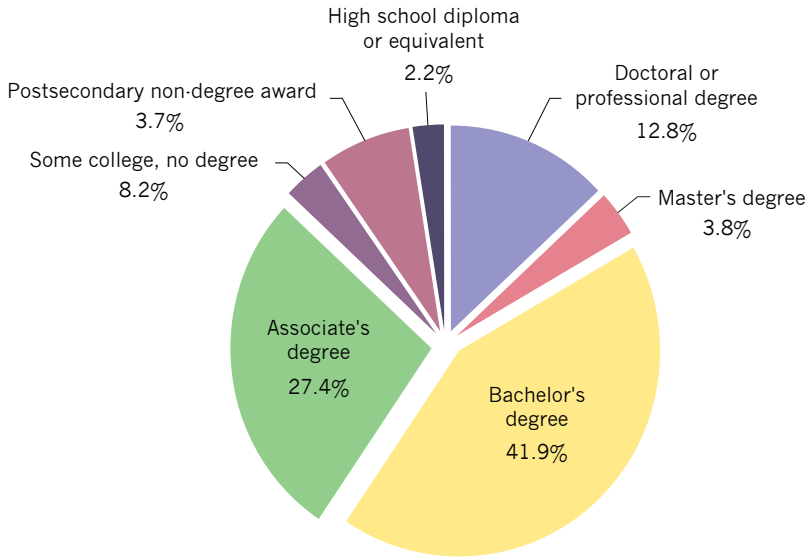
15. *Sales Engineers* and *Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products* are excluded from the tally of Sales and related occupations, as they are considered STEM occupations.

Projected Annual Openings by Occupation Type



By type of work performed, the majority of STEM occupations are *Research, Development, Design, or Practitioner occupations*, accounting for more than half of projected STEM openings. Just over a quarter of annual job openings for STEM occupations are in *Technologist and Technician occupations*. STEM occupations in *Sales, Managerial,* and *Postsecondary Teaching* all have significantly smaller shares of total projected STEM job openings.

STEM Openings (Demand) by Entry-Level Educational Requirement



STEM Jobs by minimum educational requirements	2010 Employment Base	Annual Job Openings
Doctoral or professional degree	10,880	406
Master's degree	3,162	120
Bachelor's degree	36,706	1,331
Associate's degree	23,113	871
Postsecondary non-degree award	6,078	261
Some college, no degree	2,815	118
High school diploma or equivalent	2,079	70

Projected Annual Job Openings for STEM by Entry-Level Educational Requirement

Summing projected STEM job openings by the entry-level educational requirement for each occupation shows that most STEM occupations require formal postsecondary education. About 27 percent of projected STEM job openings are in occupations requiring an Associate's degree, and more than half are in occupations requiring at least a Bachelor's degree. These shares are substantially higher than shares for all occupations, where about five percent of projected annual openings are in occupations requiring an Associate's degree, and about 20 percent require at least a Bachelor's degree. In fact, about 16 percent of projected annual openings in STEM occupations require an advanced degree (beyond a baccalaureate), compared to just over four percent of projected openings among all occupations.

With the exception of a handful of occupations, the majority of STEM occupations require more than a high school diploma. Just two percent of projected annual STEM job openings are available to workers with a high school diploma or equivalent, where nearly 40 percent of all projected job openings are available to these workers. Another 30 percent of all projected job openings are available to workers with less than a high school diploma, however, none of these workers are qualified for a STEM occupation.

Skills and Knowledge Assessment

Employment projections provide a picture of the required education and employment opportunities for workers in 2020. But what are some common worker traits among the STEM occupations that will be higher in demand than others? To help assess the knowledge and skills in demand for STEM occupations, the Skills-Based Projections[16] system was used. The application uses state occupational employment projections in combination with occupational knowledge, skills, and work activities from O*Net to assess future demand for specific skills and knowledge.

O*Net, the Occupational Information Network, is a compilation of the characteristics of occupations, the mix of knowledge, skills, and abilities required for each, and the variety of activities and tasks performed by workers in each occupation. The O*Net Content Model defines worker requirements as "developed or acquired attributes of an individual that may be related

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Skills Gap Index*		
Skill	**Index**	**Definition**
Reading Comprehension	100.0	Understanding written sentences and paragraphs in work related documents.
Active Listening	97.1	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
Critical Thinking	94.3	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
Speaking	91.4	Talking to others to convey information effectively.
Active Learning	88.6	Understanding the implications of new information for both current and future problem-solving and decision-making.
Coordination	85.7	Adjusting actions in relation to others' actions
Instructing	82.9	Teaching others how to do something.
Monitoring	80.0	Monitoring or assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
Writing	77.1	Communicating effectively in writing as appropriate for the needs of the audience.
Time Management	74.3	Managing one's own time and the time of others.

* As the Skills Gap Index is standardized from 1 to 100, these numeric indicators merely represent a ranking according to overall importance, so these numbers are excluded from the STEM comparison tables.

16. The Skills-Based Projections (SBP) software utilizes state occupational projections and O*Net as the two primary input data sources. O*Net is used in the generation of a broad array of career information products. It provides more than one hundred measures of knowledge, skills and work activities (collectively referred to as KSW) specific to 726 SOC-based occupations. Simply, the SBP software uses the SOC-based occupation to attach state employment projections to KSW's in the O*Net database. For each specific knowledge, skill and work activity, the SBP creates a set of links to all occupations for which it is required. The SBP then estimates base and projected skill demand by summing the employment levels for the linked occupations.

The current version of the Skills-Based Projections (SBP) software used an earlier version of the O*Net database (see technical note <dev.projectionscentral.com/sbproj/downloads/SBP_2_ReleaseNotes.pdf >), resulting in approximately 14.5 percent of the occupational employment not being imported, and therefore not part of the analysis. The majority of the occupations not imported are residual, or All Other, occupations, representing a collection of related, yet distinct occupations, for which O*Net cannot produce worker requirements.

to work performance such as work-related knowledge and skill. Knowledge represents the acquisition of facts and principles about a domain of information. Experience lays the foundation for establishing procedures to work with given knowledge. These procedures are more commonly known as skills." Thus, workers must have knowledge about the work undertaken, then must apply skills to conduct that work. In the O*Net Content Model, *skills* are defined as "work-related attributes acquired and/or developed through education and experience," while *knowledge* is defined as "acquisition of facts and principles about a domain of information."[17]

The *Skills Gap Index* measures the relative change in demand for an O*Net skill or knowledge. Higher index scores mean a larger change (or gap) between current (2010) employment levels and future (2020) demand for workers with the skill or knowledge, relative to other skills or knowledge.[18] The closer a skill or knowledge is ranked to 100, the more demand there will be for workers with that skill or knowledge. The *Skills Gap Index* in the Skills-Based Projections suite can be used to measure skills, knowledge areas, or specific work activities.

17. The O*Net® Content Model. O*Net Resource Center. <www.onetcenter.org/content.html>.

18. Skills Gap Index: For each job requirement, a standardized measure of the difference (gap) between the current supply and projected demand, calculated in four steps:
1. Skill Weight: The proportion of the total current labor force meeting specific job requirement criteria. It is calculated as the job requirement base-year employment divided by total base-year employment.
2. Skill Weight Percent Change: Employment change across the projection horizon, weighted by the percentage of total base-year employment. ((Projected Employment - Base Employment)/Base Employment) * Skill Weight
3. Skill Weight Rank: A rank score, of Skill Weight Percent Change, within a job requirement set.
4. Skills Gap Index: The Skill Weight Rank is standardized from 1 to 100.

Ranking of Skills in Demand by STEM Occupational Clusters

Life/Physical Science, Architecture, Engineering, Math and IT	***Social Science***	***Health***
Reading Comprehension	Writing	Reading Comprehension
Active Learning	Time Management	Active Learning
Active Listening	Speaking	Active Listening
Critical Thinking	*Social Perceptiveness*	Critical Thinking
Coordination	Reading Comprehension	Instructing
Complex Problem Identification	*Persuasion*	Speaking
Writing	Monitoring	Writing
Instructing	*Judgment and Decision Making*	*Learning Strategies*
Speaking	Critical Thinking	*Social Perceptiveness*
Time Management	Coordination	Coordination

Based on the 2010-2020 New Hampshire occupational employment projections

Skills in Demand

The *Skills Gap Index* represents a *relative* ranking of the difference between the number of workers currently in occupations that require a skill and the future demand for workers with that skill. Skills with the highest ranking will be more in demand in the future. Among all occupations, skills ranking the highest — those with the highest expected future demand — are basic skills and cross-functional skills. In the O*Net content model, basic skills are defined as "capacities that facilitate learning or the more rapid acquisition of knowledge," and cross-functional skills are defined as "capacities that facilitate performance of activities that occur across jobs."

Repeating the exercise for the three clusters of STEM occupations, the top ten skills in each cluster were similar to those of all occupations. Two of the three clusters ranked the same four basic skills the highest: *Reading comprehension*, *Active learning*, *Active listening*, and *Critical thinking*. The skills in demand for the Social Science occupations cluster were quite different, with *Writing*, *Time management*, *Speaking*, and *Social perceptiveness* ranking highest in demand. The top ten skills in demand for each of the STEM clusters that did not rank in the top ten for all occupations were *Complex problem identification*, *Social perceptiveness*, *Persuasion*, *Learning strategies*, and *Judgment and decision making*.[19] Four of these five skills — excepting *Learning strategies*, which is a basic skill — are considered cross-functional skills.

19. O*Net defines these skills as follows
Complex problem identification: Developed capacities used to solve novel, ill-defined problems in complex, real-world settings
Social Perceptiveness: Being aware of others' reactions and understanding why they react as they do
Learning Strategies: Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things
Persuasion: Persuading others to change their minds or behavior
Judgment and Decision Making: Considering the relative costs and benefits of potential actions to choose the most appropriate one.

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Knowledge Gap Index*		
Knowledge	**Index**	**Definition**
Customer and Personal Service	100.0	Principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
English Language	97.0	The structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
Psychology	93.9	Human behavior and performance; individual differences in ability, personality, and interests; learning and motivation; psychological research methods; and the assessment and treatment of behavioral and affective disorders.
Education and Training	90.9	Principles and methods for curriculum and training design, teaching and instruction for individuals and groups, and the measurement of training effects.
Mathematics	87.9	Arithmetic, algebra, geometry, calculus, statistics, and their applications.
Clerical	84.8	Administrative and clerical procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms, and other office procedures and terminology.
Administration and Management	81.8	Business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.
Sales and Marketing	78.8	Principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.
Computers and Electronics	75.8	Circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
Medicine and Dentistry	72.7	The information and techniques needed to diagnose and treat human injuries, diseases, and deformities. This includes symptoms, treatment alternatives, drug properties and interactions, and preventive health-care measures.

* As the Knowledge Gap Index is standardized from 1 to 100, these numeric indicators merely represent a ranking according to overall importance, so these numbers are excluded from the STEM comparison tables.

Most Common Knowledge Areas in Demand

Just as the *Skills Gap Index* represents a relative ranking of the difference between the number of workers currently in occupations that require a skill and the future demand for workers with that skill, the Knowledge Gap Index represents a relative ranking for knowledge areas. Among all occupations, the work-related knowledge areas ranking highest in demand were *Customer and personal service*, *English language*, and *Psychology*, indicating that more workers will need knowledge in these areas in the future than those competent in the knowledge area now.

When ranking knowledge gaps for each of the three STEM clusters, four knowledge areas are listed among the top ten highest ranking knowledge areas for all three clusters, and for all occupations as well. These knowledge areas are *English language*, *Customer and personal service*, *Mathematics*, and *Education and training*. This indicates that there will be more need for workers with knowledge in these subjects in the future than there are at present.

Ranking of Knowledge in Demand by STEM Occupational Cluster

Life/Physical Science, Architecture, Engineering, Math and IT	***Social Sciences***	***Health***
Computers and Electronics	English Language	Customer and Personal Service
Mathematics	Education and Training	Psychology
Engineering and Technology	Sociology and Anthropology	Medicine and Dentistry
Customer and Personal Service	Customer and Personal Service	Education and Training
English Language	Psychology	Therapy and Counseling
Design	Therapy and Counseling	English Language
Telecommunications	Mathematics	Biology
Education and Training	Computers and Electronics	Mathematics
Administration and Management	Philosophy and Theology	Chemistry
Clerical	Geography	Clerical

Based on the 2010-2020 New Hampshire occupational employment projections

The knowledge areas specifically related to the occupations in each cluster were evident in the top ten rankings. For the *Life/Physical Science, Architecture, Engineering, Math and IT* cluster, the top ranked knowledge areas were *Computers and electronics*, *Mathematics*, and *Engineering and technology*, along with *Design* and *Telecommunications*. The top six knowledge areas for the Social Science cluster were three of the shared knowledge areas along with *Sociology and anthropology*, *Psychology*, and *Therapy and counseling*. For the Health cluster, the knowledge ranking highlights the diverse nature of scientific knowledge needed for these occupations, with *Psychology*, *Medicine and dentistry*, *Therapy and counseling*, *Biology*, and *Chemistry* all ranking in the top ten.

These skills and knowledge rankings illustrate the fact that attaining an adequate level of education in a corresponding field of study is not always enough to make an applicant attractive to an employer. The ability to read, learn, listen, and think is also in demand. Workers with good basic skills and knowledge will have good employment opportunities in the future.

Occupational Licensing – Another Sign of Specialization

The State of New Hampshire regulates nearly 150 specific occupational activities by requiring licensure, certification, or registration with a state board or agency. Statutory regulation ranges from simply submitting an application form to extensive educational preparation, passing an examination, obtaining years of experience, and regular completion of continuing education.

About 35 percent of STEM occupations must be licensed, certified, or registered in New Hampshire, compared to about 20 percent of all occupations. Among the STEM occupations requiring licensure in New Hampshire, about half are health-related occupations.

Requirement of an occupational license highlights the difficulty in transferring skills among STEM occupations. These occupations usually require completion of an occupation-specific educational program and passing an examination requiring specific occupational knowledge. For example, a *Forest and conservation technician* cannot easily qualify as a licensed *Respiratory care practitioner*, despite the fact that both are classified as *Technologists and technicians* and both require an Associate's degree for entry-level employment. As the educational level required for an occupation rises, the required field of study becomes more specialized, and the ability to transfer skills from one occupation to another becomes increasingly difficult.

Not only is transferring skills more complicated, licensure requirements may also limit where the licensee is able to practice. Occupational licensure is established on a state-by-state basis. For a license issued in one state to be considered valid in another state, reciprocity or endorsement must be allowed. While the State of New Hampshire has reciprocity agreements with other states for some occupations, this is not the case for all occupations. For example, *Professional engineers* who are licensed in another state, and whose qualifications are equal to or higher than those required by New Hampshire statute and administrative rule, may be licensed in this state upon application and payment of a fee. But for *Speech-language pathologists*, a license obtained in another state does not qualify the applicant for licensure in this state, as reciprocity is not accepted.

The Pipeline of New STEM Workers: Educational Completers

Occupational projections provide a basis for evaluating the labor market demand for workers over time. The next step in this labor supply-demand analysis is to determine if there will be qualified workers to fill the projected demand for these jobs.

A majority of STEM occupations require postsecondary education in a particular field of study, or college major. The counts of students completing postsecondary education programs related to STEM occupations provide a measure of new labor supply. The most comprehensive source for the new labor supply pipeline is completer data reported by postsecondary education institutions and compiled by the National Center for Education Statistics as part of the Integrated Postsecondary Education Data System, or IPEDS. (See the section on Data Sources and Classification Systems on page 2 for further explanation of data classification and crosswalks.)

Sample of SOC - CIP crosswalk matching process

Classification of Instructional Programs (CIP)		Standard Occupational Classification (SOC)						
Occupational Title →		Computer & Information Systems Managers	Computer & Information Research Scientists	Computer Systems Analysts	Architects, except Landscape & Naval	Architecture Teachers, Postsecondary	Database Administrators	Registered Nurses
Entry-Level Degree →		*Bachelor's*	*Doctoral or professional*	*Bachelor's*	*Bachelor's*	*Doctoral or professional*	*Bachelor's*	*Associate's*
Program, Degree Conferred & Total Completers								
Architecture								
Bachelor's degree	25				25	0		
Computer and Information Sciences, General								
Associate's degree	10	0	0	0			0	
Bachelor's degree	31	10	0	10			11	
Master's degree	27	9	0	9			9	
Doctorate	1	0	1	0			0	
Information Technology								
Bachelor's degree	8	4	0	4				
Registered Nursing / Registered Nurse								
Associate's degree	472							472
Bachelor's degree	176							176
Master's degree	88							88
Nursing Science								
Bachelor's degree	94							94
Master's degree	9							9
Nursing Practice								
Bachelor's degree	14							14

Examples represent numbers of completers by degree conferred for select educational programs (left column). Shaded blocks indicate educational programs corresponding to a STEM occupation (top row). Numbers in the shaded blocks represent a count of educational program completers matching or exceeding the education level required to qualify for entry-level employment in the occupation. If the educational program corresponded to multiple occupations, program completers were distributed proportionately among corresponding occupations.

As a proxy for labor supply, counts of students completing an educational program at a New Hampshire postsecondary educational institution in 2011 were used to establish a point-in-time estimate of labor available to fill STEM occupations. There are no data available on the exact numbers of students entering the labor force, the state in which they obtained employment, the occupation in which they became employed, or indeed if the student entered the labor force at all. The following assumptions were made for this analysis:

1. Students awarded degrees from New Hampshire postsecondary institutions in 2011 would enter the labor force, as opposed to continuing their education to earn a higher degree, entering the military, or choosing an entirely different line of work.
2. It was assumed that the number of students awarded degrees in New Hampshire in specific educational programs would enter the labor force in New Hampshire.
3. Only primary majors of dual-major graduates were considered, to avoid double-counting a single graduate.
4. Some educational programs (CIP) for which there were completers in New Hampshire qualified the student for multiple occupations (SOC). Completer data for these programs were proportionately distributed across all relevant occupations, regardless of demand for that occupation.
5. For completers to be considered qualified for employment in an occupation, the degree awarded must be equal to or higher than the entry-level educational requirement of the occupation, as defined by the Bureau of Labor Statistics.[20]

The final step of ensuring that completers met the basic level of education to become employed was important to gain a more real-world picture of labor supply. In many cases, a degree program may have had completers at a New Hampshire educational institution, however, those awards were less than the entry level educational requirement of the STEM occupation, so completers were not counted. For example, though there were students in New Hampshire who earned a baccalaureate in Astronomy, this award level is insufficient for employment as a professional *Astronomer*, which has an entry-level qualification of a doctorate in Astronomy. Thus, even though some students were awarded a degree in a STEM-related program, those awarded a degree insufficient for employment were not considered labor supply for the STEM occupation.

20. Bureau of Labor Statistics, "Paving the occupational path: A new system for assigning education and training," Occupational Outlook Quarterly, Fall 2011, <www.bls.gov/opub/ooq/2011/fall/art02.pdf>.

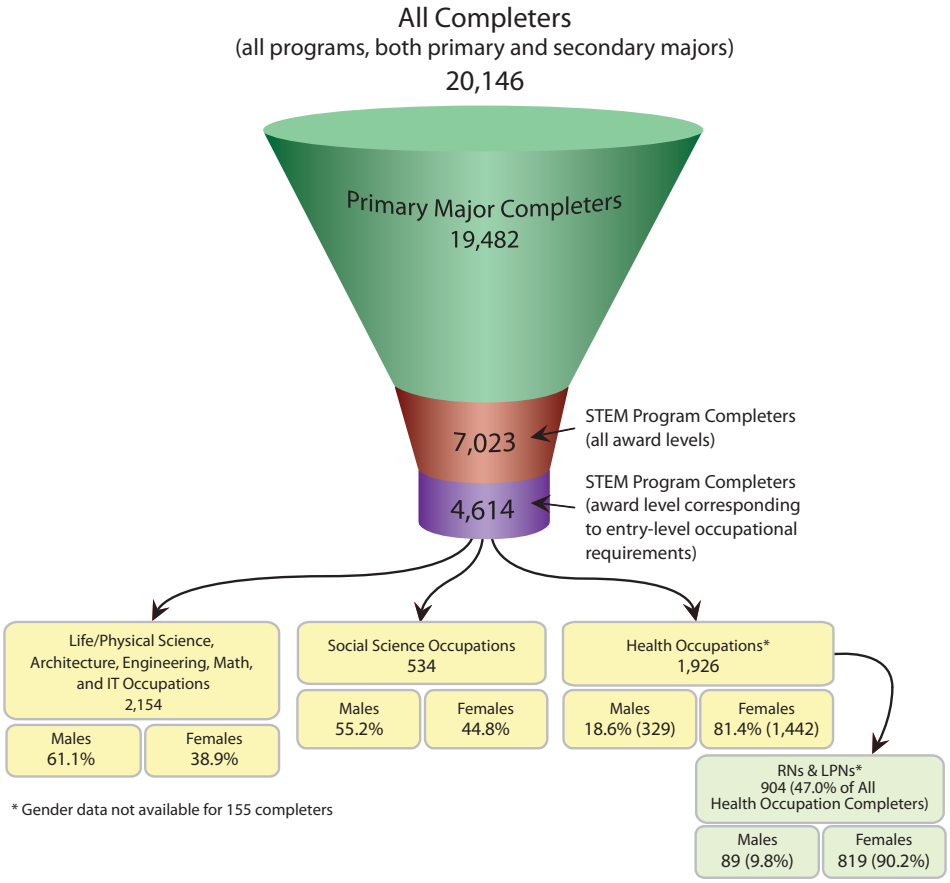
Labor Market Supply for STEM Occupations

In 2011, there were 20,146 completers from all educational programs at postsecondary institutions in New Hampshire.[21]

- 19,482 were awarded a primary degree (excludes the second major of dual-major students)
- 7,023 were awarded a primary degree in an educational program leading to a STEM occupation
- 4,614 of these completers were awarded a degree in an instructional program that corresponded to the educational requirements for entry-level employment in a STEM occupation

Of the completers with awards corresponding to entry-level employment:

- 2,154 completers were awarded a degree in an instructional program that corresponded to entry-level employment requirements for *Life/Physical Science, Engineering, Architecture, Math, and IT occupations*.
- 534 completers were awarded a degree in an instructional program that corresponded to entry-level employment requirements for *Social Science occupations*.
- 1,926 completers were awarded a degree in an instructional program that corresponded to entry-level employment requirements for *Health occupations*.



21. Integrated Postsecondary Education Data System (IPEDS) serves as data collection for the National Center for Education Statistics (NCES). These data represent only completers by state from institutions that report to NCES. Completers from the Manchester, New Hampshire campus of the Massachusetts College of Pharmacy and Health Sciences, reported as Massachusetts completers, were added to the New Hampshire IPEDS totals.

Demographics of New Hampshire's New Labor Supply Pipeline

Of the 4,614 New Hampshire students awarded degrees in educational programs corresponding to entry-level qualifications for STEM occupations, 43.5 percent were male and 56.5 percent were female. This, however, differs by STEM occupational cluster.

Among those awarded degrees in educational programs corresponding to Social Science occupations, the share of males was 55.2 percent, and the share of females, 44.8 percent.

Students awarded degrees in programs corresponding to Life/Physical Science, Engineering, Architecture, Math, and IT occupations were 61.1 percent male and 38.9 percent female. This cluster represents one common definition of STEM occupations.

Among those awarded degrees in educational programs corresponding to Health occupations, the ratio of males to females was different from the other STEM clusters. In this cluster, 81.5 percent of completers were female and 18.5 percent were male. Those awarded degrees corresponding to *Registered nurse (RN)* and *Licensed practical nurse (LPN)* were even more concentrated, 90.2 percent of completers in these programs were female. Even when excluding completers of *Registered nurse* and *Licensed practical nurse* related programs, the remaining graduates from educational programs corresponding to Health occupations were 72.2 percent female and 27.8 percent male.

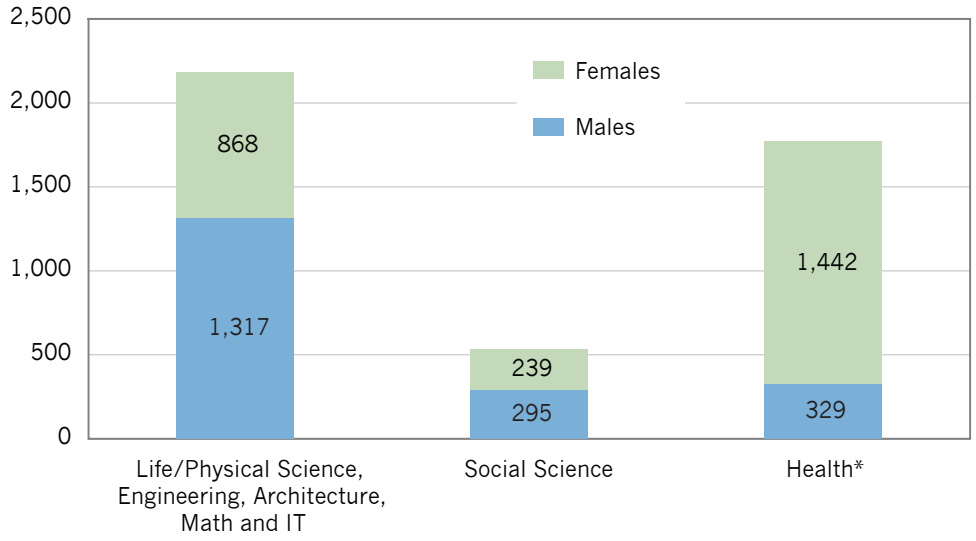
Analysis shows that workers in healthcare require many of the same skills and knowledge areas as other STEM clusters, as well as requiring advanced educational preparation and occupational licensure to practice.

Strengths in New Hampshire's Supply Pipeline

Among those completing educational programs corresponding to STEM occupations, some strengths were evident. In the three occupational clusters, just a few occupations accounted for almost half of the completers in each cluster.

Among the 2,154 completers awarded a degree in programs corresponding to entry-level

Gender of Completers by STEM Occupational Clusters



Source: IPEDS *Gender data not available for 155 completers

employment qualifications in Life/Physical Science, Engineering, Architecture, Math, and IT occupations, 53.4 percent of graduates were qualified to enter five occupations:

- *Natural science managers;*
- *Architectural and engineering managers;*
- *Life scientists, all other*
- *Environmental scientists and specialists, including health;* and
- *Engineers, all other.*

More than 1,150 completers met entry-level educational requirements for these five occupations. However, based on the completer distribution process, the *managers* and *all others* occupation categories held a many-to-one relationship with more completers than other occupations. The *all other* categories include miscellaneous specialties that are not included elsewhere in the occupational specific Standard Occupational Classification (SOC) taxonomy.

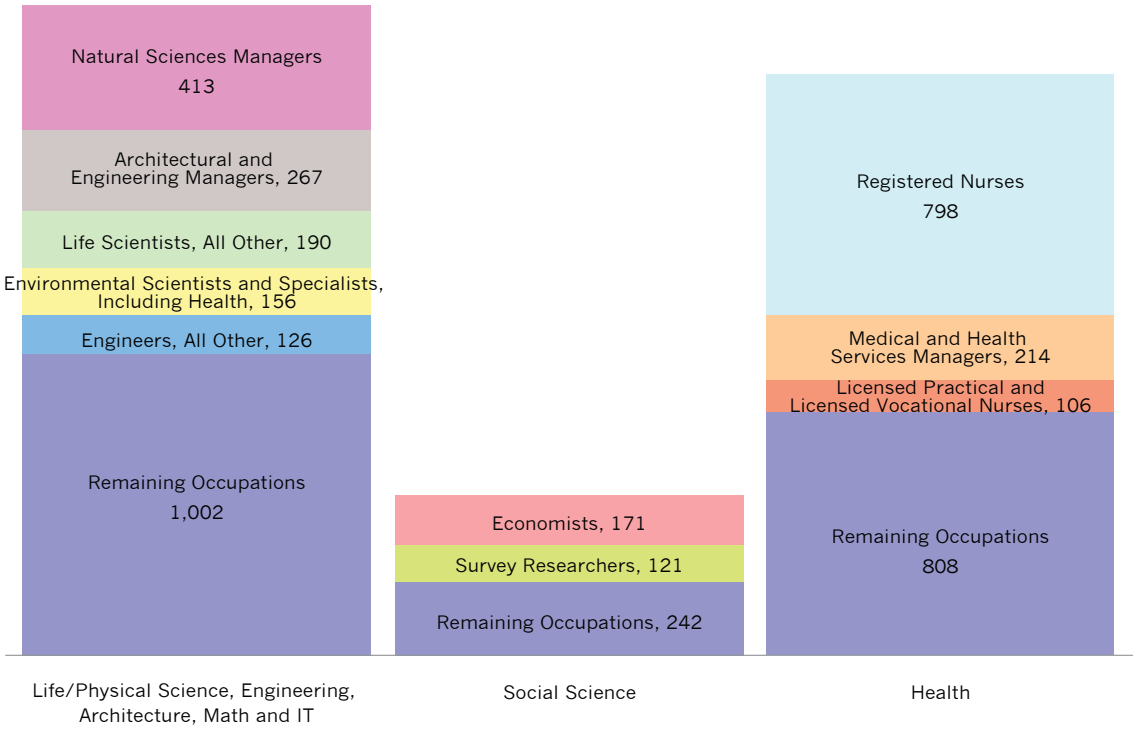
In the Social Science occupations cluster, there were fewer completers that met the degree and program requirement for entry-level employment, a total of 534 completers. Almost 300 of those met the educational and degree requirements of two occupations: *Economists* and *Survey researchers*.

Among those completing educational programs that corresponded to Health occupations, 1,926 completers met the entry-level educational requirements. Almost half, 904 completers, were qualified for employment as a *Registered nurse* or *Licensed practical nurse*.

New Hampshire's Supply Pipeline – the Immeasurable

One of the difficulties of analyzing worker supply and demand is that data must be classified in order to conduct a numerical analysis. Educational program offerings, however, are not always easily compartmentalized. Many colleges and universities offer educational programs that fit neatly into a Classification of Instructional Programs (CIP) code, then offer a concentration or specialty area of study within that program,

Dominant Occupations with Qualified New Hampshire Completers



that does not fit neatly into a code. In addition, when program completers are reported, only the total number of completers by degree for a CIP code are tallied, not a count of those completing each concentration. Yet some of these concentrations correspond to an occupation, while the overarching CIP program does not. Thus, it is not possible to include all completers in the supply estimate.

For example, there are no institutions in New Hampshire offering an exclusive program for land surveying, but an Associate's degree in Civil Engineering Technology includes adequate coursework to qualify the graduate for licensure as a *Surveyor* (though an applicant must complete six years of combined education and experience as well).

This was also the case for many occupations in the Health occupation cluster. For example, specialties of physicians and surgeons were related to specific medical residency programs, however, completer data were not available.

In other cases, qualification for employment requires an internship or certification, neither of which are reported in educational institution statistics. Completers from non-degree granting postsecondary institutions, usually earning a certificate of completion, are not reported to the National Center for Education Statistics. Without a complete count, it is not possible to estimate a labor market supply for these occupations. There are a number of medical technician occupations that fall into this category.

Finally, residual occupations — those classified as *all other* — are a miscellaneous collection of workers that do not fit readily into an existing SOC classification, or there are not enough workers in a specific line of work to add a new SOC code to the taxonomy. Because of the miscellaneous nature of these occupations, frequently it is not possible to assign a related program of education that will prepare a student for the occupation. Related miscellaneous educational programs are, on occasion, crosswalked to an *all other* occupation.

Weaknesses in New Hampshire's Supply Pipeline

On the surface, the total number of completers from New Hampshire educational institutions in STEM disciplines appears to be adequate to supply the demand for workers in STEM occupations. Closer inspection, however, highlights some of the difficulties New Hampshire may face in meeting the labor demand for STEM occupations.

STEM Occupations with No Completions in Corresponding Educational Programs Reported at New Hampshire Educational Institutions

Social Science Occupations		
SOC	**Occupational Title**	**Offered in NH, no completer data available**
19-3051	Urban and Regional Planners	Baccalaureate offered. Entry-level education is a Master's.
19-3091	Anthropologists and Archeologists	Baccalaureate offered. Entry-level education is a Master's.
25-1061	Anthropology and Archeology Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1062	Area, Ethic, and Cultural Studies Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1064	Geography Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1065	Political Science Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1066	Psychology Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1069	Social Sciences Teachers, Postsecondary, All Other*	Entry-level education of a Doctorate plus experience

* Postsecondary Teaching requires both a doctorate in the subject matter and experience. There are no specific educational preparation programs with a conferred degree in postsecondary teaching. Many professionals with a doctorate also teach at the postsecondary level, thus it is not possible to count these professionals separately.

Life/Physical Science, Engineering, Architecture, Math, and IT Occupations		
SOC	**Occupational Title**	**Offered in NH, no completer data available**
15-1151	Computer User Support Specialists	Entry-level education of a non-degree certificate - completers not reported
15-2091	Mathematical Technicians	Applied Math Option, Master's in Mathematics - completers not reported
17-1021	Cartographers and Photogrammetrists	Certificate offered in NH. Entry-level education is a Baccalaureate.
17-1022	Surveyors	Associate's offered in NH. Entry-level education is a Baccalaureate. NH License requires six years' experience, no degree
19-1022	Microbiologists	Offered at NH institution(s), no completers reported
19-2011	Astronomers	Baccalaureate offered. Entry-level education is a Doctorate.
19-4021	Biological Technicians	Associate's offered in NH. Entry-level education is a Baccalaureate.
25-1031	Architecture Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1041	Agricultural Sciences Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1043	Forestry and Conservation Science Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
SOC	**Occupational Title**	**Related programs not offered in NH, nearest program offering in:**
15-2031	Operations Research Analysts	Massachusetts
17-1012	Landscape Architects	Massachusetts / Connecticut / Rhode Island
17-2021	Agricultural Engineers	New York
17-2112	Industrial Engineers	Massachusetts / Connecticut / Rhode Island / Vermont
17-2121	Marine Engineers and Naval Architects	Maine / Massachusetts / Connecticut
17-2131	Materials Engineers	Maine / Massachusetts / Connecticut
17-2151	Mining and Geological Engineers, Including Mine Safety	None in New England
17-2161	Nuclear Engineers	Massachusetts
17-2171	Petroleum Engineers	None in New England
17-3021	Aerospace Engineering and Operations Technicians	Connecticut
17-3024	Electro-Mechanical Technicians	Maine / Rhode Island / Massachusetts / Vermont
17-3025	Environmental Engineering Technicians	Massachusetts / Connecticut
19-1012	Food Scientists and Technologists	Maine / Massachusetts / New York
19-1041	Epidemiologists	Massachusetts / Rhode Island
19-2099	Physical Scientists, All Other	Related programs offered - no completers in 2011
19-4011	Agricultural and Food Science Technicians	None in New England
19-4031	Chemical Technicians	Connecticut / Rhode Island
19-4041	Geological and Petroleum Technicians	None in New England
19-4051	Nuclear Technicians	Connecticut
19-4091	Environmental Science and Protection Technicians, Inc. Health	Massachusetts
19-4092	Forensic Science Technicians	Massachusetts / Connecticut
19-4099	Life, Physical, and Social Science Technicians, All Other	Massachusetts

* Postsecondary Teaching requires both a doctorate in the subject matter and experience. There are no specific educational preparation programs with a conferred degree in postsecondary teaching. Many professionals with a doctorate also teach at the postsecondary level, thus it is not possible to count these professionals separately.

There was a difference of 2,400 completers between the total completers from all STEM programs and completers meeting the specific educational program and award levels that corresponded to requirements for entry-level employment for STEM occupations. Among those that did not meet the requirements, some completers did not have a high enough award level to meet the minimum requirement for entry-level employment in the occupation. That is not to say the completers would not qualify for some other employment in STEM or other fields, just that there was not a direct correspondence between the completer's award and the recommended level of education for the occupation.

In some cases, a program with a qualifying award was offered at a New Hampshire educational institution, but there were no completers reported for 2011. The lack of completers may be due to a program being too new for any student to have completed, or simply that no students were interested in the major.

In other cases, the specific educational program(s) corresponding to a STEM occupation was simply not offered at New Hampshire institutions. For some occupations, this is due to a regional lack of need. For example, New England does not have much demand for *Petroleum engineers*, and likewise, there are no educational programs in petroleum engineering

Health Occupations		
SOC	**Occupational Title**	**Offered in NH, no completer data available**
25-1071	Health Specialties Teachers, Postsecondary*	Entry-level education of a Doctorate plus experience
29-1061	Anesthesiologists	Related education is a medical residency - completers not reported
29-1063	Internists, General	Related education is a medical residency - completers not reported
29-1064	Obstetricians and Gynecologists	Related education is a medical residency - completers not reported
29-1065	Pediatricians, General	Related education is a medical residency - completers not reported
29-1066	Psychiatrists	Related education is a medical residency - completers not reported
29-1067	Surgeons	Related education is a medical residency - completers not reported
29-1125	Recreational Therapists	Offered at NH institution(s), no completers reported
29-1151	Nurse Anesthetists	Additional credential earned after Nursing baccalaureate
29-1161	Nurse Midwives	Additional credential earned after Nursing baccalaureate
29-1171	Nurse Practitioners	Additional credential earned after Nursing baccalaureate
29-2032	Diagnostic Medical Sonographers	Certificate offered in NH. Entry-level education is an Associate's.
29-2033	Nuclear Medicine Technologists	Non-mandatory professional association certification
29-2035	Magnetic Resonance Imaging Technologists	Manufacturer-specific training, offered online
29-2041	Emergency Medical Technicians and Paramedics	Entry-level education of a non-degree certificate - completers not reported
29-2052	Pharmacy Technicians	Non-mandatory professional association certification
29-2053	Psychiatric Technicians	Non-mandatory professional association certification
29-2057	Ophthalmic Medical Technicians	Non-mandatory professional association certification
29-2081	Opticians, Dispensing	No postsecondary education required
29-2092	Hearing Aid Specialists	NH License requires non-specific Associate's degree plus apprenticeship

* Postsecondary Teaching requires both a doctorate in the subject matter and experience. There are no specific educational preparation programs with a conferred degree in postsecondary teaching. Many professionals with a doctorate also teach at the postsecondary level, thus it is not possible to count these professionals separately.

offered anywhere in the New England region. Conversely, for many occupations with a lower level of demand, there is a regional supply pipeline that feeds the entire region, but is not centered in New Hampshire.[22] In 2011, there were 239 degree-granting institutions in the six New England states; 29 of those were in New Hampshire. In addition, there were 302 degree-granting institutions in New York state.[23] For several occupations, the proximity of the New England states reduces the need for duplication of each program in each state. Particularly for occupations in Life/Physical Science, Engineering, Architecture, Math, and IT, a corresponding educational program not available at a New Hampshire institution was available at an institution elsewhere in New England.

The tables illustrate occupations in each of the STEM clusters for which there are no corresponding educational programs offered in New Hampshire. Also listed are some of the educational opportunities in the Northeast region.

SOC	Occupational Title	Related programs not offered in NH, nearest program offering in:
29-1011	Chiropractors	Connecticut / New York
29-1021	Dentists, General	Massachusetts / New York
29-1022	Oral and Maxillofacial Surgeons	Massachusetts / New York
29-1023	Orthodontists	Massachusetts / New York
29-1024	Prosthodontists	Massachusetts / New York
29-1029	Dentists, All Other Specialists	Massachusetts / Connecticut / New York
29-1041	Optometrists	Massachusetts / New York
29-1081	Podiatrists	New York / New Jersey
29-1131	Veterinarians	Massachusetts / New York
29-1181	Audiologists	Massachusetts / Rhode Island
29-1199	Health Diagnosing and Treating Practitioners, All Other	Maine / Vermont / Connecticut / New York
29-2031	Cardiovascular Technologists and Technicians	New York / New Jersey
29-2091	Orthotics and Prosthetists	Connecticut
29-2099	Health Technologists and Technicians, All Other	Massachusetts / Connecticut / Rhode Island / New York
29-9012	Occupational Health and Safety Technicians	Maine / Massachusetts / Connecticut / Rhode Island
29-9092	Genetic Counselors	Massachusetts
29-9099	Healthcare Practitioners and Technical Workers, All Other	Massachusetts / New York

* Postsecondary Teaching requires both a doctorate in the subject matter and experience. There are no specific educational preparation programs with a conferred degree in postsecondary teaching. Many professionals with a doctorate also teach at the postsecondary level, thus it is not possible to count these professionals separately.

22. The New England Board of Higher Education is a nonprofit interstate agency whose mission is to promote greater educational opportunities and services for the residents of New England. NEBHE was established by the New England Higher Education Compact, a 1955 agreement among the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. One of its programs is the New England Regional Student Program (RSP), known as the Tuition Break, which allows New England residents to enroll at out-of-state New England public colleges and universities at a discounted rate. The RSP Tuition Break is available when a student enrolls in an approved major that is not offered by public colleges and universities in their home state. Many of the degree programs available to New Hampshire residents are STEM-related. For complete information about NEBHE check their web site at <www.nebhe.org>. For information about programs available to New Hampshire residents, go to <www.nebhe.org/wp-content/uploads/2013-14-TuitionBreak_for_NewHampshire_Residents.pdf>.

23. National Center for Education Statistics. Digest of Education Statistics, Degree-granting institutions and branches, by control and level of institution and state or jurisdiction: 2010-11. <nces.ed.gov/programs/digest/d11/tables/dt11_280.asp>.

Experienced Worker Supply: Unemployment Rates by Occupational Group

The demand analysis for STEM occupations showed that over the 2010 to 2020 period, the number of workers is expected to increase by 17.3 percent, with 3,200 workers needed annually. Of those 3,200 workers, over half — about 1,700 workers — will be needed to replace workers who leave jobs due to retirement, job change, or other reason, while about 1,450 openings will be due to new job growth.[24]

While new graduates will fill many of these jobs, some will be filled by people currently in the labor force. What does the current employment picture looks like for STEM workers, and how many are looking for work?

There is an association between an advanced education and low unemployment. The 2012 annual average unemployment rate in New Hampshire for those with less than a high school education was 10.5 percent, and for those with a high school diploma, it improved to 8.1 percent. People who completed some college had an unemployment rate of 6.2 percent, while those completing an Associate's degree program experienced an even lower unemployment rate of 3.5 percent. The lowest unemployment rate, 3.4 percent, was among those with a Bachelor's degree or higher.[25]

There are four occupational groups, or job families, which account for a majority of STEM jobs: Computer and mathematical science occupations (15-0000); Architecture and engineering occupations (17-0000); Life, physical, and social science occupations (19-0000); and Healthcare practitioner and technical occupations (29-0000). Workers in these four job families represented 13.7 percent of New Hampshire's labor force in 2012.[26]

For people in STEM occupations, the majority of whom have some postsecondary education, the unemployment rate in 2012 was quite low. New Hampshire's average annual unemployment rate in 2012 among these four job families was 2.7 percent, well below the statewide average rate for all occupations of 5.6 percent. For those in Healthcare practitioner and technical occupations, the unemployment rate was just 1.4 percent.

Annual Average 2012		Labor Force	Employed	Unemployed	Unemployment Rate
	New Hampshire Total	738,696	697,186	41,510	5.6%
15-0000	Computer and mathematical science occupations	29,941	28,795	1,146	3.8%
17-0000	Architecture and engineering occupations	19,491	18,752	739	3.8%
19-0000	Life, physical, and social service occupations	6,295	6,088	207	3.3%
29-0000	Healthcare practitioner and technical occupations	45,478	44,819	659	1.4%
	STEM Occupational Average	101,205	98,454	2,751	**2.7%**

24. New job growth and replacements openings are estimates of the number of new workers needed annually, and not the same as job postings, which are advertisements for jobs.

25. U.S. Census Bureau, unpublished Current Population Survey data.

26. U.S. Department of Labor, Bureau of Labor Statistics Table 7. Employment status of the civilian noninstitutional population 25 years and over by educational attainment, sex, race, and Hispanic or Latino ethnicity. <www.bls.gov/cps/tables.htm#annual>.

Translating Occupational Demand into Industry Demand: a STEM Job Multiplier

This analysis has discussed both the demand for and the supply of labor in STEM occupations. But what is the greater impact of the estimated supply not meeting the estimated demand? To understand the economic impact of not meeting the demand for STEM workers, a multiplier factor was calculated. The STEM job multiplier measures the economic impact, in terms of jobs, that the inability to fill a single STEM job opening would have on New Hampshire's economy.

To assess the impact of STEM workers on the New Hampshire economy, the Economic and Labor Market Information Bureau's New Hampshire statewide, 70 industry sector, REMI Policy Insight+® econometric model[27] was used.

The employment variable in REMI is based on industry data and not occupational data. The first task was to use inverse staffing patterns[28] to convert annual job openings for STEM occupations, which uses the Standard Occupational Classification (SOC) taxonomy, into a measure of industry employment, which uses the North American Industrial Classification System (NAICS).[29]

Using inverse staffing patterns for each STEM occupation, the share of employment was distributed across NAICS industries and self-employment. The final matrix consisted of 138 STEM occupations with employment shared out among 90 different NAICS sectors and self-employment. These industry shares were then multiplied by the number of annual openings for each of the STEM occupations, and a total of employment for each industry was aggregated across all STEM occupations. Out of the total estimated annual STEM openings (3,180), the share of self-employed was 123 job openings. Examples of STEM occupations with large shares of self-employment are chiropractors, dentists, and different specialties of psychologists and therapists.[30]

After the annual job openings data for STEM occupations were converted to industry employment, data were combined into the 70 industry sectors in the REMI model. The 123 self-employment job openings were shared among all industries, as the industry employment data in the REMI model already includes data on self-employment.[31]

continued on page 29

27. Product of Regional Economic Models, Inc. of Amherst, MA.
28. See Data Sources and Classification Systems on page 2 for more information.
29. The employment share for the 2020 projected year was used.
30. Self-employment accounted for more than 30 percent of the employment base for each of these STEM occupations.
31. Employment data in the REMI model is based on the Bureau of Economic Analysis (BEA) employment estimates. Total employment in BEA terminology includes Wage and Salary employment, farm and proprietary employment.

STEM Demand by Industry – in what industries are STEM workers employed?

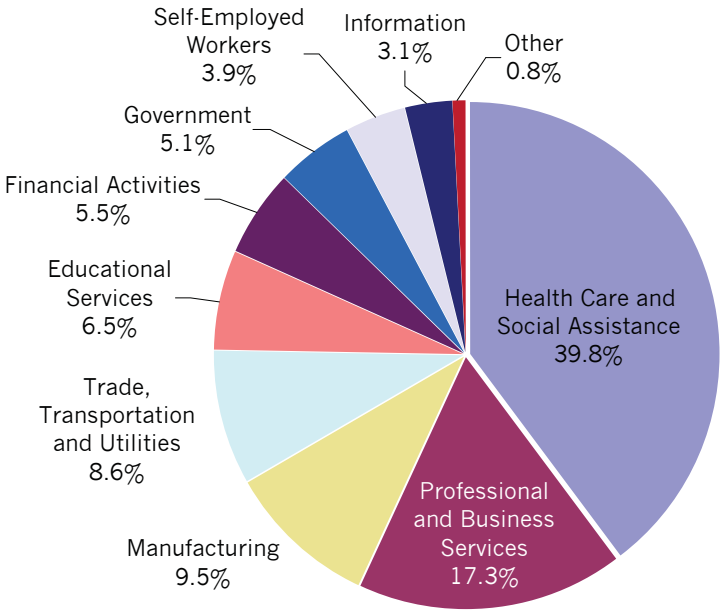
After translating and aggregating annual job openings for STEM occupations into annual demand by industry, *Health care and social assistance* had the largest share of STEM employment, followed by *Professional and business services* and *Manufacturing*. *Health care and social assistance* accounts for 39.8 percent of annual STEM job openings, *Professional and business services*, 17.3 percent of annual STEM job openings, and *Manufacturing*, 9.5 percent of annual STEM job openings.

Within the *Professional and Business Services* sector, two industry groups accounted for the majority of annual STEM job openings — *Computer systems design and related services* (NAICS 5415) and *Architectural, engineering, and related services* (NAICS 5413).

The *Wholesale trade* industry sector accounted for close to half of annual STEM job openings in *Trade, transportation and utilities*. A large portion of these job openings are in one occupation — *Sales representatives, wholesale and manufacturing, technical and scientific products*. This occupation is one of the two sales-related STEM occupations.

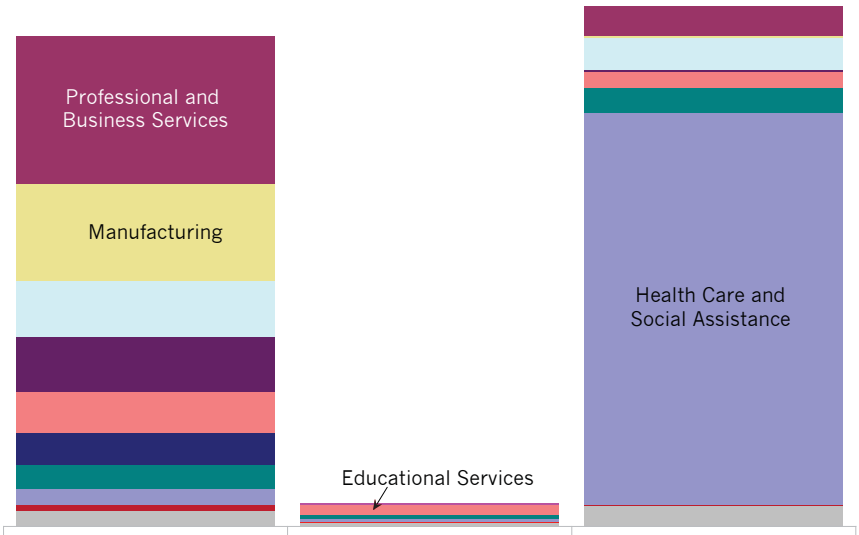
The *Information* industry sector accounted for just 3.1 percent of total annual STEM job openings, despite the name's connection to information technology. The *Financial activities* industry sector holds a larger share of annual STEM job openings, 5.5 percent. In New Hampshire, there are more *Software developers* employed in the *Finance and insurance* sector than in the *Information* sector.

STEM Openings Distributed by Selected Supersectors including Self-employed



Whereas most of the STEM job openings in the *Health* cluster are in *Health care and social assistance*, STEM job openings in *Life/Physical Science, Architecture, Engineering, Math and IT* cluster are spread across many sectors, with the largest share of employment in *Professional and business services* and *Manufacturing*. Close to half of STEM job openings in the Social science cluster are in *Educational services*.

STEM Annual Job Openings Distributed by Industry



	Life/Physical Science, Architecture, Engineering, Math and IT	Social Sciences	Health
Professional and Business Services	455	5	90
Manufacturing	297	0	5
Trade, Transportation and Utilities	173	0	100
Financial Activities	171	0	4
Educational Services	123	31	52
Information	99	0	0
Government	77	12	74
Health Care and Social Assistance	48	9	1,210
Other	19	1	5
Self-Employed Workers	48	13	62

STEM Multiplier – Results of the Counterfactual Simulation

In a counterfactual simulation, the theoretical impact of a specific event or change is estimated by removing factors such as employment or production output from the economy and comparing the results to an original baseline. Here, the REMI model was used to establish a counterfactual baseline value for not meeting the demand for workers in STEM occupations. In this counterfactual scenario, annual average job openings for STEM occupational employment, which was estimated and re-summed by industry based on the inverse staffing patterns, were removed from the REMI model baseline employment by industry[32] over a ten-year period.

Based on the 2010-2020 occupational projections, annual demand for STEM occupations was 3,180 annual job openings. Over ten years, the cumulative effect of not meeting the entire annual demand for STEM occupations would be 31,805 job openings.

- Not meeting the demand for STEM occupations (counterfactual) in the first year of the REMI simulation resulted in a total loss of 5,671 jobs. Indirect and induced jobs accounted for 2,491 of the jobs lost in the first year of the simulation.
- In ten years' time, continually not meeting any of the STEM demand (counterfactual) would have an aggregate impact on the New Hampshire economy of 54,628 jobs lost. Of that, the number of indirect and induced jobs lost amounted to 22,823.

Because the input to the model in the tenth year is tenfold the impact in the first year of the simulation, the total result in terms of jobs diminishes over time. The reason for this dilution in impact is that the REMI model is a dynamic equilibrium model that, over time, will substitute labor and technology interchangeably in order to return to the forecasted baseline employment.

- Not meeting the demand for STEM workers would cause a reduction in Gross Domestic Product (GDP) for New Hampshire of $403 million (in fixed 2005 dollars) in the first year, accumulating to $4.6 billion by the tenth year in comparison to the baseline projection.
- GDP per capita would be negatively affected by $261 (in fixed 2005 dollars) in the first year of the counterfactual simulation, rising to $1,715 (in fixed 2005 dollars) by the tenth year of the counterfactual simulation.
- Real disposable per capita personal income would be reduced in the first year by $122 (in fixed 2005 dollars), and would be further reduced by $486 (in fixed 2005 dollars) by the tenth year of the counterfactual simulation.

In terms of job losses due to the impact of the indirect and induced effects of not meeting the demand for STEM workers, *State and local government*, *Retail trade* and *Construction* would be impacted the most. In any impact study, these are commonly the sectors affected by the indirect and induced ripples from losing jobs or output in the economy. Job losses are linked to less economic activity in terms of capital investment, consumer spending and state and local government services.[33] The impact on consumer spending from not meeting the demand for STEM

32. In REMI, there are two options on how to make a change to the employment variable. The choices are to either model the employment change as Firm Behavior or as Industry Behavior.
Firm Behavior allows displacement due to competition in the local and nearby markets and the national market.
Industry Behavior does not account for any crowding out effects. It does not compete with other producers within the region and within the nation. In this counterfactual scenario the employment was removed using the Industry Behavior policy variable.

33. The secondary job losses in local and state government would best be interpreted as employment below the baseline level that would not be required in order to provide demand for shared government services. Shared services include education, public safety, water and sewage treatment, road construction and maintenance, and other services not needed (or that could not be afforded) due to a decline in the level of business activities in New Hampshire.

Industries ranked by the number of secondary jobs impacted by the loss of STEM jobs in the first year of the counterfactual simulation	Reduction in STEM Jobs	Secondary Job Loss	Total Jobs Impact
Health Care and Social Assistance	1,317	245	1,562
Professional, Scientific, and Technical Services	470	125	595
State and Local	133	455	588
Retail Trade	142	355	497
Manufacturing	313	46	359
Construction	8	337	345
Administrative and Waste Management Services	76	244	320
Wholesale Trade	127	115	242
Educational Services	214	15	229
Finance and Insurance	180	28	208
Accommodation and Food Services	0	165	165
Other Services, except Public Administration	14	144	158
Real Estate and Rental and Leasing	3	125	128
Information	102	15	117
Arts, Entertainment, and Recreation	1	57	58
Federal Civilian	37	0	37
Management of Companies and Enterprises	28	5	33
Utilities	12	6	18
Transportation and Warehousing	3	8	11

workers is most predominant in the *Retail trade* and *Accommodation and food services* industries. More than 350 retail trade jobs depend on generating a sufficient number of workers in STEM occupations. Despite the fact that no STEM occupations are in the *Accommodation and food services* industry, 165 secondary jobs are dependent upon the ability to fill STEM job openings in New Hampshire.

This scenario was run as a counterfactual simulation over a ten-year period to estimate the multiplier effect of *not* filling a STEM job opening would have on the economy. So what is the estimated impact of not meeting the demand for STEM workers?

- For each STEM job opening not filled, the impact on the economy averages 1.77 jobs (including the STEM job opening itself) over the ten-year period.[34]

A job multiplier of more than one would indicate that some of the existing jobs in the local economy will be positively affected and will expand as the new job enters the local economy. For example, when modeling a job in *Retail trade* for statewide New Hampshire in a non-competitive situation, this job would generate a multiplier of 1.64[35] over a ten-year period. A job in *Accommodation and food services*, in a non-competitive situation, would generate 1.2 jobs.[36] However, in most situations, demand for both *Retail trade* and *Accommodation and food services* employment and output are responsive to the local presence of similar establishments and will, therefore, be competing for consumers and labor.

While this counterfactual scenario is just theoretical, the results do show that continuing to meet the demand for STEM workers will produce a measurable impact on the economy.

34. This multiplier is a conservative estimate. The multiplier effect is likely higher as the model's baseline employment was reduced by industry, and not occupation. The majority of STEM occupations are paid wages higher than the average, whereas the REMI policy employment variable is based on average pay in each industry.

35. Modeled using the Industry Behavior policy variable (see footnote 6).

36. Ibid.

Real-World STEM

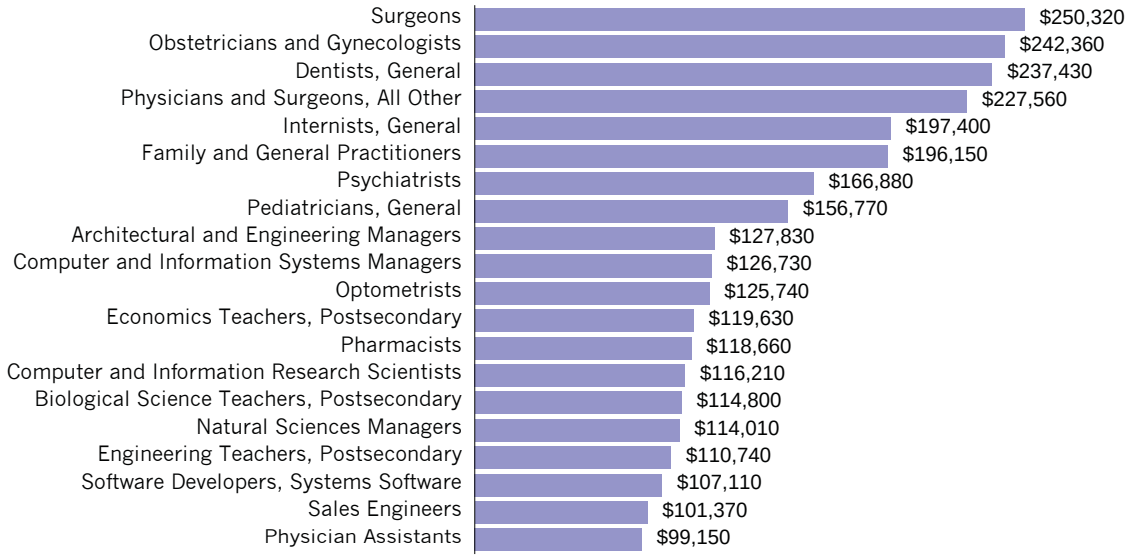
Wage Comparisons for STEM Occupations

As demonstrated by the multiplier analysis, a single STEM job is likely to have a measurable impact on the New Hampshire economy. One factor of that economic impact is the rate of pay for STEM occupations. To examine the differences in wages for STEM occupations in New Hampshire and across the region, Occupational Employment Statistics (OES) survey data were used. [37]

Data from the May 2011 OES Survey show that nearly nine out of ten STEM occupations had higher average annual salaries in New Hampshire than the average for all occupations. Among occupations with employment of at least 50 in New Hampshire, the top-paying occupations were *Surgeons*, *Obstetricians and Gynecologists*, and *Dentists, General*. Eleven of the 20 STEM occupations with the highest annual salaries were in the *Healthcare practitioners and technical* occupations job family. All but one of these eleven top-paying healthcare occupations require a minimum education of a doctorate or professional degree, and licensure by the State of New Hampshire.

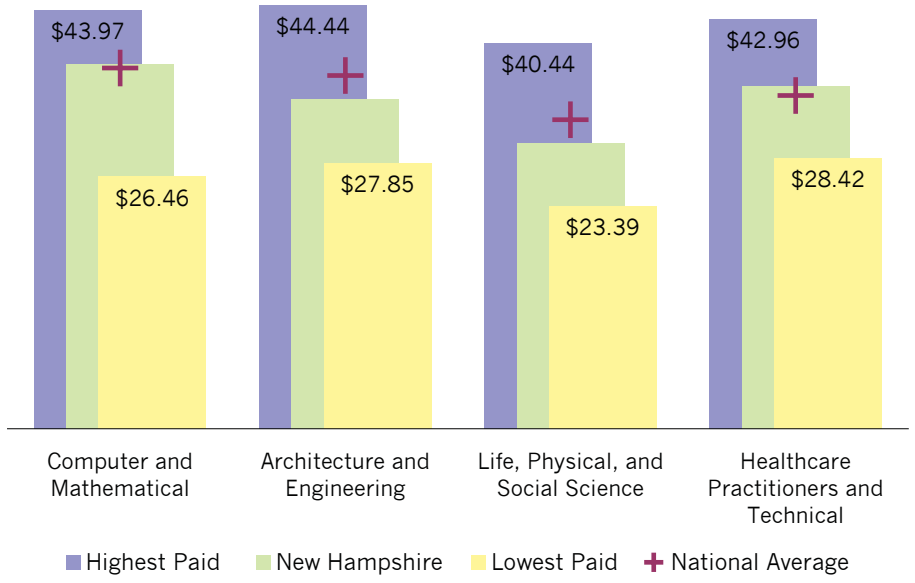
Comparing the mean hourly wage for all occupations in STEM occupational groups for each state and the nation shows wages in New Hampshire fall about in the middle

Top paying STEM occupations in New Hampshire based on May 2011 OES survey (only occupations with an estimated employment of more than 50 were included)



37. The Occupational Employment Statistics (OES) program is based on a semiannual survey of employers conducted by state employment security agencies in all 50 states. The New Hampshire survey was conducted by New Hampshire Employment Security's Economic and Labor Market Information Bureau (ELMIB), in cooperation with the U.S. Bureau of Labor Statistics. The survey collects data on occupational employment and wage rates of workers in all nonfarm industries. The survey does not include the self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers.

STEM Occupations Wage Range Hourly rate



Mean Hourly Wages for STEM Occupational Groups		NH	ME	VT	MA	US
	All Occupations	**$21.74**	**$19.32**	**$20.71**	**$26.32**	**$21.74**
15-0000	Computer and Mathematical Occupations	$38.22	$30.64	$31.91	$42.93	$37.85
17-0000	Architecture and Engineering Occupations	$34.57	$32.14	$33.67	$39.45	$37.08
19-0000	Life, Physical, and Social Science Occupations	$29.93	$27.73	$30.52	$35.69	$32.44
29-0000	Healthcare Practitioners and Technical Occupations	$35.95	$35.58	$35.91	$39.55	$34.97

between the highest and lowest rates of pay. New Hampshire has a slightly higher than national average wage for *Computer and mathematical* occupations and *Healthcare practitioners and technical* occupations. Mean hourly wage in New Hampshire for *Architecture and engineering* occupations and *Life, physical and social science* occupations is slightly lower than the national average.

Location Quotient by STEM Occupational Group		NH	ME	VT	MA
15-0000	Computer and Mathematical Occupations	1.10	0.56	0.89	1.55
17-0000	Architecture and Engineering Occupations	1.12	0.84	0.98	1.23
19-0000	Life, Physical, and Social Science Occupations	0.74	0.91	1.29	1.78
29-0000	Healthcare Practitioners and Technical Occupations	1.02	1.17	1.06	1.23

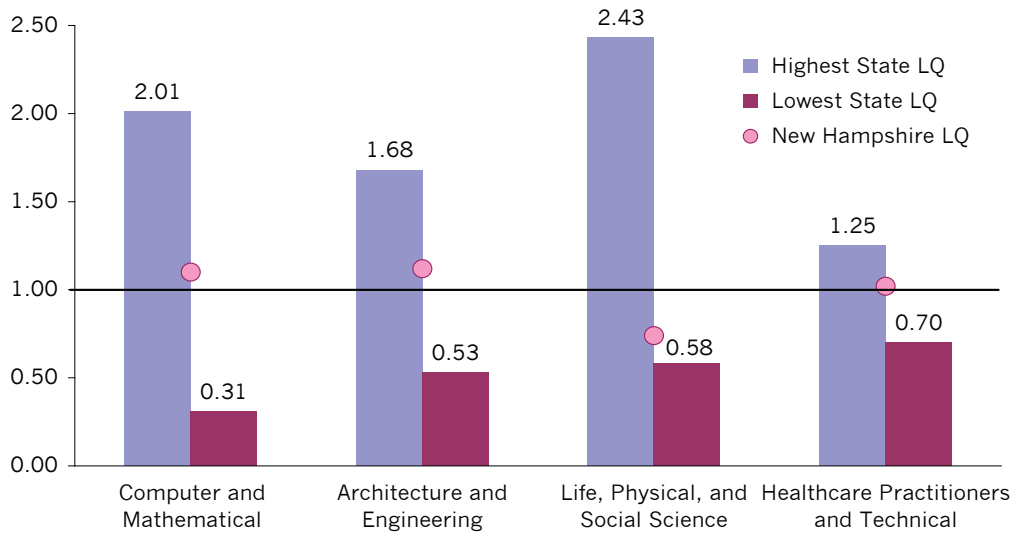
Location Quotient

Does New Hampshire have more workers in STEM occupations than the national average or neighboring states? To answer this question, a *location quotient* (LQ) can be used. A location quotient compares the concentration of occupational employment in an area to the national average for that occupation. A location quotient greater than one means the area has a higher share of employment in the occupation. A location quotient of less than one means employment in the occupation for the area is lower than the national average for the occupation.

New Hampshire's strengths among STEM occupations are in the *Computer and mathematical* and *Architecture and engineering* job families. The LQ in New Hampshire for the *Life, physical and social science* job family is lower than one and the lowest in the region, indicating a smaller concentration of employment for these occupations in the state.

When comparing all states nationally, the location quotients for each state are furthest apart for employment in *Life, physical and social sciences* occupations. The high and low location quotients for *Health practitioner and technical* occupations are much closer together. Wider differences in the relative concentration of occupational employment among states indicate that employment in these occupations is likely concentrated in fewer states, while a larger share have low levels of employment. On the other hand, narrower differences in location quotients among states reflect employment levels that are more equal between states.

Comparison of All State Location Quotients by STEM Job Families



Location Quotient for select STEM Occupations		NH	ME	VT	MA
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	2.18	0.40	0.64	1.63
41-9031	Sales Engineers	1.57	0.76	0.67	1.89
15-1132	Software Developers, Applications	1.79	0.55	0.71	1.88
15-1133	Software Developers, Systems Software	1.08	0.22	0.77	2.87
11-3021	Computer and Information Systems Managers	1.71	0.66	0.78	1.95
17-2071	Electrical Engineers	1.55	0.50	1.09	1.95

Workers providing services where a physical presence with clients is needed, such as healthcare, usually must perform work where clients live. Employment for these workers is likely to be more wide-spread and less concentrated by state.

However, location quotients are affected not only by population, but also by technological advances. Workers providing services that can be provided remotely, such as software development, have no need for a physical presence in every community. Work can be performed in central locations, with clients spread across the nation. This could lead to differences in concentration of occupations and location quotients. Also, some occupations are linked to industries that benefit from economies of agglomeration, resulting in industry (and occupational) clustering.

Among STEM occupations in New Hampshire, *Sales representatives, wholesale and manufacturing, technical and scientific products* have the strongest concentration of employment with a location quotient of 2.18. The other sales-related STEM occupation, *Sales engineers*, also has a high concentration of employment in New Hampshire. The state has a high concentration (relative to the nation) of *Software developers, applications*; *Software developers, systems software*; *Computer and information systems managers*; and *Electrical engineers* as well.

Online Job Postings: Experienced Worker Demand

To provide a real-world example of STEM demand, a sampling of actual on-line job postings identified as jobs available in New Hampshire were extracted from the Northeast Consortium's real-time demand web portal.[38] In the last quarter of 2011,[39] STEM occupations were strongly represented in on-line job postings. Four of the ten occupations with the most jobs posted on-line were STEM occupations:

- *Registered nurses;*
- *Mechanical engineers;*
- *Computer software engineers, applications;* and
- *Computer programmers.*

The share of job postings for each occupation with a specific skill or knowledge listed in the posting text was calculated. Based on the skills requested in the posting text for the above four STEM occupations, the top ten most-requested skills or knowledge areas were identified, as was the share of job postings for each occupation listing specific years of experience. The comparison of the four STEM occupations with the largest volume of on-line postings in the last quarter of 2011 revealed several similarities.

In postings for the four STEM occupations, *communication skills* was one of the ten most-often listed skills or knowledge area. In postings for three of the four STEM occupations, *writing skills* was in the top ten, and in postings for two of the four STEM occupations, *customer service* was one of the ten most-often listed skill or knowledge areas. Two of these skills — *communication skills* and *writing* — also ranked in the top ten skills in demand for each STEM cluster; *customer service* ranked in the top five knowledge areas in demand for each STEM cluster (see the section on *Skills and Knowledge Assessment* on page 10).

The years of experience requested by employers in a job posting is another factor in the ability of labor supply to meet labor demand. Among the four STEM occupations with the highest number of on-line job postings, well over half of the postings specified years of experience. The two computer-related occupations had the highest share of postings requesting experience, with 40 percent of postings for *Computer software engineers, applications* asking for five or more years of experience, and 36 percent of postings for *Computer programmers* asking for five or more years of experience. *Registered nurses* had the largest share of on-line job postings asking

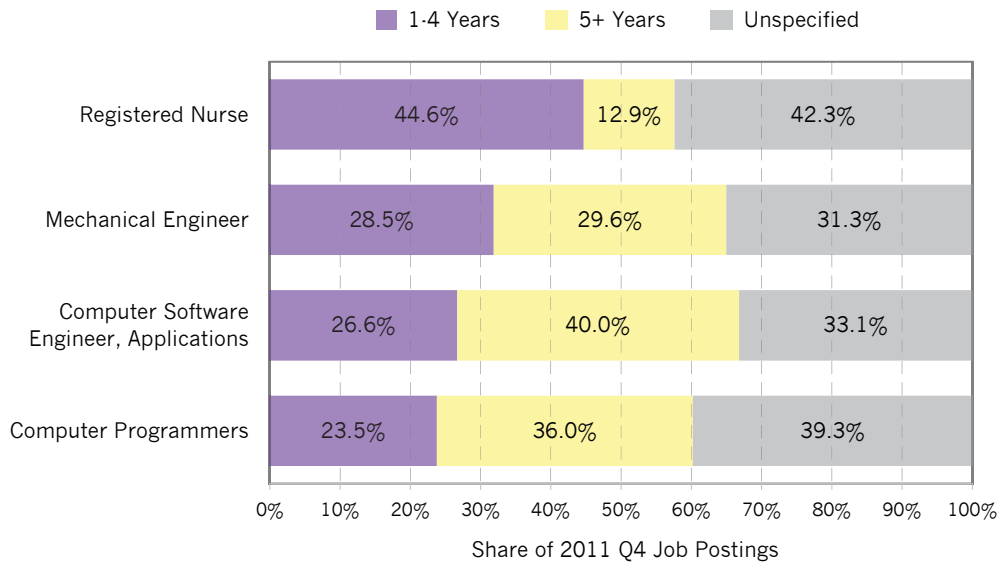
38. In 2009, the US Department of Labor's Employment and Training Administration issued a grant for State Labor Market Information Improvement. New Hampshire's Economic and Labor Market Information Bureau, in conjunction with seven other northeast states and consultants from the Center on Education and the Workforce at Georgetown University, Burning Glass Technologies, and Direct Employers Association, formed the Northeast Consortium to examine the potential for identifying green jobs in demand through skills listed in on-line job posting data. Research was funded by a grant from the US Department of Labor using American Recovery and Reinvestment Act funds. <public.greencareercentral.org>.

39. The Northeast Consortium analyzed the content of on-line job postings by occupation between 2009 and 2011. The latest quarter with real-time data available was fourth quarter 2011.

for one to four years of experience, while postings for *Mechanical engineers* were about evenly split between those asking for one to four years' experience, those asking for five or more years of experience, and those not specifying experience.

Even using this limited sample of on-line job postings, it is clear that there is active demand for workers in STEM occupations in the New Hampshire labor market. The occupational skills and knowledge assessment is supported by the skills or knowledge requested in on-line job postings. The data also highlights an additional factor of labor demand — experience. The new supply of labor for many STEM occupations may be adequate, however, many new labor market entrants are lacking the years of experience requested by employers. This factor can impact the connection between supply and demand. Those in the supply pipeline have difficulty in getting hired due to insufficient experience. At the same time, those on the demand side find that there is not enough supply with adequate experience to meet their needs.

Experience Requirements



Conclusion

The age-old puzzle, "Which came first – the chicken or the egg?" can be applied to concepts of STEM labor supply and demand. Is demand driven by an abundant supply of workers with the educational qualification for STEM occupations, or are individuals pursuing STEM careers because the demand for STEM occupations is growing?

The analysis showed a strong demand for STEM workers in New Hampshire. Workers in STEM occupations are:

- more likely to have higher levels of education,
- have the skills and knowledge most in demand, and
- are expected to have very favorable employment opportunities between 2010 and 2020.

Estimated openings for STEM occupations are 3,180 positions annually from 2010 to 2020. The counterfactual simulation estimated that every STEM job opening left unfilled has an economic impact of 1.77 jobs. These exercises illustrate the demand for and value of workers in STEM occupations for New Hampshire.

The supply of labor, measured by postsecondary educational program completers, for STEM occupations in New Hampshire was also positive. In 2011, there were approximately 4,600 postsecondary program completers qualified to enter employment in a STEM occupation, slightly above total average annual job openings for STEM occupations. Supply exceeded demand in each of the three STEM clusters, *Life/Physical Science, Architecture, Engineering, Math and IT occupations*; *Social Science occupations*, and *Health occupations*.

Yet these completers did not equal the annual demand for each individual STEM occupation, indicating a potential over-supply in some occupations and a potential shortage in others. In addition, estimates of labor supply were made with the assumption that all completers from New Hampshire postsecondary institutions would be entering the New Hampshire workforce, which is not the case. This amplifies potential labor shortages for many occupations. Among current STEM workers, the experienced labor supply, the unemployment rate in 2012 was about 2.7 percent, well below the statewide average of 5.6 percent. This hints at the potential for labor shortages in STEM occupations as well.

New Hampshire's workforce is considered well-educated, providing the state an advantage in economic development. According to the 2007-2011 American Community Survey, 41.5 percent of New Hampshire's male population, age 25 years and older, had an Associate's degree or higher, compared to 35.5 percent nationally. Among New Hampshire's female population, age 25 years and older, 43.7 percent had an Associate's degree or higher, compared to 36.1 percent for the nation.[40] However, workers with postsecondary degrees are not enough to maintain the state's advantage in a global economy.

How can New Hampshire prepare to meet the future demand for STEM workers? In order to produce a continuous supply of talent for individual STEM occupations, attention must be turned to developing and maintaining an interest in science, mathematics, engineering and technology among primary and secondary school students.

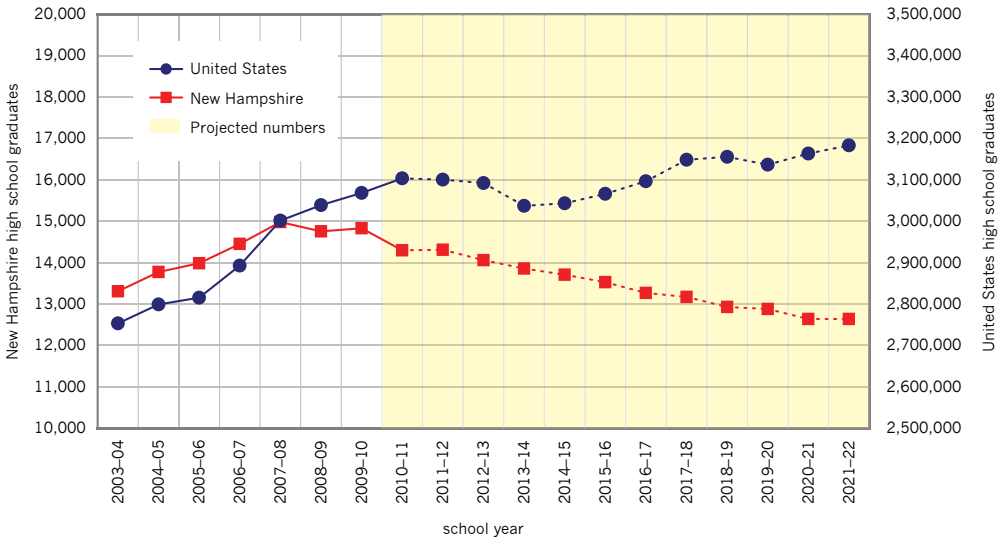
40. 2007-2011 American Community Survey, Table B15002: Sex By Educational Attainment for the Population 25 Years and Over. Universe: Population 25 years and over. <factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>.

MATH NECAP Scores NH 2012-2013 School Year	Grade		
	4	8	11
Proficient with Distinction	30	21	2
Proficient	47	47	35
Partially Proficient	15	17	26
Substantially Below Proficient	8	15	36

Standardized test scores [41] for the 2012-2013 school year in New Hampshire for children in grades 4 and 8 were relatively strong in mathematics, with 77 percent scoring "proficient" or "proficient with distinction" in grade 4, and 68 percent in grade 8. Yet by grade 11, when students have the option to select class topics, test scores of "proficient" or "proficient with distinction" fell to 37 percent, and the percent scoring "substantially below proficient" was more than double the share for grade 8.

Compounding the problem of a future labor supply in New Hampshire is a sheer lack of population among primary and secondary school-age students. The National Center for Education Statistics estimates the number of public high school graduates through the 2021-2022 school year, based on current population age and demographics. According to projections, the number of public high school graduates in New Hampshire is expected to decline from 14,830 (actual count) for the 2009-2010 school year, to 12,640 by the 2021-2022 school year. Nationally, the number of public high school graduates is expected to stabilize and slowly increase.[42]

Actual and Projected Numbers for Public High School Graduates



Source: Projections of Education Statistics to 2021,
National Center for Education Statistics,
Institute of Education Sciences, U.S. Department of Education

41. A standardized test, the New England Common Assessment Program (NECAP) is administered annually to multiple grades and includes mathematics and science as specific test topics.

42. National Center for Education Statistics. Institute of Education Sciences. Projections of Education Statistics to 2021. U.S. Department of Education. <nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2013008>.

This STEM labor supply and demand analysis has shown that for New Hampshire to remain a player in the global economy, increasing the number of graduates in STEM programs will not be enough. Students will need to not only meet entry-level educational requirements for STEM occupations in demand, but also look for ways to gain work experience prior to entering the labor force. Actual on-line job postings reinforce the real-time demand for workers in STEM occupations with the right skills and experience. Labor force entrants must learn all expectations of job performance — not just the theoretical and technical knowledge aspects of an occupation, but also the skills of reading, active listening, critical thinking, active learning, and complex problem solving.

New Hampshire faces a potential labor shortage in the future, and STEM occupations are no exception. This problem cannot be addressed from just one perspective. The business community must ensure that the education community understands expectations for worker skills and abilities, and be willing to hire graduates with little or no experience. The education community must understand the skills and abilities expected by business, and be prepared to adjust curricula to meet those expectations, as well as provide students opportunities to gain work experience. Both sides of the labor equation — demand and supply — will have to work together to achieve success.

Appendix A: Occupations by STEM Group (BLS Definitions)

Key

Sub-domain	
1	Life and Physical Science, Engineering, Math, and IT Occupations
2	Social Science Occupations
3	Architecture Occupations
4	Health Occupations
	Split across 2 sub-domains

Types of occupations	
A	Research, Development, Design, or Practitioner Occupations
B	Technologist and Technician Occupations
C	Postsecondary Teaching Occupations
D	Managerial Occupations
E	Sales Occupations

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
1.D	11-3021	Computer and Information Systems Managers
1.D and 3.D	11-9041	Architectural and Engineering Managers
1.D	11-9121	Natural Sciences Managers
1.A	15-1111	Computer and Information Research Scientists
1.A	15-1121	Computer Systems Analysts
1.A	15-1122	Information Security Analysts
1.B	15-1131	Computer Programmers
1.A	15-1132	Software Developers, Applications
1.A	15-1133	Software Developers, Systems Software
1.A	15-1134	Web Developers
1.A	15-1141	Database Administrators
1.A	15-1142	Network and Computer Systems Administrators
1.A	15-1143	Computer Network Architects
1.B	15-1151	Computer User Support Specialists
1.B	15-1152	Computer Network Support Specialists
1.A	15-1199	Computer Occupations, All Other
1.A	15-2011	Actuaries
1.A	15-2021	Mathematicians
1.A	15-2031	Operations Research Analysts
1.A	15-2041	Statisticians
1.B	15-2091	Mathematical Technicians
1.A	15-2099	Mathematical Science Occupations, All Other
3.A	17-1011	Architects, Except Landscape and Naval
3.A	17-1012	Landscape Architects
1.B	17-1021	Cartographers and Photogrammetrists
1.B	17-1022	Surveyors
1.A	17-2011	Aerospace Engineers
1.A	17-2021	Agricultural Engineers
1.A	17-2031	Biomedical Engineers
1.A	17-2041	Chemical Engineers
1.A	17-2051	Civil Engineers
1.A	17-2061	Computer Hardware Engineers
1.A	17-2071	Electrical Engineers

Appendix A: Occupations by STEM Group (BLS Definitions) *continued*

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
1.A	17-2072	Electronics Engineers, Except Computer
1.A	17-2081	Environmental Engineers
1.A	17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
1.A	17-2112	Industrial Engineers
1.A	17-2121	Marine Engineers and Naval Architects
1.A	17-2131	Materials Engineers
1.A	17-2141	Mechanical Engineers
1.A	17-2151	Mining and Geological Engineers, Including Mining Safety Engineers
1.A	17-2161	Nuclear Engineers
1.A	17-2171	Petroleum Engineers
1.A	17-2199	Engineers, All Other
1.B and 3.B	17-3011	Architectural and Civil Drafters
1.B	17-3012	Electrical and Electronics Drafters
1.B	17-3013	Mechanical Drafters
1.B	17-3019	Drafters, All Other
1.B	17-3021	Aerospace Engineering and Operations Technicians
1.B	17-3022	Civil Engineering Technicians
1.B	17-3023	Electrical and Electronics Engineering Technicians
1.B	17-3024	Electro-Mechanical Technicians
1.B	17-3025	Environmental Engineering Technicians
1.B	17-3026	Industrial Engineering Technicians
1.B	17-3027	Mechanical Engineering Technicians
1.B	17-3029	Engineering Technicians, Except Drafters, All Other
1.B	17-3031	Surveying and Mapping Technicians
1.A	19-1011	Animal Scientists
1.A	19-1012	Food Scientists and Technologists
1.A	19-1013	Soil and Plant Scientists
1.A	19-1021	Biochemists and Biophysicists
1.A	19-1022	Microbiologists
1.A	19-1023	Zoologists and Wildlife Biologists
1.A	19-1029	Biological Scientists, All Other
1.A	19-1031	Conservation Scientists
1.A	19-1032	Foresters
1.A	19-1041	Epidemiologists
1.A	19-1042	Medical Scientists, Except Epidemiologists
1.A	19-1099	Life Scientists, All Other
1.A	19-2011	Astronomers
1.A	19-2012	Physicists
1.A	19-2021	Atmospheric and Space Scientists
1.A	19-2031	Chemists
1.A	19-2032	Materials Scientists
1.A	19-2041	Environmental Scientists and Specialists, Including Health
1.A	19-2042	Geoscientists, Except Hydrologists and Geographers
1.A	19-2043	Hydrologists
1.A	19-2099	Physical Scientists, All Other

Appendix A: Occupations by STEM Group (BLS Definitions) *continued*

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
1.B	19-4011	Agricultural and Food Science Technicians
1.B	19-4021	Biological Technicians
1.B	19-4031	Chemical Technicians
1.B	19-4041	Geological and Petroleum Technicians
1.B	19-4051	Nuclear Technicians
1.B	19-4091	Environmental Science and Protection Technicians, Including Health
1.B	19-4092	Forensic Science Technicians
1.B	19-4093	Forest and Conservation Technicians
1.B and 2.B	19-4099	Life, Physical, and Social Science Technicians, All Other
1.C	25-1021	Computer Science Teachers, Postsecondary
1.C	25-1022	Mathematical Science Teachers, Postsecondary
3.C	25-1031	Architecture Teachers, Postsecondary
1.C	25-1032	Engineering Teachers, Postsecondary
1.C	25-1041	Agricultural Sciences Teachers, Postsecondary
1.C	25-1042	Biological Science Teachers, Postsecondary
1.C	25-1043	Forestry and Conservation Science Teachers, Postsecondary
1.C	25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary
1.C	25-1052	Chemistry Teachers, Postsecondary
1.C	25-1053	Environmental Science Teachers, Postsecondary
1.C	25-1054	Physics Teachers, Postsecondary
1.E	41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
1.E	41-9031	Sales Engineers

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
2.A	19-3011	Economists
2.A	19-3022	Survey Researchers
2.A	19-3031	Clinical, Counseling, and School Psychologists
2.A	19-3032	Industrial-Organizational Psychologists
2.A	19-3039	Psychologists, All Other
2.A	19-3041	Sociologists
2.A	19-3051	Urban and Regional Planners
2.A	19-3091	Anthropologists and Archeologists
2.A	19-3092	Geographers
2.A	19-3094	Political Scientists
2.A	19-3099	Social Scientists and Related Workers, All Other
2.B	19-4061	Social Science Research Assistants
2.C	25-1061	Anthropology and Archeology Teachers, Postsecondary
2.C	25-1062	Area, Ethnic, and Cultural Studies Teachers, Postsecondary
2.C	25-1063	Economics Teachers, Postsecondary
2.C	25-1064	Geography Teachers, Postsecondary
2.C	25-1065	Political Science Teachers, Postsecondary
2.C	25-1066	Psychology Teachers, Postsecondary
2.C	25-1067	Sociology Teachers, Postsecondary
2.C	25-1069	Social Sciences Teachers, Postsecondary, All Other

Appendix A: Occupations by STEM Group (BLS Definitions) *continued*

Key

Sub-domain		Types of occupations	
1	Life and Physical Science, Engineering, Math, and IT Occupations	A	Research, Development, Design, or Practitioner Occupations
2	Social Science Occupations	B	Technologist and Technician Occupations
3	Architecture Occupations	C	Postsecondary Teaching Occupations
4	Health Occupations	D	Managerial Occupations
	Split across 2 sub-domains	E	Sales Occupations

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
4.D	11-9111	Medical and Health Services Managers
4.C	25-1071	Health Specialties Teachers, Postsecondary
4.C	25-1072	Nursing Instructors and Teachers, Postsecondary
4.A	29-1011	Chiropractors
4.A	29-1021	Dentists, General
4.A	29-1022	Oral and Maxillofacial Surgeons
4.A	29-1023	Orthodontists
4.A	29-1024	Prosthodontists
4.A	29-1029	Dentists, All Other Specialists
4.A	29-1031	Dietitians and Nutritionists
4.A	29-1041	Optometrists
4.A	29-1051	Pharmacists
4.A	29-1061	Anesthesiologists
4.A	29-1062	Family and General Practitioners
4.A	29-1063	Internists, General
4.A	29-1064	Obstetricians and Gynecologists
4.A	29-1065	Pediatricians, General
4.A	29-1066	Psychiatrists
4.A	29-1067	Surgeons
4.A	29-1069	Physicians and Surgeons, All Other
4.A	29-1071	Physician Assistants
4.A	29-1081	Podiatrists
4.A	29-1122	Occupational Therapists
4.A	29-1123	Physical Therapists
4.A	29-1124	Radiation Therapists
4.A	29-1125	Recreational Therapists
4.A	29-1126	Respiratory Therapists
4.A	29-1127	Speech-Language Pathologists
4.A	29-1128	Exercise Physiologists
4.A	29-1129	Therapists, All Other
4.A	29-1131	Veterinarians
4.A	29-1141	Registered Nurses
4.A	29-1151	Nurse Anesthetists

Appendix A: Occupations by STEM Group (BLS Definitions) *continued*

Key

Sub-domain	
1	Life and Physical Science, Engineering, Math, and IT Occupations
2	Social Science Occupations
3	Architecture Occupations
4	Health Occupations
	Split across 2 sub-domains

Types of occupations	
A	Research, Development, Design, or Practitioner Occupations
B	Technologist and Technician Occupations
C	Postsecondary Teaching Occupations
D	Managerial Occupations
E	Sales Occupations

Sub-domain and Type of Occupation	2010 SOC code	2010 SOC title
4.A	29-1161	Nurse Midwives
4.A	29-1171	Nurse Practitioners
4.A	29-1181	Audiologists
4.A	29-1199	Health Diagnosing and Treating Practitioners, All Other
4.B	29-2011	Medical and Clinical Laboratory Technologists
4.B	29-2012	Medical and Clinical Laboratory Technicians
4.B	29-2021	Dental Hygienists
4.B	29-2031	Cardiovascular Technologists and Technicians
4.B	29-2032	Diagnostic Medical Sonographers
4.B	29-2033	Nuclear Medicine Technologists
4.B	29-2034	Radiologic Technologists
4.B	29-2035	Magnetic Resonance Imaging Technologists
4.B	29-2041	Emergency Medical Technicians and Paramedics
4.B	29-2051	Dietetic Technicians
4.B	29-2052	Pharmacy Technicians
4.B	29-2053	Psychiatric Technicians
4.B	29-2054	Respiratory Therapy Technicians
4.B	29-2055	Surgical Technologists
4.B	29-2056	Veterinary Technologists and Technicians
4.B	29-2057	Ophthalmic Medical Technicians
4.B	29-2061	Licensed Practical and Licensed Vocational Nurses
4.B	29-2071	Medical Records and Health Information Technicians
4.B	29-2081	Opticians, Dispensing
4.B	29-2091	Orthotists and Prosthetists
4.B	29-2092	Hearing Aid Specialists
4.B	29-2099	Health Technologists and Technicians, All Other
4.B	29-9011	Occupational Health and Safety Specialists
4.B	29-9012	Occupational Health and Safety Technicians
4.B	29-9091	Athletic Trainers
4.B	29-9092	Genetic Counselors
4.B	29-9099	Healthcare Practitioners and Technical Workers, All Other

Appendix B: STEM Demand Data Table

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
11-3021	Computer and Information Systems Managers	2,423	2,864	81	Bachelor's degree		More than 5 years	None	Very Favorable
11-9041	Engineering Managers	1,042	1,076	24	Bachelor's degree		More than 5 years	None	Favorable
11-9121	Natural Sciences Managers	99	110	7	Bachelor's degree		More than 5 years	None	Favorable
15-1111	Computer and Information Research Scientists	67	82	3	Doctoral or professional degree		None	None	Favorable
15-1121	Computer Systems Analysts	2,920	3,414	105	Bachelor's degree		None	None	Very Favorable
15-1131	Computer Programmers	1,404	1,588	52	Bachelor's degree		None	None	Very Favorable
15-1132	Software Developers, Applications	4,761	5,990	173	Bachelor's degree		None	None	Very Favorable
15-1133	Software Developers, Systems Software	2,248	2,736	72	Bachelor's degree		None	None	Very Favorable
15-1141	Database Administrators	499	631	21	Bachelor's degree		1 to 5 years	None	Very Favorable
15-1142	Network and Computer Systems Architects and Administrators	1,610	2,000	66	Bachelor's degree		None	None	Very Favorable
15-1150	Computer Support Specialists	2,815	3,250	118	Some college, no degree		None	Moderate-term OJT	Very Favorable
15-1179	Information Security Analysts, Web Developers, and Computer Network Architects	956	1,089	28	Bachelor's degree		1 to 5 years	None	Very Favorable
15-1199	Computer Occupations, All Other	1,026	1,197	36	Bachelor's degree		None	None	Very Favorable
15-2011	Actuaries	68	80	5	Bachelor's degree		None	Long-term OJT	Very Favorable
15-2021	Mathematicians	n	n	n	Master's degree		None	None	Not Favorable
15-2031	Operations Research Analysts	143	156	6	Bachelor's degree		None	None	Favorable
15-2041	Statisticians	85	93	6	Master's degree		None	None	Favorable
15-2099	Mathematical Science Occupations, All Other	n	n	n	Bachelor's degree		None	None	Favorable

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
17-1011	Architects, Except Landscape and Naval	255	313	11	Bachelor's degree	Yes	None	Internship/ residency	Very Favorable
17-1012	Landscape Architects	128	140	4	Bachelor's degree	Yes	None	Internship/ residency	Less Favorable
17-1021	Cartographers and Photogrammetrists	82	99	4	Bachelor's degree		None	None	Favorable
17-1022	Surveyors	269	342	13	Bachelor's degree	Yes	None	None	Very Favorable
17-2011	Aerospace Engineers	n	n	n	Bachelor's degree		None	None	Less Favorable
17-2021	Agricultural Engineers	n	n	n	Bachelor's degree		None	None	Not Favorable
17-2031	Biomedical Engineers	48	76	4	Bachelor's degree	Yes	None	None	Favorable
17-2041	Chemical Engineers	70	79	3	Bachelor's degree	Yes	None	None	Favorable
17-2051	Civil Engineers	930	1,096	36	Bachelor's degree	Yes	None	None	Very Favorable
17-2061	Computer Hardware Engineers	181	197	6	Bachelor's degree	Yes	None	None	Favorable
17-2071	Electrical Engineers	1,197	1,216	31	Bachelor's degree	Yes	None	None	Favorable
17-2072	Electronics Engineers, Except Computer	539	565	15	Bachelor's degree	Yes	None	None	Favorable
17-2081	Environmental Engineers	272	344	13	Bachelor's degree	Yes	None	None	Very Favorable
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	46	50	1	Bachelor's degree	Yes	None	None	Less Favorable
17-2112	Industrial Engineers	1,101	1,164	31	Bachelor's degree	Yes	None	None	Favorable
17-2131	Materials Engineers	64	70	2	Bachelor's degree	Yes	None	None	Less Favorable
17-2141	Mechanical Engineers	1,492	1,563	55	Bachelor's degree	Yes	None	None	Favorable
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	n	n	n	Bachelor's degree		None	None	Not Favorable
17-2161	Nuclear Engineers	n	n	n	Bachelor's degree		None	None	Not Favorable
17-2199	Engineers, All Other	1,599	1,743	50	Bachelor's degree		None	None	Favorable
17-3011	Architectural and Civil Drafters	354	368	8	Associate's degree		None	None	Less Favorable
17-3012	Electrical and Electronics Drafters	168	172	3	Associate's degree		None	None	Not Favorable
17-3013	Mechanical Drafters	178	189	5	Associate's degree		None	None	Less Favorable

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
17-3019	Drafters, All Other	371	356	7	Associate's degree		None	None	Less Favorable
17-3021	Aerospace Engineering and Operations Technicians	n	n	n	Associate's degree		None	None	Not Favorable
17-3022	Civil Engineering Technicians	142	169	6	Associate's degree		None	None	Very Favorable
17-3023	Electrical and Electronic Engineering Technicians	953	966	19	Associate's degree		None	None	Favorable
17-3024	Electro-Mechanical Technicians	34	36	1	Associate's degree		None	None	Not Favorable
17-3025	Environmental Engineering Technicians	n	n	n	Associate's degree		None	None	Favorable
17-3026	Industrial Engineering Technicians	305	308	7	Associate's degree		None	None	Less Favorable
17-3027	Mechanical Engineering Technicians	392	400	8	Associate's degree		None	None	Less Favorable
17-3029	Engineering Technicians, Except Drafters, All Other	667	675	13	Associate's degree		None	None	Favorable
17-3031	Surveying and Mapping Technicians	209	239	7	High school diploma or equivalent		None	Moderate-term OJT	Favorable
19-1011	Animal Scientists	n	n	n	Doctoral or professional degree		None	None	Not Favorable
19-1012	Food Scientists and Technologists	30	33	1	Bachelor's degree		None	None	Less Favorable
19-1013	Soil and Plant Scientists	16	16	1	Bachelor's degree	Yes	None	None	Not Favorable
19-1021	Biochemists and Biophysicists	n	n	n	Doctoral or professional degree		None	None	Favorable
19-1022	Microbiologists	27	29	1	Bachelor's degree		None	None	Less Favorable
19-1023	Zoologists and Wildlife Biologists	85	90	3	Bachelor's degree		None	None	Not Favorable
19-1029	Biological Scientists, All Other	91	96	2	Doctoral or professional degree		None	None	Not Favorable
19-1031	Conservation Scientists	59	65	1	Bachelor's degree	Yes	None	None	Less Favorable
19-1032	Foresters	47	49	1	Bachelor's degree	Yes	None	None	Not Favorable
19-1041	Epidemiologists	n	n	n	Master's degree		None	None	Less Favorable
19-1042	Medical Scientists, Except Epidemiologists	358	479	14	Doctoral or professional degree		None	None	Very Favorable
19-1099	Life Scientists, All Other	68	77	1	Bachelor's degree		None	None	Favorable
19-2011	Astronomers	n	n	n	Doctoral or professional degree		None	None	Less Favorable

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
19-2012	Physicists	55	55	2	Doctoral or professional degree		None	None	Not Favorable
19-2021	Atmospheric and Space Scientists	50	56	1	Bachelor's degree		None	None	Favorable
19-2031	Chemists	140	153	6	Bachelor's degree		None	None	Favorable
19-2032	Materials Scientists	37	41	1	Bachelor's degree		None	None	Less Favorable
19-2041	Environmental Scientists and Specialists, Including Health	408	481	19	Bachelor's degree	Yes	None	None	Very Favorable
19-2042	Geoscientists, Except Hydrologists and Geographers	82	103	4	Bachelor's degree	Yes	None	None	Favorable
19-2043	Hydrologists	64	73	3	Master's degree		None	None	Favorable
19-2099	Physical Scientists, All Other	205	223	9	Bachelor's degree		None	None	Favorable
19-4011	Agricultural and Food Science Technicians	n	n	n	Associate's degree		None	None	Less Favorable
19-4021	Biological Technicians	200	233	10	Bachelor's degree		None	None	Favorable
19-4031	Chemical Technicians	110	122	3	Associate's degree		None	Moderate-term OJT	Less Favorable
19-4041	Geological and Petroleum Technicians	15	17	0	Associate's degree		None	Moderate-term OJT	Less Favorable
19-4051	Nuclear Technicians	n	n	n	Associate's degree		None	Moderate-term OJT	Less Favorable
19-4091	Environmental Science and Protection Technicians, Including Health	163	196	10	Associate's degree	Yes	None	Moderate-term OJT	Very Favorable
19-4092	Forensic Science Technicians	44	50	3	Bachelor's degree		None	Moderate-term OJT	Favorable
19-4093	Forest and Conservation Technicians	85	85	4	Associate's degree		None	None	Not Favorable
19-4099	Life, Physical, and Social Science Technicians, All Other	456	510	25	Associate's degree		None	Moderate-term OJT	Very Favorable
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	3,882	4,480	151	Bachelor's degree		None	Moderate-term OJT	Very Favorable
41-9031	Sales Engineers	423	477	19	Bachelor's degree		None	Moderate-term OJT	Very Favorable
19-3011	Economists	16	16	0	Bachelor's degree		None	None	Not Favorable

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
19-3022	Survey Researchers	111	115	3	Bachelor's degree		None	None	Not Favorable
19-3031	Clinical, Counseling, and School Psychologists	692	794	32	Doctoral or professional degree	Yes	None	Internship/ residency	Very Favorable
19-3039	Psychologists, All Other	47	55	3	Master's degree		None	Internship/ residency	Favorable
19-3051	Urban and Regional Planners	275	300	9	Master's degree		None	None	Favorable
19-3091	Anthropologists and Archeologists	10	14	0	Master's degree		None	None	Less Favorable
19-3099	Social Scientists and Related Workers, All Other	115	124	6	Bachelor's degree		None	None	Favorable
19-4061	Social Science Research Assistants	27	32	2	Associate's degree		None	None	Favorable
25-1000	Postsecondary STEM Teachers[1]	2,080	2,356	57	Doctoral or professional degree		None	None	Very Favorable
11-9111	Medical and Health Services Managers	1,301	1,547	57	Bachelor's degree	Yes	None	None	Very Favorable
25-1072	Nursing Instructors and Teachers, Postsecondary	224	254	7	Master's degree	Yes	None	None	Favorable
29-1011	Chiropractors	207	251	8	Doctoral or professional degree	Yes	None	None	Very Favorable
29-1020	Dentists[2]	527	597	22	Doctoral or professional degree	Yes	None	Internship/ residency	Very Favorable
29-1031	Dietitians and Nutritionists	311	357	16	Bachelor's degree	Yes	None	Internship/ residency	Very Favorable
29-1041	Optometrists	142	180	9	Doctoral or professional degree	Yes	None	None	Very Favorable
29-1051	Pharmacists	1,885	2,136	73	Doctoral or professional degree	Yes	None	None	Very Favorable
29-1060	Physicians and Surgeons[2]	2,885	3,436	111	Doctoral or professional degree	Yes	None	Internship/ residency	Very Favorable
29-1071	Physician Assistants	459	573	20	Master's degree	Yes	None	None	Very Favorable
29-1081	Podiatrists	43	50	2	Doctoral or professional degree	Yes	None	Internship/ residency	Favorable
29-1111	Registered Nurses[3]	13,961	17,055	562	Associate's degree	Yes	None	None	Very Favorable
29-1122	Occupational Therapists	866	1,042	34	Master's degree	Yes	None	None	Very Favorable

1. Data for Postsecondary Teachers requiring a Doctorate or Professional degree have been combined to this summary level.
2. Data for Dentists, all specializations and Physicians and Surgeons, all specializations have been combined to summary levels.
3. Data for Registered Nurses includes other nursing specialties: Nurse Anesthetists, Nurse Midwives, and Nurse Practitioners

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
29-1123	Physical Therapists	1,398	1,806	57	Doctoral or professional degree	Yes	None	None	Very Favorable
29-1124	Radiation Therapists	69	75	2	Associate's degree		None	None	Less Favorable
29-1125	Recreational Therapists	58	64	3	Bachelor's degree	Yes	None	None	Less Favorable
29-1126	Respiratory Therapists	534	657	22	Associate's degree	Yes	None	None	Very Favorable
29-1127	Speech-Language Pathologists	563	621	17	Master's degree	Yes	None	None	Favorable
29-1128	Therapists, All Other	301	365	12	Master's degree		None	None	Very Favorable
29-1131	Veterinarians	326	375	11	Doctoral or professional degree	Yes	None	None	Favorable
29-1181	Audiologists	94	132	5	Doctoral or professional degree	Yes	None	None	Very Favorable
29-1199	Health Diagnosing and Treating Practitioners, All Other	220	264	8	Master's degree		None	None	Very Favorable
29-2011	Medical and Clinical Laboratory Technologists	518	535	12	Bachelor's degree		None	None	Less Favorable
29-2012	Medical and Clinical Laboratory Technicians	555	620	17	Associate's degree		None	None	Very Favorable
29-2021	Dental Hygienists	1,172	1,483	55	Associate's degree	Yes	None	None	Very Favorable
29-2031	Cardiovascular Technologists and Technicians	206	250	7	Associate's degree		None	None	Very Favorable
29-2032	Diagnostic Medical Sonographers	217	291	10	Associate's degree		None	None	Very Favorable
29-2033	Nuclear Medicine Technologists	78	88	2	Associate's degree		None	None	Favorable
29-2037	Radiologic Technologists and Technicians	1,047	1,259	37	Associate's degree		None	None	Very Favorable
29-2041	Emergency Medical Technicians and Paramedics	1,340	1,696	63	Postsecondary non-degree award	Yes	None	None	Very Favorable
29-2051	Dietetic Technicians	79	89	2	High school diploma or equivalent		None	Moderate-term OJT	Favorable
29-2052	Pharmacy Technicians	1,411	1,652	48	High school diploma or equivalent	Yes	None	Moderate-term OJT	Very Favorable

Appendix B: STEM Demand Data Table *continued*

New Hampshire Long-term Occupational Projections, 2010 to 2020

SOC Code	Occupation Title	2010 Base	2020 Projected	Total Job Openings	Education Value	NH License	Work/ Experience Value	Job Training Value	Descriptor
29-2053	Psychiatric Technicians	n	n	n	Postsecondary non-degree award		None	Short-term OJT	Favorable
29-2054	Respiratory Therapy Technicians	38	39	1	Associate's degree		None	Moderate-term OJT	Not Favorable
29-2055	Surgical Technologists	307	341	8	Postsecondary non-degree award		None	None	Favorable
29-2056	Veterinary Technologists and Technicians	654	828	28	Associate's degree		None	None	Very Favorable
29-2061	Licensed Practical and Licensed Vocational Nurses	2,663	3,187	123	Postsecondary non-degree award	Yes	None	None	Very Favorable
29-2071	Medical Records and Health Information Technicians	1,080	1,260	40	Postsecondary non-degree award		None	None	Very Favorable
29-2081	Opticians, Dispensing	345	393	12	High school diploma or equivalent	Yes	None	Long-term OJT	Favorable
29-2091	Orthotists and Prosthetists	33	34	1	Master's degree		None	None	Not Favorable
29-2799	Health Technologists and Technicians, All Other	635	756	25	Postsecondary non-degree award		None	Short-term OJT	Very Favorable
29-9011	Occupational Health and Safety Specialists	207	224	9	Bachelor's degree	Yes	None	Moderate-term OJT	Favorable
29-9012	Occupational Health and Safety Technicians	n	n	n	High school diploma or equivalent		None	Moderate-term oOJT	Less Favorable
29-9091	Athletic Trainers	106	133	6	Bachelor's degree	Yes	None	None	Very Favorable
29-9799	Healthcare Practitioners and Technical Workers, All Other, including genetic counselors	549	644	29	Bachelor's degree		None	None	Very Favorable

Appendix C: Supply-Demand Comparison

Standard Occupational Classification (SOC)	Occupational Title	NEW Supply/ 2011 NH Completers Match	2010 - 2020 Projections Demand/Annual Openings	Difference: NEW Supply less Annual Demand
11-3021	Computer and Information Systems Managers	32	81	(49)
11-9041	Engineering Managers	247	24	223
11-9111	Medical and Health Services Managers	214	57	157
11-9121	Natural Sciences Managers	295	7	288
15-1111	Computer and Information Research Scientists	5	3	2
15-1121	Computer Systems Analysts	23	105	(82)
15-1179	Information Security Analysts, Web Developers, and Computer Network Architects	53	28	25
15-1150	Computer Support Specialists	26	118	NA
15-1131	Computer Programmers	11	52	(41)
15-1132	Software Developers, Applications	20	173	(153)
15-1133	Software Developers, Systems Software	19	72	(53)
15-1141	Database Administrators	21	21	0
15-1142	Network and computer systems architects and administrators	20	66	(46)
15-1799	Computer Occupations, All Other	33	36	(3)
15-2011	Actuaries	2	5	(3)
15-2021	Mathematicians	7	NP	NA
15-2031	Operations Research Analysts	0	6	(6)
15-2041	Statisticians	7	6	1
15-2091	Mathematical Technicians	NA	no NH data	
15-2099	Mathematical Science Occupations, All Other	52	1	51
17-1011	Architects, Except Landscape and Naval	25	11	14
17-1012	Landscape Architects	0	4	(4)
17-1021	Cartographers and Photogrammetrists	0	4	(4)
17-1022	Surveyors	0	13	(13)
17-2011	Aerospace Engineers	46	NP	NA
17-2021	Agricultural Engineers	NA	NP	
17-2031	Biomedical Engineers	2	4	(2)
17-2041	Chemical Engineers	17	3	14
17-2051	Civil Engineers	49	36	13
17-2061	Computer Hardware Engineers	5	6	(1)
17-2071	Electrical Engineers	12	31	(19)
17-2072	Electronics Engineers, Except Computer	12	15	(3)
17-2081	Environmental Engineers	6	13	(7)

Appendix C: Supply-Demand Comparison *continued*

Standard Occupational Classification (SOC)	Occupational Title	NEW Supply/ 2011 NH Completers Match	2010 - 2020 Projections Demand/Annual Openings	Difference: NEW Supply less Annual Demand
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	7	1	6
17-2112	Industrial Engineers	0	31	(31)
17-2121	Marine Engineers and Naval Architects	0	no NH data	NA
17-2131	Materials Engineers	0	2	(2)
17-2141	Mechanical Engineers	34	55	(21)
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	0	NP	NA
17-2161	Nuclear Engineers	0	NP	NA
17-2171	Petroleum Engineers	0		0
17-2199	Engineers, All Other	127	50	77
17-3011	Architectural and Civil Drafters	2	8	(6)
17-3012	Electrical and Electronics Drafters	2	3	(1)
17-3013	Mechanical Drafters	2	5	(3)
17-3019	Drafters, All Other	2	7	(5)
17-3021	Aerospace Engineering and Operations Technicians	0	NP	NA
17-3022	Civil Engineering Technicians	19	6	13
17-3023	Electrical and Electronic Engineering Technicians	29	19	10
17-3024	Electro-Mechanical Technicians	0	1	(1)
17-3025	Environmental Engineering Technicians	0	NP	NA
17-3026	Industrial Engineering Technicians	8	7	1
17-3027	Mechanical Engineering Technicians	32	8	24
17-3029	Engineering Technicians, Except Drafters, All Other	24	13	11
17-3031	Surveying and Mapping Technicians	NA	7	
19-1011	Animal Scientists	1	0	1
19-1012	Food Scientists and Technologists	NA	1	
19-1013	Soil and Plant Scientists	7	1	6
19-1021	Biochemists and Biophysicists	3	NP	NA
19-1022	Microbiologists	0	1	(1)
19-1023	Zoologists and Wildlife Biologists	27	3	24
19-1029	Biological Scientists, All Other	7	2	5
19-1031	Conservation Scientists	8	1	7
19-1032	Foresters	11	1	10
19-1041	Epidemiologists	0	NP	NA
19-1042	Medical Scientists, Except Epidemiologists	6	14	(8)
19-1099	Life Scientists, All Other	58	1	57
19-2011	Astronomers	0	NP	NA
19-2012	Physicists	7	2	5
19-2021	Atmospheric and Space Scientists	11	1	10
19-2031	Chemists	29	6	23

Appendix C: Supply-Demand Comparison *continued*

Standard Occupational Classification (SOC)	Occupational Title	NEW Supply/ 2011 NH Completers Match	2010 - 2020 Projections Demand/Annual Openings	Difference: NEW Supply less Annual Demand
19-2032	Materials Scientists	1	1	0
19-2041	Environmental Scientists and Specialists, Including Health	164	19	145
19-2042	Geoscientists, Except Hydrologists and Geographers	14	4	10
19-2043	Hydrologists	5	3	2
19-2099	Physical Scientists, All Other	NA	9	
19-3011	Economists	169	0	169
19-3022	Survey Researchers	123	3	120
19-3031	Clinical, Counseling, and School Psychologists	33	32	1
19-3032	Industrial-Organizational Psychologists	22	no NH data	NA
19-3039	Psychologists, All Other	NA	3	
19-3041	Sociologists	13	9	4
19-3051	Urban and Regional Planners	0	0	0
19-3091	Anthropologists and Archeologists	0	no NH data	NA
19-3092	Geographers	51	no NH data	NA
19-3094	Political Scientists	46	6	40
19-3099	Social Scientists and Related Workers, All Other	38	NP	NA
19-4011	Agricultural and Food Science Technicians	0	10	(10)
19-4021	Biological Technicians	NA	3	
19-4031	Chemical Technicians	0	0	0
19-4041	Geological and Petroleum Technicians	0	NP	NA
19-4051	Nuclear Technicians	0	2	(2)
19-4061	Social Science Research Assistants	44	10	34
19-4091	Environmental Science and Protection Technicians, Including Health	NA	3	
19-4092	Forensic Science Technicians	0	4	(4)
19-4093	Forest and Conservation Technicians	15	25	(10)
19-4099	Life, Physical, and Social Science Technicians, All Other	NA	4	
25-1000	Postsecondary Teachers[1]	0	53	(6)
25-1071	Health Specialties Teachers, Postsecondary	50	7	43
25-1072	Nursing Instructors and Teachers, Postsecondary	50	8	42
29-1011	Chiropractors	0		
29-1020	Dentists[2]	0	22	(22)
29-1031	Dietitians and Nutritionists	17	16	1

Appendix C: Supply-Demand Comparison *continued*

Standard Occupational Classification (SOC)	Occupational Title	NEW Supply/ 2011 NH Completers Match	2010 - 2020 Projections Demand/Annual Openings	Difference: NEW Supply less Annual Demand
29-1041	Optometrists	0	9	(9)
29-1051	Pharmacists	51	73	(22)
29-1060	Physicians and Surgeons[2]	68	111	NA
29-1071	Physician Assistants	53	20	33
29-1081	Podiatrists	0	2	(2)
29-1111	Registered Nurses[3]	796	562	234
29-1122	Occupational Therapists	62	34	28
29-1123	Physical Therapists	41	57	(16)
29-1124	Radiation Therapists	1	2	(1)
29-1125	Recreational Therapists	0	3	(3)
29-1126	Respiratory Therapists	5	22	(17)
29-1127	Speech-Language Pathologists	25	17	8
29-1128	Exercise Physiologists	9		9
29-1129	Therapists, All Other	9	12	6
29-1131	Veterinarians	0		0
29-1181	Audiologists	0	5	(5)
29-1199	Health Diagnosing and Treating Practitioners, All Other	NA	8	
29-2011	Medical and Clinical Laboratory Technologists	25	12	13
29-2012	Medical and Clinical Laboratory Technicians	9	17	(8)
29-2021	Dental Hygienists	28	55	(27)
29-2031	Cardiovascular Technologists and Technicians	0	7	(7)
29-2032	Diagnostic Medical Sonographers	0	10	(10)
29-2033	Nuclear Medicine Technologists	NA	2	
29-2034	Radiologic Technologists and Technicians	4		4
29-2035	Magnetic Resonance Imaging - Radiologic Technologists and Technicians	NA	37	
29-2041	Emergency Medical Technicians and Paramedics	NA	63	
29-2051	Dietetic Technicians	16	2	14
29-2052	Pharmacy Technicians	NA	48	
29-2053	Psychiatric Technicians	NA	NP	
29-2054	Respiratory Therapy Technicians	6	1	5
29-2055	Surgical Technologists	10	8	2
29-2056	Veterinary Technologists and Technicians	32	28	4
29-2057	Opthalmic Medical Technicians	NA		
29-2061	Licensed Practical and Licensed Vocational Nurses	106	123	(17)
29-2071	Medical Records and Health Information Technicians	77	40	37

Appendix C: Supply-Demand Comparison *continued*

Standard Occupational Classification (SOC)	Occupational Title	NEW Supply/ 2011 NH Completers Match	2010 - 2020 Projections Demand/Annual Openings	Difference: NEW Supply less Annual Demand
29-2081	Opticians, Dispensing	NA	12	
29-2091	Orthotists and Prosthetists	0	1	(1)
29-2092	Hearing Aid Specialists	NA		
29-2099	Health Technologists and Technicians, All Other	NA	25	
29-9011	Occupational Health and Safety Specialists	87	9	78
29-9012	Occupational Health and Safety Technicians	0	NP	NA
29-9091	Athletic Trainers	16	6	10
29-9092	Genetic Counselors	0		0
29-9099	Healthcare Practitioners and Technical Workers, All Other	NA	29	
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	NA	151	
41-9031	Sales Engineers	NA	19	

NOTE: Completers for NEW Supply were distributed proportionately to qualifying occupations

1. Occupations combined due to SOC code changes made in 2010

   15-1150 - Computer Support Specialists includes Computer User Support Specialists and Computer Network Support Specialists

2. Data for Postsecondary Teachers requiring a Doctorate or Professional degree have been combined to this summary level.

3. Data for Dentists, all specializations and Physicians and Surgeons, all specializations have been combined to summary levels.

4. Data for Registered Nurses includes other nursing specialties: Nurse Anesthetists, Nurse Midwives, and Nurse Practitioners

NP - Employment data does not meet disclosure standards

NA - Data not available

Appendix D: REMI Methodology

The explanation below is the economic theory and empirical data behind the REMI model.

The REMI Model

REMI Policy Insight® is a structural model, meaning that it clearly includes cause-and-effect relationships. The model is based on two key underlying assumptions from mainstream economic theory: households maximize utility and producers maximize profits. Since these assumptions make sense to most people, lay people as well as trained economists can understand the model. The tool is often used by economic developers and planners to gage the potential impact on a regional economy of proposed projects such as transportation infrastructure, office and retail development, relocation or expansion of businesses, etc.

In the model, businesses produce goods and services to sell locally to other firms, investors, governments, and individuals, and to sell as exports to purchasers outside the region. The output is produced using labor, capital, fuel, and intermediate inputs. The demand, per unit of output, for labor, capital, and fuel depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply and demand for labor determine the wage rates in the model. These wage rates, along with other prices and productivity, determine the cost of doing business for each industry in the model. An increase in the cost of doing business causes either an increase in prices or a cut in profits, depending on the market for the product. In either case, an increase in costs would decrease the share of the local and U.S. market supplied by local firms. This market share, combined with the demand described above, determines the amount of local output. Many other feedbacks are incorporated in the model. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment, and population growth impacts government spending.

The effects of a change scenario to the model are determined by comparing the baseline REMI forecast with an alternative forecast that incorporates the assumptions for the change scenario.