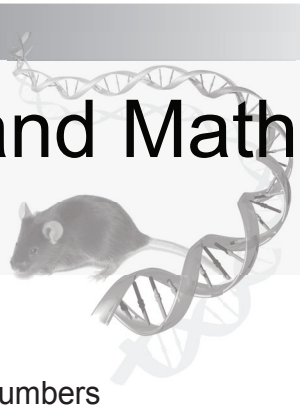
By ERIK STIMPFLE, Research Analyst; and TODD MOSHER, Economist

Science, Tech, Engineering, and Math

Knowledge-based workers in Alaska



Science and engineering are embedded into the fabric of our lives, from improving everyday activities to developing our economy.

Even during the coldest winter days, we remain warm in comfortably heated buildings and connected to the outside world by television, Internet, and cell phones. Science and technology operate behind the scenes, quietly and efficiently providing most of the comforts of modern living.

This article focuses on the state's scientists, engineers, surveyors, mathematicians, computer programmers, architects, and other workers who need highly specialized skills to do their jobs. These science, technology, engineering, and math occupations are collectively referred to as STEM occupations.

STEM workers' contributions to Alaska's economy are numerous. Geologists search for mineral deposits, and environmental scientists obtain permits before a new mine can operate. In the fishing industry, biologists research ways to raise king crab in hatcheries and determine how many salmon can be harvested each year while ensuring their return in the years ahead. These are just a few examples of STEM activities; science and technology are everywhere in Alaska's industries.

1 STEM Occupations

Categories and 2008 Alaska employment numbers

ARCHITECTS, SURVEYORS, AND CARTOGRAPHERS (1,554)

- Architects, Except Landscape and Naval (321)
- Architectural and Civil Drafters (236)
- Cartographers and Photogrammetrists (82)
- Drafters, All Other (154)
- Electrical and Electronics Drafters (53)
- Landscape Architects (<50)
- Mechanical Drafters (<50)
- Surveying and Mapping Technicians (187)
- Surveyors (464)

BUSINESS AND FINANCE (4,212)

- Accountants and Auditors (1,860)
- Budget Analysts (226)
- Cost Estimators (138)
- Credit Analysts (<50)
- Financial Analysts (244)
- Financial Specialists, All Other (1,470)
- Logisticians (257)

COMPUTER AND MATH SCIENCE (4,385)

- Actuaries (<50)
- Computer and Information Scientists, Research (58)
- Computer Programmers (680)
- Computer Software Engineers, Applications (326)
- Computer Software Engineers, Systems Software (290)
- Computer Specialists, All Other (375)
- Computer Support Specialists (1,124)
- Computer Systems Analysts (465)
- Database Administrators (121)
- Mathematical Scientists, All Other (<50)
- Mathematical Technicians (<50)
- Mathematicians (<50)
- Network and Computer Systems Administrators (541)
- Network Systems and Data Communications Analysts (191)
- Operations Research Analysts (139)
- Statisticians (58)

ENGINEERS (6,145)

- Aerospace Engineering and Operations Technicians (<50)
- Aerospace Engineers (71)
- Agricultural Engineers (<50)
- Biomedical Engineers (<50)
- Chemical Engineers (<50)
- Civil Engineering Technicians (449)
- Civil Engineers (700)
- Computer Hardware Engineers (74)
- Electrical and Electronic Engineering Technicians (310)
- Electrical Engineers (282)
- Electro-Mechanical Technicians (100)
- Electronics Engineers, Except Computer (234)
- Engineering Technicians, Except Drafters, All Other (678)
- Engineers, All Other (1,223)
- Environmental Engineering Technicians (249)
- Environmental Engineers (247)
- Health and Safety Engineers, Except Mining Safety Engineers and Inspectors (226)
- Industrial Engineering Technicians (94)
- Industrial Engineers (83)
- Marine Engineers and Naval Architects (<50)
- Materials Engineers (<50)
- Mechanical Engineering Technicians (<50)
- Mechanical Engineers (288)
- Mining and Geological Engineers, Including Mining Safety Engineers (150)
- Nuclear Engineers (0)
- Petroleum Engineers (482)

LIFE AND PHYSICAL SCIENTISTS (4,739)

- Agricultural and Food Science Technicians (<50)
- Animal Scientists (<50)
- Astronomers (<50)
- Atmospheric and Space Scientists (86)
- Biochemists and Biophysicists (<50)
- Biological Scientists, All Other (194)
- Biological Technicians (480)
- Forest and Conservation Technicians (*)
- Foresters (*)
- Geological and Petroleum Technicians (616)
- Geoscientists, Except Hydrologists and Geographers (331)
- Hydrologists (<50)
- Life Scientists, All Other (<50)
- Life, Physical, and Social Science Technicians, All Other (327)

(continued on the next page)

Defining the STEM workforce

Describing Alaska's STEM workforce is a challenge. There is no accepted national list of STEM occupations, and definitions vary depending on the source and the purpose of the research.

For this article, the Research and Analysis section of the Alaska Department of Labor and Workforce Development created a working definition for STEM occupations as a contribution to the ongoing discussion.

For an explanation of our criteria, refer to the methodology on page 12. Based on these criteria, we identified 135 STEM positions, 132 of which had employment in Alaska in 2008. (See Exhibit 1.)

We organized STEM occupations into eight broad categories: business and finance; computer and math science; architects, surveyors, and cartographers; engineers; social scientists; life and physical scientists; and postsecondary teachers. STEM occupations that did not fit into any of these categories were grouped into "all other."

Forecasted STEM openings

In 2008, Alaska had roughly 24,441 STEM-related jobs, and this number is projected to increase to 27,174 by 2018. (See Exhibit 2.)

An estimated 2,748 new STEM-related positions will be created during the forecast period, and an additional 5,376 will open as workers retire, change occupations, or leave the labor force. All together, more than 8,100 projected STEM openings will need to be filled.

In 2008, the highest STEM employment was in engineering, life and physical sciences, and computer and math science, in that order. (See Exhibits 2 and 3.) Occupations in these categories, as well as in business and finance, are each expected to generate more than 1,000 openings by 2018, and taken together will account for over 77 percent of STEM openings. Engineering-related occupations are expected to produce slightly more than 2,000 openings — the highest of any category.

Help wanted: Seeking skilled workers

Over the next ten years, STEM workers will be in demand for a range of occupations. Exhibit 4 lists the STEM occupations forecasted to generate the most job openings from growth and replacements.[1] Accountants and auditors top the list with about 580 total openings. STEM postsecondary teachers

[1]Growth openings are equal to the positive change in employment (i.e., new jobs). Replacement openings are vacancies left by workers who choose another occupation or exit the workforce.

STEM Occupations (continued) 1

Alaska, 2008

LIFE AND PHYSICAL SCIENTISTS (continued)	
Chemical Technicians (141)	Materials Scientists (<50)
Chemists (112)	Medical Scientists, Except Epidemiologists (<50)
Conservation Scientists (210)	Microbiologists (<50)
Environmental Science and Protection Technicians, Including Health (189)	Nuclear Technicians (0)
Environmental Scientists and Specialists, Including Health (595)	Physical Scientists, All Other (126)
Epidemiologists (<50)	Physicists (<50)
Food Scientists and Technologists (<50)	Soil and Plant Scientists (<50)
Forensic Science Technicians (<50)	Zoologists and Wildlife Biologists (635)

POSTSECONDARY TEACHERS (834)[1]	
Agricultural Sciences Teachers (*)	Engineering Teachers (*)
Anthropology and Archeology Teachers (*)	Environmental Science Teachers (*)
Architecture Teachers (*)	Forestry and Conservation Science Teachers (*)
Atmospheric, Earth, Marine, and Space Sciences (*)	Geography Teachers (*)
Biological Science Teachers (*)	Mathematical Science Teachers (*)
Chemistry Teachers (*)	Physics Teachers (*)
Computer Science Teachers (*)	Sociology Teachers (*)
Economics Teachers (*)	

SOCIAL SCIENTISTS (478)	
Anthropologists and Archeologists (<50)	Social Science Research Assistants (<50)
Economists (70)	Sociologists (<50)
Geographers (<50)	Survey Researchers (75)
Industrial-Organizational Psychologists (0)	Urban and Regional Planners (220)
Market Research Analysts (<50)	

ALL OTHER (2,094)	
Audio and Video Equipment Technicians (144)	Film and Video Editors (<50)
Audio-Visual Collections Specialists (<50)	Fire Inspectors and Investigators (<50)
Broadcast Technicians (75)	Graphic Designers (172)
Chemical Plant and System Operators (<50)	Multimedia Artists and Animators (<50)
Commercial and Industrial Designers (<50)	Museum Technicians and Conservators (53)
Computer and Information Systems Managers (397)	Natural Sciences Managers (264)
Construction and Building Inspectors (234)	Numerical Tool and Process Control Programmers (<50)
Desktop Publishers (<50)	Sales Engineers (<50)
Embalmers (<50)	Sound Engineering Technicians (<50)
Engineering Managers (426)	Statistical Assistants (54)
Farm, Ranch, and Other Agricultural Managers (<50)	Traffic Technicians (<50)
Farmers and Ranchers (<50)	

[1]There are no employment estimates for individual postsecondary teachers.
An asterisk (*) indicates suppressed data.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

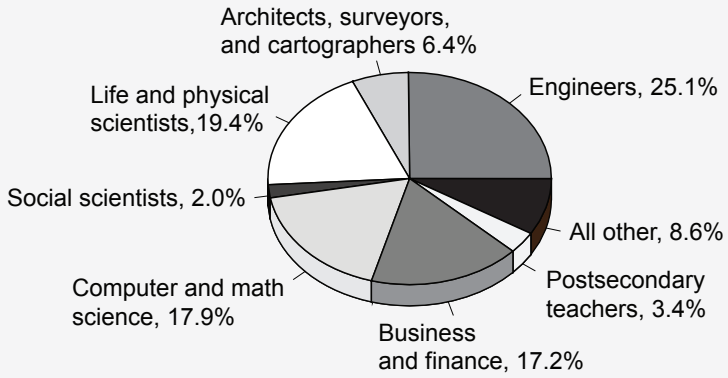
2 Projected STEM Employment by Category
Alaska, 2008 to 2018

	Employment			Openings, 2008 to 2018		
Occupational Categories	2008	2018	Percent change	Growth[1]	Replacement[2]	Total
Business and Finance	4,212	4,681	11.1%	469	763	1,232
Computer and Math Science	4,385	4,945	12.8%	560	607	1,167
Architects, Surveyors, and Cartographers	1,554	1,757	13.1%	203	520	723
Engineers	6,145	6,755	9.9%	610	1,430	2,040
Social Scientists	478	537	12.3%	59	160	219
Life and Physical Scientists	4,739	5,273	11.3%	535	1,244	1,779
Postsecondary Teachers	834	959	15.0%	125	208	333
All Other[2]	2,094	2,267	8.3%	187	444	631
Total for All STEM:	24,441	27,174	11.2%	2,748	5,376	8,124

[1]Growth openings are equal to the positive change in employment (i.e., new jobs).
[2]Replacement openings are vacancies left by workers who choose another occupation or exit the workforce.
Note: Data for individual occupations are at: http://labor.alaska.gov/research/occs/alaskaoccs/OccList.htm.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

3 Makeup of STEM Employment[1]
Alaska, 2008

Total STEM Employment: 24,441



[1]Excludes self-employed workers, private household workers, most agricultural workers, fishermen, and others not covered by the state's unemployment insurance program.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

are next, with estimated job vacancies of 300-plus.

Engineering-related occupations accounted for eight of the 30 occupations on the list. Civil and petroleum engineers are expected to generate more than 200 openings each, and both professions pay excellent annual wages. Openings for civil engineering technicians may exceed 160 positions, and these workers often train to become fully licensed engineers.

Seven computer science-related occupations made the list, and taken together they account for more than 1,000 job openings. Of this group, computer support specialists topped the list at more than 260 potential openings.

Education is essential

An estimated 95 percent of STEM workers need more than a high school diploma for their positions, compared to just 47 percent of non-STEM workers.[2] About 75 percent of STEM workers need a bachelor's or graduate degree, compared to only 20 percent of non-STEM workers. (See Exhibit 5.)

College degrees that prepare workers for STEM occupations require more math and science courses, and preparation for those classes begins in grade school.

Because an educated workforce is fundamental to STEM jobs, emphasis at the national level is on improving math and science education for students in kindergarten through 12th grade. This push includes getting kids interested in math and science careers as well as maximizing teacher and student performance.

Americans have known for some time that our high

[2]Based on O*NET surveys of occupation incumbent workers, applied to Alaska 2008 employment estimates.

school students lag behind other countries in math and science. Every three years, the Program for International Student Assessment reports test scores in math and science for 15-year-olds, and the 2009 results are not much different from previous years. In math, students in 17 of 33 countries performed better than Americans, and in science, 12 of 33 countries outranked the U.S.

One encouraging sign for Alaska is that more high school students are taking STEM-related courses at the University of Alaska. These dually enrolled students receive high school and college credits for attending college classes.

Between 2002 and 2010, the number of dually enrolled students in STEM-related classes increased from 35 to 417.[3] In 2010, there were 203 students enrolled in math and 101 students taking engineering technology courses. The remainder were enrolled in a variety of STEM-related disciplines such as computer science, biology, biomedical science, physical science, and natural resource management.

STEM jobs pay well

The average annual wage for STEM workers is $73,251 — almost $28,000 higher than for non-STEM workers. As in most professions, STEM occupations that require a higher level of education typically have more earning power.

Workers in STEM occupations earn higher average wages than their non-STEM counterparts at every level of education. (See Exhibit 6.) The difference is greatest at the lower levels of education attainment, where STEM-related technical certificates apparently trump general associate degrees and other certificates.

The wage gap between STEM and non-STEM occupations diminishes with higher levels of education. Still, on average, STEM jobs requir-

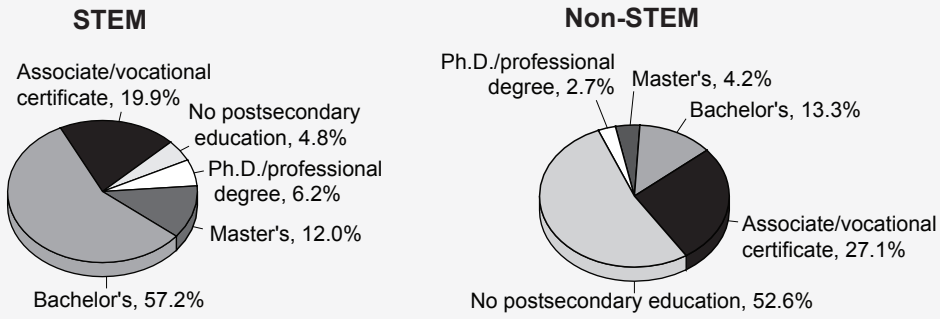
[3] Source: University of Alaska, Statewide Planning and Institutional Research

Highest Projected STEM Occupation Openings 4
Alaska, 2008 to 2018

Occupation	2008 Employment	Growth Openings[1]	Replacement Openings[2]	Total Openings
Accountants and Auditors	1,860	225	356	581
STEM Postsecondary Teachers	834	125	208	333
Zoologists and Wildlife Biologists	635	70	213	283
Computer Support Specialists	1,124	136	132	268
Surveyors	464	68	198	266
Geological and Petroleum Technicians	616	67	157	224
Petroleum Engineers	482	50	172	222
Civil Engineers	700	100	114	214
Environmental Scientists and Specialists, Including Health	595	82	107	189
Computer Programmers	680	15	154	169
Civil Engineering Technicians	449	63	104	167
Biological Technicians	480	60	79	139
Computer Systems Analysts	465	75	57	132
Network and Computer Systems Administrators	541	69	59	128
Engineering Managers	426	36	83	119
Urban and Regional Planners	220	27	86	113
Computer Software Engineers, Applications	326	64	48	112
Surveying and Mapping Technicians	187	28	83	111
Computer and Information Systems Managers	397	35	74	109
Computer Software Engineers, Systems Software	290	60	43	103
Mechanical Engineers	288	17	83	100
Geoscientists, Except Hydrologists/ Geographers	331	39	60	99
Architectural and Civil Drafters	236	24	72	96
Environmental Engineering Technicians	249	40	52	92
Mining and Geological Engineers, Including Mining Safety Engineers	150	30	62	92
Architects, Except Landscape and Naval	321	49	37	86
Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	226	20	66	86
Electrical and Electronic Engineering Technicians	310	15	67	82
Conservation Scientists	210	21	61	82
Construction and Building Inspectors	234	26	53	79

Note: Excludes residual ("all other") occupations.
[1]Growth openings are equal to the positive change in employment (i.e., new jobs).
[2]Replacement openings are vacancies left by workers who choose another occupation or exit the workforce.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

5 Required Education Levels[1]
Alaska, 2008



[1]Based on required education data from O*NET database, weighted by employment.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

6 Average Earnings by Education Level
All Alaska jobs, 2009

Education Level	STEM	Non-STEM	Difference
Associate degree, certificate, or some college	$63,192	$49,059	28.8%
Bachelor's degree	$75,499	$62,732	20.4%
Master's degree	$79,733	$70,731	12.7%
Doctorate or professional degree	$86,052	$82,751	4.0%

Note: Based on O*NET required education data and an employment weighted average of May 2009 OES wage estimates. Excludes residual ("all other") occupations.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

7 Ten Highest-Paying STEM Jobs
Alaska, 2009

Occupation	Annual Wages
Petroleum Engineers	$154,500
Chemical Engineers	$125,820
Engineering Managers	$118,440
Materials Engineers	$108,180
Geoscientists, Except Hydrologists and Geographers	$104,410
Electrical Engineers	$100,250
Industrial Engineers	$98,790
Mechanical Engineers	$98,790
Mining and Geological Engineers, Including Mining Safety Engineers	$95,200
Natural Sciences Managers	$92,340

Note: Based on May 2009 OES wage estimates.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

ing a bachelor's degree pay 20 percent more than those in non-STEM categories, and those needing a master's degree pay 13 percent more.

As a group, STEM postsecondary teachers had the highest wages, with an average salary of about $92,000. (See Exhibit 8.)

For individual occupations, petroleum engineers top the list with average earnings of $154,500, and eight of the ten highest paying occupations are engineering-related. (See Exhibit 7.)

Engineers typically earn a bachelor's degree and spend several years gaining on-the-job experience before they can take an exam to become fully licensed and start earning top-dollar wages.

An aging STEM workforce

There are relatively few young STEM workers. In 2008, only about 9 percent were under the age of 25 (see Exhibit 9), compared to 20 percent of non-STEM workers. This is likely because it takes time to obtain the necessary postsecondary education or training for STEM employment.

Alaska's STEM workforce is aging, and replacements will be needed as these workers retire. About 41 percent of Alaska's STEM workers were ages 45 to 64 in 2008, and many of these workers will retire in the near future. It will be a challenge to replace them, because these workers typically have many years of experience, education, knowledge, and skills built up over a career. However, the large number of aging workers also means continued opportunities for younger workers just starting their careers, provided they have the required education and training.

Most STEM workers are men

STEM workers in Alaska are predominately male, a long-time trend that mirrors the rest of the nation. Business and finance was the only category with significantly more women than men. (See Exhibit 10.) Social sciences had an almost even split of males and females. But in nearly every other category, there were significantly more men.

Engineering had the highest difference, with four males to every female.

However, data from the National Science Foundation suggest that the number of women choosing STEM careers is on the rise. Women made up 27 percent of the nation's science and engineering workforce in 2007, compared to only 12 percent in 1980.[4]

Despite the apparent gender gap in science and engineering, Alaska's women are closing the gap in some individual occupations.

Eight of the top 15 STEM occupations with the highest percentage of females require a background in science. (See Exhibit 11.) Four of those are in the environmental sciences. Conservation scientists are 52 percent female, followed by environmental technicians (48 percent), environmental scientists (47 percent), and environmental engineers (36 percent). In contrast, only 20 percent of engineers overall are women.

Finding qualified workers

Employers who can't find workers locally have to look outside the state. In 2008, about 16 percent of workers in STEM-related jobs were nonresidents, compared to 20 percent nonresidency for non-STEM positions.

Finding qualified Alaska residents is a challenge for employers in a variety of industries. Because most STEM workers need a bachelor's degree or higher, short-term training programs are less likely to provide a quick fix for any worker shortages.

Among STEM occupations, the life and physical sciences category had the highest percentage of nonresidents; about 23 percent of its workers were from outside the state. However, rates for individual occupations can vary widely.

For residency information for specific occupations, refer to the Alaska Occupations Web site, which provides data on more than 500 occupations.[5]

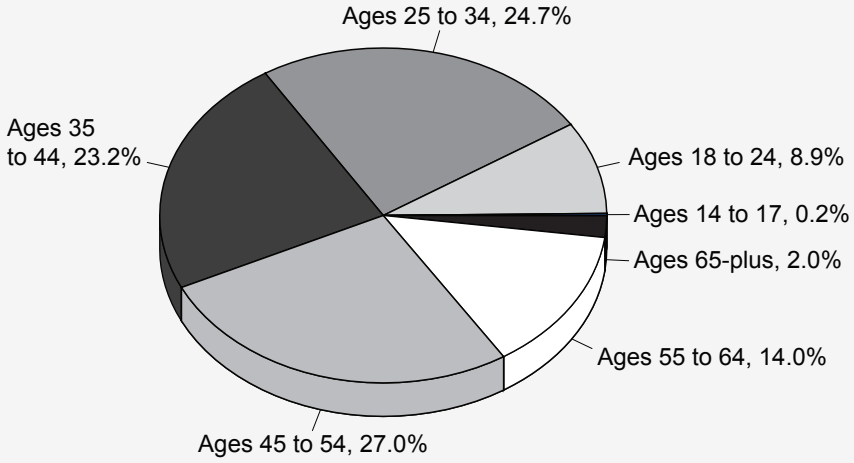
[4]Source: The National Science Foundation's Science and Engineering Indicators 2010 Report
[5]See http://labor.alaska.gov/research/occs/alaskaoccs/home.htm.

8 Average Wages by Category
All Alaska jobs, 2009

Occupational Category	STEM Wages	Non-STEM Wages
Postsecondary Teachers	$91,968	$71,259
Engineers	$89,053	*
Architects, Surveyors, and Cartographers	$69,335	*
Computer and Math Science	$66,853	*
Business and Finance	$65,046	$63,390
Life and Physical Scientists	$62,895	*
Social Scientists	$61,503	$70,863
All Other[1]	$78,266	$44,790

[1]For a list of occupations see Exhibit 1.
*All occupations in this category are STEM.
Note: Based on an employment weighted average of May 2009 OES wage estimates.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

9 Age of STEM Workers
Alaska, 2008



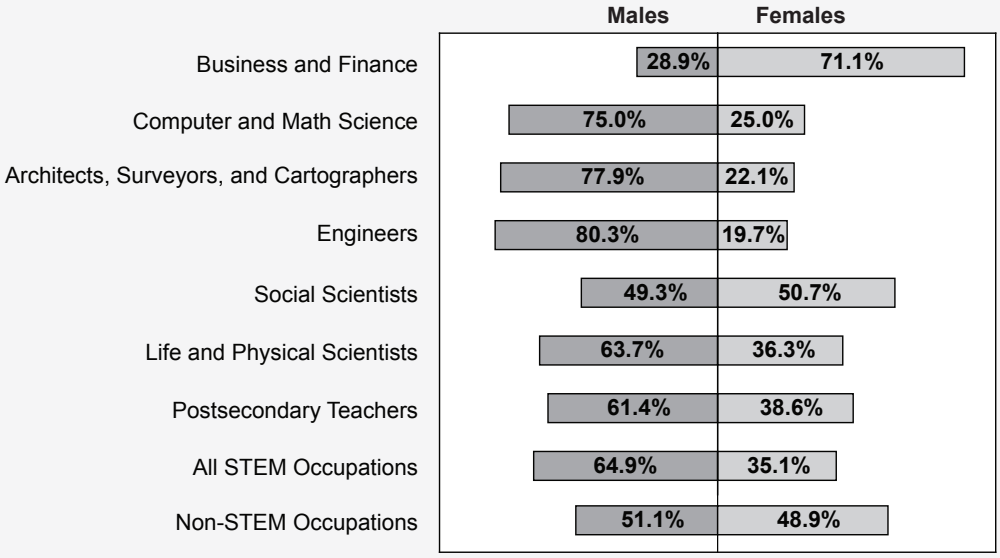
Note: Based on 2008 Alaska Permanent Fund Dividend data.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

The national push for STEM

In 2007, Congress passed the America Competes Act, with the goals of promoting scientific research and development and helping the U.S. stay competitive. The act was partly in response to a 2007 federal report titled "Rising Above the Gathering Storm."

The report concluded that although the United

10 Gender Makeup of STEM Categories
Alaska, 2009



Note: Based on 2008 Alaska Permanent Fund Dividend data.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

11 Highest Percentages of Women
Alaska STEM jobs, 2008

Occupation	Percent female
Budget Analysts	77.9%
Accountants and Auditors	72.7%
Graphic Designers	57.9%
Financial Analysts	54.7%
Conservation Scientists	51.7%
Environmental Science and Protection Technicians, Including Health	47.5%
Environmental Scientists and Specialists, Including Health	47.1%
Urban and Regional Planners	45.6%
Operations Research Analysts	45.5%
Natural Sciences Managers	44.2%
Biological Technicians	42.7%
Chemists	41.6%
STEM Postsecondary Teachers	38.6%
Environmental Engineers	35.5%
Database Administrators	35.4%

Note: Only includes occupations with 100 or more jobs. Excludes residual ("all other") occupations. Gender percentages are based on 2008 Alaska Permanent Fund Dividend data.
Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

States was still among the world's leaders in scientific research, discovery, and innovation, it was in danger of losing its global technological edge.

The act increased funding for scientific research and development, promoted STEM-related education, and extended tax credits for companies engaged in scientific research.

In late December of 2010, the America Competes Act was reauthorized with bipartisan support and was signed into law on Jan. 4. The act includes research and development tax credits for private companies and more than $40 billion in funding for the National Science Foundation, the Department of Energy, and the National Institute of Standards and Technology.

The America Competes Act is just one example of U.S. efforts to promote STEM-related education. One of the largest is led by a nonprofit group called Change the Equation. This umbrella organization's 110 corporate partners have pledged millions of dollars worth of funding and in-kind contributions to promote STEM-related education.

Research dollars for Alaska

It is difficult to obtain data on the research expenditures of private companies, but information on government funding awarded to the University of Alaska is quantifiable and a good example of how these dollars filter into the state economy.

In 2009, the National Science Foundation awarded $40.5 million for research and $162.2 million for major research equipment to the University of Alaska Fairbanks.[6] Most of the equipment funding was for the construction of a new research vessel, the R/V Sikuliaq, which is scheduled to begin operations in 2014 and will port in Seward.

UAF will operate the 254-foot, $123 million ship, which will be owned by the National Science Foundation and is under construction in Marinette, Wisc. Scientists from Alaska and

[6]Source: The National Science Foundation's Budget Internet Information System, http://dellweb.bfa.nsf.gov/

around the world will have a new platform to study climate change, sea ice, fisheries, and sub-sea volcanic activity.

Research resembles an industry

Scott Goldsmith, an economics professor at the University of Alaska Anchorage, has studied the benefits of scientific research and development conducted by the university. He wrote that research is an economic enterprise comparable to mining, seafood, timber, or oil and gas.[7] Research brings money into Alaska and creates jobs.

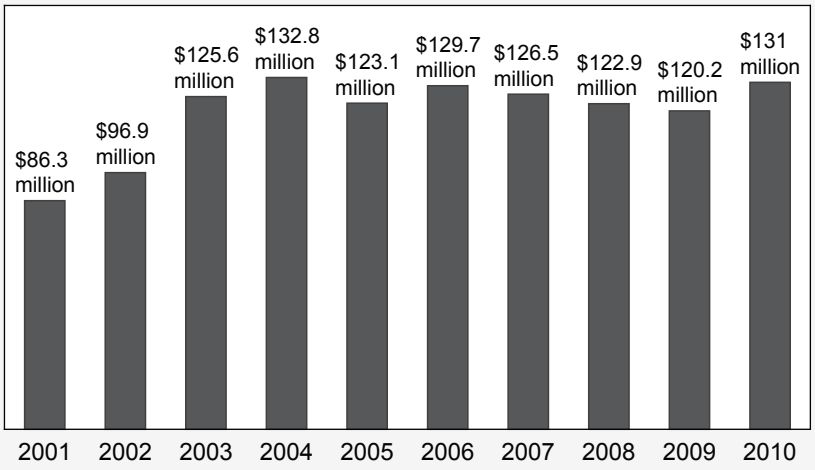
Goldsmith estimated that in 2006, university research money helped fund $52.6 million in payroll — or 1,292 jobs — within the university and an additional 1,100 jobs in Alaska's private sector, or $39.5 million in wages. Research expenditures have increased since these 2006 data.

Research dollars support more than just science. During fiscal year 2010, the University of Alaska spent $131 million on research-related activities. (See Exhibit 12.) These expenditures include wages for employees and the purchase of goods and services from local businesses. The university spends additional money when building new science labs, which provides jobs for construction workers.

Most of the university's research budget comes from nonstate funds. According to the University of Alaska in Review 2010 Report, the university system leveraged $5.70 in external funding for every dollar of state funding provided during fiscal year 2009.

A large portion of that funding came from the federal government, but private grants and donations also contributed significantly. During FY 2009, the federal government provided roughly 86 percent of the funding for UA research; private, local, and other sources funded 12 percent; and 2 percent came from state government.[8]

University Research Expenditures **12**
U of A, fiscal years 2001 to 2010



Note: Includes activities directly related to scientific and academic research, including capital expenditures.
Source: University of Alaska Statewide Planning and Institutional Research

STEM for Alaska's future

The contributions that engineers, scientists, and other STEM workers make to the state are multifaceted, as they solve problems and bolster the economy throughout Alaska's industries. As we move into the future, we need an educated and highly skilled STEM workforce to provide solutions for short-term and long-term challenges of life in Alaska.

[7]Source: Scott Goldsmith, "University of Alaska Research: An Economic Enterprise," UAA Institute of Social and Economic Research, http://iser.uaa.alaska.edu/Publications/ua_econent.pdf
[8]Percentages are based on data from Table 5.07 of the University of Alaska in Review 2010 Report.

Methodology: Defining jobs in science, technology, engineering, and math

The first step for this article was to define which occupations would be considered STEM. Currently, there is no widely accepted list of STEM jobs. Based on a review of existing literature and occupational data, we developed our own method for defining STEM occupations.

A position qualified as STEM by passing criteria in one or more of the following five subjects: mathematics, computer technology, architecture, engineering, or science. Data and information from the Occupational Information Network (O*NET)[1] were the primary evaluation tool. We considered the following occupational characteristics: knowledge, abilities, skills, tools and technologies, and occupational tasks.

Many occupations use sophisticated tools and technology; the difference is how they use it. The use of tools and technology must be direct and active or creative, and not passive or indirect. This means that simple use of a technology was not enough for an occupation to qualify as STEM. "Active or creative use" means workers use the technology in a sophisticated manner, employing relevant skills, knowledge, and abilities. "Passive use" means the technology itself is doing most or all of the work; there is little reasoning, creation, or direct application of relevant skills or knowledge.

An example of an active use of computer technology would be a computer programmer who develops a custom program to store, access, and process data. An example of a passive use of computer technology would be a clerk who enters the names and addresses of clients into a database. The programmer applies considerable knowledge and skill using computer languages. On the other hand, the data clerk uses the computer to complete a routine task.

A work in progress

The STEM occupations list is in some ways a work in progress. We hope to collaborate further with other states and researchers to establish a more universal set of criteria. To date, there is no clear consensus.

Occupations in the health care category have largely been treated by others as a separate entity, and not considered for inclusion as STEM occupations. Although we followed that precedent for this article, we acknowledge that many occupations in the health care arena would otherwise qualify as STEM jobs by our criteria (on the basis of life sciences and/or the active use of computer technology).

The construction category has a similar precedent. By our criteria, some construction occupations not on our list might qualify upon further examination, but for now we have excluded the construction category with few exceptions.

Further Alaska STEM-related research projects may expand the definition of STEM-related occupations to the health care and construction fields in the future.

For a complete description of our methods, please visit: http://www.labor.state.ak.us/research/stem/stemmethod.pdf.

Note: Economist Kelsey Kost contributed to the development of the STEM occupations list.

[1] O*NET is developed under the sponsorship of the U.S. Department of Labor/Employment and Training Administration, and its data are available at http://online.onetcenter.org.