

## **Science, Technology, Engineering, and Math Skills: The Foundation for a Highly Skilled Workforce**

### **Overview**

The Workforce Investment Board of Will County has issued this publication for the purpose of providing specific information on Will County's growing need to increase the quality of science, technology, engineering, and mathematics (STEM) skills of its current and future workforce. Employment projections demonstrate that the jobs of tomorrow will require higher STEM skill levels supported with lifelong learning.

The Workforce Investment Board of Will County plays a key role in the workforce and economic development of our County. It brings together a myriad of employment, training, and educational services and transforms them into a comprehensive and easily accessed system that supports the development of a world-class workforce. The Board's activities support industry-based workforce development strategies, labor market analysis, community planning, focused economic development efforts, collaborative partnerships with education and training providers, and improvement of the economic vitality of the County.

Additionally, the Workforce Investment Board of Will County is a member of The Workforce Boards of Metropolitan Chicago, a consortium of nine workforce boards in the Chicago metropolitan region<sup>1</sup>. Recognizing that that cross-geographic issues impact the economic vitality of each of their local areas, the Workforce Boards have adopted a regional approach in addressing workforce issues on a regional basis. Through this regional collaboration, the consortium is implementing strategies to ensure that the education and workforce system is aligned with the skills that businesses need in their workforce and support the continued economic strength of the region.

### **Our Economy – Our Future**

In recent years, economists and public policy experts have focused a great deal of attention on Science, Technology, Engineering and Mathematics (STEM) occupations. Their message has been that our country's future in a global economy is dependent on its ability to be innovative. Innovation in this context is defined as the ability to rapidly translate knowledge and insights into new high value products and services.<sup>2</sup> Innovation requires knowledge acquired through education or, more specifically, STEM skills.

**In the 21<sup>st</sup> Century, economic power will be derived from skills and innovation. Nations that don't invest in skills will weaken: it is that straightforward.**

Louis Gerstner Jr., former chairman and CEO, IBM, *Meeting the Challenge of a Changing World, Strengthening Education for the 21<sup>st</sup> Century*, U. S. Department of Education, January 2006

America's educational system has received intense scrutiny as it relates to its ability to provide U. S. students with the science, engineering, technology and mathematic skills needed to support the innovation that our country requires. As stated in a report prepared by The National Commission on Mathematics and Science Teaching for the 21<sup>st</sup> Century:

...the Commission is convinced that the future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically. From mathematics and sciences will come the products, services, standards of living, and economic and military security that will sustain us at home and around the world. From them will come the technological creativity American companies need to compete effectively in the global marketplace.<sup>3</sup>

<sup>1</sup> The Workforce Boards of Metropolitan Chicago (Workforce Boards) are a consortium of nine Workforce Boards that include the Chicago Workforce Board, Cook County Workforce Investment Board, DuPage Workforce Board, Grundy Livingston Kankakee Workforce Board, Lake County Workforce Investment Board, McHenry County Workforce Investment Board, River Valley Workforce Investment Board, The Workforce Board of Northern Cook County, and the Workforce Investment Board of Will County.

The Science, Technology, Engineering, and Mathematics (STEM) fields are collectively considered core technological underpinnings of an advanced society. In many forums, the strength of the STEM workforce is viewed as an indicator of a nation's ability to sustain itself.

STEM Fields, Wikipedia,  
([http://en.wikipedia.org/wiki/STEM\\_fields](http://en.wikipedia.org/wiki/STEM_fields))

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<sup>2</sup> Council on Competitiveness, <http://www.compete.org/explore/drive-innovation-entrepreneurship>

<sup>3</sup> *Before It's Too Late, A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21<sup>st</sup> Century*, September 2000, page 4.

## Occupational Outlook

There is an increasing need for individuals in the workplace with strong STEM skills. As reflected in Figure 1, the nation's STEM workforce is expected to increase 8% between 2008 and 2013, and Will County has a projected increase of 5%. Currently Will County's 17,657 STEM occupations represent 7.2% of the County's total labor force (245,585). That number is expected to increase to 18,571 by 2013 and remain steady at 7.2% of the County's labor force (257,380).

**Figure 1**

Projected Job Growth/STEM Occupations				
	2008 STEM Jobs	2013 STEM Jobs	Change	% Change
<b>Will Total</b>	17,657	18,571	915	5%
<b>Regional Total</b>	468,128	504,789	36,658	8%
<b>Illinois Total</b>	698,153	741,969	43,815	6%
<b>National Total</b>	17,540,463	18,911,170	1,370,703	8%

Source: Economic Modeling Systems, Inc.

In addition to 915 new jobs, over the next five years 1,389 skilled replacement workers will be needed for STEM jobs that are vacated by workers retiring or otherwise leaving STEM jobs. This number is reflective of the large number of Baby Boomers expected to retire in the coming years. It is particularly significant in terms of STEM occupations because as skilled Baby Boomers retire, an increasing proportion of the entering workforce will be from segments of the population that historically have lower levels of postsecondary education and are, therefore, less likely to have the skills needed to perform STEM occupations.<sup>4</sup>

The County's STEM occupations that will have the highest demand for new and replacement workers through 2013 are reflected in Figure 2. Of those twenty high demand occupations, one has a decrease in the number of new jobs. However the number of job openings due to projected retirements warrants its inclusion on this table. Of the twenty jobs, the top high demand job classification is accountants and auditors (282) followed by postsecondary teachers (258), automotive service technicians and mechanics (160), computer support specialists (101), and computer software engineers, applications (97).

A summary of the County demand for all STEM occupations, new and replacement jobs, by major job category is reflected in Figure 3. The majority (26.7%) of the region's STEM occupations are in the Computer and Mathematical Science Occupations, followed by the Business and Financial Operations Occupations (16.7%) and Education, Training and Library Occupations (15.7%).

The O\*NET system serves as the nation's primary source of occupational information and is supported by the U.S. Department of Labor (<http://online.onetcenter.org/>). For the purpose of occupational data presented in this report, STEM occupations are those identified on the online O\*NET system. Disciplines include: Chemistry, Computer Science, Engineering, Environmental Science, Geosciences, Life Sciences, Mathematics, and Physics/Astronomy. The O\*NET system classifies 129 occupations as STEM occupations; 103 are represented in the County's labor force data. Of those represented in the County, fewer than ten individuals are employed in 30 of the STEM occupations.

<sup>4</sup> *Keeping Illinois Competitive*, Northern Illinois University, June 2006, page 2.

**Figure 2**

Will County Top Twenty High Demand STEM Occupations						
Occupation	2008 Jobs	2013 Jobs	Change	% Change	New & Replacement	% New & Replacement
Computer software engineers, applications	413	486	73	18%	97	24%
Network systems & data communications analysts	286	331	45	16%	62	22%
Computer software engineers, systems software	375	424	49	13%	71	19%
Industrial engineers	166	187	21	13%	40	24%
Computer systems analysts	416	456	40	10%	85	20%
Network and computer systems administrators	337	368	31	9%	66	19%
Postsecondary teachers	1,715	1,869	154	9%	258	15%
Cooks, institution and cafeteria	444	478	34	8%	90	20%
Cost estimators	489	529	40	8%	86	18%
Accountants and auditors	2,155	2,302	147	7%	282	13%
Construction managers	963	1,029	66	7%	89	9%
Computer specialists, all other	323	341	18	6%	52	16%
Electrical engineers	189	200	11	6%	32	17%
Computer and information systems managers	325	341	16	5%	39	12%
Automotive service technicians and mechanics	1,260	1,314	54	4%	160	13%
Computer support specialists	556	581	25	4%	101	18%
Mechanical engineers	243	250	7	3%	32	13%
First-line supervisors/managers-food prep workers	1,047	1,072	25	2%	61	6%
Civil engineers	401	408	7	2%	53	13%
Computer programmers	601	580	(21)	(3%)	40	7%

Source: Economic Modeling Systems, Inc.

**Figure 3**

Will County STEM New and Replacement Jobs By Occupational Category 2008 - 2013	
Occupational Categories	New and Replacement Jobs
Computer & Mathematical Science Occupations	616
Business & Financial Operations Occupations	385
Education, Training & Library Occupations	362
Architecture & Engineering Occupations	344
Installation, Maintenance, & Repair Occupations	160
Food Preparation & Serving Related Occupations	151
Management Occupations	116
Life, Physical & Social Science Occupations	101
Production Occupations	71

Source: Economic Modeling Systems, Inc.

While many STEM occupations require either a bachelor degree or master degree, there are a large number of occupations requiring other levels of education or training.

Figure 4 demonstrates the range of training required for STEM occupations (Note: This chart is illustrative and does not include all STEM occupations represented in the County.)

**Figure 4**

Educational/Training Requirements	
Accountants and auditors	Bachelor's degree
Actuaries	Degree plus work experience
Architectural and civil drafters	Postsecondary vocational award
Automotive service technicians and mechanics	Postsecondary vocational award
Biochemists and biophysicists	Doctoral degree
Chemical equipment operators and tenders	Moderate-term on-the-job training
Chemical plant and system operators	Long-term on-the-job training
Civil engineering technicians	Associate's degree
Compliance officers	Long-term on-the-job training
Computer and information scientists, research	Doctoral degree
Computer and information systems managers	Degree plus work experience
Computer programmers	Bachelor's degree
Computer software engineers, applications	Bachelor's degree
Computer software engineers, systems software	Bachelor's degree
Computer specialists, all other	Associate's degree
Computer support specialists	Associate's degree
Computer systems analysts	Bachelor's degree
Construction managers	Bachelor's degree
Cooks, institution and cafeteria	Moderate-term on-the-job training
Cost estimators	Work experience in a related field
Database administrators	Bachelor's degree
Dietetic technicians	Moderate-term on-the-job training
Electrical and electronic engineering technicians	Associate's degree
Engineering managers	Degree plus work experience
Engineering technicians, except drafters, all other	Associate's degree
Environmental engineering technicians	Associate's degree
Epidemiologists	Master's degree
Farm, ranch, and other agricultural managers	Degree plus work experience
First-line supervisors/managers - food preparation and serving workers	Work experience in a related field
Industrial engineering technicians	Associate's degree
Mathematical scientists, all other	Master's degree
Mathematical technicians	Master's degree
Mathematicians	Doctoral degree
Mechanical engineering technicians	Associate's degree
Medical scientists, except epidemiologists	Doctoral degree
Microbiologists	Doctoral degree
Network and computer systems administrators	Bachelor's degree
Network systems and data communications analysts	Bachelor's degree
Numerical tool and process control programmers	Long-term on-the-job training
Operations research analysts	Master's degree
Postsecondary teachers	Doctoral degree
Statisticians	Master's degree

Source: Economic Modeling Systems, Inc.

As a group, STEM workers earned about 70% more than the national average in 2005, according to the Bureau of Labor Statistics.<sup>5</sup>

Figure 5, below, shows some of the hourly earnings in Will County for STEM occupations. These top occupations range from more than \$25.00 per hour to nearly \$50.00 per hour.

**Figure 5**

Will County STEM Occupations with Highest Average Hourly Rate			
Occupation	Average Hourly Rate	Occupation	Average Hourly Rate
Chemical engineers	\$46.76	Health and safety engineers	\$29.66
Nuclear engineers	\$43.95	Industrial engineers	\$29.33
Construction managers	\$40.46	Transportation inspectors	\$29.31
Engineering managers	\$39.77	Cost estimators	\$28.22
Electrical engineers	\$36.23	Engineers, all other	\$28.03
Physicists	\$35.08	Natural sciences managers	\$27.86
Nuclear medicine technologists	\$34.93	Postsecondary teachers	\$27.78
Mechanical engineers	\$32.84	Materials engineers	\$27.49
Actuaries	\$30.54	Civil engineers	\$26.92
Computer & info. systems managers	\$30.38	Numerical tool & process control programmers	\$26.80
Chemists	\$29.99	Computer software engineers-systems	\$26.76

Source: Economic Modeling Systems, Inc.

### Creating a Pipeline of STEM Workers

A recent study conducted by Northern Illinois University provides an assessment of Illinois' STEM education. That report reaffirms many of the same findings as recent national reports and identifies the following challenges that will impact Illinois' future economic vitality<sup>6</sup>:

Student Academic Achievement - More than half of Illinois high school students did not have the requisite mathematics and science skills for post-secondary education or jobs in the emerging new economy.

Alignment of 21<sup>st</sup> Century Knowledge and Skills – State curricula, assessments, and pedagogy are not consistently aligned with the 21<sup>st</sup> Century knowledge and skills needed for the state's economy.

Teacher Preparation – Many mathematics and science teachers do not have the proper qualifications to teach those subjects or access to ongoing professional development to improve their teaching.

<sup>5</sup> *Occupational Outlook Quarterly*, STEM Occupations, U.S. Bureau of Labor Statistics, Spring 2007, page 27.

<sup>6</sup> *Keeping Illinois Competitive*, Northern Illinois University, June 2006, page 1.

Investment in STEM Education – Strategies may not be adequate to recruit and retain the most qualified individuals for STEM professions and for research and development for innovation.

Lifelong Learning – In the 21<sup>st</sup> Century, all citizens and workers will need increasing mathematics and science skills and opportunities for lifelong learning.

### Investment in the Future

The America Creating Opportunities To Meaningfully Promote Excellence in Technology, Education and Science Act (American COMPETES Act), signed into law by President Bush on August 9, 2007, is the most recent federal legislation to address the nation's need to remain a leader in innovation and strengthen the STEM skills of its citizens. The America COMPETES Act proposes a total of \$33.6 billion in newly authorized spending levels for research and education programs.<sup>7</sup>

The Act focuses on three primary areas: 1) increasing research investment, 2) strengthening educational opportunities in science, technology, engineering, and mathematics from elementary through graduate school, and 3) developing an innovation infrastructure.<sup>8</sup> The Act proposes to strengthen educational opportunities in STEM and critical foreign languages by:

- Authorizing competitive grants to States to promote better alignment of elementary and secondary education with the knowledge and skills needed.
- Strengthening the skills of thousands of math and science teachers by establishing training and education programs.
- Expanding the Scholarship Program at NSF to recruit and train individuals to become math and science teachers.

- Assisting states in establishing or expanding statewide specialty schools in math and science that students from across the state would be eligible to attend and providing expert assistance in teaching from national laboratories' staff at those schools.
- Facilitating the expansion of Advanced Placement (AP) and International Baccalaureate (IB) programs by increasing the number of teachers prepared to teach AP/IB and pre-AP/IB math, science, and foreign language courses in high need schools.
- Developing and implementing bachelor degree programs with concurrent teaching credentials and part-time master degree education programs for math, science, and critical foreign language teachers.
- Creating partnerships between national laboratories and local high-need high schools to establish centers of excellence in math and science education.
- Expanding existing NSF graduate research fellowship and traineeship programs as well as NSF's science, mathematics, engineering and technology talent program.
- Providing Math Now grants to improve math instruction in the elementary and middle grades and provide targeted help to struggling students.
- Expanding programs to increase the number of students from elementary school through postsecondary education who study critical foreign languages and become proficient.<sup>9</sup>

<sup>7</sup> White House Press Release, President Bush Signs America COMPETES Act, August 2007,

<http://www.whitehouse.gov/news/releases/2007/08/20070809-3.html>; no funds appropriated at the time of this report's release.

<sup>8</sup> EdNews, Summary of the America COMPETES Act, <http://www.ednews.org/articles/10558/1/SUMMARY-OF-THE-AMERICA-COMPETES-ACT/Page1.html>

<sup>9</sup> Ibid

## Summary

In fiscal year 2004, U.S. expenditures totaling \$2.8 billion supported programs designed to increase the number of students in STEM fields and employees in STEM occupation and to improve related educational program. According to testimony delivered to the Committee on Education and the Workforce in 2006, only half of those programs had been evaluated and there was limited coordination between programs.<sup>10</sup> Therefore, it was difficult to assess the impact.

This year, the Bush Administration has proposed that \$33.6 billion in public funds be appropriated to address the nation's need for individuals with strong STEM skills. Is it enough?

In reviewing the STEM literature in the context of workforce development, there are three reoccurring themes:

- The need to improve teacher abilities to equip our youth with the mathematic and science skills needed for postsecondary education in preparation for STEM careers.
- The need to increase awareness of and interest in STEM career opportunities for both young adults and career changers.
- The need to maximize the benefit of publicly funded programs and initiatives through increased collaboration and coordination between programs.

In an effort to address two of these points, the Workforce Investment Board of Will County, as a member of the Workforce Boards of Metropolitan Chicago, is compiling an inventory of STEM initiatives underway in the metro Chicago area and other STEM resources. More information regarding the inventory is available at the regional website ([www.workforceboardsmetrochicago.com](http://www.workforceboardsmetrochicago.com)).

In conclusion, Will County's future economy is highly dependent on its ability to develop a STEM workforce that meets the needs of its employers. This will include jobs that can be foreseen – as well as those that will emerge as a result of future innovation. The choice is simple, either the region's citizens acquire the skills needed for these jobs or employers will find skilled workers elsewhere.

**Thanks to globalization, driven by modern communications and other advances, workers in virtually every sector must now face competitors who live just a mouse-click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing.**

*Rising Above the Gathering Storm, Energizing and Employing America for a Brighter Economic Future, Executive Summary, National Academy of Sciences, 2007.*

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<sup>10</sup> *Science, Technology, and Mathematic Trends and the Role of Federal Government*, testimony before the Committee on Education and the Workforce House of Representatives, Statement of Cornelia M. Ashby, Director, Education, Workforce, and Income Security Issues, U. S. Government Accountability Office, May 2006.