

TRAINING AND EMPLOYMENT NOTICE	NO. 23-07
	DATE December 31, 2007

TO: ALL STATE WORKFORCE AGENCIES
ALL STATE WORKFORCE LIAISONS
ALL ONE-STOP CENTER SYSTEM LEADS

FROM: EMILY STOVER DeROCCO /s/
Assistant Secretary
Employment and Training Administration

SUBJECT: Building and Sustaining an Educated and Prepared STEM Workforce

1. **Purpose.** To share the Department of Labor's vision for the public workforce system's role in developing the talent needed for high growth industries requiring science, technology, engineering and math (STEM) skills.

2. **References.**

U.S. Department of Labor, Employment & Training Administration, *The STEM Workforce Challenge and the Role of the U.S. Department of Labor in a National Solution*, Washington, D.C. (2006).

U.S. Department of Labor, Employment & Training Administration, *Science, Technology, Engineering and Math (STEM) and the Workforce Investment System Roundtable: Connections in Action (transcript)*, available at <http://www.workforce3one.org/members/getmfileinfo.cfm?id=326>, Washington, D.C. (2007).

Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, National Academy of Sciences, National Academy of Engineering, Institute of Medicine, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, available at http://www.nap.edu/catalog.php?record_id=11463#toc, Washington, D.C. (2007).

3. **Background.**

Many of the fastest growing jobs in America will be filled by "knowledge workers" who have specialized skills especially in the areas of Science, Technology, Engineering and Math (STEM). STEM-related fields are many and diverse; equally diverse are the industries in which STEM jobs are critically important to growth and competitive success. There is increasing attention to the nation's capacity to be a world leader in innovating and applying scientific and technological advances.

Four major trends dramatically impact the STEM pipeline of the future: (1) an increasing number of high school graduates with insufficient academic grounding in STEM to successfully enter post secondary education to pursue STEM careers; (2) waning enrollment in technical studies, including two- and four-year college-level, graduate, and post-graduate science and engineering programs; (3) impending retirement of a large portion of the existing STEM workforce; and, (4) declining immigration of science, technology, engineering, and mathematics professionals.

In its report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, the Committee on Prospering in the Global Economy of the 21st Century set forth four recommendations for federal policy makers to consider in order to enhance the science and technology skills of American citizens and enable this country to successfully compete in the global economy: (1) increase America's talent pool by vastly improving K-12 science education; (2) sustain and strengthen the nation's commitment to research that has the potential to fuel the economy, provide security, and enhance the quality of life; (3) make the United States the most attractive setting in which to study and perform research so that this nation can develop, recruit, and retain the best and brightest students, scientists, and engineers; and (4) ensure that the United States is the premier place in the world to innovate.

The U.S. Department of Labor (DOL) is already an important partner in federal efforts to strengthen the STEM pipeline. Through the Workforce Innovation in Regional Economic Development (WIRED) initiative, DOL is investing regionally in STEM talent development strategies.

In February 2006, DOL launched the WIRED initiative focusing on the role of talent development in driving regional economic competitiveness, increased job growth, and new opportunities for American workers. The WIRED framework brings together all the key players in a region to leverage their collective public and private sector assets and resources to implement strategies that will optimize innovation and successful regional economic transformation. The STEM fields are essential building blocks in innovation and economic transformation.

Much of President Bush's American Competitiveness Initiative, which is designed to encourage American innovation and strengthen the nation's ability to compete in the global economy, focuses on the development of skills in math and science in K-12 systems. Without this foundation, students cannot enter and advance in the

engineering and technology fields that are defining the innovation economy. More than ever, education is a critical component of economic development. The availability of a skilled workforce is the single most important factor companies consider when deciding where to open or expand a business. It is this reality that creates a cycle in many regional economies where there are not enough educated workers to attract new companies, so the people who possess an education must leave the region to find opportunities.

4. The Department of Labor's Current Contributions to a Stronger STEM Pipeline.

To help fill gaps in the nation's response to the STEM workforce challenge, DOL's Employment and Training Administration (ETA) seeks ways to employ its infrastructure, capacity, investments, and initiatives for maximum impact. DOL, in conjunction with other federal workforce agencies, annually invests \$15 billion in talent development activities. Moreover, the Department's unique commitment to regional talent development and economic growth strategies provides a powerful framework for collaboration and alignment across federal funding streams – both DOL and non-DOL - and public and private stakeholders.

The Department is promoting an action agenda in collaboration with other stakeholders and investors that should help to: expand the pool of potential STEM workers; strengthen the gateway for non-traditional populations into STEM careers; ease the transition for dislocated or transitioning workers into STEM fields; and integrate national, state, regional, and local efforts into a more powerful set of partnerships and coordinated strategies.

DOL believes the public workforce investment system has an important role in strengthening the STEM pipeline, specifically in collaboration with multiple agencies across the federal government and a wide array of strategic partners in the public and private sectors. Of particular interest to DOL is broadening participation in the STEM fields by women, under-represented minorities, and individuals with disabilities.

Currently, DOL is gathering information from the workforce investment system about efforts to connect to STEM education and employment opportunities locally. Toward this goal, the Department sponsored a Web conference, or Webinar, in early May, open to members of the workforce investment system, economic development experts, educators and employers, that discussed innovations and partnership across the system. This session demonstrated that the system is becoming increasingly aware of STEM as it affects the workforce and early efforts are underway to build non-traditional partnerships to promote the STEM pipeline.

5. Role of the Public Workforce System in Building and Sustaining a Prepared STEM Workforce.

The Department of Labor encourages Workforce Investment Boards (WIBs) and One-Stop Career Centers to be knowledgeable and engaged partners in efforts to help address the escalating challenges of “growing” the STEM pipeline. The public workforce investment system is uniquely positioned in many communities to be an important partner because of its universal access to human capital that ranges from at-risk youth to experienced workers; its strong partnerships with community colleges, employers, and faith-based and community organizations; and its continued transformation supporting high growth industries, many of which require a highly skilled STEM workforce.

At the community level, K-12 and postsecondary education (particularly research universities) have a leading role on educating students in the STEM fields and preparing them for employment. But the demands of the current and future STEM pipeline require immediate action from many other stakeholders, including the public workforce investment system, foundations, professional associations dedicated to STEM fields, non-profit organizations, employers, and government.

There are a number of steps that WIBs and One-Stop Career Centers can take to be proactive partners and address gaps in current efforts to prepare the STEM workforce. Many of them draw on the expertise of the public workforce investment system in workforce preparation and its role as an intermediary between employers and talent development institutions.

WIBs and One-Stop Career Centers need to be committed to developing strategies for talent development in support of economic growth and to facilitating alignment and integration of existing public and private STEM resources. In order to prepare and expand the number of students entering STEM-related careers, WIBs and One Stops must be prepared to implement STEM workforce education strategies across the continuum of education with a focus on post-secondary opportunities for workers. Public workforce entities need to:

- Become knowledgeable on STEM pipeline issues. Attached to this TEN is a background paper on the STEM workforce challenge that identifies additional resources. Also attached is a description of how existing initiatives/funding can be utilized, such as the High Growth Job Training Initiative, Community-Based Job Training Grants and WIRED. WIBs and One- Stop Career Centers need to analyze what this information means to their region and community.
- Meet with organizations in the state and community that are leaders in the STEM fields and participate in forums dedicated to this issue.
- Identify STEM-related industries that are growing and expanding in the local and regional economy.

- Conduct a gap analysis. With STEM partners, WIBs should gather data on the need for additional STEM education and training in your region, identify gaps in existing services and infrastructure, and develop strategies to fill those gaps.
- Build capacity within One-Stop Career Centers to provide career guidance on the STEM fields which identifies approaches for developing proficiency including apprenticeship, internships, on-the-job training, alternative career pathways/career lattice models and non-academic training routes.
- Provide services to develop a skilled workforce to meet the needs of STEM employers including:
 - Recruiting and screening qualified STEM workers;
 - Posting job listings;
 - Providing incumbent worker training and linkages to other training resources;
 - Developing customized labor market information;
 - Providing job retention services such as mentoring and career guidance;
 - Identifying work-based learning opportunities in STEM fields for internships, apprenticeships, on-the-job training, and other training activities;
 - Providing information on STEM to alternative schools, faith and community-based organizations and other training providers in the workforce investment system;
 - Offering summer academic enrichment activities in the STEM fields;
 - Designing educational tools and programs for displaced and incumbent workers; and
 - Supporting participants' school preparation and critical transition points such as high school to college, between 2- and 4-year college, and from undergraduate study to the workplace.

By taking the above steps and engaging in a broad range of activities related to STEM, the public workforce investment system can meet the goals of:

- Coordinating and aligning regional STEM workforce preparation and training activity;
- Implementing employment activities, strategies and resources (new and existing) that result in significant and sustainable impact;
- Increasing accessibility and broadening STEM education and training opportunities targeted to women, under-represented minorities, individuals with disabilities, youth and dislocated workers;
- Increasing the number of workers entering STEM employment;
- Increasing access for STEM employers to job candidates with sought-after skills and background; and
- Establishing and expanding strategic partnerships with the workforce system and regional STEM employers; higher education institutions, including community colleges; K-12 and alternative secondary schools; faith-based and community organizations; industrial and national laboratories, and STEM professional associations to build the region's STEM expertise, financial and operational capacities.

In an increasingly global, knowledge-driven society, STEM education and skills development are critical to American economic competitiveness and growth. Long-term strategies will require coordinated efforts among public, private, and non-profit entities to promote innovation and to prepare an adequate supply of qualified workers for employment in STEM fields.

6. **Actions Required.** States are requested to share this Training and Employment Notice with appropriate stakeholders.
7. **Inquiries.** Questions should be directed to the appropriate ETA regional office.

Connecting Department of Labor Resources to Science, Technology, Engineering and Math (STEM) Skill Acquisition

The following programs and initiatives administered by the Department of Labor's Employment and Training Administration are potential resources for furthering the acquisition of Science, Technology, Engineering and Math skills (STEM) among adult and youth learners:

The High Growth Job Training Initiative Funding is Variable

The High Growth Job Training Initiative targets investments to support the development and implementation of workforce solutions in the context of strategic public/private partnerships to ensure that workers have the skills and competencies in high-growth, high-demand occupations. The workforce solutions funded under the High Growth Job Training Grants address critical workforce challenges identified by strategic partnerships, which include business and industry, education and training providers, and the workforce investment system. These investments provide job training and related activities for workers to assist them in obtaining or upgrading employment in the 14 high-growth industries of Advanced Manufacturing, Aerospace, Automotive, Biotechnology, Construction, Energy, Financial Services, Geospatial Technology, Health Care, Homeland Security, Hospitality, Information Technology, Retail, and Transportation.

These funds may be used in several ways that benefit STEM training, including:

- Developing curricula to build core competencies and train workers;
- Identifying and disseminating career and skill information;
- Building the capacity of the education system to train in high-growth, high-demand industries; and
- Increasing the integration of community and technical college activities with industry and the public workforce investment system.

Many of these 14 industries identified through the High Growth Job Training Initiative have described a critical shortage of workers with STEM competencies and a number of HGJTI grants are currently supporting projects that address this need. In addition, ETA is currently developing a summary of competencies for STEM-related occupations. This competency model framework will serve as the basis for a formal solicitation for grant applications focused on training in STEM-related occupations in high-growth industries.

For more information, see: <http://www.doleta.gov/BRG/JobTrainInitiative/>

Community Based Job Training Grants

PY06 Funding: \$125,000,000

In 2005, ETA implemented the Community-Based Job Training Grants to strengthen the role of community colleges in promoting the U.S. workforce's full potential. This competitive grant program builds on the High Growth Job Training Initiative by building the capacity of community colleges to train workers for the skills required to succeed in high-growth, high-demand industries. Businesses in these industries face increasing difficulties in finding workers with the right skills.

Funds available under this initiative may be used to benefit STEM training by:

- Developing training curricula with local industries in the STEM fields, hiring qualified faculty, arranging on-the-job experiences with industry, and using up-to-date equipment; and
- Training new and experienced workers in identified high-growth, high-demand industries, with the aim of employing and/or increasing the retention and earnings of trained workers, while meeting the skill needs of businesses within targeted industries.

Under the Community Based Job Training Grants initiative, publicly-funded community and technical colleges were asked to submit proposals that identified workforce challenges and implemented workforce solutions for locally identified high-growth, high-demand occupations, including proposals to address critical STEM competencies identified by high-growth, high-demand occupations.

For more information, see: <http://www.doleta.gov/business/Community-BasedJobTrainingGrants.cfm>

Trade Adjustment Assistance Funds

There is approximately \$220 million available each year to provide training to workers laid-off due to the effects of foreign trade.

Funds may be used to pay the costs of individual training programs in science, technology, engineering or math (STEM) fields through:

- Classroom training, including remedial education;
- On-the-job training; and
- Customized training designed to meet the needs of a specific employer or group of employers.

Additional funds (trade readjustment allowances) are available to help individuals attend full-time training by providing income support while they are in school.

For more information, see: <http://www.doleta.gov/tradeact/>

Workforce Investment Act Rapid Response Funds

Up to \$250 million is available to states each year to respond to mass layoffs and plant closings. These funds are comprised of 25% of each state's WIA dislocated worker formula funds.

Based upon state or local policy, Rapid Response funds may be used to support activities and strategies that could include STEM education and training opportunities, such as:

- Informing individuals about available career and training opportunities related to STEM;
- Connecting Rapid Response strategies and activities to economic development and providing information to employers to help promote employment in STEM-related industries or occupations;
- Providing information on individual training programs in STEM fields; and
- Assisting with the design and implementation of customized training plans or working with employers in STEM areas to design training programs that provide STEM-related employers with skilled workers as part of a lay-off aversion strategy.

For more information or to discuss potential strategies and linkages, contact your state or local Rapid Response team or see: <http://www.doleta.gov/layoff/rapid.cfm>.

Workforce Investment Act National Emergency Grant Funds

Approximately \$150 million was available in PY 2006 for National Emergency Grants (NEG). These funds are used to temporarily expand service capacity at the state and local levels in response to significant dislocation events.

These funds may be used for several activities that could support STEM, including:

- Conducting career assessments and informing eligible individuals about available career and training opportunities related to STEM;
- Helping eligible individuals develop Individual Employment Plans in STEM-related fields;
- Paying the costs of individual training programs for participants in STEM fields; and
- Making available needs related payments to help eligible individuals attend full-time training.

For more information, see: <http://www.doleta.gov/NEG/>

Workforce Investment Act Youth Formula Grant

Currently, \$940 million (2006 Budget) is allotted to states for youth programming and services through the Workforce Investment Act (WIA). States use these resources in various ways to support workforce training and development of young people who are both “in-school” and “out-of-school.”

The following are opportunities where WIA can leverage STEM activities/training for youth:

- WIA funds are being used to connect those young people who leave traditional educational institutions to alternative education programs. These various opportunities to link youth to the workforce can be focused around linking them to high-demand STEM careers and educational pathways.
- WIA resources also support the operation of after-school programs that engage young people during critical out-of-school hours. This provides an opportunity for strategic partnerships to provide activities focused on experiential, hands-on, applied learning strategies that engage young in-school youth and make STEM careers and educational pathways fun and exciting.
- Pre-apprenticeship programs, funded by WIA, are designed to offer individuals basic skills, job readiness, and trade-specific training that can significantly increase a youth’s likelihood of entering and succeeding in formal apprenticeships. The workforce system can encourage pre-apprenticeships that will assist youth in gaining the necessary skills for successful career pathways and advancement in high-growth, high-demand STEM industries.
- In-school youth who are served by the workforce system can access, and be encouraged to take, math and science Advanced Placement (AP) and International Baccalaureate (IB) courses designed to give them college credit for successfully passing the exam and prepare them for higher education.

For more information, see: <http://www.doleta.gov/youth%5Fservices/Formula-Funded.cfm>

WIA Adults & Dislocated Worker Formula Grants

Approximately \$2.5 billion in funding was available in PY 2006 for adult and dislocated worker services. Adult and dislocated worker funds may be used to carry out core, intensive and training services. These services are available to eligible adults and dislocated workers and may be used to provide STEM training in many ways, including:

- Providing comprehensive and specialized assessments of skill levels and service needs such as diagnostic testing and use of other assessment tools and in-depth interviewing and evaluation to identify employment barriers and appropriate employment goals;
- Providing occupational skills training in STEM-related fields;
- Providing on-the-job training in relevant STEM fields; and
- Training that focuses on skill upgrading and retraining and entrepreneurial skills; adult education and literacy activities; and customized training.

For more information, see: http://www.doleta.gov/programs/general_info.cfm

Wagner-Peyser Act Funds

The Wagner-Peyser Act provides formula funding to states to assist job seekers in finding jobs and employers in finding qualified workers and, in some areas, to provide job training and related services. The Act was amended in 1998 to require that employer services be provided through the One-Stop service delivery system. These funds can be used to inform the workforce about STEM through the following activities:

- Providing job search and placement services to job seekers including counseling, testing, occupational and labor market information, assessment, and referral to employers;
- Partnering with employers to provide appropriate recruitment services and special technical services;
- Targeting services for workers who have received notice of permanent layoff or impending layoff, or workers in occupations which are experiencing limited demand due to technological change, impact of imports, or plant closures; and
- Developing and providing labor market and occupational information.

For more information, see: http://www.doleta.gov/programs/Wagner_Peyser.cfm

The STEM Workforce Challenge:

the Role of the Public Workforce System in a National Solution for a Competitive Science, Technology, Engineering, and Mathematics (STEM) Workforce



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This report was prepared for the U.S. Department of Labor,
Employment and Training Administration by Jobs for the Future.



The STEM Workforce Challenge and the Role of the U.S. Department of Labor in a National Solution

Executive Summary

Science, Technology, Engineering, and Mathematics (STEM) fields have become increasingly central to U.S. economic competitiveness and growth. Long-term strategies to maintain and increase living standards and promote opportunity will require coordinated efforts among public, private, and not-for-profit entities to promote innovation and to prepare an adequate supply of qualified workers for employment in STEM fields.

American pre-eminence in STEM will not be secured or extended without concerted effort and investment. Trends in K-12 and higher education science and math preparation, coupled with demographic and labor supply trends, point to a serious challenge: our nation needs to increase the supply and quality of “knowledge workers” whose specialized skills enable them to work productively within the STEM industries and occupations. It will not be sufficient to target baccalaureate and advanced degree holders in STEM fields. Our nation’s economic future depends upon improving the pipeline into the STEM fields for sub-baccalaureate students as well as BA and advanced degree holders, for youth moving toward employment and adults already in the workforce, for those already employed in STEM fields and those who would like to change careers to secure better employment and earnings.

The seriousness of this challenge has penetrated public and opinion-makers’ consciousness—and government, industry, and education and training providers have begun to respond. NIH, NSF, and the Department of Education have been leading the federal effort. Industry associations, individual firms, foundations, and other organizations have identified and tried to fill gaps. State governments, too, are working to strengthen the STEM workforce pipeline. Much remains to be done, though, within government and across diverse sectors, to ensure that U.S. education, workforce, and economic systems rise to the STEM challenge.

The U.S. Department of Labor is already an important partner in federal efforts to strengthen the science, technology, engineering and math (STEM) pipeline. The U.S. Department of Labor invests about \$14 billion a year in the nation’s workforce system and in increasing the skills and education of our current workforce. In addition, the Department of Labor has begun investing regionally in ways that overcome typical fragmentation in planning and action among industry, government, non-governmental organizations, and education and training institutions.

The Department of Labor has the potential to play an even more important role in addressing gaps in the nation’s approach to strengthening the STEM pipeline in three areas: 1) building the gateway to STEM careers; 2) enhancing the capacity of talent development institutions to produce more and better skilled STEM workers; and 3) catalyzing and supporting innovation, entrepreneurship, and economic growth. The leadership of the Employment and Training Administration is committed to—and stands ready to—contribute and collaborate to develop an overall national strategy around the STEM workforce pipeline and to improve coordination across federal agencies.

The STEM Challenge to U.S. Competitiveness and Growth

There is broad consensus that the long-term key to continued U.S. competitiveness in an increasingly global economic environment is the adequacy of supply and the quality of the workforce in the STEM fields. Scientific innovation has produced roughly half of all U.S. economic growth in the last 50 years (National Science Foundation 2004). The STEM fields and those who work in them are critical engines of innovation and growth: according to one recent estimate, while only about five percent of the U.S. workforce is employed in STEM fields, the STEM workforce accounts for more than fifty percent of the nation's sustained economic growth (Babco 2004). Opinion leaders and the public broadly agree that education in math and science is critical to the nation's future success. According to a recent Educational Testing Service survey, 61 percent of opinion leaders and 40 percent of the general public identify math, science and technology skills as the most important ingredients in the nation's strategy to compete in the global economy (Zinth 2006).

This engine of growth is increasingly precarious in today's global economy. The Business Roundtable (2005) warns that, if current trends continue, more than 90 percent of all scientists and engineers in the world will live in Asia. The Business-Higher Education Forum (2005) concludes: "Increased global competition, lackluster performance in mathematics and science education, and a lack of national focus on renewing its science and technology infrastructure have created a new economic and technological vulnerability as serious as any military or terrorist threat." The seminal National Academy of Sciences study, *Rising Above the Gathering Storm* (2006), argues that, absent a serious and rapid response, the U.S. will lose quality jobs to other nations, lowering our standard of living, reducing tax revenues, and weakening the domestic market for goods and services. Once this cycle accelerates, it will be difficult to regain lost preeminence in technology-driven innovation and its economic benefits.

The STEM education and workforce challenge is multi-faceted.

- *Many students never make it into the STEM pipeline, because of inadequate preparation in math and science or poor teacher quality in their K-12 systems.* Of the 2005 high school graduates who took the ACT test, for example, only 41 percent achieved the College Readiness Benchmark in mathematics and 26 percent achieved that benchmark in science (ACT 2006).
- *Many who are academically qualified for postsecondary studies in science and math fields at both the two- and four-year levels, don't pursue those programs: They might be dissuaded by disappointing postsecondary experiences, high tuition or demanding curricula and courses of study, relatively low salaries in STEM fields compared to other professions, or the lack of role models with whom they can identify* (American Association of State Colleges and Universities 2005). Whatever the reasons, trends in undergraduate and graduate enrollment in the biological, engineering, and physical sciences are troubling, as modest growth in STEM field degree graduates is being eclipsed by more dramatic growth in graduates from non-STEM programs (U.S. Government Accountability Office 2005).

- *The low engagement with STEM-related learning is particularly acute among minority, female, and lower-income students, who comprise a growing proportion of the total college-going public.* In the 2000 National Assessment of Educational Progress for twelfth grade students, about three out of four white and Asian students scored at or above basic level (which is far below proficient) on the math assessment, while fewer than half of Hispanics and under a third of African American students attained that level (National Science Foundation 2005).

Preparation for STEM success is one concern. Equally important are trends in the overall supply and employment of STEM field workers.

- *A large segment of the existing STEM workforce is approaching retirement age with the rest of the baby boomers.*
- *Women appear to be choosing non-STEM employment opportunities with increasing frequency.* According to industry data, for example, the percentage of women in the IT workforce declined from a high of 41 percent in 1996 to 32 percent in 2004, even as the percentage of women in the workforce as a whole remained steady at around 46 percent during that period (Information Technology Association of America 2005).
- *In addition, the reliance on immigrants for meeting employer demand for skilled STEM workers has become increasingly problematic.* In the wake of September 11, foreign immigration has become more complicated and visa processes have been tightened. In addition, as other countries expand their STEM-related economic growth, some who might have sought employment opportunity in the U.S. are able to find good jobs closer to home.

The STEM workforce pipeline challenge is not just about the supply and quality of baccalaureate and advanced degree earners. A large percentage of the workforce in industries and occupations that rely on STEM knowledge and skills are technicians and others who enter and advance in their field through sub-baccalaureate degrees and certificates or through workplace training. Competitiveness in STEM fields requires a focus on the skills and the supply of those involved in STEM fields from the most complex research and development and leadership positions to production, repair, marketing, sales and other jobs that require competencies built upon math, science, engineering, and technology knowledge. Getting more Americans ready for, interested in, and sufficiently skilled to be productive in STEM-related jobs will require attention to segments of the workforce that are often overlooked in STEM discussions: incumbent workers who need skill upgrading, dislocated workers who are trying to find new jobs in industries with a future, and individuals from groups traditionally underrepresented in STEM fields. The Department of Labor has an important role to play in this arena.

Responding to the STEM challenge will require a concerted and multi-faceted approach. No single agency can respond effectively. Tax, immigration, and innovation policies need to be reviewed through the lens of the STEM pipeline. Perhaps most important, education and workforce preparation policies need to be carefully reassessed.

This will require changes in: K-12 students' foundational preparation in math and science; improvements in access to and success in science, math and technology education and training both in our elite research universities and in the thousands of two- and four-year educational institutions that prepare most Americans for employment; stronger teacher and faculty training in the STEM disciplines; more effective linkages and economic signals between the education/ talent development sectors and the employers who depend upon their graduates; better assessments of the quality of STEM-related education and programming; and strategies that expand and deepen workplace-based training and retraining for STEM workers at all levels.

No single sector of society can respond adequately in isolation from others. Much greater collaboration is called for: within the federal government; across different levels of government; and among the key business, government, and non-governmental institutions whose policies and practices shape the quality and quantity of the STEM workforce.

The STEM Fields and the STEM Workforce Pipeline

Science, Technology, Engineering, and Mathematics (STEM) related fields are many and diverse. About 150 different college majors have been identified by the National Science Foundation as STEM majors. Equally diverse are the industries in which STEM jobs are critically important to growth and competitive success. Some of these industries are obvious: advanced manufacturing, biotechnology, chemical engineering, energy, actuarial science and health care all rely on high-level skills and education in the STEM fields in their workforce. Other industries may seem less obvious for their reliance on STEM knowledge and skills, such as construction, retail, transportation, and hospitality. But changing technology and expectations of the workforce in these industries make STEM knowledge important even in these industries. For example, mechanics in the trucking industry must deal with sophisticated computer technology in both diagnostics and repair procedures. In construction, the increased importance of math and technical knowledge on the construction site and in construction business offices has become an obstacle to entry into apprenticeship and other training programs for individuals who fifteen years ago would have easily found their way into those programs.

According to the U.S. GAO (2005), employment in STEM fields rose from an estimated 7.2 million to around 8.9 million in the years between 1994 and 2003—an increase of about 23 percent during a time when non-STEM employment rose by only 17 percent. The Bureau of Labor Statistics (2006) projects significant growth in the overall STEM workforce between now and 2014; of the 20 fastest-growing occupations over the coming decade, 17 will be in health care and computer fields.

The overwhelming majority of the last decade's expansion in STEM employment was in computer and math fields (78 percent) as opposed to science (only 20 percent growth) or engineering fields (no apparent growth). Getting sufficient numbers of individuals qualified for advanced education in STEM is one challenge; but connecting qualified and skilled workers to jobs in their fields is also problematic, particularly in science and engineering. A recent NSF report found that two-thirds of workers with science and engineering degrees are employed in positions that are only somewhat or not at all related to their educational expertise.

Current Responses to the STEM Challenge

The steady drumbeat of industry, government, and educators' warnings about the future of technology-based growth has led to important action by various stakeholders to address weaknesses in the pipeline into STEM occupations and fields in the United States.

Federal government: The federal government has taken a hard look at its own activities to support STEM and made efforts to coordinate and expand them. In October 2005, the U.S. GAO issued a report cataloguing and assessing the impact of federal programs designed to increase the number of students and graduates or to improve educational programs in the STEM fields. The agency found 13 different federal civilian agencies spent about \$2.8 billion in fiscal year 2004 for over 200 different programs, mostly within the National Institutes of Health and the National Science Foundation. Although about half of the programs had evaluations as part of their investment, agencies reported little about the effectiveness of these investments. More recently, the National Science and Technology Council (2006) catalogued and issued recommendations for improving the impact of the federal investment in STEM education research, with particular focus on the Department of Education, NIH, and NSF, noting several ways that federal agencies can work together to ensure that gaps in STEM education research will be adequately funded and that research will be effectively disseminated to policymakers.

In his 2006 State of the Union Address, President George W. Bush announced the American Competitiveness Initiative. The Initiative promotes American innovation, emphasizes the need to increase the nation's ability to compete in the global economy, and promotes growth of the workforce's knowledge base, skill level, and use of technology. A week later, the budget act signed into law included an Academic Competitiveness Council chaired by the Secretary of Education and consisting of members of the federal government whose agencies have education programs in science, technology, engineering and mathematics. In FY 2007, Congress committed \$5.9 billion to increase investments in research and development, strengthen education, and encourage entrepreneurship.

Industry: Industries and firms dependent upon a strong science and math workforce pipeline have launched a variety of programs that target K-12 students and undergraduate and graduate students in STEM fields. Industry associations that include the Society for Manufacturing Engineers, the American Chemical Society, the American Physical Society, the National Association of Manufacturers, and the National Science and Technology Education Partnership invest in STEM education initiatives that involve curricular improvements, career-focused websites, mentoring programs, scholarships, and other incentives and supports. Individual firms and their corporate foundations, including Raytheon, Bayer, and General Electric, have created outreach efforts of their own (Delaware Valley Industrial Resource Center and National Council for Advanced Manufacturing 2006).

Foundations: Foundations, too, are investing in efforts to promote expanded enrollments and success in STEM education, particularly among groups traditionally underrepresented in these programs. Project Lead the Way operates in more than 1000 schools in almost all the nation's states, promoting pre-engineering courses for middle and high school students. The Alfred Sloan

Foundation has invested in a career information website targeted to pre-college, college, and early career professionals regarding STEM occupations and opportunities. The Bill and Melinda Gates and the Michael and Susan Dell Foundations have collaborated with the State of Texas on an ambitious new Texas Science, Technology, Engineering and Math (T-STEM) Initiative to create new T-STEM Academies across the state, establish a best practice network, and support other efforts to increase the number of young people who enter STEM postsecondary programs.

State government: According to a recent Education Commission of the States report, state governments are also beginning to respond. Some are raising graduation requirements in mathematics and science. Others have developed or imported pre-engineering curricula for high schools. Other areas for state action have included teacher training and recruitment, dual enrollment in STEM courses, real-world learning opportunities for students in science and technology courses, and grants to students who pursue STEM postsecondary programs and employment (Zinth 2006).

The entrepreneurial spirit that motivates these varied and vibrant efforts is impressive. But much more can and must be done. To date, these critical efforts at the national, state, and local levels have focused primarily on students at four-year universities and traditional high schools. If the pipeline for a qualified and flexible STEM workforce is to expand to meet the growing need, the nation must look to attracting and educating additional, less traditional pools of potential STEM workers: incumbent workers, dislocated workers, students working toward community college technical credentials, even students in alternative education settings who are trying to find their way back into the economic and educational mainstream. To tap these potential sources of new STEM employees, all the nation's talent development systems need to work in concert.

The Department of Labor, which coordinates a national public workforce development system and \$14 billion of investments in workforce skills, is an important stakeholder and potential contributor to a robust national strategy for tackling the STEM workforce pipeline challenge. The Department's Employment and Training Administration is already deeply involved in supporting efforts to prepare more STEM workers. Its experience, capacity, and training and education assets puts the Department in a position to help the nation address this critical economic and security challenge—and to integrate its efforts to support innovation and growth with those of others in government, industry, and the education community.

The Department of Labor's Current Contributions to a Stronger STEM Pipeline

In seeking to help fill gaps in the nation's response to the STEM workforce challenge, the Department of Labor's Employment and Training Administration seeks ways to employ its infrastructure, capacity, investments, and initiatives for maximum impact. The Department's \$14 billion of activities and investments in talent development is a significant asset. Moreover, the Department's unique commitment to regional workforce quality and economic growth strategies provides a powerful structure for collaboration and alignment across funding streams and public and private stakeholders.

Specifically, in collaboration with multiple agencies across the federal government, the state and local workforce investment system, and a wide array of strategic partners in the public and private sectors, ETA is committed to:

- **Building the gateway to STEM careers** by helping to prepare an educated, skilled STEM workforce in the context of its investments in preparing talent for economic development in regional economies;
- **Enhancing the capacity of talent development institutions** to produce more and better skilled STEM workers through investment of Department resources and through greater integration and alignment of existing public and private resources, so that more workers have access to postsecondary opportunities;
- **Catalyzing and supporting innovation, entrepreneurship, and economic growth** that can expand STEM employment opportunities.

Many of the Department's major initiatives are directly relevant to national strategies to improve STEM workforce pipeline outcomes. These include:

- *President's High Growth Job Training Initiative*: This initiative is ETA's foundation effort for engaging business, education, and the workforce investment system to work together to develop solutions to the workforce challenges facing high growth industries, including those industries with significant STEM-related employment. ETA identified fourteen sectors that are projected to add substantial numbers of new jobs to the economy or affect the growth of other industries or are being transformed by technology and innovation requiring new sets of skills for workers. The fourteen sectors are:
 - Advanced Manufacturing
 - Aerospace
 - Automotive
 - Biotechnology
 - Construction
 - Energy
 - Financial Services
 - Financial Services
 - Geospatial Technology
 - Health care
 - Homeland Security
 - Hospitality
 - Information Technology
 - Retail
 - Transportation

The initiative invests in national models and demonstrations in these sectors, many of which have high and growing concentrations of employment that is STEM-based. Initial investments have targeted the health care, biotechnology, advanced manufacturing, and construction sectors, among others.

Here are a few examples of the Department's STEM-related investments through this initiative: In the geospatial industry, for example, the University of Southern Mississippi is working with community colleges and industry partners to develop career ladders and apprenticeship training programs. In the advanced manufacturing industry, the Arkansas Department of Workforce Services focuses on training for technicians in such STEM-reliant fields as programmable logic controllers, plastics engineering, and robotics. The program includes a college, community colleges, the state WIB, and the state departments of Workforce Education, Economic Development, and Higher Education. In health care, the CVS Regional Learning Center is implementing pharmacy technician training programs for incumbent workers as well as people looking to enter the industry for the first time.

Community-based Job Training Grants: This relatively new competitive grants program, which builds upon the High Growth Job Training Initiative, is designed to improve the capacity of community colleges to train workers in skills needed by regional employers. It recognizes that many job opportunities of today and tomorrow require postsecondary education and training and that our community colleges will play an increasingly important role in developing the skills and talent of American workers. In 2005, \$125 million in grants were made to 70 community colleges in 40 states. A second competition was conducted in 2006. Because the grants are targeted to the fourteen sectors defined above as having either high growth or high demand, many of these grants promote community college programs that prepare individuals for work in these sectors.

Northwest Iowa Community College is developing a biotech initiative that will combine a high school science curriculum component, an Associates Degree Lab Technician program for biotechnology careers, and a skills enhancement component for incumbent workers. Tanaka Valley College of the University of Alaska in Fairbanks is developing a set of curricula in technical skills needed in the state's energy industry that can be delivered in industry-based instructional sites with industry instructors. These funded programs involve multiple workforce partners including community colleges, local and/or state WIBs, businesses, trade associations, and K-12 education.

Workforce Innovation in Regional Economic Development (WIRED) is ETA's flagship initiative that focuses on the role of talent development in driving regional economic competitiveness, increased job growth, and new opportunities for American workers. The WIRED initiative is a regional initiative; it focuses on labor market areas that are comprised of multiple jurisdictions within state or across state borders, enabling Governors a unique opportunity to design and implement strategic approaches to regional economic development and job growth. Designed particularly for regions hard hit by global trade, dependent upon a single

industry, or recovering from natural disasters, WIRED emphasizes strategic partnerships to accelerate and support regional transformation linking economic development, workforce, and education systems. To date, twenty-six regions have been selected for participation. In many of these efforts, collaboration to catalyze talent development for STEM-related fields is at the core of the regional strategy.

The Northwest Florida Initiative is designed to create high wage high skill jobs in the target industries of aerospace and defense, life sciences, information technology, electronics engineering, and construction. The Denver regional strategy will focus on partnerships to address the “Colorado Paradox” of high in-migration of skilled and educated workers coupled with comparatively poorly-performing K-12 and higher education institutions in-state. The initiative will focus on raising standards in local educational institutions and reversing the current pattern. The California Innovation Corridor noted that it has the greatest concentration of potential innovation assets in the world; however it continues to seek to “Grow its Own” in order to meet the challenges of competing in the regional and global market as well as educating enough qualified technical workers to fill sectors of California’s high-tech economy. This WIRED grant has a three-tiered approach: Innovation Support, Industrial Rejuvenation, and Talent Development.

National Emergency Grants and Dislocated Worker funds: An important component of the Department of Labor’s portfolio is its responsibility to minimize the negative economic and employment impacts of dislocation from plant closings, regional employment shifts, and global competition. The Department provides funds that are spent for training and retraining services for dislocated workers, through the local and state public workforce system. The Department also makes available to local workforce investment boards National Emergency Grant funds for large group layoffs. While these resources are available for employees in all industries, the importance of STEM fields for American competitiveness and economic growth has led to increased allocation of these funds for STEM-related training and skill development. Funds have been used to train workers on new technologies, to enable them to earn industry certifications, and to provide entrepreneurial training and skills for workers interested in opening their own small businesses. An example of how these funds can support STEM pipeline activities: in the Merrimack Valley of Massachusetts, when Lucent Technologies laid off a large number of workers, dislocated worker and NEG funds were used to retrain STEM workers for employment in the defense and homeland security industries (Lazonick and Quimby 2006).

Interagency Aerospace Revitalization Task Force: In the last session of the 109th Congress, H.R. 758 was passed and signed by the President. This new legislation, which originated in the House Committee on Commerce, Science and Transportation, establishes a new Federal Interagency Aerospace Revitalization Task Force intended to develop a strategy for the federal government for aerospace workforce development. The legislation appoints the Assistant Secretary of Labor for Employment and Training as the Chairperson of the Task Force. This is further evidence that Congress has identified the critical role workforce development plays, and therefore the Department of Labor, in ensuring that one of the nation's most important STEM related industries has a stable, high-skilled job pipeline necessary to compete globally in this highly competitive industry.

InDemand Magazine: InDemand Magazine is a quarterly publication that the Employment & Training Administration produces to connect today's students with the careers of tomorrow. It is available on CareerVoyages.gov and each issue explores careers in a different high growth industry. It provides students, as well as guidance counselors, parents and teachers, with interesting and relevant information and tips about career opportunities; education and the skills needed for various jobs; and how to help students build successful futures. There are opportunities for young people in fields ranging from art to math, from sports to science, and from design occupations to the trades.

These and other Departmental efforts—including youth employment funding under WIA, WIA adult worker programs, the longstanding registered apprenticeship system, and faith and community-based organization programs funded by ETA—give the Department an opportunity to address serious gaps in the nation's STEM workforce pipeline strategy and to augment and help integrate investments available through other federal and other public and private sources.

A Call to Action: Toward a Pro-Active Response to the STEM Challenge

The Department has embraced the beginnings of an action agenda that, in collaboration with other stakeholders and investors, should help to: expand the pool of potential STEM workers; strengthen the gateway for non-traditional populations into STEM careers; ease the transition for dislocated or transitioning workers into STEM fields; and integrate national, state, regional, and local efforts into a more powerful set of partnerships and coordinated strategies.

Some specific contributions that the Department can—and does—make to this agenda include the following:

Building the Gateway to STEM Careers: Labor Department programs can promote alternative learning models in STEM education; support the development of career awareness materials highlighting employment in high growth, high demand STEM industries; establish a framework for defining competencies and skills essential for 21st century STEM workers; and explore the use of technology-based learning for STEM competencies.

Enhancing the Capacity of Talent Development Institutions: Labor Department investments can support community college efforts to train workers for STEM occupations; develop competency-based apprenticeship and internship models in STEM fields; promote the professional development of teachers, recognizing education as a high growth industry; and strengthen the public workforce system's capacity to support employer commitment to developing a skilled STEM workforce.

Catalyzing and Supporting Innovation, Entrepreneurship, and Growth: The Department's activities can accelerate the development and success of emerging and leading growth companies through access to resources, expertise, and private sector networks; invest in entrepreneurship and intrapreneurship talent development strategies; and assist entrepreneurs in finding and strengthening the skills of their workforce as their firms grow.

These kinds of investment priorities can provide important leadership and address gaps and opportunities that currently constrain the nation's ability to generate sufficient qualified and prepared workers for the STEM fields—from the most skilled research and technical scholars to the production, service, and technician-level employees who are so critical to industry health and growth. These investments will have even greater impact if they can be linked effectively with the investments of other stakeholders, starting with other federal agencies (particularly the Department of Education, NIH, and NSF) and extending to industry, foundations, and state governments across the nation.

The time is now for coordinated efforts to seed innovative new ideas, incubate the most promising of these initiatives, and scale demonstrably successful programs to strengthen the STEM pipeline. The Department of Labor's Employment and Training Administration is committed to partnering with others in the public, private, and not-for-profit sectors to achieve this critically important goal. The future well-being, security, and prosperity of the nation depend upon our collective success.

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