CALIFORNIA'S NEED FOR ENGINEERS
AND STEM EDUCATION

A Thesis

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Tyler Johnstone

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Abstract

of

CALIFORNIA'S NEED FOR ENGINEERS AND STEM EDUCATION

by

Tyler Johnstone

Given that CA will have a tremendous need for engineers in the next 50 years, how are California's schools, specifically K-14, preparing students to enter those fields via training or higher education at higher education institutions.

California's labyrinth of education laws makes the shift from outstanding test takers to highly qualified engineers, a difficult task. With less than 70% of students even graduating high school across the state, how long can the state succeed? While California is at the leading edge of engineering advancements, the state may lose its edge if there are not major reforms. Reforms include increased professional development, inclusionary practices, curriculum development, connection/cooperation with local industry, financial support and administrative actions.

_______________________, Committee Chair
Su Jin Jez, Ph.D.

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Date

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INTRODUCTION

"Without fundamental knowledge and skills [in math and science], the majority of students scoring below this level [proficient]—particularly those below the basic level—lack the foundation for good jobs and full participation in society"

Rising Above the Gathering Storm, National Research Council, 2007

California: the Golden State where dreams come true. Home to the eighth largest economy in the world, world-renowned universities and research institutions, and the "happiest place on Earth," California has long been at the center of the social and economic world (Taylor, 2011). Beginning with the Gold Rush of the mid-nineteenth century, California has always been at the forefront of research, innovation, invention, and success. In education, California's leadership role began under John Swett, who as state superintendent of public instruction, championed free public schools for all California children in the 1860s (Wood, 1925). California's renowned post-secondary education began in California with the Master Plan for Higher Education in 1960, since considered the world standard for public higher education institutions (UCOP, 2009). As the higher education system expanded, so too did the supply of skilled workers across the state. Shortly after, in the 1970s and 80s, the computer and aerospace industries exploded across California, with hundreds of thousands of employees by the closing decades of the twentieth century. Now in the twenty first century, California is at risk of losing it place at the forefront of technology and innovation. As schools across the state struggle with dismal student achievement levels and funding below the national average, the educational institutions at the foundation of California's spirit of discovery are nearing the brink of collapse (Taylor, 2011 pg 36).

This thesis seeks to answer the following questions:

1. How can K-12 schools in California respond to the challenge of maintaining the state's status as a national and international leader in knowledge and discovery in the face of growing competition from other states and nations?
2. What policies can state and local leaders implement to support student learning, preparing them for careers in science and technology?

For California to continue as a world leader in innovation and technology, the state needs an influx of high-skilled workers to fill the ranks in the growing fields of engineering. California's Economic Development Division estimates an average growth of 17.6% across the fields of engineering by 2018 (EDD, 2010).

Need for Engineers and Highly Skilled Technology Workers

In the next fifteen years, industry will need thousands of engineers to maintain the pace of research and discovery. According to the Employment Development Department of California, by 2018, California will need an additional 19,000 engineers above 2008 levels (EDD, 2010). As outlined in Table 1.1, across the broad landscape of engineering, some fields will experience relatively minor growth, such as mechanical and materials engineers, while biomedical engineering is poised to nearly double over the next decade (EDD, 2010).

Table 1.1 Employment Growth for Engineering Fields in California

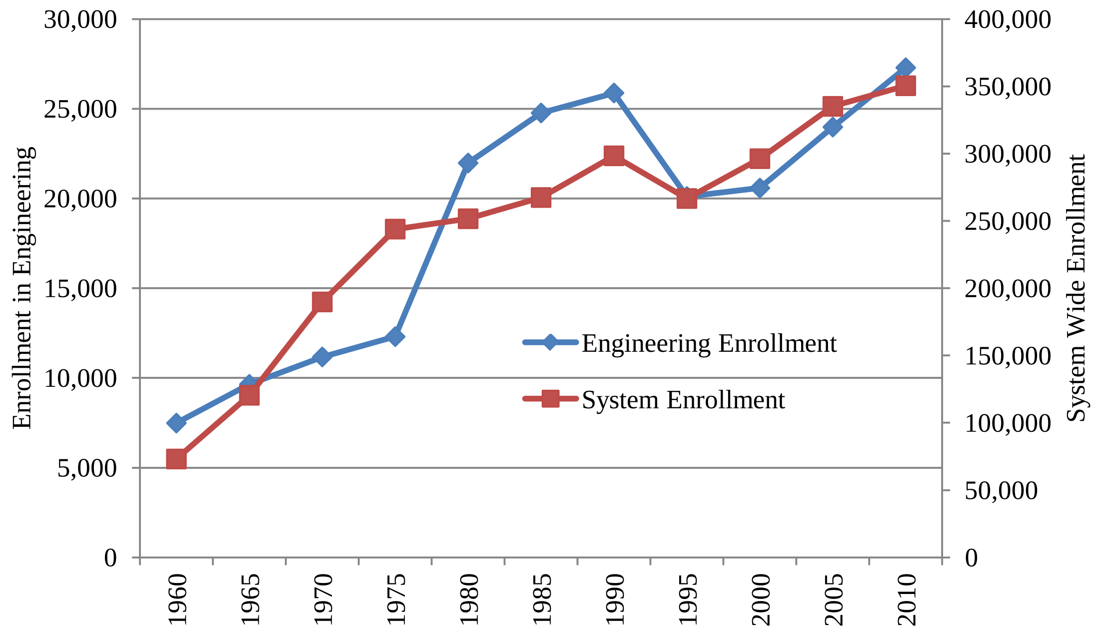
Engineering Field	Additional Employees Needed by 2018	% Change 2008-2018	2010- First Quarter Median Salary
Aerospace Engineers	1,900	11.7%	$106,180
Biomedical Engineers	2,500	80.6%	$89,967
Chemical Engineers	100	5.0%	$95,218
Civil Engineers	6,600	15.8%	$91,273
Computer Hardware Engineers	2,200	12.6%	$111,293
Environmental Engineers	1,200	21.4%	$84,976
Health and Safety Engineers	300	11.5%	$87,703
Industrial Engineers	3,200	16.2%	$84,899
Materials Engineers	100	3.8%	$93,825
Mechanical Engineers	600	2.6%	$87,155
Nuclear Engineers	300	12.0%	$105,627
Petroleum Engineers	200	18.2%	$117,179
	Total 19,200	Avg. 17.62%	Avg. $96,274.58

Source: Economic Development Department, 2010

As the need for engineers expands, students at the California's universities need to be ready to meet this need for highly skilled engineering. Since adoption of the Master Plan for Higher Education in 1960, California's higher education institutions strived to meet the three main goals of education, research, and statewide economic development (Master Plan, 2011). In line with these goals, figure 1.2 below illustrates how student enrollment in engineering programs tracks with the demands of California's economy, tying together the goals of education, research and statewide economic development. Early in the Master Plan, growth in year-to-year enrollment growth in engineering programs outpaced overall enrollment growth as the state was at the cutting age of the early Space Age.

Figure 1.1 California State University: System Wide Enrollment &

Engineering Enrollment 1960-2010



Source: CSU, 2010

Engineering enrollment spiked again in the 1980s, in the closing years of the Cold War as the aerospace industry exploded, especially in Southern California (Vartabedian, 1991). As state funding for the CSU system declined with the economic downturn, so did overall and engineering enrollment during the early 1990s (CPEC, 2011). As total enrollment increased again after 2000, engineering was once again on the rise, especially in the fields of computer science and information technology. By 2010, enrollment in engineering again exceeded the overall enrollment trend. As the need for engineers grows over the next decade, enrollment in engineering programs across the system should remain strong (EDD, 2010).

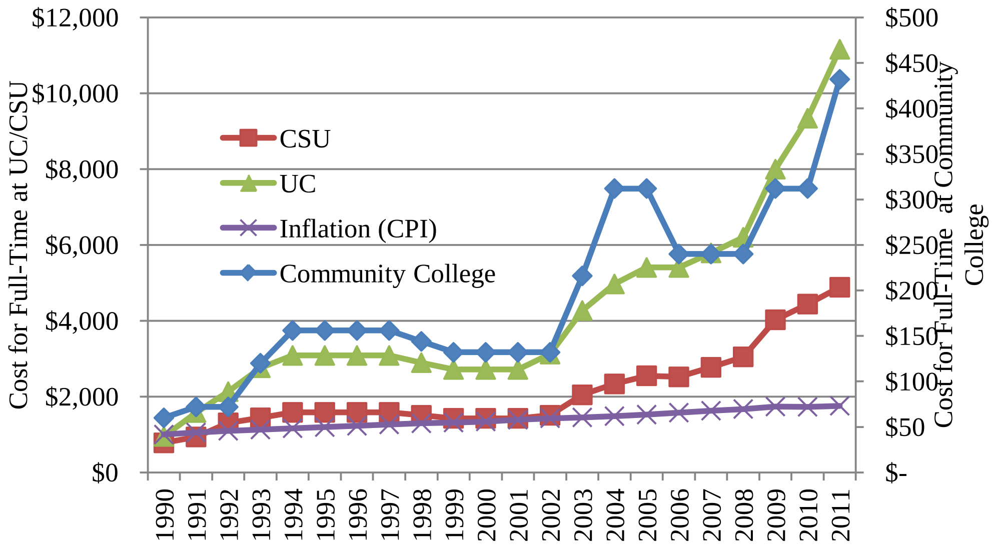
Crisis in Education

Funding for California's schools is chronically at some of the lowest rates in the nation (Taylor, 2011). These financial burdens compound the difficulties already faced in educating the nearly six million California students. In addition to the low levels of per student funding, employment practices in education result in a continual cycling of beginning teachers from one school to the next. Across the state, layoffs are based on seniority, thus when layoffs occurs, it is the new teachers shuffled from school to school (Dillion, 2011). Legislation, including those surrounding employment and funding are among those detailed in chapter 4. California's convoluted education policy realm, from funding to curriculum, is one tenet the literature review seeks to understand, as it relates to the many barriers to successful implementation of STEM education. These challenges are in stark contrast to the high engagement and expensive resources necessary for STEM education programs. A single STEM program, can cost upwards of $100,000 above infrastructure and personnel costs, far higher than a foreign language or literature class, it may be replacing (PLTW, 2011).

Standardized tests, focusing on rote memorization in the core subject areas of English, math, science and history, have taught students and schools to focus only in these areas, as they are tied to accountability and progress. As students learn via rote memorization, the higher order thinking skills necessary for success in STEM fields are lost. The same students struggling with the basic skills necessary for success in higher education, are the same generation who were educated in the age of standards-based curriculum and rote testing. The connection between the focus on testing and the lack of critical thinking skills is not a tenuous one. According to Amber Vayo. In the National Education Association's Higher Education Journal, examining the education system from kindergarten to graduate school, Vayo notes, "the lack of critical thinking skills and ability to analyze—possibly the most dangerous by-products of assessment mania—are a direct cause of failure to thrive in college" (2008). Because of the emphasis on testing, compounded with the shortage in education funding, California's students may not meet the need for innovative and creative employees in the highly demanding fields of advanced engineering and technology programs.

Higher education faces a different crisis. As tuition and fees increase, access to college falls. Across the three public higher education systems, the rising cost of education has far outpaced the inflation index.

Figure 1.2 Annual Tuition for Full Time Students



Sources: Bureau of Labor Statistics, California Community Colleges System Office, California State University, University Office of the President

While the University of California (UC) and California State University (CSU) systems continue to model excellence in education and research, students entering these institutions lack basic academic skills. This documented lack of basic skills is evidenced at the California Community Colleges, where only 15% of students in mathematics and 27% in English met the benchmark for transfer level coursework (CCCCO, 2011). At the California State University, more than 60% of students need remedial classes in either math or English (CSU, 2011). The documented lack of skills is plaguing California Community Colleges and State University System, giving rise to the Basic Skills Initiative (CA Community Colleges System Office) and a host new of remedial program across the CSU system. This lack of basic skills would be a determinant to any higher education system, however the problem is compounded in California as the lack of basic skills, represent exactly what is missing in the workforce of next generation.

In short, a report by CSU, Sacramento Institute on Higher Education Leadership and Policy details the need of an average of 46,100 STEM job openings over the next four years (Offenstein & Shulock, 2009, p.8). California will need more engineers to maintain prominence in discovery and invention. California schools are not producing students able to master even the basic skills necessary for success in post-secondary education.

New Industries

Gene research, individualized medicine, and cancer research are only the beginning of the biomedical industry in California. Over the past decade, an industry cluster grew around the San Francisco Bay Area into what is now one of the largest centers for medical research. With advanced research institutions including University of California, San Francisco (UCSF) and Stanford University, and a new cluster beginning around UC San Diego, there will be supply of talented bio-engineers available (UCSD, 2011).

Adjacent to this Bay Area biomedical cluster, Silicon Valley continues to be the world leader in computer and software technology. New types of engineering emerge with breakneck speed especially in the fields of computer and systems engineering. As automation advanced throughout industry and everyday life, computer and systems engineers are responsible for concept development (systems) and hardware (computer) that makes this automation possible.

These two fields are emblematic of the growth potential for California's economy, provided there is a sufficient trained workforce prepared to enter these growing industries.

In the next decade, California will need thousands more STEM engineers and highly skilled workers. New industries including high tech computer application, automation and biomedicine cannot grow without an influx of engineers. California schools are in a state of fiscal crisis. Students in K-12 school receive lower per student funding than almost any other student in the country (Taylor, 2011). Higher education institutions, once pinnacles of research and excellence, are now facing grave financial (rising fees and diminishing state funding) and academic challenges (students lacking basic and critical thinking skills). Something must change in California's education system to address these challenges and meet the needs for the state's workforce in the decades ahead.

In the remainder of this thesis, I will discuss how California fits within the national STEM landscape and what can be done to improve that standing. Chapter 2 will discuss the current literature on STEM education and look at best practices in the recruitment of engineers and other STEM professionals from around the nation. Chapter 3 summarizes the policies and legislation from California, other states, and the federal government supporting and blocking the advancement of the STEM education agenda. Chapter 4 takes a detailed look at the aforementioned legislation and makes the connection between policy objectives, increasing STEM professionals and the legislative agenda supporting this objective. Chapter 5 concludes with recommendations for California and policy opportunities that would enhance California standing's in regard to STEM education. Appendix A is an introductory table detailing the United States' place among world nations in standardized math test scores. Appendix B outlines a summary of state report cards relating to STEM policies. Appendix C is a multi-page listing of all STEM related legislation in states and Congress since 2001.

Chapter 2

LITERATURE REVIEW

In the rapidly growing field of STEM education, much of the relevant research and published academic literature centers upon pedagogical methods and best practices rather than long-term outcomes. In the next decade, there needs to be a substantial emphasis by researchers connecting the development and implementation of STEM programs in secondary schools with results in terms of post-secondary education and STEM workforce needs met. Several case studies including a study by Tyson, Borgman, and Hanson (2007) provide the vast majority of data driven analysis. In California specifically, Offenstein and Shulock (2009) look at this state's STEM workforce needs, supporting the central question of this thesis- there is a growing need for STEM professionals and not a clear plan for how California intends to educate them. This chapter includes a overall survey of STEM programs before examining the documented need for more STEM workers in the coming decade. With this research from Bureau of Labor Statistics (BLS) at the onset, the review continues with a summary of the seminal work, *Rising Above the Gathering Storm*, by the National Research Council (2007). The *Rising Above the Gathering Storm* report along with the work from Barbara Schneider (2003), places the statistics from the BLS into a real context about the dire need for highly skilled STEM workers in the coming years. The section concludes with a review two academic articles, one looking at STEM policies in California from Offenstein and Shulock (2009) and the second Tyson, Borman, Lee and Hanson (2007), a statewide longitudinal study in Florida tracking high school course work with post-secondary majors and post-graduation employment.

STEM Education Rises in National Prominence

“Half a century ago, when the Soviets beat us into space with the launch of a satellite called Sputnik, we had no idea how we would beat them to the moon. The science wasn't even there yet. NASA didn't exist. But after investing in better research and education, we didn't just surpass the Soviets; we unleashed a wave of innovation that created new industries and millions of new jobs. This is our generation's Sputnik moment.”
President Obama, 2011 State of the Union Address

In the same speech, where President Obama called on Americans to rise to our “Sputnik moment,” he cited the need for “100,000 new teachers in the fields of science and technology and engineering and math” (White House, 2011). From that speech forward, STEM was part of the national education discussion. By year’s end, the President’s Council of Advisors on Science and Technology released the report *Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (2011)* highlighting the status and need for STEM education.

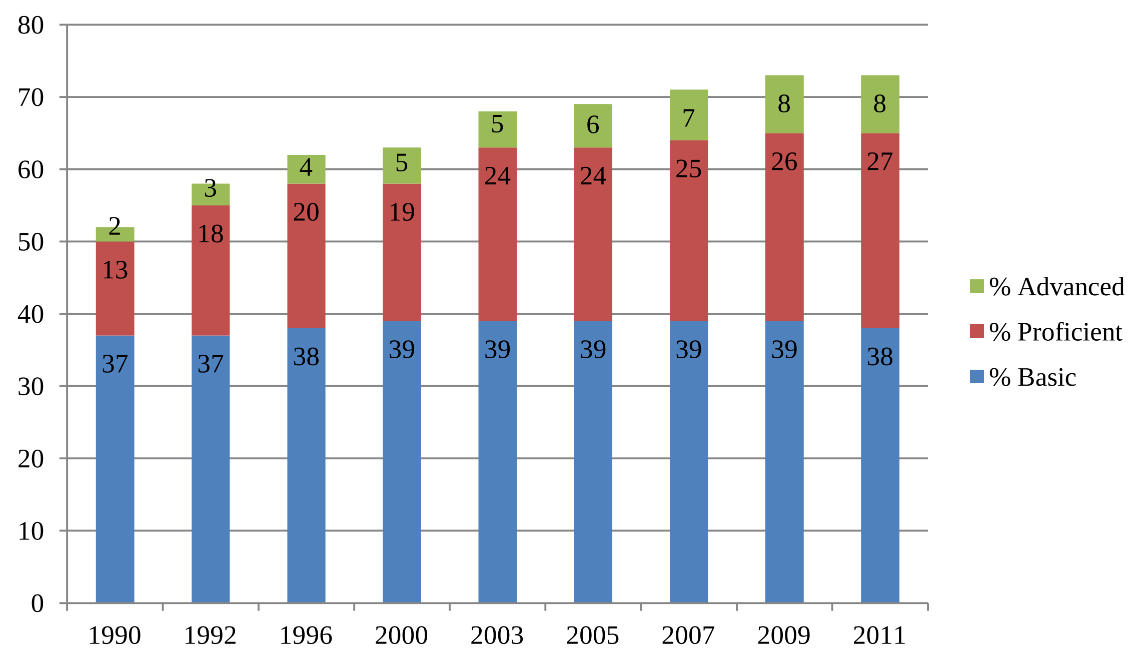
What is STEM education? Science, Technology, Engineering, and Mathematics (STEM) education is an all-encompassing term covering education in the fields of practical and applied sciences. Programs begin as early as elementary school, engaging students in hands-on, applied problem solving and continue through bachelor degrees and professional training programs. Especially in the new areas of technology and engineering, The focus behind STEM education is the creation of a generation of students skilled in innovation and applied learning, bring back the spirit of discovery, identified as our “Sputnik moment.”

Most STEM classes are very hands-on and project-orientated, and suggest to students that there is no right way to complete an assignment or project (PLTW, 2011). Instead of the standard model of lecture and practice, student in STEM classes face real-world problem and learn to embrace this practical curriculum in the classroom in the same way that engineers and designers face constraints and challenges in their every day work. This practical application of STEM curriculum invigorates the critical thinking skills necessary for success according to Amber Vayo (National Journal of Higher Education, 2007).

Need for Analysis on the State of Knowledge and Discovery

At a May 2005 meeting of the National Academies of Science, Former Secretary of Education and then Senator Lamar Alexander called for a national study about the future of science and discovery. Joined by Representative Frank Wolf, a bipartisan request was made of the National Academies of Science to convene a panel of experts to assess the future of science and discovery in the United States. Two years later, in 2007, *Rising Above the Gathering Storm*, was released with great fanfare (National Research Council). The report, a culmination of efforts of Nobel Laureates, CEOs of Fortune 500 companies, education leaders and Presidential appointees, set not only a list of national STEM priorities but also outlined implementation strategies for achieving these priorities to ensure America’s role as the preeminent international leader in knowledge and discovery. The report showed, while there was great promise and reason for optimism with recent gains in math and science, there were still millions of students failing to reach the benchmark of proficiency in these core subjects. The report writes "without fundamental knowledge and skills, the majority of students scoring below this level [proficient]—particularly those below the basic level—lack the foundation for good jobs and full participation in society (National Research Council, 2007)."

Figure 2.1 1990-2011: Trends in eighth-grade NAEP mathematics achievement level



Source: National Center for Education Statistics, 2012

Need for an Educated Workforce

Published in 2003, Barbara Schneider clearly outlined the dim future for students without a college education,” for young people who hold only a high school diploma is unclear, being able to support a family and maintain a reasonable life-style with only high school degree seems unlikely.” The Occupational Outlook from the Bureau of Labor Statistics estimates that jobs requiring a bachelor’s or master’s degree will grow at least 16% by 2018, double the expected growth of job requiring on the job training (8%) (2010).

STEM Education to STEM Careers: Florida Case Study

With support from the National Academies of Sciences, researchers from the University of Florida examined the coursework, post-secondary education and employment of 94,078 Florida students. As the fourth largest state and an increasingly diverse population, Tyson, Borman, Lee and Hanson (2007), related the demographics of Florida as representative of the nation. In a first of its kind study for STEM education, the researchers categorized secondary math and science classes based upon the skills necessary for success. Tracking the progress of students completing these courses with later enrollment in post-secondary education and eventual employment, the research provides a very complete picture relating completion of rigorous math and science course work with later pursuit of a STEM major in post-secondary education.

Table 2.1 High School Course Completion to BA/STEM

	BA/BS	STEM BA/BS

HS Course Level Completed	n	%	n	% of total BA/BS
Mathematics				
General Consumer Math	451	2.6	15	3.3
Pre-algebra	34	3.8	1	2.9
Algebra I / Geometry	822	5.6	40	4.9
Algebra II	3835	18.6	198	5.2
Trigonometry/ Statistics	4315	38.1	440	10.2
Pre Calculus	7512	41.2	453	14.6
Calculus or Higher	7012	46.7	1131	34.6
Science				
Physical Earth Science	250	3.9	18	7.2
Intro Chemistry	343	4.5	18	5.2
Biology, Ecology	2232	9.7	137	6.1
Chemistry I or Physics I	3982	19.6	351	8.8
Chemistry I and Physics I	9051	40.3	1693	18.7
Chemistry II or Physics II	181	42.6	72	39.8

Source: Tyson, Borman, Lee and Hanson, 2007, p.256-257

Certainly, there are some limitations to the study. The longitudinal database includes only one class of public high school graduates. For any type of statewide comparison data, multiple years would improve the reliability of the results. Given that these students graduated high school in 1996 & 1997, at the early edge of the technology boom, it is possible that this economic event swayed more students into technology fields than in a normal year. Collecting this data over a decade would provide a better average on the true effects of advanced high school course work as related to post-secondary majors. Additionally, the post-secondary data is limited to only the eleven campuses of the State University System including the University of Florida and Florida State University. Students entering the military, pursuing education out of state or at any private post-secondary institution were omitted from the post-secondary BA and STEM

BA data sets. There is likely an addition cadre of students pursuing STEM majors at post-secondary institutions not included in this data set. Inclusion of those students would only further the evidence supporting the hypothesis that rigorous high school course lead to higher proportions of students in STEM majors, when compared with students with less rigorous high school courses.

Furthermore, post-baccalaureate employment data is only included for those students working in the state of Florida, ignoring those students who entered the workforce outside of Florida. Inclusion of those outside of Florida in STEM professions would again bolster the data supporting the effects of early and rigorous STEM education on increasing the STEM workforce.

Even with these data limitations, the study suggests strong evidence for offering and supporting student success in advanced secondary STEM classes leading to more students pursuing STEM education in college.

Chapter 3

LEGISLATIVE METHODOLOGY

Across the nation, state and federal governments are in the process of implementing a host of legislative initiatives and education programs aimed at improving STEM programs. These legislative initiatives include additional funding and grants specifically targeting STEM populations or localities where there is an extraordinary need for new employment to research targeting effective local and statewide practices for STEM education. The efforts span kindergarten to post-secondary, some focusing on individual grade levels, others being "pipelines" inclusive of all grades.

Chapter 3 outlines the process by which I collected information on legislation and policy agendas across the state. The foundation for my methodology draws directly from the literature review, whereby I looked up individual programs and policies referenced in each of the research pieces cited previously.

The original model for this research intended to compare California with nine other states: Texas, Florida, Oregon, Colorado, Illinois, New York, Virginia, Washington, and Massachusetts. In comparison with other states California's exceptional size and resources does set it apart; still there is precedence with previous national research comparing California with similar states. The aforementioned states are often compared with California in terms of demographics, population, workforce environment, and political climate. However, upon further research I discovered that much of the important STEM programs and legislation were occurring in nearly every state. With this information, I subsequently increased the sample size to look at all states and the District of Columbia (Education Commission of the States, 2011). With California's six million K-12 students, no other state compares in terms of number of students served. However, with the exception of size, K-12 public education in California does not differ substantially in terms of education policies. Acknowledging disparities in funding and different curriculum, education is education. Policies involving teacher training, curricular connections with local industries and state administration differ little from state to state. Because of these similarities, I found that most policies and programs from around that nation could be replicated in California without great shifts in the education system.

The legislative research began using Internet research from the State Legislative bodies for each state. While this method was inclusive, searching for STEM related legislation; it would not be practical without additional resources and time. In my literature review several articles cited the Education Commission of the States (ECS), as a comprehensive source of legislative information. With the mission to "help states develop effective policy and practice for public education by providing data, research, analysis and leadership; and by facilitating collaboration, the exchange of ideas among the states and long-range strategic thinking," this single source provided a vast compendium of STEM legislative efforts (ECS, 2011). While the Education Commission appears unbiased and honorable in its presentation of data, I sought an alternative source to confirm and supplement the data collected from the ECS. California's Legislative Analyst Office uses the National Conference of State Legislatures (NCSL) for information relating to pending legislation and policies in other states. Research with

NCSL was limited in scope, providing information from only the last four years and only listed enacted legislation. The lack of scope prevents a longitudinal analysis of STEM efforts across the last decade or more. Furthermore, in that NCSL's database includes only enacted legislation, there is no means to identify, STEM initiatives that failed to pass either the state legislature or were vetoed by the governor. Still, the NCSL provided an additional 243 bills for inclusion my research (NCSL, 2011). Between these two comprehensive sources for tracking legislative action across the nation, I have a complete map of recent legislation surrounding STEM policy across the states.

Supporting much of this state legislation, nearly $1 billion in annual funding comes from the Federal Government (President's Commission on Science and Technology, 2010). Authorization for allocation of these funds is spread across hundreds of individual programs and numerous federal agencies. In the report titled Prepare and Inspire: K-12 Education in Science, Technology, Engineering and Mathematics (STEM) for America's Future (2010), the President's Commission of Science and Technology compiled all federal research and funding information into a single report and provided recommendations to the President. While this report provided much of the information on federal grant programs, two reports by the Congressional Research Service, in 2006 and 2011, outlined all the pending legislation related to STEM education (Kuenzi, Matthews, Mangan, 2006; Gonzales, 2011). The second part of Chapter 4 addresses federal funding, grants and pending and enacted legislation.

Upon completing this research, I will compile all the relevant information and include a table in appendix C summarizing the entirety of this research. This table will serve as the basis for my analysis and subsequent recommendations for California's STEM policy in Chapters 4 and 5.

Chapter 4

LEGISLATIVE ANALYSIS FOR CALIFORNIA

For California schools to meet the upcoming demand for engineering and high skill STEM professionals, the state must make a concerted effort in fully supporting STEM programs. While no other state can claim national prominence in STEM education, there are a variety of efforts across the country that offer a model for California to follow.

In reviewing legislation that supports building the supply of STEM labor from across the nation over the last decade, six categories emerged: Connection to STEM Industry, Professional Development, Training, and Recruitment, Curriculum Inclusion of STEM, Funding, Inclusion of Underrepresented Populations, and State/Local Administrative Actions . In conducting the collection and analysis of the legislation, each bill was summarized and searched for commonalities. Of the hundreds of bills collected, many related to minute programmatic changes or specific spending allocations and thus were not of enough significance to be included in my final analysis.

While California has made some progress in each of these categories, a careful examination of best practices from other states, leads to the recommendations in the next chapter for California. In the following six sections, aligned with the aforementioned categories, I examine proposed or enacted legislation or programs in California and offer a comparison with legislation from other states.

1. Connection to STEM Industry

As part of the Legislative analysis conducted in chapter 3, I analyzed 76 bills from across the country. A full summary of this analysis including detailed legislative data and a bill summary is included in Appendix C. From these 76 bills, the vast majority related to connections with local industries. As states look to attract new high tech industries, state education officials must be sure that there is sufficient labor availability to meet fill these jobs. Nearly every state has some effort in place to analyze either current STEM programs as they relate to available or future jobs or an education/industry partnership council examining economic activity, industry development or labor needs on a regional or state level. Predicting what industry cluster may emerge within a region or state is a difficult task.. Since 2008, Governor Schwarzenegger vetoed two bills relating to work force needs assessments in specific industries.

- California- 2010: S.B. 946 (Alquist)- Required High Speed Rail Authority to work with Employment Development Department to develop labor market needs assessment and identify education and skills needed for construction, maintenance and operation of the high speed rail line.

    Vetoed by Governor Schwarzenegger for costs and excessive workload for EDD within the January 2012 timeline.

- California- 2008: A.B. 2471 (Karnette)- Established a Digital Arts Studio Partnership and Workforce Program to train students in digital technology skills

    Vetoed by Governor Schwarzenegger as not a priority for the state.

While California failed to enact these two pieces of legislation looking at specific industries and projects, labor markets assessments for other industries have successfully passed in California and other states.

- California- 2009: S.B. 471 (Romero & Steinberg)- Creates the Stem Cell and Biotechnology Education and Workforce Development Act of 2009. Establishes stem cell and biotechnology education and workforce development as a state priority and promotes stronger links among industry sectors, the state Institute for Regenerative Medicine and public schools
- Hawaii - 2007: S.B. 907- Creates the Office of Aerospace Development to coordinate space activities and indentify and promote opportunities for expanding aerospace related industries in the state including a Pacific International Center. Promote innovative education and workforce development programs that will enhance public aware of the state's aerospace potential.
- Illinois- 2008: S.B. 621 (Veto Overridden)- Requires Department of Commerce and Economic Development to conduct a study to indentify current and projected shortages in critical occupations and devise strategies to alleviate these shortages.
- Utah- 2007: S.B. 53- Engineering partnership between Weber State University and Utah State University to meet the need for electrical engineers in the state including Hill Air Force Base.
- Florida- 2007: S.B. 1232- Creates State Career and Professional Ace to improve academic performance and workforce needs. Requires school districts develop strategic plans to address and meet local and regional workforce needs and

establish a career and professional academy. Requires career courses lead to industry certification and mandates a certain percentage of students succeed in these industry certifications for the courses to continue.

In analyzing the success or failure of the industry based legislation, the veto messages tell an important story. Both of the vetoed bills were identified as not aligned with the priorities of the state. Specifically, the Digital Arts Studio (AB 2471) represented an interesting idea but in the midst of a great recession, Governor Schwarzenegger could not justify the cost for creating a partnership benefiting an extremely small industry cluster. The 2010 veto of the High Speed Rail workforce needs assessment seemed to be an additional cost added to a project that was already billions over budget before a single mile of track was completed. There seemed to be the undertone in the Governor's message that when jobs became available there would be sufficient labor available- a specific labor needs assessment was not necessary and represented an unnecessary workload burden for the Employment Development Department.

In California as well as the other states listed, the successful legislation fulfilled a need for either a current or projected future industry in the state. As each state tried to recover from the recession, there was a concerted effort to identify which industries would come back strong and which future industries could be enticed to relocate. A prime example is Hawaii's Office of Aerospace Development. With the defunding of NASA and the end of the shuttle era, private companies have great latitude in selecting the location for the next generation of space activities. With a geographic advantage, Hawaii sought to position itself as an ideal home for private space endeavors.

2. Professional Development, Training, and Recruitment for STEM educators

Across the nation, teachers have historically been paid less than other individuals with comparable education levels. In California, the median K-12 teacher salary is $66,995, while the median salary for a graduate/professional degree was $73,078, (CDE, 2009 & CPEC, 2009). Currently, the credential process for Career Technical Education (CTE) teachers, which includes the vast majority of STEM teachers, requires only the following minimum requirements: background check, 3-years paid or unpaid industry experience, application and fee, and a high school diploma (CTC CTE Credential, 2009). Within the first five years of teaching, CTE credentialed teachers would need to earn a preliminary teaching credential through an accredited university including passage of a course in health education, the U.S. Constitution, and use of technology in education (CTC, 2009). These requirements are lower than those even for a substitute teacher, substitute teachers have to pass a comprehensive basic knowledge exam, emphasizing the need for CTE teachers (CTC, 2011). Part of the need for CTE teachers stems from the fact that individuals employed in private industry are likely compensated much higher than a beginning teacher. Even lower than the average teacher salary, the statewide average salary for new teachers is $40,421 (CDE, 2009). For beginning engineers and high-skill STEM professionals, beginning salaries range from $55,000 to $65,000 (EDD, 2011). For recent college graduates, the financial portion of their career decision is obvious.

Low pay was cited as one of the primary decisions for undergraduates not pursuing teaching in a 2003 study by Anthony Milanowski. In order for college students to enter teaching, the study found that pay would have to be forty-five percent above the local average in order for roughly half of all college students to consider entering the teaching profession. As the data from California proves, salaries for teachers are far below this mark of one hundred forty-five percent of the local average.

With the need for STEM teachers growing, laws ranging from scholarships and loan forgiveness to fast-tracking the teacher credentialing process, all aim to attract and retain STEM professionals as classroom teachers.

- Arkansas- 2007: H.B. 2414- Created a fund providing scholarship and loan forgiveness for teachers in high need fields including STEM education
- Ohio- 2007: OAC 3301- Creates a forty-hour temporary teaching permit for qualified non-licensed individuals and adds a rule creating a two-year provisional educator license for STEM schools.
- Tennessee- 2010: E.O. 68- Creates Tennessee Innovation Network in department of education to manage coordination, professional development and curriculum development for STEM education across the state.
- Texas- 2009: S.B. 2262- Allows a teacher with at least two years industry experience to participate in academy program towards STEM teaching certificate. Prior rule required a minimum of five-years experience.

3. Curriculum Inclusion of STEM

At the core of the expansion of STEM is the inclusion of STEM advanced curriculum in K-12 education. In the age of standardized testing, there is little interest in the creation of new standardized tests for students. The California Department of Education did create a framework of fifteen career technical education area standards in 2005, however there is not standardized testing across the state as there is for math, science, English and history (CDE CTE, 2005). With California's adoption of National Common Core Standards for math in 2014, there is the anticipation of a greater focus on critical thinking and application skills in mathematics more inline with STEM skills rather than the current model of testing basic math skills.

It is important to differentiate between STEM, Career Technical Education (CTE) and the standard K-12 curriculum. The previously cited Florida case study provides a proper frame of reference for this comparison. With STEM, the "M" represents mathematics. However, that does not mean that any secondary math class should be considered part of a STEM program. The same is true of any technology class. Some California districts require students complete an introductory technology course, often beginning keyboarding or take some type of internship in their chosen field. Both of these would likely qualify as a CTE course but neither would be a STEM course unless the internship was with in the STEM industry. There is still some level of subjectivity into what is exactly a STEM course and what should be considered part of the standard curriculum. In the Florida case study, cited in Chapter 2, Table 2.1, students highest level of math and science completed were compared with their overall post-secondary degree progress. For students completing Algebra I and Geometry, the minimum requirement for a high school diploma in California, only 5.6% of students completed a BA/BS and only 4.9% of those who did complete their BA/BS earned a degree in a STEM field (Tyson, 2007, p. 256-257). Even for students taking more advanced math classes such as pre-calculus, just over 41% of students completed a BA/BS and only 14% of those degrees were in a STEM field (Tyson, 2007, p. 256-257). As California and the nation move away from standardized testing, the distinction between STEM, CTE and standard curriculum needs to be legislated.

In contrast to previous focus on standardized test, more recently much of the legislative focus across the country looked to incorporate STEM topics into the current curriculum. Ideas from across the country include emphasizing STEM careers to retrofitting school buses as "Mobile Technology Platforms" with computers hosting math and science content software.

- California- 2010: S.B. 1444 (Hancock)- Defined STEM as a sequence of courses ant prepare students for a specific set of technically sophisticated skills. Directed the Superintendent of Public Instruction to set aside grant funding for this sequence of courses.

    Vetoed by Governor Schwarzenegger as possibly limiting opportunities for future STEM program development and alignment with future federal grant requirements.

- Arizona- 2009: H.B. 1273- Creates Mobile Technology Platforms in converted schools buses with math and science software meeting state standards.
- Massachusetts- 2007: E.O. 489- Align curriculum from kindergarten to higher education and workforce training with an emphasis on STEM as well as other subjects and methods that enhance creativity and problem solving skills.
- New Hampshire- 2008: H.B. 1282- Expands pre-engineering curriculum for students with deletion of course requirements and an expansion of offering both in depth and breadth.
- Texas- 2009: H.B. 3- Allows a student completing high school coursework with advanced math or English skills an exemption of college placement testing.
- Texas- 2007: H.B. 2978- Texas Board of Education shall design and administers an exploratory engineering summer program and administer a scholarship for students who graduate with certain credentials.

4. Funding for STEM programs

Introducing a STEM program to a new school or district is hugely expensive. An estimate by Project Lead the Way, a national STEM curriculum provider, estimates $100,000 for a middle school and $200,000 for starting a basic high school STEM program with needed technology, curriculum, materials and training. (PLTW, 2011). Without the investment of funding from the State Legislature and California Department of Education, STEM education is not possible across the state. Federal grants and support from local industry connections will help offset local expenditures but there is simply no other reality than that STEM education programs are hugely expensive. To teach English or social science requires textbooks and a teacher. To teach STEM requires the latest in technology, access to engineering software, science hardware and an endless series of project materials. While there is funding from federal grants, the State of California does not have any specific categorical relating to STEM education (CDE Categorical, 2011)

- California- 2011: S.B. 1- Requires the state Superintendent of Public Instruction to allocate $8,000,000 in grants annually from the Renewable Resource Fund to district to implement programs that support employment in clean technology or renewable energy businesses.
- Arkansas- 2009: H.B. 1682- Funding for State Science and Technology Authority for research and development on improving STEM facilities in K-12 schools.
- Colorado- 2007: H.B. 1243- Establishes STEM after-school grant program to assist local program providers and secondary schools defray the cost of providing after-school STEM programs.
- Pennsylvania- 2010: H.B. 101 (Veto overridden)- Codifies Science in Motion program providing grants to higher education institutions that establish partnerships with secondary districts for the purchase of science or technical equipment.
- Texas- 2011: H.B. 2910- Establishes Texas STEM Challenge scholarship program for students pursuing STEM education.

- Washington- 2007: H.B. 1779- Establishes GET ready for Math and Science scholarship program for the state's students highly qualified in math or science who study and commit to working in STEM field in the state.
- Wisconsin- 2010: S.B. 437- Makes K-5 schools eligible to apply for state or federal STEM grants with the aim of starting a pilot program designed to develop STEM instructional strategies and support underrepresented students entering STEM profession.

5. Inclusion of Underrepresented Populations

A STEM professional, especially engineers, scientists and mathematicians, has long been the realm of white men. Due to social and cultural pressures and an unequal K-12 education system, women & minorities have had a hard time entering these fields. A 2007 report by the National Science Foundation's Models for Excellence program found five factors lead to the disparity of underrepresented minorities in STEM fields: low teacher expectations, lack of access to college preparatory courses, home-school disconnect, lack of role models and under-qualified teachers (Models for Excellence). Several states have addressed the lack of minorities entering STEM fields with a variety of inclusionary practices.

- Illinois- 2011: H.B. 1256- Creates Diversity in Engineering program whereby a "targeted group member" must be represented in proportion to the statewide labor market.

- Illinois- 2006: IAC 110.170- Indentified ten criteria for High Technology School to Work program grants including efforts to recruit female and minority students into the programs.
- New Mexico- 2007: S.B. 402- Created the Alliance for Underrepresented Students at New Mexico State University whose purposes includes collaboration with K-12 educators to support STEM education and student achievement.

California, with a major minority population has adopted no legislation with the aim of increasing minority participation and success in STEM fields. On the local level, especially in Sacramento, there are grants from local partnerships including Society of Women Engineers to increase STEM participation but there is no coherent statewide initiative.

6. State/Local Administrative Actions

For STEM education to succeed at the larger level there must be support from the statewide Department of Education or Governor's office. Direction at the state level is necessary for macro analysis of future industry. In addition, an advisory panel with access to the Governor or Legislature can assist in proposing legislation in response to or with the hope of shaping future industries. If this analysis was completed at the local level, cities and counties would create a patchwork system of enticements and projections, all with the aim of drawing industry to their locality.

Many states across the country, including California, have organized advisory panels including members from K-12, higher education, STEM industries and government with the aim of organizing, building, or expanding STEM industries and education within their state. With California's exceptional size in area and population, a statewide assessment is not practical. In my recommendations, I outline a regional analysis model, more akin to the area and population of a smaller state, included in the following examples.

- Arizona- 2006: E.O. 7- Creates the Governor's Council on Innovation and Technology to strengthen innovation in technology infrastructure, enhance university research, inspire cooperation with industry and higher education and create and retain high quality jobs in the state.
- Iowa- 2010: E.O. 74- Creates the Governor's STEM Advisory Council aimed at providing a world-class education, encouraging innovation and enhancing economic development.
- Maine- 2009: S.B. 412- Directs Department of Education to survey and collect information on all public-private partnerships, pilot projects, non-profits and other organizations already working with STEM.
- Montana- 2009: H.B. 506- Proclaims the third week of March as "Math, Engineering, Technology, and Science Week"
- Virginia- 2011: H.B. 2172- Requires that the Virginia Index of Performance account for a schools increase in enrollment and elective course offerings in STEM programs.

- California- 2010: A.C.R. 88- Establishes the California Task Force on Science, Technology, Engineering, and Mathematics Education for the purpose of promoting and improving STEM education across the state.

California should continue the CA Task Force on STEM Education until at least 2020 to support the development of policies enhancing STEM Education across the state. Under the umbrella of this task force, the California Department of Education should apply for federal grants and private partnerships to support the funding needs for STEM education development and implementation.

As K-12 teachers provide early exposure to the world of STEM, educators should be versed in the latest technology and advances in science and engineering. Our understanding of the basics of math remains relatively consistent, while changes in technology and science occur at breakneck speed. Connection with local industry provides the bridge in which industry can infuse the latest developments into the classroom.

Finally, administrative action at the state level should not only support and encourage STEM development but also should not hinder program development. Currently the California Task Force on STEM education is set to expire in 2014. As STEM professions will expand for at least the next decade, this task force should be reauthorized to continue its research and coordination efforts.

Chapter 5

CONCLUSIONS

Based upon the legislative research and analysis, the following recommendations emerged. Recommendations are first separated in each of the category areas (Connection to STEM Industry, Professional Development, Training, and Recruitment, Curriculum Inclusion of STEM, Funding, Inclusion of Underrepresented Populations, and State/Local Administrative Actions) followed by a concluding summary of recommendations section.

1. Recommendations for Connection to STEM Industry

   As California is the largest state in the nation, conducting a statewide assessment of future labor force needs is simply not practical. The Employment Development Department, along with the Bureau of Labor Statistics perform projections on job trends that are more than sufficient for providing the general picture. Even at the county level, the EDD projections provide a good overview of future workforce needs.

   For example, by 2018 the fastest growing industry sector in the state will be biomedical engineering. EDD expects an additional 140 high skill biomedical engineers will be needed in Los Angeles County (EDD Projections LA County, 2012). This projection is useful but terms of ties to STEM education, where is the connection. All the information gives us is a projection six years in the future. Will these be high skilled biomedical engineers or lab technicians? Where will these 140 individuals be trained? Are there education programs at local community colleges, trade/technical schools, for-profit institutions or public undergraduate and graduate programs?

Current biomedical companies, higher education institutions, and K-12 schools all should meet to determine where within the locality will the demand really be and answer the questions: where will these future employees come from? What skills will these new employees need? Where is their training or education available? Currently, there is not the connection at the local level matching labor needs and an action plan between industry and education partners on where these future employees will come from.

Assuming at least four years of post-secondary education, these future employees are completing their junior year of high school. The time is now to draw upon the EDD projections as a foundation and create an action plan for local connections between STEM industries and education.

2. Recommendations for Professional Development, Training, and Recruitment of STEM educators

There are three separate challenges in this area. First, in the recruitment of new STEM teachers. There is a large pay disparity between private industry professionals and public school STEM teachers. Financial incentives would induce some to enter the teaching profession and share their knowledge and experience with the next generation of STEM professionals (Milanowski, 2003). In a focus group at the University of Wisconsin, Madison, Milanowski found that just over half of the sample of current junior and senior STEM undergraduates, would consider teaching if the salaries were 20% higher than they expected to make in their chosen STEM field. This is a significant burden in looking to hire new STEM teachers.

Another option for increasing recruitment is expansion of California's current APLE loan forgiveness program. The APLE program provides between $11,000-19,000 for teachers entering math and science in schools that meet specific requirements (socio-economic, academic performance, or rural, among others). Given the critical need for recruitment of STEM teachers in California schools, this program should be expanded to include all STEM teachers, regardless of school specific circumstances.

The second problem is the training for new and current teachers. This includes new STEM teachers, either those just entering teaching as well as those transferring from another subject area. The conceptual nature of STEM learning lends itself towards more individualized and project based learning than in most other content areas (Barron et al., 1998). For current educators looking to switch from non-STEM subjects to STEM, training and professional development will ease the transition. Accomplishing this training could be in the form of industry externships or trainings at local higher education institutions. For teachers just entering the teaching from another profession, the teacher credentialing process serves as a good introduction to classroom management and adapting the structure of teaching rather than performing STEM work.

The final challenge is introducing STEM topics into the core curriculum of other classes. As the state of California moves from its own standards to Common Core national standards in all subject areas in the next three years, teacher training and professional development will be required across the state. A similar large-scale effort would brief teachers on the basics of STEM and offer ideas for inclusion into the regular curriculum. Much of this training would be provided by the local connection with industry and STEM professionals. Students in an American history class should examine the growth of technology and science advancement, just as they would military conquests or boundless western expansion. In math and science, STEM topics provide the connection to real local industries and can draw students attention with critical thinking topics.

3. Recommendations for Curriculum inclusion of STEM

If California is to improve STEM education, there must a model for STEM curricula. In the age of standardized testing, schools and teachers rely on the state to provide standards and approved curriculum. While there are a series of fifteen approved career technical education standards, the approved Engineering and Design Industry standards provide only general guidelines rather than industry specific content. As an example, in the engineering and design content area, one set of standards states that all students should:

> "C10.1 Understand the process of producing proportional two- and three-dimensional sketches and designs.

> C10.2 Use sketching techniques as they apply to a variety of architectural and engineering models.
> C10.3 Use freehand graphic communication skills to represent conceptual ideas, analysis, and design concepts" (CTE Framework, 2005).

These are undoubtedly important engineering skills but as STEM extends beyond engineering, the above standards have little relevance in computer or biomedical sciences. There must be the realization that industry demands vary across the many regions of the state. Acknowledging the geographic mobility of the state's populations especially for higher education, schools should connect with local STEM industries to develop a set of skills and practices that prepare students for entering the workforce prepared. As technology and industry practices change, the curriculum should have the flexibility at the local level to adopt and include these new industry changes.

4. Recommendations for Funding for STEM programs

California is in the process of recovering from one of the worst financial collapses in state history. Funding for higher education and K-12 have been slashed in recent years. Categorical funding for specific programs has been reduced or eliminated, yet still there is the immediate need to support and expand STEM education across the state. California is in a race with other states and nation to attract the industry and employees that will lead the STEM revolution of the next decade. Failing to appropriately fund education and training for today's K-12 students will result in a decade of missed opportunities for STEM workers in the state. As the economy grows, these short-term cuts will hopefully be restored as the current financial crisis passes.

Still, ignoring the current problems, there is a systematic funding problem for education in California. As a national leader in the STEM fields, California should be collecting far more in federal grant dollars. With the recent focus on STEM education by President Obama, a Congressional report identified nearly $3.4 billion in annual grants available for STEM programs across all federal agencies (National Science and Technology Council, 2011).

While there is not a specific dollar amount or grant program the state should pursue, the summary of aforementioned legislative efforts in other states should provide guidelines. Funding is needed for:

1. Grants and scholarships for students committed to studying and working in STEM in California
2. Professional development for K-12 STEM teachers
3. Grants to schools and district for facilities, equipment and program development to support STEM curriculum

To prevent over-reliance on competitive grant awards, there should be a set-aside of general fund education dollars to support STEM programs at the state and local level. The current budget crisis may delay the availability of this funding, so in the interim, states and local districts can look to the federal government, the National Science Foundation and non-profits for grant funding. There is more than $3 billion in federal grants annually across the STEM fields.

Additionally, the clear connection between STEM education in K-12 schools and higher education and the STEM industries across the state lends itself to public-private partnership administered at the state and regional levels.

5. Recommendations for Inclusion of Underrepresented Populations

California must adopt a statewide effort to encourage minority enrollment in STEM programs. No state has successfully implemented a large-scale program aimed at narrowing the gap in STEM participation between whites and Asians and other minority groups. Various states have tried to encourage enrollments especially in Illinois where grants and scholarships are awarded based in part upon efforts to recruit females and minorities and to instill parity between racial makeup of the engineers and the overall workforce. However, even tying purse strings to STEM funding, will not hurting efforts to raise the number of women and minorities is not a panacea for the problem. States, without the ability to consider race or as part of admission to public higher education, have limited ability to promote minority enrollment at public universities. Moreover, the state has little influence in shifting cultural and societal pressures that may keep minorities from pursuing STEM careers. The only practical action is to improve access to college preparatory courses across the state, especially in areas with large minority populations as early engagement of minority students opens the door to both higher education and STEM professions. This could be done with targeted categorical grant funding. To some extent, this change is already underway. Between 1999 and 2008, the number of blacks taking AP exams increased 249%, Hispanics increased 233%, while white increased by 113% (NCES Race and Gender Trends, 2010).

Unfortunately, even with increasing the number of minorities and women entering the STEM pipeline, there is a significant amount of "leakage" prior to completion. Students studying math and science in secondary rarely end up in STEM careers. This problem is noted by Norm Augustine, chair of the National Academies Committee on Prospering in the Global Economy of the 21st Century.

"As one might suspect, there is a great deal of leakage along that extended educational highway. To begin with, about one-third of U.S. eighth-graders do not receive a high school diploma. And of those who do, about 40 percent do not go on to college. About half who do begin college do not receive a bachelor's degree. Of those who do receive such a degree, two-thirds will not be in science or engineering."

Norm Augustine, 2007 House Testimony

6. Recommendations for State/Local Administrative Actions

California needs to continue the CA Task Force on STEM Education until at least 2020 to support the development of policies enhancing STEM Education across the state. Under the umbrella of this task force, the California Department of Education should apply for federal grants and private partnerships to support the funding needs for STEM education development and implementation.

As K-12 teachers provide early exposure to the world of STEM, educators should be versed in the latest technology and advances in science and engineering. Connection with local industry provides the bridge by which industry can infuse the latest developments into the classroom.

Finally, administrative action at the state level should not only support and encourage STEM development but also should not hinder program development. Currently the California Task Force on STEM education is set to expire in 2014. As STEM professions will expand for at least the next decade, this task force should be reauthorized to continue its research and coordination efforts.

Recommendation Summary

If California intends to seriously pursue high paying, high skill jobs in the engineering and technologies industry into the future, STEM must be a priority in K-12 education. First, there needs to be a determination of what are the actual needs for STEM professionals in the next decade both in terms of what positions need to be filled and what skills are needed for those jobs. This will require an investment from the Legislature but only as a small part of overall STEM funding. Second, there is a need for better curriculum applicable to STEM careers. Just as not every student is going to college, not every student will pursue a STEM career. However, STEM training should be offered and available to all students. Curriculum development will only be a small portion of the funding required. The vast majority will be spent in grants supporting development, implementation and maintaining STEM programs across the state. As STEM careers will vary across the regions of the state, implementation of a uniform STEM curriculum would be difficult and ineffective in achieving the goal of training more STEM professionals.

Within the STEM industry, there is historic underrepresentation of minorities and women. As minority enrollment in college grows and women graduates continue to outpace their male counterparts, it is crucial that STEM participation rates grow for these populations. Evidence from the literature review suggests there are cultural and social pressures against participation in STEM beginning as early as elementary and middle school. Changes to professional development and curriculum should aim to excite and include all students in the growing STEM fields.

APPENDICES

APPENDIX A

2007 Trends in International Mathematics Achievement, 8th Grade

Year	Jurisdictions	Average scale scores	Standard error
2007	International Average	500	(0.0)
	Chinese Taipei	598	(4.5)
	Korea, Rep. of	597	(2.7)
	Singapore	593	(3.8)
	Hong Kong SAR	572	(5.8)
	Japan	570	(2.4)
	Hungary	517	(3.5)
	England	513	(4.8)
	Russian Federation	512	(4.1)
	United States	*508*	*(2.8)*
	Lithuania	506	(2.3)
	Czech Republic	504	(2.4)
	Slovenia	501	(2.1)
	Australia	496	(3.9)
	Sweden	491	(2.3)
	Italy	480	(3.0)
	Israel	463	(3.9)
	Ukraine	462	(3.6)
	Romania	461	(4.1)
	Bosnia and Herzegovina	456	(2.7)
	Lebanon	449	(4.0)
	Thailand	441	(5.0)
	Turkey	432	(4.8)
	Georgia	410	(5.9)
	Iran, Islamic Rep. of	403	(4.1)
	Syrian Arab Republic	395	(3.8)
	Egypt	391	(3.6)
	Colombia	380	(3.6)
	Palestinian Nat'l Auth.	367	(3.5)
	Kuwait	354	(2.3)
	Saudi Arabia	329	(2.9)
	Ghana	309	(4.4)

Source: National Center for Education Statistics- International Data Explorer, 2011

Appendix B

2012 State by State Report Card on STEM Education Policies

	State Recruitment of STEM Teachers	Targeted STEM Professional Development	State Support for Pre-AP	End of Course Exams for STEM	Internships for Students	Dual/Early Enrollment in STEM College Programs	After School STEM Programs with State Support	College Readiness Assessments in math & science	Rigorous Graduation requirements in math and science	STEM targeting females, minorities with State support
Alabama	■	■	■				■		■	
Alaska										
Arizona	■						■		■	
Arkansas	■	■	■	■				■	■	
California	■	■				■		■		■
Colorado	■	■					■	■		■
Connecticut	■				■	■				
Delaware	■	■							■	■
Florida	■	■			■	■		■		■
Georgia	■	■	■	■					■	■
Hawaii	■	■								
Idaho										
Illinois	■	■	■		■			■		
Indiana		■	■	■					■	
Iowa	■	■								
Kansas	■					■				
Kentucky	■	■	■	■	■		■	■	■	
Louisiana	■	■		■			■	■		
Maine		■						■		
Maryland	■			■						
Massachusetts	■	■		■						
Michigan		■		■		■		■	■	
Minnesota		■	■	■				■	■	
Mississippi	■		■	■				■		

	State Recruitment of STEM Teachers	Targeted STEM Professional Development	State Support for Pre-AP	End of Course Exams for STEM	Internships for Students	Dual/Early Enrollment in STEM College Programs	After School STEM Programs with State Support	College Readiness Assessments in math & science	Rigorous Graduation requirements in math and science	STEM targeting females, minorities with State support
Missouri	■			■			■			
Montana	■									
Nevada	■						■			
New Hampshire						■				
New Jersey				■						■
New Mexico	■	■	■					■	■	■
New York	■			■	■					■
North Carolina	■			■				■	■	
North Dakota	■									
Ohio	■			■		■		■	■	■
Oklahoma	■	■	■	■				■	■	
Oregon										
Pennsylvania	■			■						
Rhode Island				■						
South Carolina	■	■						■		
South Dakota									■	
Tennessee	■			■			■		■	
Texas	■	■	■	■	■		■	■	■	■
Utah	■	■		■	■		■			■
Vermont	■									
Virginia	■			■					■	
Washington	■	■			■		■	■		■
West Virginia	■			■				■	■	
Wisconsin			■							■
Wyoming	■							■		
District of Columbia				■						

Source: Education Commission of the States, 2012.

Appendix C

Proposed and Enacted Legislation: 2001-2012
50 States and Federal Legislation

State	Action	Date	Bill Title	Summary
AR	Signed into Law	4/2009	H.B. 1273	Creates Mobile Technology Platforms in converted school buses with math and science software meeting state standards
AR	Signed into Law	4/2007	H.B. 1682	Funding for State Science and Technology Authority for R and D on improving and enhancing STEM facilities in K-12 schools
AR	Signed into Law	3/2007	H.B. 2414	Creates fund for attracting qualified STEM teachers with industry competitive salary enhancements.
AR	Signed into Law	4/2005	H.B. 2540	Arkansas Commission for Coordination of Educational Efforts. Adds to the commission's duties, requiring the commission to make recommendations to improve science, technology, engineering and mathematics education from kindergarten through the bachelor's level in higher education, and make recommendations to improve the use of educational technology
AZ	Issued	4/2006	E.O. 7;	Governor's Council on Innovation and Technology: The Council will be charged with the following duties: 1) Strengthening the innovation and technology infrastructure of Arizona; 2) Enhancing university research and education in high tech fields; 3) Inspiring cooperation between industry and university research; and 4) Creating and retaining high quality jobs in Arizona.
CA	Signed into Law	4/2011	S.B. 1	Requires the superintendent of public instruction to award grants to districts that propose to implement or maintain a partnership academy focused on employment in clean technology businesses and renewable energy businesses, and that provides skilled workforces for products/services related to energy and/or water conservation, renewable energy, pollution reduction, or other technologies. Requires the controller annually to allocate $8,000,000 from the Renewable Resource Trust Fund or other related fund
CA	Vetoed	9/2010	S.B. 964	Requires the High-Speed Rail Authority to contract with the Employment Development Department to develop a labor market assessment of the workforce and identify the education and skills needed for construction, operation and maintenance of the high-speed train system.

CA	Vetoed	9/2010	S.B. 1444	Defines STEM education as courses or a sequence of courses that prepare pupils for occupations and careers that require technically sophisticated skills, including the application of mathematical and scientific skills and concepts. Expresses the legislature's intent that the superintendent of public instruction allocate funds designated for STEM education consistent with the definitions set forth in the bill.
CA	Signed into Law	8/2010	A.C.R. 88	Establishes, until January 1, 2014, the California Task Force on Science, Technology, Engineering and Mathematics Education for the purpose of promoting the improvement of mathematics, science, engineering, and technology education across the state. Provides the task force consists of members of the legislature and experts appointed by the speaker of the assembly and the senate committee on rules. Provides the duties of the task force are to (1) increase legislative awareness about mathematics, science, engineering, and technology education issues, (2) inform legislators regarding trends in mathematics, science, engineering, and technology education, and (3) raise awareness among the public regarding the shortage of Californians prepared to contribute to the state's future technology workforce. Directs the task force to submit an annual report on its work to the legislature
CA	Signed into Law	10/2009	SB 471	Creates the Stem Cell and Biotechnology Education and Workforce Development Act of 2009. Establishes stem cell and biotechnology education and workforce development as a state priority and to promote stronger links among industry sectors, the state Institute for Regenerative Medicine and public schools. Directs the department to promote stem cell and biotechnology education and workforce development in
CA	Vetoed	9/2008	A.B. 2471	Establishes the Digital Arts Studio Partnership and Workforce Program to train youth in digital technology skills
CO	Signed into Law	5/2007	H.B. 1243	Establishes the science, technology, engineering, and mathematics ("STEM") after-school education pilot grant program ("grant program") in the office of economic development. Allows a provider that coordinates STEM after-school education programs to apply for a grant to defray the administrative and personnel costs associated with coordinating the programs and to directly support secondary schools' participation in the programs.

DE	Issued	1/2010	Exec. Order #15	Creates the Delaware STEM Education Council to (a) strengthen cross-disciplinary dialogue between teachers and stakeholders in STEM subjects; and (b) leverage the members' collective expertise regarding the STEM-based initiatives currently underway to identify the most effective programs and curricula.
DE	Issued	6/2006	EXECUTIVE ORDER NOS. 88 and 93	Executive Order No. 88 establishes the Delaware Science and Technology Council to: (a) Improve the competitive position of Delaware so that it is recognized broadly as a center of excellence in science and technology; (b) Provide advice, guidance and advocacy on issues and opportunities in research, education, business, economic development and public policy; (c) Develop and implement a statewide science and technology strategic plan; (d) Foster Delaware's uniqueness as a dynamic place for scientific and business talent by developing an innovative, entrepreneurial and business friendly environment, facilitating incubation and commercialization and encouraging collaborations within the State and the region; (e) Identify and secure resources to support Council initiatives in cooperation with the Council on Competitiveness and other appropriate state and regional initiatives;
FL	Signed into Law	6/2007	S.B. 1232	Creates the State Career and Professional Education Act to improve academic performance and to respond to workforce needs; requires a school district to develop strategic plans to address and meet local and regional workforce needs and to establish a career and professional academy; requires career courses lead to industry certification; requires a specified number of students must achieve certification or college credit for a course to continue; provides for transfer of credits to state university system.
FL	Signed into Law	5/2006	H.B. 1237	Creates 21st Century Technology, Research, and Scholarship Enhancement Act; creates Florida Technology, Research, and Scholarship Board within Board of Governors of State University System; requires that board provide recommendations for 21st Century World Class Scholars Program and Centers of Excellence Program; requires minimum investment of private funds; creates a State University System Research and Economic Development Investment Program to provide funds.

HI	Signed into Law	6/2007	S.B. 907	Creates the Office of Aerospace Development to coordinate space activities and identify and promote opportunities for expanding and diversifying aerospace-related industries in the state, which may include a Pacific International Center for space exploration system. Promote innovative education and workforce development programs that will enhance public awareness of the state's aerospace potential and enable residents to pursue employment in Hawaii's aerospace industry
HI	Signed into Law	5/2007	S.B. 885 (Section 1-10)	Directs the department of education to establish and administer a career and technical education program that meets the requirements of the federal Perkins Act of 2006. Provides the department's program may include: (1) Pathway programs of study, including but not limited to natural resources, graphic design, computer networking, and management information systems; (2) Academies for various focuses of study, including the performing arts, travel, and science, technology, engineering, and mathematics; (3) An agriculture education program; (4) Specialized programs, including project EAST (environmental and spatial technology); and (5) Other school activities, including robotics.
IA	Issued	8/2011	Executive Order #74	Orders the creation of the Governor's Science Technology, Engineering and Mathematics ("STEM") Advisory Council in order to strengthen science, technology, engineering and mathematics education as part of providing a world-class education, encouraging innovation and enhancing economic development.
IA	Signed into Law	7/2011	H.F. 645 - Multiple Sections	Establishes the Iowa online advanced placement academy science, technology, engineering, and mathematics initiative within the international center for talented and gifted education at the state university of Iowa, to deliver, with an emphasis on science, technology, engineering, and mathematics coursework, pre-advanced placement and advanced placement courses to high school students throughout the state, provide training opportunities for teachers to learn how to teach advanced placement courses in Iowa's high schools, and provide preparation for middle school students to ensure success in high school.

IL	Signed into Law	8/2011	H.B. 1256	Creates the Diversity in Engineering Scholarship Program. Defines "targeted group member" as a person belonging to a class of race, color or sex, whose percent of the workforce within the Department of Transportation's professional classification that includes civil engineers is less than that class's percent of the statewide labor market for such job activities as recorded in the Department's annual affirmative action plan.
IL	Signed into Law	7/2011	S.B. 621	Permits 4 or more contiguous districts at least partially in the same municipality to jointly operate, through an institution of higher education located in the municipality, a science and mathematics partnership school for serving some or all of grades K-8.
IL	Veto Overridden	9/2008	S.B. 2632	Subject to appropriation, requires the department of commerce and economic opportunity to conduct a study to identify current and projected shortages in critical occupations and specific skill sets within businesses and industries, and to devise strategies to alleviate any identified shortages.
IL	Adopted	4/2006	14 IAC 110.170	Identifies 10 criteria the department must use when reviewing grant proposals and making awards for the High Technology School-to-Work Program. Criteria include the appropriateness of the targeted industries and occupations; the appropriateness of the targeted student population; the efforts to recruit female and minority students into the project; and the strength of the local partnership and private sector involvement.
IL	Adopted	11/2005	14 IAC 110.170	The goal of the High Technology School-to-Work Program is to improve education and to prepare Illinois' students to transition from school to high skilled, high paying jobs in the areas of science, mathematics, and advanced technology.
MA	Issued	8/2007	Executive Order No. 489	Establishes the Readiness Project to develop a plan to implement fundamental and systemic reforms to public education in the Commonwealth over the next ten years. The project will have three chairs appointed by the Governor. The plan will include recommendations to: (1)... (4) Align curricula from pre-Kindergarten through high school, higher education and work force development, including with an emphasis on science, technology, engineering and math as well as other subjects and methods that enhance creativity and problem-solving skills;

MD	Signed into Law	4/2009	S.B. 235	Establishes the MDK12 Digital Library for the purpose of providing access to digital content for K-12 students and educators, improving school library programs with digital technologies, and connecting digital content with State science, technology, engineering, and math initiatives; provides that the library is a purchasing consortium for the acquisition of digital content; establishes a steering committee; provides for professional development for librarians and educators with regard to the library.
ME	Signed into Law	6/2011	S.P. 490	Establishes the Science, Technology, Engineering and Mathematics Council to develop strategies for enhancing science, technology, engineering and mathematics (STEM) education from prekindergarten through postsecondary education.
ME	Signed into Law	2/2010		Directs the state department of education to conduct a study to provide comprehensive baseline data to support state and local efforts to improve science, technology, engineering and mathematics learning (STEM).
ME	Signed into Law	6/2009	S.B. 412	Directs the Department of Education to collect information on science, technology, engineering and math initiatives in consultation with public and private partnerships, businesses, pilot projects and nonprofit and other organizations that are already working with STEM issues by November 1, 2009. The department shall focus on finding ways to inspire young people in prekindergarten to grade 12 to become interested in the science, technology, engineering and math.
ME	Issued	12/2006	EXECUTIVE ORDER 23 FY 06/07	Establishes the Governor's Council on Jobs, Innovation, and the Economy to: 1. Develop a recommended action plan for moving the state forward on the innovation-focused and cluster development activities that will define the state's investment strategies.
MO	Signed into Law	6/2009	H.B. 506	Requires the Governor to annually issue a proclamation declaring the third week of March as Math, Engineering, Technology, and Science Week.
NC	Signed into Law	7/2010	S.B. 1198	Requires the education cabinet to set as a priority an increase in the number of students earning postsecondary credentials in the fields of science, technology, engineering, and mathematics (STEM) to reduce the gap between needed credentialed workers and available jobs in those fields by 2015.

NC	Signed into Law	7/2009	S.B. 1069	Establishes the joint legislative Joining Our Businesses and Schools (JOBS) Study Commission to study issues related to economic development through instructional program frameworks that aid in the transition to postsecondary education and future careers, including technical and vocational needs of each economic development region, employment and workforce preparation needs of the State as a whole, and the shortage of highly skilled employees such as technicians, teachers, and allied health practitioners.
ND	Signed into Law	3/2011	S.B. 2289	Modifies the state department's program of grants for innovations in schools (science or technology projects or programs). Amount of grants is capped at $7,500 for K-12 level; at $20,000 for higher education. Allows the Department to require matching funds.
NH	Signed into Law	6/2008	H.B. 1282	Expands the Department of Education's pre-engineering technology curriculum in public schools program for students in specified grades interested in engineering careers; removes digital electronics and computer integrated manufacturing from the course requirements; requires the evaluation of existing programs.
NM	Signed into Law	4/2009	S.B. 205	Enacts the New Mexico Research Applications Act; provides for a nonprofit corporation to interact with business and government entities, universities, private foundations and national laboratories for the purpose of fostering economic development in the areas of technology and intellectual property;
NM	Signed into Law	4/2007	S.B. 422	Creates the Alliance for Underrepresented Students at New Mexico State University. The purposes of the alliance are to: (4) collaborate with and provide assistance to k-12 grade educators and postsecondary educational institutions to support STEM education and student achievement.
NM	Vetoed	4/2007	H.B. 900	Broadens the scope of university research and economic development. Forges links between New Mexico's educational institutions, business and industrial communities and government through the development of research parks on university property. Engages in other cooperative ventures of innovative technological significance that will advance education, science, research, conservation, health care or economic development within the state.
NY	Vetoed	10/2009	A.B. 7229	Creates the Academic Research Information Access (ARIA) Program for the benefit of persons operating in the fields of science, technology, and medical research and development.

OH	Signed into Law	6/2011	H.B. 153 - Funding for STEM School Facilities	Permits the Ohio school facilities commission, upon receipt of a written proposal by the governing body of a STEM school, to provide funding to assist the STEM school in acquiring classroom facilities. Requires the STEM school to pledge at least a matching amount of non-state funds.
OH	Signed into Law	7/2009		Amends provisions related to the two-year provisional educator license for teaching science, technology, engineering or math in grades 6-12 in a STEM school. Adds meeting all other requirements for a professional educator license to the requirements a provisional educator license-holder in a STEM school must meet to be issued a professional educator license.
OH	Signed into Law	7/2009	H.B. 1 - Section 3333.62, 3333.66	Amends selection criteria for postsecondary institutions' funding proposals for the choose Ohio first scholarship program, which supports undergraduate and/or graduate education for Ohio residents in STEM fields, medicine and STEM education
OH	Adopted	10/2008	OAC 3333-1-61, -61.1 thru -61.5	The Ohio innovation partnership, consisting of the choose Ohio first scholarship and the Ohio Research scholars program, aims to strengthen the state and its citizens to compete in the fields of science, technology, engineering, and mathematics (STEM), as well as medical fields and STEM education. The choose Ohio first scholarship program will support undergraduate and graduate education by Ohio students in STEM fields and medicine.
OH	Adopted	10/2008	OAC 3333-1-62, -62.1 thru -62.5	Proposes new rules regarding the Ohio Research Scholars Program. Provides general guidelines for proposals; objectives to be reflected in proposals; the review process; awards and agreements; and funding of the program. The Ohio innovation partnership, consisting of the choose Ohio first scholarship and the Ohio research scholars program, aims to strengthen the state and its citizens to compete in the fields of science, technology, engineering, and mathematics (STEM), as well as medical fields and STEM education. The Ohio research scholars program will support an increase in highly-qualified research talent in critical STEM and medical areas with a focus on long-term regional economic development.
OH	Adopted	9/2008	OAC 3301-23-41, -24-15	Creates forty-hour temporary teaching permit for qualified non-licensed individuals. Amends qualifications for temporary teaching permit for non-licensed individuals. Adds rule creating two-year provisional educator license for STEM schools.

OH	Signed into Law	10/2007	H.B. 119 - STEM Provisions	Establishes the STEM Subcommittee of the Partnership for Continued Learning; sets governance; authorizes the subcommittee to accept proposals and approve grants to up to five STEM schools that will serve any of grades 6-12 to open for instruction in FY 2009.
OH	Signed into Law	6/2006	H.B. 115	Appropriates funds for support of the Ohio Core Program. Funds will be used to: (1) Support the participation of teachers licensed in Ohio and mid-career professionals not currently employed by a school district or licensed to teach at the primary or secondary education levels in a twelve-month intensive training program that leads to teacher licensure in a laboratory-based science, advanced mathematics, or foreign language field at the secondary education level and employment with an Ohio school district;
PA	Veto Overridden	11/2010	H.B. 101 - Article XV-F	Codifies existing "Science in Motion" program. Authorizes the department to administer a grant program to higher education institutions that establish partnerships with schools or districts to provide for the lease or purchase of scientific or technical equipment for use in science classrooms.
TN	Issued	7/2010	Executive Order #68	Establishes the Tennessee STEM Innovation Network within the department of education and requires the department to undertake various STEM activities in coordination with local education agencies, including but not limited to teacher professional development and curriculum development.
TX	Adopted	7/2011	19 TAC 102.1093	Establishes the requirements necessary for a school to be designated as a T-STEM Academy.
TX	Signed into Law	6/2011	S.B. 1620	Defines an "applied STEM course" as a STEM course offered as part of a school district's career and technology education curriculum. Directs the state board to establish a process for the review and approval of applied STEM courses to satisfy the math and science requirements for the recommended high school program, to be substituted for a specific math or science course. Directs the state board for educator certification to specify that to obtain a certificate to teach an "applied STEM course" at a secondary school, the candidate must pass the certification test administered by the recognized national or international business and industry group that created the curriculum the applied STEM course is based on, and have at least an associate's degree and 3 years work experience in an occupation the applied STEM course is intended to prepare students for.

TX	Signed into Law	6/2011	H.B. 2910 - T-STEM Challenge Scholarship Program	Establishes the Texas Science, Technology, Engineering, and Mathematics (T-STEM) Challenge Scholarship program. Establishes initial and continuing student eligibility criteria, including that a student work no more than 15 hours a week for a business participating in the program.
TX	Signed into Law	6/2009	H.B. 2425	Authorizes private higher education institutions to participate in specified engineering recruitment programs, including one-week summer programs for middle and high school students, and scholarship programs for engineering students.
TX	Signed into Law	6/2009	S.B. 2262	Transfers 21.462, "Mathematics, Science and Technology Teacher Preparation Academies," to 61.0766. Allows a teacher with at least two years experience to participate in an academy program (prior legislation required eligible teachers to have at least five years experience).
TX	Signed into Law	6/2009	H.B. 3 - Section 61 and 63 (College Placement Testing and Math, Science Courses for High-Demand Occupations)	Provides that a student who has completed a recommended or advanced high school program and demonstrated the performance standard for college readiness on the Algebra II and English III end-of-course assessments is exempt from the placement testing requirement upon entering an institution of higher education.
TX	Vetoed	6/2009	H.B. 518, Section 3	Beginning in the 2012-13 school year, directs the higher education coordinating board to assist in repaying the eligible student loans of certain undergraduates who agree to teach math or science in districts determined by the state education agency to have teacher shortages in these subjects. Establishes the mathematics and science teacher investment fund to provide loan repayment assistance.
TX	Signed into Law	5/2007	H.B. 2978	Requires the Texas Higher Education Coordinating Board to design and administer a one-week summer program to take place on campuses that offer engineering degree programs and establish and administer a degree scholarship program for students who graduate with certain credentials
UT	Signed into Law	3/2009	S.B. 105	Changes the engineering, computer science and related technology student loan program to a scholarship program

UT	Adopted	9/2008	R277-492	Creates new R277-492 administering the Utah Science Technology and Research (USTAR) Initiative Centers Program. Establishes components that must be included in a district or charter school proposal for a USTAR grant award.
UT	Signed into Law	3/2008	S.B. 2 - Section 22	Establishes the Utah Science Technology and Research Initiative (USTAR) Centers Program to provide a financial incentive for charter schools and school districts to adopt programs that result in a more efficient use of human resources and capital facilities. Enumerates the potential benefits of the program:
UT	Signed into Law	2/2007	S.B. 53	Provides for an engineering partnership between Weber State University and Utah State University to meet the demand for electrical engineers in the state, including the demand at Hill Air Force Base, and appropriates funds for the partnership.
UT	Adopted	5/2006	R277-717	Changes made to definitions, proposal criteria, budget, state board funding priorities, proposal applications and timelines.
UT	Signed into Law	3/2006	S.B. 187	This bill establishes an informal science and technology education program within the Governor's Office of Economic Development; and 16 < provides program staffing, governance, and duties.
VA	Signed into Law	3/2011	H.B. 2172/S.B. 953	Requires the Board of Education to take into account in its guidelines for the Virginia Index of Performance program a school division's increase in enrollments and elective course offerings in science, technology, engineering, and mathematics.
VA	Signed into Law	3/2011		Establishes the Virginia Higher Education Opportunity Act of 2011 for the purpose of fueling strong economic growth in the Commonwealth and preparing Virginians for the top job opportunities
VA	Signed into Law	3/2006	H.B. 1244	Creates the Mathematics, Science, Engineering and Technology Career Grant Program to provide higher education grants to domiciles who are enrolled in an undergraduate program preparing students for careers in professions in the areas of mathematics, science, engineering, and technology; includes public or private nonprofit educational institutions.
WA	Signed into Law	12/2011	H.B. 2159	Requires the office of the superintendent of public instruction, subject to funds appropriated for the purpose, to allocate grants to: (1) high schools to implement a training program to prepare students for employment as entry-level aerospace assemblers; (2) skill centers to implement enhanced manufacturing skills programs; and (3) high schools to implement specialized courses in science, technology, engineering and mathematics (STEM)

WA	Signed into Law	12/2011	H.B. 2160	Directs the professional educator standards board to revise standards for the elementary education endorsement and middle level and secondary mathematics and science teacher endorsements as well as other subject area endorsements with STEM-related components, and establishes deadlines by which standards related to math and science must be revised. Requires that the revised standards integrate STEM knowledge and skill and be aligned with Common Core math standards, the 2009 revision of state mathematics student learning standards and performance expectations, the biology end-of-course assessment, and the 2012 student science learning standards, and next generation standards and related student performance expectations. Also requires that the endorsement standards include the concepts and instructional practices of the interdisciplinary connections with engineering and technology. Directs the professional educator standards board to revise assessments required for certification of prospective teachers and teachers adding subject area endorsements, so that these assessments measure the aforementioned revised standards. Requires the professional educator standards board, in implementing evidence-based assessment of teaching effectiveness, to require candidates for the residency certificate to demonstrate effective subject specific instructional methods that address the revised standards. Directs the professional educator standards board to revise certificate renewal rules for teachers at the elementary and secondary levels in STEM-related subjects by September 1, 2014. Specifies the revised rules must include the requirement that continuing education or professional growth plans for these teachers include a specific focus on the integration of science, mathematics, technology, and engineering instruction.
WA	Signed into Law	3/2010	H.B. 2621	Designates resource programs for science, technology, engineering, and mathematics instruction in K12 schools; requires the Superintendent of Public Instruction to designate schools to serve as resources and examples on how to combine a small, highly personalized learning community, an interdisciplinary curriculum with a strong focus on science, technology, engineering, and mathematics delivered through a project-based instructional approach, and active partnerships with business and the local community

WA	Signed into Law	4/2007	S.B. 5731	Establishes a committee on the education of students in high demand fields. The committee: (1) develops a plan to increase the capacity of Washington institutions of higher education by 10,000 students per year by 2020 to produce degrees in high impact, high demand areas of study; (2) develops a marketing project to inform students, parents, and educators of opportunities in high demand fields; (3) investigates ways to motivate students to take more mathematics and science courses; and (4) identifies ways that the business community can enter into more partnerships with the state to ensure that Washington institutions of higher education produce graduates in high demand fields that are ready and able to find employment in Washington.
WA	Signed into Law	4/2007	H.B. 1779	Establishes the GET ready for math and science scholarship program. The purpose of the program is to provide scholarships to students who achieve level four on the mathematics or science portions of the tenth grade Washington assessment of student learning or achieve a score in the math section of the SAT or the math section of the ACT that is above the ninety-fifth percentile, major in a mathematics, science, or related field in college, and commit to working in mathematics, science, or a related field for at least three years in Washington following completion of their bachelor's degree.
WA	Signed into Law	3/2006	H.B. 2817	Recognizes the vital importance to the state's economic prosperity and the economic benefit of placing a priority on enrolling and conferring degrees upon students in the fields of engineering, technology, biotechnology, science, computer science, and mathematics
WI	Signed into Law	4/2010	S.B. 437	Creates Section 119.315 to make schools that enroll pupils in grades K-5 eligible to apply for funding (if state or federal funding is available) to participate in a pilot program designed to develop innovative instructional programs in science, technology, engineering and mathematics; to support pupils who are typically under-represented in these subjects; and increase the academic achievement of pupils in those subjects.

WV	Signed into Law	4/2009	H.B. 3229	Creates the Science and Research Council to increase the capacity of the state and higher education institutions to attract, implement and use cutting- edge, competitive research funds and infrastructure through the Experimental Program to Stimulate Competitive Research, the Research Trust Fund and the Research Challenge Fund, encourage collaboration among public and private higher education institutions and the private sector and promote education in the fields of science, technology, engineering and math.
WV	Signed into Law	4/2006	H.B. 4690	(1) Increase West Virginia's capacity for high quality engineering instruction and research; (2) Increase access throughout the state to high quality instruction and research opportunities in science, technology, engineering, and math; (3) Stimulate economic development throughout West Virginia by increasing the number of professional engineers available to business and industry.

Source: Education Commission of the States, 2011

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