Florida STEM Strategic Plan

An Action Plan for Systemic Reform of STEM Education and Workforce Readiness

"If the United States had in recent years closed the gap between its educational achievement levels and those of better-performing nations such as Finland and Korea, GDP in 2008 could have been $1.3 trillion to $2.3 trillion higher. This represents 9 to 16 percent of GDP."

McKinsey & Company. (2009).
The Economic Impact of the Achievement Gap in America's Schools, p. 5,6.

April 2011

FCR-STEM Florida Center for Research in Science, Technology, Engineering, and Mathematics

STEM Strategic Plan Task Force

The STEM Strategic Plan Task Force consisted of more than 70 leaders from the business, industry, education, policy, and philanthropic communities. Together we researched, created, and revised this STEM Strategic plan over an 18 month period. Appendix A contains a complete list of Task Force Members.

The Task Force members above collaborated to revise the Florida STEM Strategic Plan during the February 1, 2011, work session. Members are listed from left to right.

Bottom Row: Latasha Fisher, Robert Weinberg, Mariel Milano, Laura Lang, Mabry Gaboardi, Artrease Spann, Jose Sanchez, Stacy Carlson, Kellen Nixon, David White, Paula Waller, Pamela Tedesco
Middle Row: Faye Jones, Ricardo Garcia, Maryke Lee, Percy Luney, John Hall, Bryan Kamm, Gerry Meisels, Marsha Hill, Deborah Kelly, Nancy Thompson, Paul Wahnish, Christi Moss, Danielle Sherdan, John Baker, Robert Schoen, Ginger Littleton
Top Row: Jimmie Davis, Jr., Jon Rogers, Eric Roe, Bruce Furino, Tony Anderson, Rabieh Razzouk

The attached release of the *Florida STEM Strategic Plan* arrives at a critical juncture in the Sunshine State's economic transition. Investments made in technology clusters, such as life sciences, appear to be taking hold, with Florida trailing only California in the growth of high-tech companies between 2003 and 2006. The continued health of these companies, however, depends on a readily available talent supply. The good news of employment growth in technology-related sectors is tempered by concerns that too much of the talent needed must be imported from other states and countries. Data points, such as those found on The Florida Scorecard (www.TheFloridaScorecard.com), illustrate the gap between workforce needs and workforce preparedness. In 2009, less than thirty percent of our 8th and 12th grade students performed at proficient or advanced levels on the National Assessment of Education Progress in science or mathematics. We must do better.

This imperative is not lost on the business community. The Florida Chamber Foundation's Talent Supply and Education Caucus recently identified innovation in science, technology, engineering and mathematics (STEM) education as its highest strategic priority. A year prior, the Florida Legislature increased high school graduation requirements in science and mathematics and instituted new end-of-course assessments in high school science and mathematics. Efforts are being made on many fronts, including business and industry, policy, K-12 and postsecondary education communities, and philanthropic organizations.

In order to affect real change, each of these efforts must be harnessed to leverage gains that only can be realized from coordinated, informed, strategic collaboration. This report furthers the state's progress toward such a cohesive platform. The product of countless hours of research, collaboration, and deliberation by its Task Force members and the hundreds of STEM-related organizations they represent, the contents found in these pages serve to inform the ongoing efforts of the Florida Chamber Foundation's Talent Supply and Education Caucus, as well as other STEM-focused programs and efforts. To this end, the Foundation pledges continued involvement in conjunction with ongoing efforts and those to follow, including the creation of a statewide STEM organization with broad-based representation across the spectrum of academic, business, philanthropic, and regional STEM leadership.

I encourage all Floridians to join in the efforts outlined in this STEM Strategic Plan; working together we can, will and must successfully accomplish these objectives and move Florida to a more globally competitive position. For more information on this Plan or on joining this effort, please contact The Florida Chamber Foundation.

Dale A. Brill, Ph. D.
President, Florida Chamber Foundation

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Executive Summary

STEM is an acronym for the fields of study of Science, Technology, Engineering, and Mathematics. STEM refers to both the subjects themselves and, importantly, to their integration. To be competitive in the global economy, we are challenged to develop and implement effective standards, curricula, and assessments that include and integrate all four fields of STEM.

The STEM Strategic Task Force, composed of over 70 members of the business, industry, education, policy, and philanthropic communities, relied on state of the state reports, literature reviews, roundtable discussions, and earlier initiatives to gain a clear picture of both the current and the desired STEM performance in Florida, and business-recommended and evidence-based strategies for overcoming that gap. With this information, the Task Force held face-to-face and virtual meetings to synthesize the statewide input and draft this strategic STEM plan for the state. The three goals below, with associated measurable objectives and action items included in this report, are the culmination of 18 months of effort by the Task Force. We, the Task Force, strongly suggest that Florida move quickly to implement this plan, that we may remain nationally and internationally competitive.

The Students

Goal 1: Increase the percentage of students successful at each level (PK-12 and postsecondary, including career and technical, undergraduate and graduate) to ensure our diverse population is:

- Capable of conducting real-world STEM projects and inquiry;
- Capable of authentic and collaborative problem solving;
- Proficient in applying multidisciplinary knowledge and skills through STEM;
- Proficient in English and other languages in order to succeed on a global scale; and
- Knowledgeable about and interested in STEM careers.

Goal 1 measurable objectives have two main areas of focus:

- Increasing the performance of all students and their interest in STEM, and
- Decreasing the gaps in interest and achievement between groups of students.

Key action items, listed below, should be implemented by 2013 if the measureable objectives are to be met.

- Sequence the curriculum to promote maximum student learning. Concepts should build on one another as students progress and students must be expected to apply learning.
- Improve assessments to encourage proficiency in applying STEM skills and content knowledge, particularly in technology and engineering.
- Provide teachers with effective STEM curricula and resources that exemplify the integration of STEM.
- Integrate technology and engineering content standards into the state standards at all grade levels.
- Create technology and engineering course requirements for the middle grades.

- Increase the number of career academies in Florida that are STEM focused.
- Disseminate information and resources to parents about how to support their children's STEM education and choice of STEM careers.
- Incorporate strategies shown by programs in Florida and other states to be successful in attracting all students, including underrepresented minorities, to STEM or STEM-related majors.
- Increase awareness of and access to financial aid for postsecondary degrees and certifications, particularly in STEM majors.
- Utilize workforce development systems (e.g., Regional Workforce boards, Employ Florida Banner Centers and career academies) and industry representatives to familiarize students with careers.

Supporting action items, included within the goal sections, may take place over a longer time frame.

The Educators

Goal 2: Increase the quality and quantity of STEM educators.

All educators who teach STEM at any level are STEM educators. This includes, but is not limited to, grades PK-5 teachers, grades 6-12 STEM teachers, principals, guidance counselors, and postsecondary STEM educators, including instructors at universities, colleges, technical programs, and in industry settings. We suggest that all STEM educators should be knowledgeable about STEM, should be able to effectively guide learning, and should recognize and collaboratively teach to the integrated nature of STEM.

In order to meet student achievement objectives within Goal 1, key action items for Goal 2 focus on professional development and support for educators currently impacting student performance.

- Identify or create scalable programs that show evidence of positively impacting educator learning, practice, and student achievement for both incoming and practicing educators.
- Increase the number of high-quality STEM research experiences for educators.
- Engage educators in job-embedded professional learning communities.
- Require teachers, principals, guidance counselors, and post-secondary STEM educators to participate in high-quality professional development.
- Secure funding for the dissemination of high-quality educator professional development programs.
- Streamline the process to remove ineffective educators.
- Continue to research the effectiveness of performance pay for educators.
- Create incentives for the hiring and retention of experienced, effective mathematics and science teachers in low-performing schools that often serve a high proportion of minority and low-income students.
- Provide cultural competency training to PK-20 educators.
- Work with teacher preparation programs in Florida's colleges and universities to implement the supporting action items related to undergraduate programs.

Supporting action items, to be enacted over a longer time period, are related to recruitment of knowledgeable incoming STEM educators/practitioners and the equitable placement of STEM educators to ensure that all students have access to high-quality teaching.

Sustainable Infrastructure

Goal 3: Create a statewide sustainable STEM leadership organization to align existing and emerging STEM initiatives and represent Florida as one voice in meeting STEM demands.

Leadership and organization are required to ensure that the recommendations of this plan are acted upon quickly and are updated as necessary to meet local, state, national, and international STEM demands. For this purpose, we recommend as the most immediate priority of this plan the creation and maintenance of an industry-driven Florida STEM leadership board to align the voices, needs, and resources of industry, educators, philanthropists, policymakers, parents, and students. Once this board is created, additional objectives, described within Goal Section 3, must be addressed in order to support long-term sustainability.

Suggestions as to the roles and responsibilities of the Florida STEM leadership board are described below.

- Develop and maintain collaborative relationships with regional STEM councils.
- Communicate with regional councils to identify short and long-term local industry workforce training/certification needs.
- Oversee, track, and report progress on implementing the Florida STEM Strategic Plan.
- Identify and disseminate best practices and resources from successful STEM initiatives.
- Identify funding sources to support STEM initiatives within the state.
- Organize, secure funding for, and implement a statewide, STEM outreach campaign.
- Inform and influence state policy about STEM-related matters.
- Create a sub-panel to review approaches for integrating technology and engineering content standards into the Next Generation Sunshine State Standards (NGSSS) and/or the Common Core State Standards (CCSS) and make recommendations to the Florida STEM leadership board.

STEM in Florida: Where do we stand?

Many states have adopted effective innovation practices—if not yet a comprehensive innovation agenda—by making investments in K–12 education and raising science, technology, engineering, and math (STEM) standards; using their role as the main funders of higher education to improve these institutions' production of math and science-related degrees; and linking research and development to key industrial, economic, and labor and skills targets.[1]

A variety of economic studies over the years reveal that half or more of the growth of the nation's Gross Domestic Product (GDP) in recent decades has been attributable to progress in technological innovation.[2]

Currently, students in Florida perform below students in many other states and nations on science and mathematics assessments. As students in Florida progress through our public schools from elementary to high school, their performance declines relative to that of their peers in other states and nations.[3] Additionally, achievement gaps in Florida between White, Hispanic, and African American students increase from elementary to high school.[4] Nearly half of the high school graduates entering Florida's community colleges require remediation in mathematics.[5] Less than 25 percent of bachelor's degrees awarded through Florida's State University System (SUS) in 2010 were in STEM fields,[6] though 9 of the 10 highest paying careers in Florida are in STEM fields.[7] Industry leaders consistently report a shortage of qualified professionals to fill STEM positions and note the increasing need for employees in all positions who are STEM literate and capable of engaging in collaborative problem solving.[8]

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[1] National Governors Association. (n.d.). *Innovation America: A final report*. Washington, DC: Author. p. 2. Retrieved October 20, 2010, from http://www.nga.org/portal/site/nga/menuitem.1f41d49be2d3d33eacdcbeeb501010a0/?vgnextoid=b1da18bd4bae0110VgnVCM1000001a01010aRCRD.

[2] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2010). *Rising above the gathering storm, revisited: Rapidly approaching category 5.* Washington, DC: National Academies Press. p. 18. Retrieved October 20, 2010, from http://www.nap.edu/openbook.php?record_id=12999&page=1.

[3] According to the National Assessment of Educational Progress (NAEP; see http://nces.ed.gov/nationsreportcard/states/) and Trends in International Mathematics and Science Study (TIMSS; see http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2009001), each of which are administered in the 4th and 8th grades, and the Programme for International Student Assessment (PISA; see http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2008016) given to students at age 15. Additionally, the performance of Florida's students is related to that of students of other nations by linking NAEP and TIMSS scores by Phillips, G. W. (2007). *Chance favors the prepared mind: Mathematics and science indicators for comparing states and nations.* Washington, DC: American Institutes for Research. Retrieved March 10, 2011, from www.air.org/files/phillips.chance.favors.the.prepared.mind.pdf.

[4] Florida Comprehensive Achievement Test (see http://fcat.fldoe.org/mediapacket/2009/pdf/09pressPacketGR3_10_MathGraphs.pdf).

[5] Florida Department of Education. (2009). *Florida public high school graduates: State summary by type of institution attended.* Tallahassee, FL: Author.

[6] Board of Governors Interactive University Data website (http://www.flbog.org/resources/iud/).

[7] Florida Research and Economic Database (http://fred.labormarketinfo.com/).

[8] From the STEM*florida* 2010 Business Roundtables described in a following section.

The picture is not entirely bleak: Florida's student and teacher data-tracking system is among the best in the nation,[9] its standards for mathematics were rated among the highest in the nation,[10] and development of the CPALMS website,[11] providing high-quality STEM resources linked to Florida's standards, has received national and international attention. Additionally, there are many points of light in the state, from industry-sponsored student mathematics competitions[12] to teacher research experiences funded by the National Science Foundation (NSF),[13] but these piecemeal initiatives lack the necessary coherence to transform the STEM landscape in our state.

Many other states and nations lead Florida in the initiative to align STEM education and workforce needs, adopt globally competitive standards for all STEM fields, and create a fertile environment for innovation. If we are to remain nationally and internationally competitive, we too must collaborate to provide a world-class education for all of our citizens, rich in inquiry and real-world experiences that will provide them an advantage in the global market.

What is STEM and why does it matter?

> Science, technology, engineering, and mathematics are closely interlinked areas—so closely interlinked that it is often difficult to know exactly where one starts and the other ends.[14]

STEM, originally coined SMET in the 1990's by the NSF, is an acronym for the fields of study of Science, Technology, Engineering, and Mathematics. STEM refers to both the subjects themselves and, importantly, to their integration. Science is the study of the natural world and mathematics is the study of patterns and relationships. Both have been part of the core academic curriculum in the United States for many years. Technology and engineering have typically not been integrated into the core academic curriculum, and are not as widely understood by the general public. Technology is the study of our "human-made" world. Engineering is the systematic process used to develop solutions to human needs and wants utilizing math and science to create technology.

Many examples of STEM can be found in our everyday world. Inventions such as automobiles, laptop computers, and new medicines, as well as pencils, light bulbs, and plastic, are a part of everyday life in the 21st century. Although most people's lives involve working with objects made by humans, technology and engineering have not found their way into our mainstream education system. This has become a national concern.

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[9] See www.fldoe.org/arm/pdf/afs.pdf.
[10] Carmichael, S. B., Martino, G., Porter-Magee, K., & Wilson, W. S. (2010). The state of state standards – and the common core – in 2010. Washington, DC: Thomas B. Fordham Institute. Retrieved October 20, 2010, from http://www.edexcellence.net/publications-issues/publications/the-state-of-state.html.
[11] See http://www.floridastandards.org/.
[12] See http://www.fleng.org/mathcounts.cfm.
[13] See http://www.magnet.fsu.edu/education/ret/.
[14] WestEd. (2010). Technology and Engineering Literacy Framework for the 2014 Nation Assessment of Educational Progress: Pre-Publication Edition. San Francisco, CA: Author. p. 1.10. Retrieved November 10, 2010, from http://www.nagb.org/publications/frameworks/prepub_naep_tel_framework_2014.pdf.

Near the end of the 19th century, the quest to identify what to teach in public education centered on subjects not typically learned at home: math, language arts, reading, and writing. Because the US was predominantly an agrarian society, the skills related to technology and engineering were taught by parents to their children to support the work done on the farm. The US of today is very different, and as we have moved into the 21st century, the school curriculum has not kept pace with technological advancements. Without the knowledge and skills developed through the study of technology and engineering, our students are limited in their ability to solve real-world, authentic problems. To update our curriculum, we must recognize the importance of all four fields of study, their relationship to each other, and the necessity to expose our students to relevant STEM instruction. Educators have been able to quantify and compare data regarding student proficiency in both mathematics and science, but this is not yet the case for technology and engineering. Educational standards, assessments, and curricula are not yet well established and accepted for technology and engineering. This must change.

To be competitive in the global economy, we are challenged to develop and implement effective standards, curricula, and assessments that include and integrate all four fields of STEM as a major component of school reform. Along with the vision and support of educators, business partners, and our community leaders, Florida will be positioned to grow and prosper for years to come.

History of the Florida STEM Strategic Plan

In January 2009, after consulting with business and education leaders, Enterprise Florida, Inc. (EFI) released a Discussion Paper on K-12 STEM education. EFI's Action Recommendation was to call for the creation of a Florida STEM Council to "act as a formal conduit for business direction, support, and engagement in STEM education." Simultaneously, the Florida Center for Research in Science, Technology, Engineering and Mathematics (FCR-STEM), working with the Florida Chamber, began the process of establishing a task force of business, education, and government representatives to develop a STEM Plan for the State of Florida. In late summer of 2009, prior to the first meeting of the task force, Workforce Florida, Inc. (WFI) announced a request for proposal (RFP) to provide $580,000 in support of efforts to improve STEM outcomes in Florida. In order to avoid duplication of efforts and increase the likelihood of developing a STEM Plan that would have a state-wide impact, leaders of the FCR-STEM task force made a decision to collaborate with the Consortium of Florida's Education Foundations (CFEF) and others in responding to the RFP. In October 2009 our joint proposal, **STEM***florida*, was selected.

Under the **STEM***florida* initiative, FCR-STEM compiled the baseline STEM data relevant to Florida in, "A Snapshot: The State of STEM in Florida," comparing the performance of K-12 students in our state and nation to that of students in other states and nations, using findings from:

- the Trends in International Mathematics and Science Study (TIMSS),
- the Programme for International Student Assessment (PISA),
- the National Assessment of Educational Progress (NAEP),
- the Florida Comprehensive Assessment Test (FCAT),
- student enrollment in upper level courses, and
- student achievement on Advanced Placement (AP) exams.

Within the Florida SUS and Independent Colleges and Universities of Florida (ICUF), metrics including course enrollment, majors chosen, and degrees awarded across a variety of STEM fields were examined. Additionally, all of the above sources were explored for evidence regarding the relative performance of females and minorities, in order to ensure that we focus on improving the STEM proficiency of ALL Floridians. Finally, FCR-STEM examined Florida's STEM progress in the workforce using sources including *Science and Engineering Indicators 2010*, produced biennially by the National Science Board.

In early 2010, a series of five roundtable discussions were hosted around the state to engage business leaders in a dialogue about STEM business needs in Florida. During the roundtables, business leaders identified important outcomes for improved STEM performance in Florida. FCR-STEM then compiled these outcomes and the business leaders' recommended strategies for realizing them in the Education Link Report. This report also identified key variables related to improvements in STEM teaching and learning and additional information relevant to achieving the desired outcomes. All of the above reports were reviewed and approved by attendees at the 2010 STEM Business and Education Conference. Additional critical information was provided by the Female and Minority Initiative and resultant Report, and many strategies included herein originated in that Report.

These discussions and reports provided the STEM Strategic Task Force a clear picture of both the current and the desired STEM performance in Florida, and business-recommended and evidence-based strategies for overcoming that gap. With this information, the Task Force held face-to-face and virtual meetings to synthesize the statewide input from both the business and education communities and draft this strategic STEM plan for the state.

> What must be preserved in the United States, if the nation is to compete, is an adequate supply of scientists and engineers who can perform creative, imaginative, leading-edge work - that is, who can *innovate*.[15]

Rationale for STEM plan components

In order to achieve the desired outcomes, it was important to consider the major variables affecting the outcomes, and how those variables interact. Figures 1 and 2 show the key variables that influence improvement of STEM teaching and learning, as identified in the Education Link Report. Although it is recognized that family and society play a critical role in student success, these figures focus on the variables that can be strongly influenced by businesses, educators, and policymakers. The Education Link Report explores these variables in more depth, specifically addressing questions and strategies that arose during the business roundtables.

[15] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2010). *Rising above the gathering storm, revisited: Rapidly approaching category 5.* Washington, DC: National Academies Press. p. 48.

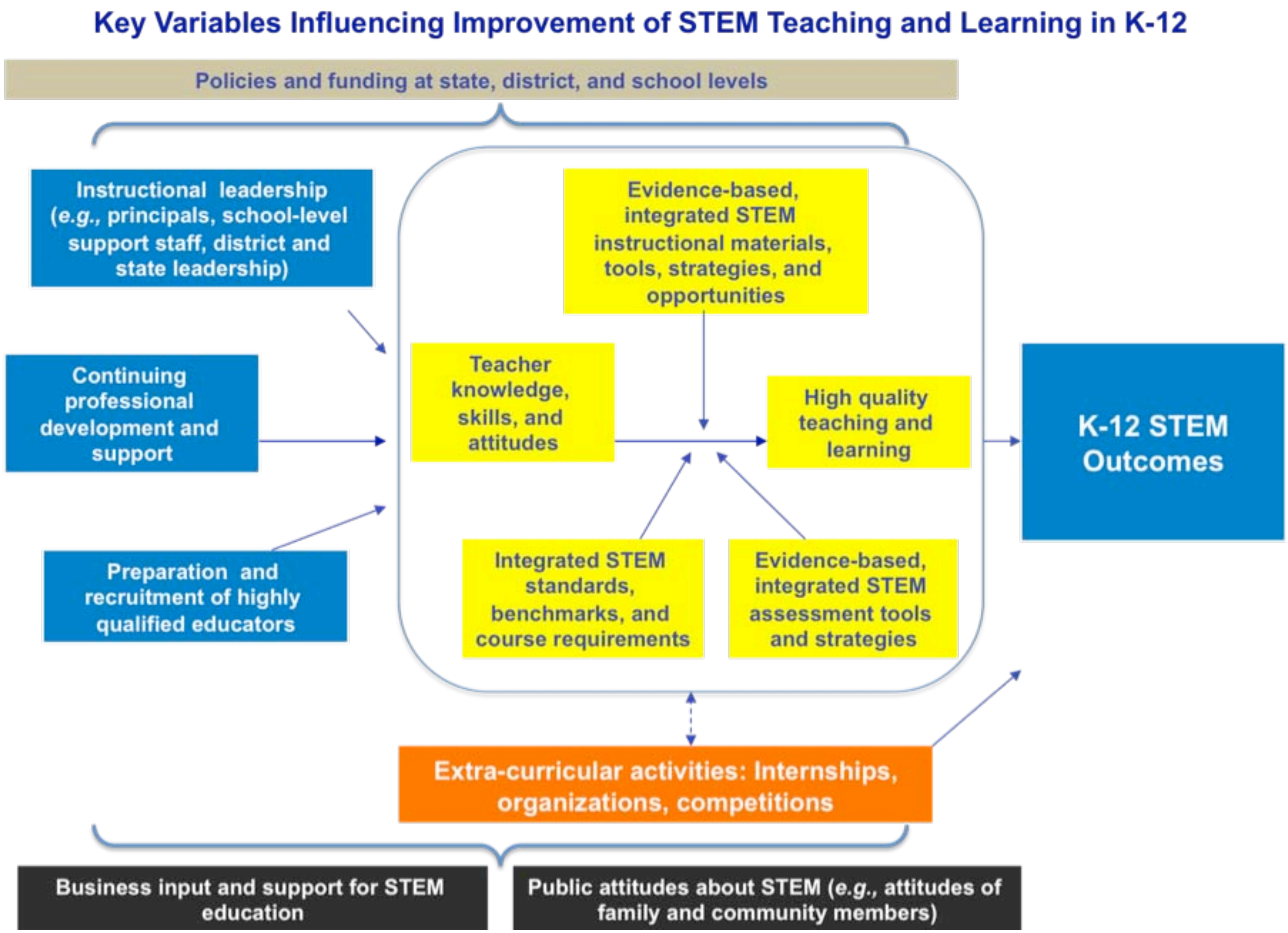

Figure 1. Key variables influencing improvement of STEM teaching and learning in K-12 have been identified by research. By considering all of the variables, and systematically strengthening each component, improved outcomes are more likely to be realized.

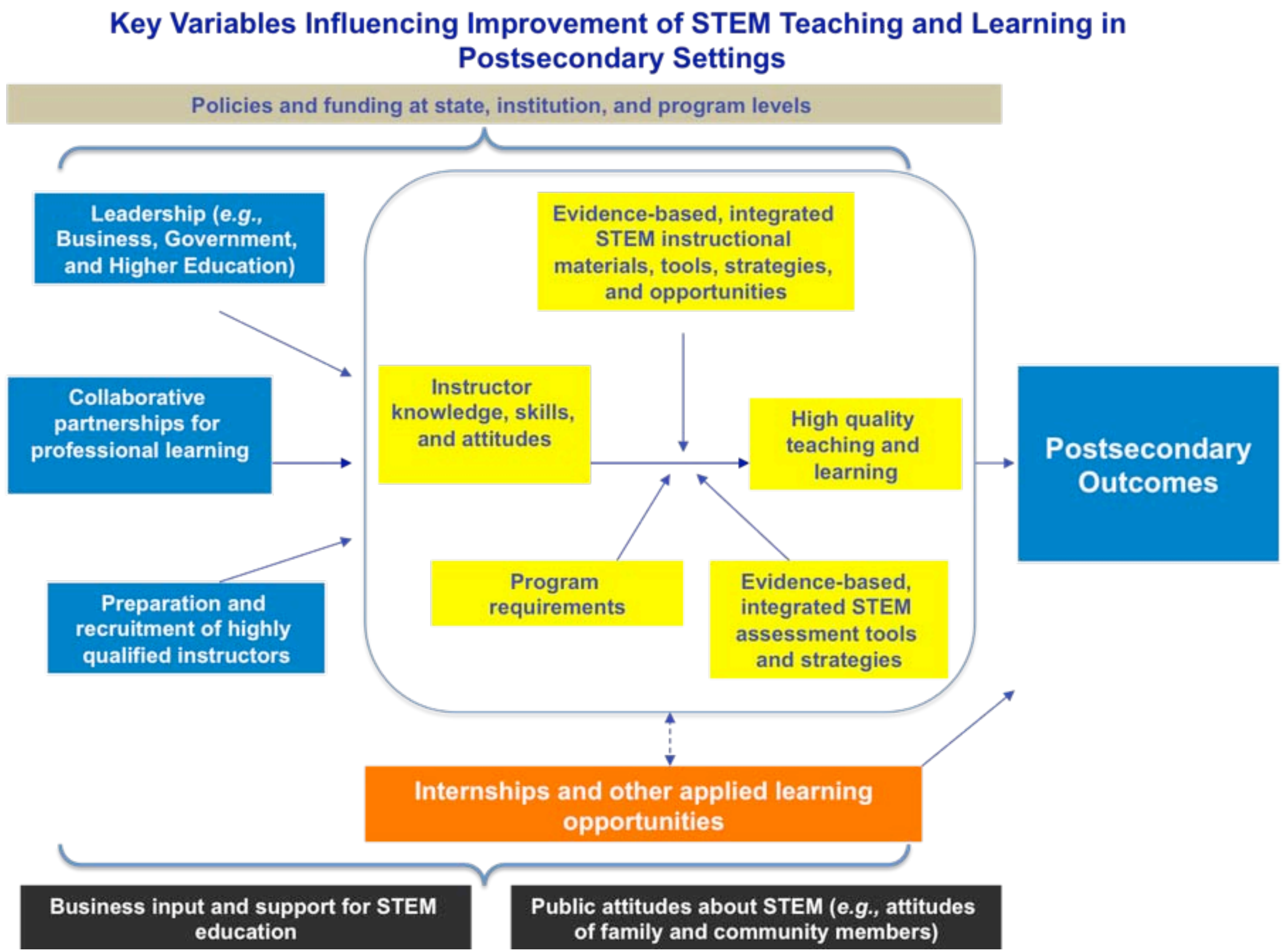

Figure 2. Key variables influencing improvement of STEM teaching and learning in postsecondary settings have been identified by research. By considering all of the variables, and systematically strengthening each component, improved outcomes are more likely to be realized.

Desired Outcomes: The Goals

The following three goals were initially identified during the **STEM***florida* Business Roundtables and reviewed during the 2010 STEM Business and Education Conference. They have been adapted by this Task Force in light of very recent federal and state STEM initiatives.

The Students

Goal 1: Increase the percentage of students successful at each level (PK-12 and postsecondary, including career and technical, undergraduate and graduate) to ensure our diverse population is:

- Capable of conducting real-world STEM projects and inquiry;
- Capable of authentic and collaborative problem solving;
- Proficient in applying multidisciplinary knowledge and skills through STEM;
- Proficient in English and other languages in order to succeed on a global scale; and
- Knowledgeable about and interested in STEM careers.

The Educators

Goal 2: Increase the quality and quantity of STEM educators.

Sustainable Infrastructure

Goal 3: Create a statewide sustainable STEM leadership organization to align existing and emerging STEM initiatives and represent Florida as one voice in meeting STEM demands.

Towards achieving each goal, the Task Force identified measurable objectives and action items, included in the following sections. For each goal section, key action items must be acted on initially, according to the timeline indicated, followed by supporting action items.

THE STUDENTS

Goal 1: Increase the percentage of students successful at each level (PK-12 and postsecondary, including career and technical, undergraduate and graduate) to ensure our diverse population is:

- Capable of conducting real-world STEM projects and inquiry;
- Capable of authentic and collaborative problem solving;
- Proficient in applying multidisciplinary knowledge and skills through STEM;
- Proficient in English and other languages in order to succeed on a global scale; and
- Knowledgeable about and interested in STEM careers.

Introduction

> Technology and engineering literacy is the capacity to use, understand, and evaluate technology as well as to understand technological principles and strategies needed to develop solutions and achieve goals.[16]

Science and mathematics have long been included in the core academic curriculum of PK-12 schools and have widely accepted standards, curricula, and assessments that technology or engineering do not. The lack of measurable objectives related to technology and engineering in this plan highlights the need for measures in these areas. Strategies for creating and identifying technology and engineering standards, curricula, and assessments, and including them within the core academic curricula are included within the action items, below.

[16] WestEd. (2010). Technology and Engineering Literacy Framework for the 2014 National Assessment of Educational Progress: Pre-Publication Edition. San Francisco, CA: Author. p. xi. Retrieved November 10, 2010, from http://www.nagb.org/publications/frameworks/prepub_naep_tel_framework_2014.pdf.

Our **Measurable Objectives** have two main areas of focus:

- Increasing the performance of all students and their interest in STEM, and
- Decreasing the gaps in interest and achievement between groups of students.

To measure our progress within PK-12, we look to:

- The NAEP;
- The FCAT;
- End-of-Course Exams;
- Advanced STEM course-taking and success in AP and Career Technical Education (CTE) courses;
- Intent to pursue a STEM major as reported on the SAT Reasoning Test (SAT) and Pre-SAT (PSAT); and
- The Voluntary Prekindergarten (VPK) Assessment[17], the PISA, the TIMSS, or other potential future measures of progress.

As indicators of postsecondary success, we report the number and percent of postsecondary students earning bachelor's degrees, master's degrees, and doctorates in STEM fields. Additional important indicators of success at the high school and postsecondary levels include:

- The number of STEM-related associate's degrees earned within Florida's colleges[18]
- The number of approved industry certifications earned in STEM fields at the high school level, and
- The number of career and technical industry certifications earned at the postsecondary level.

As these degrees and certifications are currently not tracked and reported for all STEM fields,[19] they are not included in our measurable objectives. Because they are essential for Florida's STEM success, we note within our action items that we must increase the number of certifications earned at all levels. Meaningful tracking systems for STEM-related associate's degrees and for all STEM certifications would be useful.

Key Action Items must be implemented by 2013 if the measurable objectives are to be met. **Supporting Action Items** may take place over a longer timeframe.

At all levels, we must implement research-based instructional strategies. "In order for deep learning to occur, learners should: be motivated; be intellectually engaged; use evidence to critique claims, strategies, and designs; actively examine their own thinking; and attempt to make sense of their new knowledge in the context of the larger framework (Banilower, et al., 2008; Carpenter et al., 1999; NCTM, 2000)."[20] Strategies to help facilitate deep learning at all levels are included in Appendix C and in the Education Link Report.[20]

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[17] See Appendix B. This assessment is currently available for teachers to track students' progress. Data could be compiled and reported at the state level.

[18] Data that are collected on student enrollment and degrees earned in the Florida Colleges are reported in the following: Florida Department of Education. (2011). The Fact Book: Report for the Florida College System. Retrieved February 28, 2011, from http://www.fldoehub.org/CCTCMIS/c/Documents/Fact%20Books/fb2011.pdf.

[19] The Florida Department of Education reports only the number of industry certifications earned by students in career academies: Florida Department of Education. (2010). *Career and Professional Academy Enrollment and Performance Report 2009-2010.* Retrieved February 23, 2011, from https://www.fldoe.org/workforce/pdf/capepr0910.pdf.

[20] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 12-30.

Measurable Objectives

NAEP Performance

Data Source: NAEP: http://nces.ed.gov/nationsreportcard/states/. Science and mathematics will be tested in 2015. Mathematics will also be tested in 2011, 2013, and 2017. Technology and Engineering Literacy will be assessed for the first time in 2014.

1.A. Increase performance on all NAEP Science and Mathematics exams by 20 percentage points by the year 2017, as indicated by the percentage of students at the "proficient" level or above. For Technology and Engineering Literacy, to be first tested in 2014, we expect Florida students to rank nationally in the upper 30 percent at 4th, 8th, and 12th grades. Data are included in Appendix D.

1.B. Reduce by half the achievement gaps on all NAEP Science and Mathematics exams, as indicated by the percentage of students at the "proficient" level or above, by 2017. For Technology and Engineering Literacy, we expect gaps to be less than the 2017 target gaps for science and mathematics. Data are included in Appendix D.

FCAT Performance

Data Source: FCAT 2.0 scores as reported by the Florida Department of Education (FL DOE): https://app1.fldoe.org/FCATDemographics/. See Appendix D for reference data from the current FCAT. The FCAT 2.0 will be aligned with the Next Generation Sunshine State Standards (NGSSS).

1.C. Increase the percentage of students scoring at or above grade level (Level 3) on the FCAT 2.0 by 5 percentage points per year in Science[21] and by 3 percentage points per year in Mathematics[22] until 2017.

1.D. Reduce by half all achievement gaps on FCAT 2.0 by 2017 in both Science[21] and Mathematics,[22] as indicated by the percentage of students scoring at or above grade level (Level 3).

End-of-Course Exam Performance

Data Source: End-of-Course Exam scores as reported by the FL DOE: http://www.fldoe.org/arm/.

1.E. Increase the percentage of students scoring at or above Level 3 on the End-of-Course Exam by 3 percent per year until 2017 on Algebra 1,[23] Geometry,[24] and Biology 1.[24]

1.F. Reduce by half all achievement gaps on the End-of-Course Exams, as indicated by the percentage of students scoring at or above Level 3, from the baseline scores by 2017 on each Algebra 1,[23] Geometry,[24] and Biology 1.[24]

[21] Grades 5 and 8; baseline for achievement levels reported in 2012-2013.
[22] Grades 3-8; baseline for achievement levels reported in 2011-2012.
[23] Baseline for achievement levels in 2011-2012.
[24] Baseline for achievement levels in 2012-2013.

Advanced STEM Course-Taking and Success

Data Sources: AP information reported by the College Board: http://apreport.collegeboard.org/report-downloads; STEM Career and Technical Education (CTE) data provided by the FL DOE. Data and a listing of state approved STEM CTE courses are included in Appendix D.

1.G. Increase by 10 percentage points both enrollment and success in high school STEM courses by 2017 as indicated by the:

a. **Percentage of students enrolled in one or more AP Mathematics courses,**
b. **Percentage of students scoring 3 or above on one or more AP Mathematics exams,**
c. **Percentage of students enrolled in one or more AP Science courses,**
d. **Percentage of students scoring 3 or above on one or more AP Science exams,**
e. **Percentage of students enrolled in one or more state approved STEM CTE courses,**
f. **Percentage of students earning credit in one or more STEM CTE courses.**

Student Interest in STEM

Data Source: College Board: http://apreport.collegeboard.org/report-downloads. Data are included in Appendix D.

1.H. Increase the number of high school students taking the PSAT and SAT who report an interest in majoring in a STEM area[25] to meet workforce needs.[26]

Potential Future Measures

Data from the VPK Assessment, currently available for classroom use, could be compiled and tracked at the state level. Additionally, through the US Department of Education's Race to the Top (RTTT) competition, Florida has committed to participate in the PISA and the TIMSS at high enough levels to provide data with which to compare Florida's students to students in other nations in future years.

Postsecondary Success in STEM

Data Source: Florida Board of Governors Interactive University Database http://www.flbog.org/resources/iud/degrees_search.php. See Appendix D for the number and percentage of degrees in each field.

1.I. Increase the number of students earning postsecondary degrees in each STEM area[25] to meet workforce needs[26] by 2017.

1. J. Reduce by half the gaps between and the percentage of STEM degrees earned by a subgroup and the percentage of that subgroup in the general 20-34 age population in Florida.

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[25] The following areas were included as STEM: Agriculture/Agricultural Operations/Related Sciences, Natural Resources/Conservation, Architecture/Related Services, Computer/Information Sciences/Support Services, Engineering, Engineering Technologies/Technicians, Biological/Biomedical Sciences, Mathematics and Statistics, Physical Sciences, Health Professions/Related Clinical Sciences.

[26] See https://www.employflorida.com/ for real-time, region-specific job availability.

Key Action Items
PreK-12

1.1. **Sequence the curriculum to promote maximum student learning. Concepts should build on one another as students progress and students must be expected to apply learning.**

   a. Review the order in which courses are taken by students to evaluate whether they build on one another appropriately or are simply a result of tradition. For example, students take Earth/Space Science and Biology before Chemistry, and Chemistry before Physics. Conceptually, however, Physics is the basis for Chemistry, and both are foundational for Earth/Space Science and Biology. If the order is not ideal, reorder the curriculum to support better aligned learning experiences for students.
   b. Structure courses and individual lessons such that students must demonstrate that they can apply their learning. Project/problem-based learning and extended final projects are excellent opportunities for the application of learning that prepare students for real work experiences.
   c. Provide educators with free technology to easily map resources and benchmarks onto their course calendars (e.g., iCPALMS; http://www.icpalms.org/).

1.2. **Improve assessments to encourage proficiency in applying STEM skills and content knowledge, particularly in technology and engineering.**

   a. Increase the use of formative assessment to support differentiated instruction. Determine what each student knows to establish how best to help each student demonstrate the knowledge and skills associated with the learning objectives.
   b. Integrate performance-based assessment, during which students demonstrate proficiency in project/problem-based learning, into classrooms on a daily basis. For assessments to increase student learning, educators should provide useful, educative feedback to the students.
   c. Continue to improve the FCAT 2.0 to test higher order thinking skills.
   d. Create or adopt a statewide, authentic assessment to measure technology and engineering proficiency.

1.3. **Provide teachers with effective STEM curricula and resources that exemplify the integration of STEM.**

   a. Increase the number of high-quality, vetted resources aligned to the standards freely available online via CPALMS (http://www.floridastandards.org/) to promote individualized/differentiated instruction.
   b. Identify or create scalable resources and programs that evidence positive impacts on student achievement. Pilot studies and large-scale studies to evaluate program effectiveness are necessary.[27] Emphasis should be placed on curricula that integrate problems and projects relevant to students in Florida.

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[27] Pages 18-20 of the Education Link Report provide information about programs currently evaluated for effectiveness. Few curricula have been adequately assessed and even fewer show sufficient evidence of effectiveness. Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010 from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf.

c. Amend Science and Engineering Fair guidelines to incorporate a wide range of STEM projects.
d. Review adopted mathematics and science textbooks for appropriate integration of technology and engineering content and skills in core subject areas.
Note: The FL DOE will be implementing new instructional materials for the science NGSSS in the 2011-2012 academic year.

1.4. **Integrate technology and engineering content standards into the state standards at all grade levels**.[28] The 'Technology and Engineering Literacy Framework for the 2014 National Assessment of Educational Progress'[29] provides an excellent guide for this work. Additionally the National Research Council is facilitating the creation of the "Conceptual Framework to Guide the Development of Next Generation Standards for K-12 Science Education" for release in spring of 2011. This framework "describes the major ideas and practices in the natural sciences and engineering that all students should be familiar with by the end of high school."[30] From this framework, "Achieve, Inc., an independent, bipartisan, non-profit education reform organization that works closely with states will develop a full set of internationally-benchmarked standards based on the Framework."[30] The framework, which is expected to include engineering ideas and practices, should be reviewed once it is released to determine the extent to which the standards created from the framework are likely to provide sufficient integration.

1.5. **Create technology and engineering course requirements for the middle grades.**[28]

1.6. **Increase the number of career academies in Florida that are STEM focused.** As part of the RTTT, every school district must implement a rigorous STEM career academy that is approved by the state. For a listing of state approved STEM career academies, see Appendix E. It should be noted that career academies in other career clusters (such as manufacturing and logistics) are STEM focused, though they are not reported as STEM academies because their curricula are not directly tied to the Algebra I, Biology, or Geometry end-of-course exams**.** This makes it difficult to report on the total number of career academies related to STEM.

1.7. **Disseminate information and resources to parents about how to support their children's STEM education and choice of STEM careers.** Encourage parents, particularly those of minority students, to have greater involvement in the STEM education of their children. "Correlational findings suggest that minority students with parental involvement, despite coming from lower income households, have STEM achievement as high as White students with similar levels of parental involvement (Yan, 1999; Jeynes, 2003)."[31]

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[28] See Florida STEM Council Suggested Roles and Responsibilities, Item H on p. 32 of this document.
[29] WestEd. (2010). Technology and Engineering Literacy Framework for the 2014 National Assessment of Educational Progress: Pre-Publication Edition. San Francisco, CA: Author. Retrieved November 10, 2010, from http://www.nagb.org/publications/frameworks/prepub_naep_tel_framework_2014.pdf.
[30] http://www7.nationalacademies.org/bose/Standards_Framework_Homepage.html Accessed on February 15, 2011.
[31] Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 24.

a. Promote Family Science and Family Engineering activities.[32]
b. Provide information about STEM through established organizations such as Boy Scouts, Girl Scouts, and other youth programs, including religious-based organizations.

Postsecondary

1.8. **Incorporate strategies shown by programs in Florida and other states to be successful in attracting all students, including underrepresented minorities, to STEM or STEM-related majors**. The following is excerpted from the Education Link Report. "In their independent evaluation of the Meyerhoff Scholars Program, Gordan and Bridglall (2004) report that the program "systematically and deliberately" combines research-based strategies to encourage success, monitors and evaluates program effectiveness, and modifies strategies accordingly. Program strategies include the following:

a. Recruit a population of underrepresented students of color who strive to achieve. By creating a culture of academically and socially supportive peers, the program seeks to avoid the isolation in which many students of color find themselves on college campuses.
b. Require incoming freshmen to participate in a Summer Bridge Program.
c. Designate the most effective faculty and expect them to teach freshman courses.
d. Help incoming students identify gaps in their knowledge and provide instructional support for addressing those gaps. Faculty are expected to "reinforce fundamental concepts while simultaneously exposing students to rigorous material that is challenging" (p. 41).
e. Construct multiple support groups to address many areas of student academic and social life.
f. Supply sufficient financial support, contingent on maintaining high achievement.
g. Provide students with culturally relevant experiences.
h. Monitor, mentor, and advise students before they arrive and throughout their undergraduate years." [33]

Additional information is included in Appendix F.

1.9. I**ncrease awareness of and access to financial aid for postsecondary degrees and certifications, particularly in STEM majors.**

a. Ensure that students and parents are aware of:
    - Bright Futures scholarships,
    - Access to at least one free PSAT exam,
    - Dual enrollment programs at colleges and universities, and
    - Industry certification-based college credit articulation.[34]

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[32] See Familyengineering.org.
[33] This information is taken directly from the Education Link Report. Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 28-30.
[34] For more information, see http://bannersecondary.com/Default.aspx?tabid=3431.

b. Ensure that career counselors are aware of STEM-related grants, assistantships, scholarships, and fellowships offered by public and private sources. For example, the National Science and Mathematics Access to Retain Talent Grant, also known as the National SMART Grant,[35] provides up to $4,000 per year to full-time undergraduates who are in their third and fourth years of study, are eligible for federal Pell Grants, and are majoring in physical, life, or computer sciences, mathematics, technology, or engineering.
c. Include in the statewide STEM website (see Objective 3.D.) a clearinghouse of financial aid sources.
d. Consider state-funded scholarships for students seeking postsecondary STEM degrees.

1.10. **Utilize workforce development systems (e.g., Regional Workforce boards, Employ Florida Banner Centers and career academies) and industry representatives to familiarize students with careers.**

a. Identify and inform students at each level of education about programs and initiatives that are available. Some examples include Engineering Forums (e.g., University of Central Florida (UCF) program), compilation of best practices, Workforce Board summer youth programs, Suncoast Careers, and internship/externship experiences for students (e.g., STEMflorida.net).
b. Link curriculum and instruction to workforce needs, with the strength of the ties increasing as students are closer to entering the workforce. Use workforce development systems like the Banner Centers[36] and the Employ Florida Marketplace website[37] to gain real-time information about workforce needs and current and projected job availability.

Supporting Action Items

1.11. **Maximize tracking of students into the most rigorous coursework.** The goal must be to stretch ALL students to excel.

a. Eliminate low-track courses such as Informal Geometry and Algebra IA/IB.
b. Identify “weed-out” courses and provide support to students struggling in these courses.
c. End practices that isolate students based on language. STEM courses and activities should be structured to remove barriers and include students with limited English proficiency. Testing accommodations will help these students to some extent, but they also will need help in their native language with technical vocabulary in science and mathematics, which may be unfamiliar or confusing to students and their parents.

Note: Currently the State of Florida requires high school students to complete four mathematics courses and three science courses (two with a laboratory component) as a requirement for graduation. To date, only Algebra I has been specifically required. In view of the increasing academic skills demanded in college and the workforce, Florida enacted legislation in 2010 (CS/CS/SB 4) that, over time, will ramp up the rigor of coursework students take to fulfill these requirements. Beginning with students entering grade 9 in the

[35] See http://studentaid.ed.gov.
[36] See http://www.workforceflorida.com/PrioritiesInitiatives/BannerCenters/BannerCenters.php.
[37] See https://www.employflorida.com/.

2010-2011 school year, students must take both Algebra I and Geometry. Beginning with students entering grade 9 in the 2011-2012 school year, one of the three credits in science must be Biology I, and beginning with students entering grade 9 in the 2013-2014 school year, the three required science courses must include Biology I, Chemistry or Physics, and an equally rigorous third course. Additionally, as part of RTTT, every school district is required to increase the number of accelerated STEM course offerings.

1.12. **Staff schools with effective guidance or career counselors at all levels (elementary, middle, and high school) in ratios appropriate to the student population.**

a. Ensure that guidance counselors and all STEM educators are well informed about STEM careers and programs of study, and that they encourage students to enroll in upper-level STEM courses and earn industry certifications.[38]
b. Increase use of career counseling tools and resources, such as the electronic Personal Education Planner (ePEP) and other tools on the FL DOE career planning website, www.facts.org.
c. Guidance counselors should use student input on the ePEP to link students to STEM volunteers and opportunities.

1.13. **Coordinate efforts between informal science outreach organizations, leverage existing resources, and create a STEM awareness campaign**.

a. Collaboratively develop traveling STEM exhibits and share these with areas/schools that do not have easy access to museums or other informal learning venues.
b. Identify or develop a platform to facilitate communication among informal science outreach organizations and between these organizations and businesses, educators, and the community. The website described in Objective 3.D may be appropriate.
c. Create a STEM Awareness Campaign aimed at students and their families, and collaborate with existing STEM awareness campaigns, such as the Entertainment Industries Council's Science, Engineering, and Technology (SET) Project.[39]

1.14. **Evaluate the success of existing out-of-school, after school, and summer camp programs focusing on STEM.** The Northwest Regional Educational Laboratory published a literature review on the importance of after school literacy programs for the National Partnership for Quality Afterschool Learning. A similar literature review should be conducted on STEM after school and outreach programs incorporating the examples of programs listed in Appendix G.

[38] The following may be a useful document: http://facts23.facts.org/florida/facts/Home_Page/Counselors_and_Educators/Advising_Manuals/Counseling_for_Future_Education_Handbook/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os3iDEEtPfx9TQwN3Sz8DA093C38_M19_A393E_1wkA6gChzA0QAqDzPBIsDFEGiCu4eXgbezoaexmb6fR35uqn5Bdnaao6OiIgDDNWST/

[39] See http://eiconline.org/readyontheset/default.html.

1.15. **Establish and nurture role model relationships.**

a. Promote Mentornet (http://www.mentornet.net/) to students, educators and the business community as a possible social media mentoring model. Under this model, a student can form a relationship with the mentor perceived to have the most to offer that student, without geographical barriers. This approach is particularly useful for underrepresented students in rural areas. Other programs to explore and promote are the Architecture, Construction, and Engineering (ACE) Mentor Program (http://www.acementor.org/) and Virtual-Mentor.net, available through Pinellas County.

b. Engage more advanced students in mentoring younger learners**.** For example, the National Science Foundation Graduate Teaching Fellows in K-12 Education (NSF GK-12) Program[40] provides fellowships and training to graduate students in STEM fields who work in K-12 schools in a mentoring or supportive role. The purpose is to improve their communication and teaching skills while enriching STEM content and instruction for their K-12 partners.

c. Seek and recruit role models to whom underrepresented minority students can relate, including PK-20 educators, members of the business and industry communities, and upper-level students. The Southeastern Consortium for Minorities in Engineering (SECME), an exemplary program of this nature, is described in Appendix G.

d. Identify or develop a website dedicated to underrepresented minority students in STEM. Two such websites, dedicated to females in STEM, that can serve as models include engineeryourlife.org and engineergirl.org.

1.16. **Increase STEM faculty awareness of diversity by requiring faculty to report the number and percentage of female and traditionally underrepresented minority students engaged in their research and design projects.** Data should be reported to that university's office of undergraduate research initially and, in the future, to the Board of Governors.

[40] See http://www.nsfgk12.org/.

THE EDUCATORS

Goal 2: Increase the quality and quantity of STEM educators/practitioners.

Introduction

All educators that teach STEM[41] at any level are STEM educators. This includes, but is not limited to, grades PK-5 teachers, grades 6-12 STEM teachers, principals, guidance counselors, and postsecondary STEM educators, including instructors at universities, colleges, technical programs, and in industry settings. **We suggest that all STEM educators should be knowledgeable about STEM, should be able to effectively guide learning, and should recognize and collaboratively teach to the integrated nature of STEM.** In order to achieve our goal, we must focus on four overarching, interrelated priorities, listed in order of time-dependence:

- Ongoing professional development of STEM educators/practitioners,
- Retention of high-performing STEM educators/practitioners,
- Recruitment of knowledgeable STEM educators/practitioners, and
- Equitable placement of STEM educators to ensure that all students have access to high-quality teaching.

In order to meet Goal 1 Measurable Objectives, we must first focus on the educators currently impacting student achievement by identifying, funding, implementing, and requiring participation in high-quality, **ongoing professional development for STEM educators/practitioners** that shows evidence of positively impacting educator learning and practice, and student achievement.

Retention of high-performing STEM educators/practitioners involves developing measures to accurately assess educator performance, rewarding high performance, providing professional development for struggling educators, selectively retaining the most effective educators, and removing ineffective ones.

According to research summarized in the Education Link Report, both increased STEM coursework and increased amounts of supervised teaching are aspects of educator preparation associated with increased effectiveness. Our measurable objectives and action items related to **recruitment of knowledgeable STEM educators/practitioners**, then, involve producing and recruiting educators with strong STEM content knowledge and effective teaching skills, demonstrated during ample amounts of supervised teaching.

To address the second area of focus within Goal 1, "decreasing the gaps in interest and achievement between groups of students," we must address the placement of educators. If all students are to succeed, all students need capable educators. This must be a priority for Florida, and we include the **equitable placement of STEM educators** as a strong priority within Goal 2.

[41] Defined on p. 5-6 of this report to be the integration of the fields of Science, Technology, Engineering, and Mathematics.

Measurable Objectives

Data Sources: All practicing PK-12 teacher, principal, and guidance counselor data are tracked by school districts and reported to the FL DOE, including certification data. Postsecondary educator participation in professional development can be tracked and reported by colleges, universities, and industry. Coursework requirements for elementary educator preparation programs are reported at the college or university level.

2.A. Ensure that by 2014 every:

a. STEM teacher (PK-12) participates in long-term (80 hours minimum), job-embedded and STEM content- and pedagogy-focused professional development;

> "…experts in the field typically suggest that professional development be of sufficient duration, content-focused, aligned with teachers' real work experiences (curriculum and standards; school, district, and state policy), focused on student thinking, and involve active learning and peer collaboration (e.g., Desimone, 2009; Scher and O'Reilly, 2009)…. Additionally, they (Scher and O'Reilly, 2009) report that programs focused both on content and pedagogy had a larger positive impact on student achievement than did programs that focused only on one component."[42]

b. Principal participates in long-term (80 hours minimum), job-embedded and content- and pedagogy-focused professional development that guides him/her to strengthen and support STEM teaching and learning in his/her school, including improvement strategies for the entire school population;

c**. Guidance counselor** participates in professional development about STEM careers, pathways, financial opportunities, and potential barriers;

d. Postsecondary STEM educator participates in professional development about evidence-based, STEM-specific pedagogy to prepare and inspire a diverse population of students; and

e. Teacher and postsecondary educator has earned the appropriate industry certification(s) for their STEM discipline.

Additionally, in order to meet business needs, **content for professional development should align with the appropriate industry certification** for the STEM discipline taught, where appropriate.

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[42] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 36.

2.B. Track and report at the state level by 2015 the percentage of effective practicing STEM educators of grades 6-12 continuing to teach the following year.

2.C. Increase the number of appropriately certified incoming middle (6-8) and middle/upper (6-12) grades educators so that all STEM positions for grades 6-12 are filled by knowledgeable educators by the 2013-2014 school year. See Appendix D for data.

Note: Although most practicing 6th through 12th grade STEM educators are appropriately certified,[43] there is a critical shortage of incoming middle and high school level mathematics, science, and technology instructors. For this objective to be met, additional educators must be recruited, and these incoming educators must pass certification exams. Educators may enter the profession through a variety of pathways.[44] Each pathway requires the appropriate certification, and research[45] suggests that students of traditionally and alternatively certified teachers do not show consistent, significant differences in performance. In Florida there is wide variation in the coursework and supervised teaching requirements among university- and college-based ("traditional") teacher preparation programs. Suggestions to improve teacher preparation programs are included as action items.

2.D. Remove the certification for Middle Grades Integrated Curriculum for incoming teaching candidates by 2013.

2.E. Replace the current K-6 elementary certification for incoming teaching candidates with certifications for grades PK-2 and 3-5 by 2013.

2.F. Increase the STEM requirements for elementary teacher preparation programs[46] by 2013 to include rigorous STEM courses, including two math courses, two science courses, and a STEM integration course, with specific emphasis on technology.[47] See Appendix D for data.

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[43] In 2008, 97% of mathematics educators and 94% of science educators met the certification requirements for Florida according to the following document: Florida Department of Education. (2009). *Critical teacher shortage areas, 2010-2011.* Retrieved August 10, 2010 from: http://www.fldoe.org/evaluation/teachdata.asp. Data reported in Appendix D related to this objective are from this publication.

[44] See the following for a summary of certification pathways in Florida: http://certificationmap.com/states/florida-teacher-certification/#prerequisite.

[45] Summarized in the Education Link Report: Lang, L., Gaboardi, M., Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010 from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 31-35.

[46] Current requirements for certifications are included in Appendix D and were retrieved November 12, 2010 from: http://www.fldoe.org/edcert/subjlist.asp.

[47] See http://www.tecchome.org/index.html for information about incorporating technological education at the elementary level.

Key Action Items

2.1. **Identify or create scalable programs that show evidence of positively impacting educator learning, practice, and student achievement for both incoming and practicing educators.** Pilot and larger-scale studies to evaluate program effectiveness would be necessary. Professional development for principals is essential. Specific research to support this recommendation is compiled in the Education Link Report and a summary of research to support the importance of including principals is available in Appendix H.

2.2. **Increase the number of high-quality STEM research experiences for educators.** By directly participating in scientific research, educators may increase their understanding of STEM fields, which may translate into improved instruction and increased student achievement and interest in STEM careers.

a. Increase the number of government sponsored Research Experiences for Teachers (RET). For a state-by-state listing of current RET opportunities, please see http://www.retnetwork.org/ret_programs.php. This list contains programs within and outside Florida available to Florida educators.[48]
b. Increase the number of high-quality, industry-sponsored educator externships for STEM fields, such as TeacherQuest through the Technological Research and Development Authority (TRDA) for the FL DOE (http://www.theendeavouracademy.com/teacherquest/).

2.3. **Engage educators in job-embedded professional learning communities.** Educators engaging in professional learning communities, to discuss and improve their instruction, shows promise of positive effects on student achievement. However, to be productive, these meetings must focus on instruction – a condition more likely to occur when administrators provide guidance on how to use the time productively and sit in on the meetings. The learning communities should focus on data-driven teaching and assessment practices. In order to reach all schools, online training in these practices may be useful.

2.4. **Require teachers, principals, guidance counselors, and postsecondary STEM educators to participate in high-quality professional development.** In order to retain certification, teachers in Florida are expected to complete a minimum of 120 hours of professional development, 6 semester hours of college credit, or the equivalent[49] within a five-year period. For K-12 STEM teachers, at least 80 of those hours should be STEM content- and pedagogy-focused.

2.5. **Secure funding for the dissemination of high-quality educator professional development programs.**

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[48] As of 6/28/2010, 11 such programs were listed for Florida teachers, including programs through Embry-Riddle Aeronautical University (http://www.retnetwork.org/ret_programs_detail.php?p=392), the Office of Science Teaching Activities at Florida State University (http://bio.fsu.edu/osta/RET/), the National High Magnetic Field Laboratory (http://www.magnet.fsu.edu/education/ret/), and Scripps Research Institute Florida (http://www.scripps.edu/florida/education/k12/teacher-interns.html).
[49] See http://www.fldoe.org/edcert/renew.asp.

2.6. **Streamline the process to remove ineffective educators.**

Kane et al. (2006) found "large, observable differences in teacher effectiveness" within the first two years that were strong indicators of future teacher success. With improvement of teacher effectiveness measures, school leaders could assess teacher performance and suggest methods for remediation, as is done in formative assessment elsewhere in education. As the "average value-added among the top quartile of elementary school math teachers is…almost 10 times the magnitude of any difference associated with initial certification status….selectively retaining the most effective teachers appears to be a…promising strategy" (Kane et al., 2006, p.2).[50]

2.7. **Continue to research the effectiveness of performance pay for educators.** Given the lack of conclusive results on the effectiveness of performance pay for educators, it is important for Florida to attach rigorous evaluation components to the state's ongoing performance pay programs (e.g., the Merit Award Program and the Florida School Recognition Program) and any programs that may be introduced in the future.

2.8. **Create incentives for the hiring and retention of experienced, effective mathematics and science teachers in low-performing schools that often serve a high proportion of minority and low-income students.** Examine location pay as a means to incentivize working in low-performing schools.

Correlational findings indicate that minority, low socioeconomic status (SES), or low-achieving students are more likely to have inexperienced and ineffective mathematics and science teachers (Sanders & Horn, 1998; Clotfelter et al., 2005).[51]

2.9. **Provide cultural competency training to PK-20 educators.** It is important for teachers to be aware of actions that may unfairly track minority/female students or discourage them from enrolling into upper-level classes. Also, leaders must be able to foster cultural competency among teachers and create a comfort zone that will enable people to have open conversations about race. Both teachers and administrators must understand the unique cultural aspects of minority populations that may dissuade students from pursuing STEM careers. For example, in the Hispanic culture, females may have deeply rooted roles that differ from those of males. Parents may be reluctant to encourage their children to enter unfamiliar fields or to live far away from home. The Anchin Center at the University of South Florida (USF) has incorporated cultural competency training into professional development for science educators. The National School Reform Faculty Protocols provide guidance on how to have difficult conversations with faculty about race and other issues. Some school districts, such as Hillsborough and Pinellas, have provided cultural competency training on a broad scale. At the university level, cultural competency training (like sexual harassment training) could be required for faculty.

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[50] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010 from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 37.

[51] Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 23.

2.10. **Work with teacher preparation programs in Florida's colleges and universities to implement the Supporting Action Items related to undergraduate programs.** Deans from the colleges of education and representatives from the FL DOE must be included in the Florida STEM Leadership Board described in Goal 3 in order to oversee the realistic, collaborative implementation of the suggestions within this goal.

Supporting Action Items

2.11. **Modify undergraduate programs to produce graduates who excel at both STEM and teaching.**

a. Increase the enrollment in programs such as FSU-Teach and UFTeach. Recently developed programs in Florida that emphasize both increased STEM coursework and focus on the practice of teaching include FSU-Teach at Florida State University and UFTeach at the University of Florida. Modeled after the successful UTeach program,[52] both programs require that students take advanced STEM coursework, become competent in content-specific pedagogy, and complete rigorous internships. Important aspects of the UTeach program include:
   - Two free introductory UTeach courses offered to interested math and science majors,
   - Degree plans that allow most UTeach participants to graduate with their math or science degree and teacher certification in four years,
   - Professional development courses based on research in math and science teaching and learning,
   - Paid internships,
   - Familiarity with and application of technology in the classroom through integrated technology benchmarks, and
   - Continued, intensive field experiences.[53]

b. Expect education majors at all levels to complete and excel in STEM coursework. STEM faculty members should not expect less of their education majors than they do of their STEM majors.

c. Include rigorous instruction on and application of data-driven teaching and assessment practices.

d. Increase the amount of in-classroom experience of incoming teachers:
   - Create apprenticeships in which incoming teachers would "shadow" classroom teachers beginning their freshman or sophomore year, rather than later in their program.
   - Create a "practice based residency model built on partnerships with school districts and higher education institutions that places licensure candidates in classrooms full-time with high quality mentor teachers and includes authentic performance evaluation"[54] during teacher preparation and induction.

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[52] UTeach was developed in 1997 at the University of Texas at Austin through a grant from the National Science Foundation and has been replicated at universities around the nation, including Florida State University and the University of Florida, with funding from the National Math and Science Initiative and the Helios Foundation.
[53] Participants complete approximately 40 hours of field experiences during coursework and an additional 240 hours of field teaching.
[54] Governor's STEM Advisory Council. (2010). *A Foundation for the Future: Massachusetts' Plan for Excellence in STEM Education*. Boston, MA: Author. p. 27.

2.12. **Track, report, and improve the average STEM subject areas certification scores of incoming educators and use those scores to help determine teaching placements**

a. The average STEM subject area scores for districts and the state should be tracked and reported.
b. **Identify K-8 teachers with strong STEM content knowledge and encourage principals to preferentially employ these individuals in STEM subject area teaching assignments.** The subject area test for general certification at the elementary and middle school level should have embedded STEM items to be used to identify teachers who have enhanced content knowledge in mathematics and/or science. Teachers who meet identified criteria should have STEM (math, science, or math/science) endorsements noted on their certificate to enable appropriate placement in STEM teaching assignments. It should be noted that while we currently have mathematics and science subject areas on the certification exams, we still need technology, engineering, and integrated STEM assessments.
c. Require a minimum score for each subject area on the elementary level certification exams, except for special cases such as teachers specializing in Exceptional Student Education (ESE) and English as a Second Language (ESL) programs. At the elementary level, multiple areas are tested, but only an overall minimum score is required for certification. It is possible for a prospective teacher to miss all of the questions pertaining to math, but still gain certification by achieving the minimum overall score.

2.13. **Create a structure that recognizes teachers as professionals in their field.**[55]

a. Designate exemplary teachers as model teachers, showcasing their classrooms for other teachers, community members and representatives from other districts to visit.
b. Develop mechanisms for recognizing teachers as important professionals within the community.
c. Use effective teachers as resources for teaching professional development seminars for other teachers. Develop a statewide system of recognition through a career ladder for STEM teachers.

2.14. **Explore formal/informal alternative methods for members of the STEM workforce to be involved in career and technical programs.**

a. Incentivize industry creation of innovative training centers for use of real-world equipment for career academies and workforce education and training.
b. Encourage existing STEM education programs to invite STEM experts as guest teachers.

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[55] This strategy and selected associated text are adapted from the Massachusetts STEM plan: Governor's STEM Advisory Council. (2010). *A Foundation for the Future: Massachusetts' Plan for Excellence in STEM Education*. Boston, MA: Author. p. 27.

2.15. **Explore formal/informal alternative methods for professionals to become credentialed to teach in career and technical programs.**

a. Provide state tax credits or reimburse tuition costs to individuals who become credentialed to teach in career and technical programs.
b. Provide, through private industry, incentives or reimburse tuition costs to employees who become credentialed to teach in career and technical programs.
c. Examine apprenticeship and credentialing programs in other states for additional possibilities.

2.16. **Develop and implement an awareness campaign to recruit STEM teachers at the undergraduate level, graduate level, and from STEM professions, and to publicly recognize the importance of teaching.** Coordinate efforts with the STEM awareness campaign described in Action Item 1.13.c.

2.17. **Increase awareness of, and access to, financial incentives for incoming STEM educators.**

a. Ensure that students and guidance counselors are aware of currently available financial incentives for incoming STEM educators. For example, under the Federal Perkins Loan Teacher Cancellation,[56] teachers in fields in which there is a statewide shortage (e.g., science, technology, and mathematics in Florida) qualify for forgiveness of up to 100 percent of a Federal Perkins Loan if they serve in a public or nonprofit elementary or secondary school system as a full-time teacher. The Federal Stafford Loan Forgiveness[57] Program provides up to $17,500 in loan forgiveness for highly qualified full-time secondary mathematics or science teachers who teach for five or more years.
b. Include in the statewide STEM website (see Objective 3.D.) a clearinghouse of financial aid sources.

2.18. **Prepare K-12 educators to teach the Common Core State Standards in STEM.**[58]

a. Require teacher and principal preparation programs in the SUS to prepare incoming educators to teach the CCSS in STEM.
b. Provide high-quality professional development about the new standards to all elementary educators, and to STEM middle and high school educators.
c. Provide high-quality professional development for childcare providers, including those in after-school and out-of-school programs.

2.19. **Increase incentives and opportunities for tenured and tenure-track faculty to take a proactive role in recruiting and engaging students in STEM courses and majors, through teaching, research and service.**

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[56] See http://studentaid.ed.gov/PORTALSWebApp/students/english/cancelperk.jsp?tab=repaying.
[57] See http://studentaid.ed.gov/PORTALSWebApp/students/english/cancelstaff.jsp?tab=repaying.
[58] Common Core mathematics standards were developed by the Council of Chief State School Officers and The National Governors Association Center for Best Practices and were adopted by Florida in 2010. Currently national science and technology/engineering standards are being drafted.

SUSTAINABLE INFRASTRUCTURE

Goal 3: Create a statewide sustainable STEM leadership organization to align existing and emerging STEM initiatives and represent Florida as one voice in meeting STEM demands.

> Most states have STEM leadership advisory councils that frequently report to their governors. These councils include representatives from K-12 education, higher education, government laboratories, informal science education institutions, and local industry. These advisory groups are another important resource for understanding states' challenges and resources and for focusing state resources on STEM education initiatives. Connecting with these councils and sharing data, information, and strategies will increase the overall leadership and coherence of (national) STEM education efforts.[59]

Introduction

Leadership and organization are required to ensure that the recommendations of this plan are acted upon quickly and are updated as necessary to meet local, state, national, and international STEM demands. For this purpose, we recommend as the as the most immediate priority of this plan, the creation and maintenance of an industry-driven Florida STEM leadership board (Objective 3.A.) to align the voices, needs, and resources of industry, educators, philanthropists, policymakers, parents, and students. Once this board is created, the secondary objectives (3.B.-3.D.) must be addressed in order to support long-term sustainability. Finally, we provide suggestions as to the roles and responsibilities of this Florida STEM leadership board.

Measurable Objectives and Associated Action Items

3.A. Create and maintain an industry-driven Florida STEM leadership board by Fall 2011.

Action Items:

3.1. Include well-respected leaders of the STEM business, professional, education, workforce development system, policy, and philanthropic communities. At least 60 percent of the board membership should be STEM business members. (Note: STEM business members might include leaders of small, medium, and large companies, and researchers/designers in government laboratories or industry settings. Educators might include representatives from the FL DOE, school boards, Board of Governors, or practicing

[59] President's Council of Advisors on Science and Technology. (2010). *Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future.* Washington, D.C.: White House Office of Science and Technology Policy. Retrieved October 20, 2010, from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf. p. 36.

educators and researchers. Deans of the colleges of education in the SUS must be represented within this group to oversee the implementation of strategies suggested under Goal 2. Workforce development representatives should be from WFI or regional workforce boards. Representatives from the policy community might include members of organizations such as the Florida Chamber, the Florida Council of 100, etc., and policy makers such as legislators and other elected officials.)

3.2. Establish eight regional, business-led STEM councils following the eight economic development regions defined by EFI. Initial focus should be on leveraging existing regional STEM councils. For areas in which regional, business-led STEM councils do not exist, new ones should be created. Regional councils should have ratios of sector representation similar to that of the overall Florida STEM leadership board, defined in Action Item 3.1.

3.3. Identify roles and responsibilities of the Florida STEM leadership board. (Note: Suggestions are included on p. 32.)

3.4. Identify an appropriate corporate/tax structure for the Florida STEM leadership board (e.g., 501(c)3).

3.B. Identify and secure sustainable funding sources for infrastructure needs by 2012.

Action Items:

3.5. Create a white paper outlining the need for and role of the Florida STEM leadership board to be distributed to potential funders.

3.6. Search for funding from the following sources: business/industry, government (federal/state), philanthropic organizations, membership.

3.7. Decide on funding sources to pursue.

3.8. Secure funding.

3.C. Identify or create an online platform to facilitate communication among the Florida STEM leadership board, regional STEM councils, and the general public.

Action Items:

3.9. Survey the potential users (Florida STEM leadership board, regional councils, educators, parents) to identify desired components.
3.10. Identify the specifications desired for the platform.
3.11. Evaluate iCPALMS and/or other existing platforms for expansion viability.
3.12. Submit desired specifications to and receive (an) estimate(s) for creating the platform from qualified provider(s).
3.13. Secure funding for the platform development, revision, and sustainability.
3.14. Create platform.
3.15. Test platform.
3.16. Work with programmers to revise platform as needed.
3.17. Disseminate information about the website.
3.18. Encourage organizations to submit relevant information to the website.
3.19. Monitor and vet information as it is submitted to ensure quality and legitimacy of postings.
3.20. Request feedback from organizations and individuals using the website.
3.21. Maintain, revise, and update the website as needed.

3.D. Convene a temporary work group of the Florida STEM leadership board to identify or create a statewide STEM website to link research, industry, and philanthropy to schools, educators, parents, and students to facilitate mentorships, internships, partnerships, and volunteer opportunities and to inform students about possible STEM careers. This website might contain:

- A STEM volunteer database searchable by organizations, educators, parents, and students;
- A career database with associated pathways and STEM career profiles highlighting STEM professionals of diverse backgrounds;
- An option for STEM experts to submit and review resources for use in classrooms around the state through iCPALMS;
- A link to a safe and secure social network platform for student interactions focused on STEM learning and careers;
- An online postsecondary scholarship clearinghouse/database for students and parents; and
- Access to the Banner Centers to provide STEM expertise.

Action Items: See Items 3.9.-3.21., above.

Florida STEM Leadership Board: Suggested Roles and Responsibilities

A. Develop and maintain collaborative relationships with regional STEM councils.

B. Communicate with regional councils to identify short- and long-term local industry workforce training/certification needs.

C. Oversee, track, and report progress on implementing the Florida STEM Strategic Plan.

(Note: The platform described in Measurable Objectives 3.C. or 3.D. may be used to measure, track, and report progress.)

D. Identify and disseminate best practices and resources from successful STEM initiatives.

E. Identify funding sources to support STEM initiatives within the state.

F. Organize, secure funding for, and implement a statewide, STEM outreach campaign.

G. Inform and influence state policy about STEM-related matters.

H. Create a sub-panel to review approaches for integrating technology and engineering content standards into the Next Generation Sunshine State Standards (NGSSS) and/or the Common Core State Standards (CCSS) and make recommendations to the Florida STEM Leadership Board.

The panel should be chaired by a member of the Florida STEM leadership board, should include members and experts representing all sectors, and should:

- Compile information about the current level of integration of technology and engineering content standards in the NGSSS/CCSS;
- Determine the desired level of integration of technology and engineering content standards into the NGSSS/CCSS;
- Provide research about strategies for attaining the desired level;
- Create recommendations based on the above information; and
- Present the recommendations to the Florida STEM leadership board by December 2011.

Appendix A: STEM Strategic Plan Task Force Members

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Appendix B: Voluntary Prekindergarten and School Readiness Programs: Standards, Assessments, and Professional Development

The Department of Education is working with the Agency for Workforce Innovation to create one set of Standards for four-year-olds attending Voluntary Prekindergarten (VPK) and/or School Readiness programs. The 2011 Standards will be released in Summer 2011. Professional development relating to the Standards will be available statewide in Summer 2011. There are five domains of the Standards: 1) Physical Development (includes physical health and wellness, and motor development), 2) Approaches to Learning, 3) Social & Emotional Development, 4) Language, Communication, and Emergent Literacy, and 5) Cognitive Development and General Knowledge (includes Mathematical Thinking*, Scientific Inquiry*, Social Studies*, and Creative Expression Through The Arts)

The Department of Education also has the VPK Assessment, which covers four areas: Phonological Awareness, Alphabet Knowledge, Oral Language/Vocabulary, and Mathematics*.

In addition to the Standards training mentioned above, the Department of Education has a Mathematical Thinking toolkit folder (http://www.flvpkonline.org/teachertoolkit/mathThink/index.htm), and has worked to create a VPK to 3rd grade alignment of Mathematical Standards (Expectations), Teacher Resources (Instruction), and Parent Resources (Parents), which can be found here: https://www.brightbeginningsfl.org/Default.aspx.

*Includes STEM-related Standards.

Appendix C: Selected research-based instructional strategies to promote deep learning at all educational levels

The supporting text included below is excerpted from the Female - Minority Initiative Final Report (2009) and the Education Link Report (2010) as indicated.

a. **Use instructional activities that arouse greater student interest in STEM.**

   Causal research indicates that students have greater interest and achievement in STEM when teachers contextualize, personalize, and diversify instruction with multimedia, technology-assisted instruction, hands-on inquiry, project-based learning, and small within-classroom student groupings that facilitate learning (Parker & Lepper, 1992; Cordova & Lepper, 1996; Renninger et al., 2002; Schneider et al., 2002; Turner & Lapan, 2005; Bottge et al., 2007; Randler & Hulde, 2007).[60]

b. **Engage students in "minds-on, hands-on" learning.**

   There is a "clear, positive trend favoring inquiry-based instructional practices, particularly instruction that emphasizes student active thinking and drawing conclusions from data" (Minner, Levy, & Century, 2010, p. 493). "**Teaching strategies that actively engage students in the learning process through scientific investigations are more likely to increase conceptual understanding than are strategies that rely on more passive techniques**" (p. 474).[61]

   Research in STEM education suggests that **learners learn more deeply and more effectively when they are expected to creatively "learn by doing"** – to examine real-world, meaningful problems and phenomena; explore conjectures that may or may not be correct on the first try; justify and compare different solution methods and interpretations; and communicate ideas orally, in writing and using representations of concepts, such as graphs or manipulatives. The learner's underlying reasoning is most critical.[62]

c. **Encourage student self-reflection.**

   Teachers can most appropriately assess learner knowledge…. by encouraging learners' self-reflection regarding their thinking and reasoning and peer feedback (Bransford et al., 2000).[62]

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[60] Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 22-23.

[61] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 14.

[62] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 13.

d. **Praise the STEM effort of students.**

Causal research indicates that students have positive beliefs about their STEM abilities when teachers praise their efforts instead of praising their abilities, and when teachers help students understand that intelligence is incremental and malleable based on their efforts and learning. Students with these beliefs maintain stronger learning goals, use effort-based strategies to respond to challenges or failure (e.g., persist on challenging tasks), exhibit higher STEM achievement, take more STEM courses, and are more likely to choose STEM majors in college (Mueller & Dweck, 1998; Blackwell et al., 2007).[63]

e. **Provide motivational support and feedback to students.**

Correlational findings suggest that motivational support and frequent, elaborative, positive, and helpful feedback from teachers has a strong and positive relationship with increases in student motivation in STEM (Turner et al., 2002; Schweinle, Turner, & Meyer, 2006).[64]

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[63] Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 22.

[64] Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 23.

Appendix D: Additional data for use with objectives

Data related to Objective 1.A.

Percentage of students scoring proficient or advanced on NAEP Mathematics and Science in 2009

Grade	Proficient (%)	Advanced (%)	Total Proficient or Advanced (%)	Target (%): 2017
Mathematics				
4	35	5	40	60
8	23	6	29	49
12	18	1	19	39
Science				
4	31	0	31	51
8	23	1	24	44

Florida's rank on NAEP relative to other ranked states
(number of ranked states in parentheses)

Grade	Mathematics 2009	Science 2009	Average of Math & Science	Target Rank: 2014
4	23 (52)	26 (47)	24	15 (50)
8	35 (52)	35 (47)	35	15 (50)
12	9 (11)	N/A	N/A	15 (50)

Note: The number of states ranked includes the District of Columbia and the Department of Defense Education Activity, when applicable.

Data related to Objective 1.B.

Student performance on NAEP Mathematics and Science in 2009

	Total Proficient or Advanced (%)				
	Science		Mathematics		
	4th Grade	8th Grade	4th Grade	8th Grade	12th Grade
White Students	46	36	53	39	24
Black Students	10	7	20	13	7
Hispanic Students	23	17	33	22	13
Free and Reduced Lunch (FRL)	20	13	29	18	N/A
Non-FRL	47	35	55	40	N/A
Male	33	28	42	31	21
Female	31	21	39	27	16
Percentage Point Gap (White/Black)	36	29	33	26	17
Target (White/Black) Gap: 2017	**18**	**14**	**16**	**13**	**8**
Percentage Point Gap (White/Hispanic)	23	19	20	17	11
Target (White/Hispanic) Gap: 2017	**11**	**9**	**10**	**8**	**5**
Percentage Point Gap (FRL/non-FRL)	27	22	26	22	N/A
Target (FRL/non-FRL) Gap: 2017	**13**	**11**	**13**	**11**	**N/A**
Percentage Point Gap (Male/Female)	2	7	3	4	5
Target (Male/Female) Gap: 2017	**1**	**3**	**1**	**2**	**2**

Data related to Objectives 1.C. and 1.D.: The following table is included for reference only. These data are from the FCAT, as we do not yet have data from the FCAT 2.0.

Percentage of students scoring 3 or above on the FCAT in 2010

	Percentage of students scoring 3 or above on the FCAT in 2010			
	Grade 5		Grade 8	
	Mathematics	Science	Mathematics	Science
Total Students	63	49	68	43
White	74	63	79	57
Black	43	27	48	22
Black - White Gap	31	36	31	35
Not Free or Reduced Lunch	79	68	81	60
Free or Reduced Lunch	52	36	57	30
FRL - Non-FRL Gap	27	32	24	30

Data related to Objective 1.G.:

Enrollment and success in high school STEM courses

	Success determined by…	2010		2017	
		Enrollment	Successful	Enrollment	Successful
AP Mathematics Courses	Score of 3 or above on AP Exam	12.2%	5.4%	22.2%	15.4%
AP Science Courses	Score of 3 or above on AP Exam	14.8%	5.0%	24.8%	15.0%
State-Approved STEM CTE Courses	Credit earned	5.7%	5.4%	15.7%	15.4%

State-approved dual credit STEM CTE courses

Under RTTT the Florida DOE created a listing of dual credit STEM CTE courses. Each of these courses is aligned with either Algebra 1, Biology, or Geometry, so that a student who successfully completes this course and the associated end-of-course exam in either Algebra 1, Biology, or Geometry gets credit for two courses.

8106120 Animal Biotechnology 3
8106510 Plant Biotechnology 3
8106810 Agriscience Foundations 1
8106850 Agricultural Biotechnology 2
8106860 Agricultural Biotechnology 3
8113010 Environmental Resources 3
8113020 Environmental Resources 4
8600520 Principles of Engineering
8600530 Digital Electronics
8600550 Introduction to Engineering Design
8600560 Computer Integrated Manufacturing
8600570 Engineering Technology I
8600580 Aerospace Technologies I
8600590 Civil Engineering and Architecture
8600620 Aerospace Engineering
8600630 Biotechnical Engineering
8600670 Engineering Technology II
8600680 Aerospace Technologies II
8600810 Drafting/Illustrative Design Technology I
8600820 Drafting/Illustrative Design Technology II
8600830 Drafting/Illustrative Design Technology III
8601310 Power & Energy Technology I
8601320 Power & Energy Technology II
8601330 Power & Energy Technology III
8601770 Engineering Technology III
8601780 Aerospace Technologies III
8708110 Principles of the Biomedical Sciences 8
8708120 Human Body Systems
8708130 Biomedical Interventions
8708140 Biomedical Science Research
8720310 Building Construction Technology 1
8720320 Building Construction Technology 2
8720330 Building Construction Technology 3
8720340 Building Construction Technology 4
8725010 Drafting 1
8725020 Drafting 2
8725030 Drafting 3
8725040 Drafting 4
8725110 Electronic Drafting 5
8725310 Mechanical Drafting 5
8725450 Architectural Drafting5
8725550 Structural Drafting 5
83027010 Biotechnology 1
83027020 Biotechnology 2
8736030 Biotechnology 3
9200110 Automation and Production Technology 1
9200120 Automation and Production Technology 2
9200130 Automation and Production Technology 3
9200140 Automation and Production Technology 4

Data related to Objective 1.H:

Intended college major of 2010 college-bound seniors in Florida's public schools as self-reported on the SAT

Degree Field	Test-takers	
	Number	Percentage
Agriculture/Agricultural Operations/Related Sciences	471	1%
Architecture/Related services	1,272	2%
Biological/Biomedical Sciences	3,725	5%
Computer Information/Support Services	1,573	2%
Engineering	5,476	8%
Engineering Technologies/Technicians	1,216	2%
Health Professions/Related Clinical Sciences	16,315	24%
Mathematics and Statistics	524	1%
Natural Resources/Conservation	316	0%
Physical Sciences	833	1%

Total number of students responding: 68,353

Intended college major of 2010 college-bound sophomores in Florida's public schools as self-reported on the PSAT

Degree Field	Number	Percentage, %		
	Total	Total	Male (Percentage of Total Males)	Female (Percentage of Total Females)
Agriculture/Agricultural Operations/Related Sciences	1,827	1.4%	1.1%	1.6%
Architecture/Related services	2,088	1.6%	2.4%	0.9%
Biological/Biomedical Sciences	6,003	4.6%	3.8%	5.3%
Computer Information/Support Services	2,741	2.1%	3.8%	0.4%
Engineering	10,310	7.9%	14.9%	1.5%
Engineering Technologies/Technicians	2,219	1.7%	3.1%	0.3%
Health Professions/Related Clinical Sciences	25,448	19.5%	10.9%	27.4%
Mathematics and Statistics	783	0.6%	0.8%	0.4%
Natural Resources/Conservation	653	0.5%	0.6%	0.3%
Physical Sciences	1,175	0.9%	1.2%	0.6%

Total number of students responding: 130,505

Data related to Objectives 1.I and J:

Number and percentage of students receiving postsecondary STEM degrees from within the Florida SUS

All Students

Degree Field	Number of Degrees in 2009-2010			Percentage of Total Degrees in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	639	111	34	1.1%	0.7%	1.6%
Natural Resources/Conservation	293	90	24	0.5%	0.6%	1.1%
Architecture/Related Services	358	223	12	0.6%	1.4%	0.6%
Computer Information/Support Services	700	197	30	1.3%	1.2%	1.4%
Engineering	2,777	1,547	403	5.0%	9.7%	18.5%
Engineering Technologies/Technicians	523	187	0	0.9%	1.2%	0%
Biological/Biomedical Sciences	2,843	394	213	5.1%	2.5%	9.8%
Mathematics and Statistics	279	170	44	0.5%	1.1%	2.0%
Physical Sciences	537	134	164	1.0%	0.8%	7.5%
Health Professions/Related Clinical Sciences	4,409	2,146	435	7.9%	13.4%	20.0%
Total STEM Degrees	13,358	5,199	1,359	23.9%	32.5%	62.4%
Total Degrees in all Fields	55,830	15,997	2,177			

Number and percentage of females receiving postsecondary STEM degrees from within the Florida SUS

Degree Field	Number of Degrees Received by Females in 2009-2010			Percentage of Total Degrees in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	333	63	20	52%	57%	59%
Natural Resources/Conservation	162	44	10	55%	49%	42%
Architecture/Related Services	142	108	3	40%	48%	25%
Computer Information/Support Services	101	49	6	14%	25%	20%
Engineering	568	355	87	20%	23%	22%
Engineering Technologies/Technicians	73	57	0	14%	30%	0%
Biological/Biomedical Sciences	1,641	216	107	58%	55%	50%
Mathematics and Statistics	110	63	15	39%	37%	34%
Physical Sciences	216	47	65	40%	35%	40%
Health Professions/Related Clinical Sciences	3,715	1,804	353	84%	84%	81%
Total STEM Degrees (Females)	7,061	2,806	666	53%	54%	49%
Total Degrees in all Fields (Females)	32,918	9,589	1,130	59%	60%	52%

Number and percentage of males receiving postsecondary STEM degrees from within the Florida SUS

Degree Field	Number of Degrees Received by Males in 2009-2010			Percentage of Total Degrees Received by Males in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	306	48	14	48%	43%	41%
Natural Resources/Conservation	131	46	14	45%	51%	58%
Architecture/Related Services	216	115	9	60%	52%	75%
Computer Information/Support Services	599	148	24	86%	75%	80%
Engineering	2,209	1,192	316	80%	77%	78%
Engineering Technologies/Technicians	449	130	0	86%	70%	0%
Biological/Biomedical Sciences	1,202	178	105	42%	45%	49%
Mathematics and Statistics	169	107	29	61%	63%	66%
Physical Sciences	321	87	99	60%	65%	60%
Health Professions/Related Clinical Sciences	694	342	82	16%	16%	19%
Total STEM Degrees (Males)	6,296	2,393	692	47%	46%	51%
Total Degrees in all Fields (Males)	22,909	6,408	1,046	41%	40%	48%

Number and percentage of Blacks receiving postsecondary STEM degrees from within the SUS

Degree Field	Number of Degrees Received by Blacks in 2009-2010			Percentage of Total Degrees Received by Blacks in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	72	6	1	11%	5%	3%
Natural Resources/Conservation	15	5	2	5%	6%	8%
Architecture/Related Services	60	23	0	17%	10%	0%
Computer Information/Support Services	78	7	0	11%	4%	0%
Engineering	218	58	16	8%	4%	4%
Engineering Technologies/Technicians	58	16	0	11%	9%	0%
Biological/Biomedical Sciences	308	37	4	11%	9%	2%
Mathematics and Statistics	19	5	1	7%	3%	2%
Physical Sciences	38	10	4	7%	7%	2%
Health Professions/Related Clinical Sciences	900	302	34	20%	14%	8%
Total STEM Degrees (Black)	1,766	469	62	13%	9%	5%
Total Degrees in all Fields (Black)	6,780	1,589	128	12%	10%	6%

According to the 2000 US Census, **Blacks comprise 18%** of the 20-34 year-old population in Florida. The 2010 Florida census data will be released in April 2011 (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml).

Number and percentage of Hispanics receiving postsecondary STEM from within the Florida SUS

Degree Field	Number of Degrees Received by Hispanics in 2009-2010			Percentage of Total Degrees Received by Hispanics in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	76	8	3	12%	7%	9%
Natural Resources/Conservation	36	4	1	12%	4%	4%
Architecture/Related Services	133	40	0	37%	18%	0%
Computer Information/Support Services	137	21	0	20%	11%	0%
Engineering	540	129	25	19%	8%	6%
Engineering Technologies/Technicians	82	49	0	16%	26%	0%
Biological/Biomedical Sciences	524	45	8	18%	11%	4%
Mathematics and Statistics	37	11	2	13%	6%	5%
Physical Sciences	101	9	6	19%	7%	4%
Health Professions/Related Clinical Sciences	753	283	42	17%	13%	10%
Total STEM Degrees (Hispanic)	2,419	599	87	18%	12%	6%
Total Degrees in all Fields (Hispanic)	10,270	2,127	141	18%	13%	6%

According to the 2000 US Census, **Hispanics comprise 22%** of the 20-34 year-old population in Florida. The 2010 Florida census data will be released in April 2011 (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml).

Number and percentage of Whites receiving postsecondary STEM degrees from within the Florida SUS

Degree Field	Number of Degrees Received by Whites in 2009-2010			Percentage of Total Degrees Received by Whites in 2009-2010		
	Bachelor's	Master's	Doctorate	Bachelor's	Master's	Doctorate
Agriculture/Agricultural Operations/Related Sciences	411	55	13	64%	50%	38%
Natural Resources/Conservation	230	62	11	78%	69%	46%
Architecture/Related Services	121	130	4	34%	58%	33%
Computer Information/Support Services	402	92	4	57%	47%	13%
Engineering	1,589	477	93	57%	31%	23%
Engineering Technologies/Technicians	349	75	0	67%	40%	0%
Biological/Biomedical Sciences	1,495	228	129	53%	58%	61%
Mathematics and Statistics	186	65	9	67%	38%	20%
Physical Sciences	307	57	64	57%	43%	39%
Health Professions/Related Clinical Sciences	2,369	1,339	297	54%	62%	68%
Total STEM Degrees (White)	7,459	2,580	624	56%	50%	46%
Total Degrees in all Fields (White)	33,563	9,365	1,143	60%	59%	53%

According to the 2000 US Census, **Whites comprise 56%** of the 20-34 year-old population in Florida. The 2010 Florida census data will be released in April 2011 (http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml).

Data related to Objective 2.C: STEM educators for incoming middle (5-9) and middle/upper (6-12) grades

	Number of teachers in Florida (Fall 2008)	New hires as a percentage of all teachers (Fall 2008)	Projected number of completers of teacher education programs in Florida 2009-2010	Projected number of positions to be filled 2010-2011
Mathematics	11,188	6.5%	657	1585
Science	9,370	8.2%	462	1399
Industrial Arts/ Technology Education	597	5.4%	12	41

Data related to Objective 2.F.: Current minimum certification requirements in Florida. Each requires a bachelor's degree or higher, with minimum science, mathematics, or technology requirements described below.

<table>
<tr><td>Elementary Education (K-6)</td><td colspan="2">STEM credits are not required for state certification of elementary teachers, although specific teacher preparation programs may require them.</td></tr>
<tr><td rowspan="3">Middle Grades (6-8)</td><td>Middle Grades Integrated Curriculum Certification</td><td>12 semester hours in mathematics and 12 semester hours in science.</td></tr>
<tr><td>Middle Grades Mathematics Certification</td><td>18 semester hours in mathematics, including the following disciplines:
• calculus, precalculus, or trigonometry;
• geometry; and
• probability or statistics.</td></tr>
<tr><td>Middle Grades General Science Certification</td><td>18 semester hours in science, including the following:
• biological science;
• chemistry or physics; and
• earth-space science or earth science.</td></tr>
<tr><td rowspan="3">Middle and Upper Grades (6-12):</td><td>Certification in Mathematics</td><td>30 semester hours in mathematics, including:
• 6 semester hours in calculus,
• credit in geometry,
• credit in probability or statistics,
• credit in abstract or linear algebra;
OR specialization requirements completed for physics, plus 21 semester hours including the above list.</td></tr>
<tr><td>Certification in Separate Areas of Science (biology, chemistry, earth-space science, or physics)</td><td>30 semester hours in science, including 21 semester hours in the area with associated laboratory experience;
OR specialization requirements completed for another science area (biology, chemistry earth-space science, or physics) plus 18 semester hours in area of certification.</td></tr>
<tr><td>Certification in Technology Education</td><td>30 semester hours in industrial arts or industrial technology education to include credit in 4 of the 10 areas:
• Materials and manufacturing processes technology to include credit in woods, metals, and man-made materials;
• Drafting and design technology;
• Energy and power technology;
• Graphics communications technology;
• Electronics technology;
• Construction technology;
• Transportation technology;
• Biomedical technology;
• Information technology; and
• Industrial systems technology such as robotics, laser technology, fiber optics, or other feedback controlling systems.</td></tr>
</table>

Appendix E: State-approved STEM Career Academies as of February 23, 2011

Aerospace Technologies
Animal Biotechnology
Architectural Drafting
Automation and Production Technology
Biomedical Sciences
Building and Construction Technology
Drafting/Illustrative Design Technology
Drafting Technology
Electrical Drafting
Electronic Drafting
Engineering Technology
Environmental Resources
Industrial Biotechnology
Mechanical Drafting
Project Lead the Way – Aerospace Engineering
Project Lead the Way – Biotechnical Engineering
Project Lead the Way – Civil Engineering and Architecture
Project Lead the Way – Computer Integrated Manufacturing
Plant Biotechnology
Power and Energy Technology
Structural Drafting

Appendix F: Examples of undergraduate programs in Florida and other states that have been successful in attracting all students, including underrepresented minorities, to STEM or STEM-related majors[65]

- **The Meyerhoff Scholarship Program** was created in 1988 at the University of Maryland-Baltimore County (UMBC) in response to the observation that underrepresented minority students were not performing as well in college as their previous performance would predict, and were generally underrepresented at the graduate levels, particularly in STEM fields. Multiple studies have reported the success of this program in increasing student grade point average, increasing graduation rates in STEM fields, and increasing acceptance into graduate programs of Meyerhoff students relative to comparison samples of students (for a program review see Gordon & Bridglall, 2004). The program is academically demanding, with strong scholastic, financial, and social infrastructure, including peer, family, and faculty commitment and support. The highest achieving students are recruited and supported through challenging programs that include an introduction to college life and studies, and multiple research experiences. The program received the 1996 Presidential Award for Excellence in Science, Math, and Engineering Mentoring and "both internal and external evaluations show that Meyerhoff students are nearly twice as likely to persist and graduate in mathematics, engineering, and the sciences than their peers who declined offers of admission to the program and enrolled at other universities" (Gordon & Bridglall, 2004, p. 38-39). (http://www.umbc.edu/meyerhoff/)

- **SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs)** is an initiative to transform traditionally large lecture science courses into small-group inquiry and discussion courses. Instructors pose questions and students, working in small groups, explore concepts through research and discourse. Originally designed for introductory physics courses at North Carolina State University (NCSU), the SCALE-UP model is now employed in more than 50 universities around the country for large courses in several STEM disciplines. This type of studio-based inquiry learning allows students to form social relationships with their peers and their teachers in a stimulating environment. Preliminary information, some of which is not yet peer-reviewed, suggests that the program can be highly successful in terms of content retention and concept learning. For program reviews, please see Beichner (n.d.) and Beichner et al. (2007). Compared to traditional lecture courses, SCALE-UP courses show promise for increasing student gains, increasing student retention and motivation, and closing achievement gaps in STEM courses (Beichner et al., 1999; Beichner, n.d.). (http://www.ncsu.edu/per/scaleup.html)

  Florida State University implemented SCALE-UP in General Physics courses for the first time in Spring 2008 and again in Summer 2008. Implementers reported that students showed normalized gains on the Force Concept Inventory (FCI) assessment of approximately 50% (for a description of the assessment, classroom setup, and equipment, and to view the classroom area, see http://scaleup.ncsu.edu/groups/adopters/wiki/48252/Florida_State.html). This gain is roughly two times higher than the 23% FCI pre-post test gain demonstrated by 6,000 students from around the country in traditional courses (Hake, 1998). Similarly, Florida

[65] This information is taken directly from the Education Link Report. Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010 from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 28-30.

International University (FIU) and University of Central Florida (UCF) reported that the average performance on the FCI by students in the studio-style physics course was roughly 2.5 times higher than the performance of students in traditional physics courses (taught at FIU and UCF, respectively; Beichner, n.d.; Beichner et al., 2007). While these results are very encouraging, student success may be at least partly attributable to other factors, including student self-selection and instructor attitudes and abilities.

Retention and student motivation was examined using drop, fail, or withdraw (DFW) rates: At FIU, students were 75% less likely to drop, fail, or withdraw from the studio-based physics classes than the traditional physics courses. Additionally, recruitment of physics majors and minors was much higher in studio-based courses: between 10% and 20% of students chose to pursue physics minors or majors after taking the studio-based course. At Clemson, all freshman Calculus I courses were taught using the SCALE-UP model starting in Fall 2006; the DFW rate fell from 44% to 22% in courses that included almost 800 freshman students (Beichner, n.d.). Again, although promising, the influence of other factors explaining these results must be considered.

Female and minority performance improvements: NCSU found that minority and female failure rates in SCALE-UP physics courses were four to five times lower than those for traditional physics courses (Beichner, n.d.).

Appendix G: Examples of existing out-of-school and after school STEM programs[66]

- **MATHCOUNTS:** "MATHCOUNTS is a national enrichment, club and competition program that promotes middle school mathematics achievement through grassroots involvement in every U.S. state and territory…Currently in its 28th year, MATHCOUNTS is one of the Country's largest and most successful education partnerships involving volunteers, educators, industry sponsors and students… MATHCOUNTS offers two unique programs to middle school teachers and students: The MATHCOUNTS Competition Program and the FREE MATHCOUNTS Club Program."[67]

- **SECME:** Established in 1975 as the Southeastern Consortium for Minorities in Engineering by the engineering deans at seven southeastern universities, this organization sponsors programs for students, teachers and parents with the aim of increasing the numbers of underrepresented and underserved students who want to study science, mathematics, engineering and technology in college. SECME's programs start as early as pre-kindergarten and extend through high school (see www.secme.org). The Georgia Institute of Technology would have data on the success of this program. The Miami-Dade school district, University of Miami and Florida International University also have been involved in SECME initiatives.

- **California MESA:** (Mathematics Engineering Science Achievement). Established in 1970 and administered by the State of California, MESA is an academic development program that supports educationally disadvantaged students in math and science studies at the university level and their attainment of math-related degrees in engineering, science and technology. The program is funded by the state legislature, corporate contributions and grants (see http://www.ucop.edu/mesa/home.html).

- **Upward Bound Math-Science (UBMS):** In 1990, the U.S. Department of Education established a math and science initiative within Upward Bound, designed to provide disadvantaged high school students with skills and experiences to help them succeed in college. The UBMS initiative awards grants to colleges and universities to provide (1) hands-on experience in laboratories, computer facilities, and at field sites, and (2) opportunities to learn from mathematicians and scientists at host institutions. An evaluation of student transcripts collected between 1998 and 1999 and again from 2001 to 2002 indicated that UBMS improves several student outcomes in high school and college, and increases the odds of majoring in math or science (Olsen et al., 2007).

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[66] Unless indicated, this information is directly from: Jones, F., Rew, W. J., & Lang, L. (2009). *Female-Minority Initiative final report.* Tallahassee, FL: Florida State University, Learning Systems Institute. Retrieved November 28, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/female-minority_initiative_report_20february2009.pdf. p. 24.

[67] Retrieved on November 20, 2010, from http://mathcounts.org/Page.aspx?pid=1854&srcid=296.

- **Summer STEM programs and academies for students:** These experiences appear to increase students' interest in STEM. A variety of these programs are offered by Florida's universities. Examples include "Expanding Your Horizons" a STEM-related program for middle school girls sponsored by UCF's College of Engineering and Computer Science, "Saturday-at-the-Sea" sponsored by Florida State University's College of Arts & Sciences, and "Science Students Together Reaching Instructional Diversity & Excellence" (SSTRIDE) sponsored by FSU's College of Medicine. At FIU, the College of Engineering conducts outreach programs during the school year and summer months to prepare young students in science, technology, engineering, and mathematics.

Appendix H: Principal leadership

As stated in the Education Link Report:

> Research indicates that principal leadership is a key variable in predicting school effectiveness (Hallinger, Bickman, & Davis, 1996; Hallinger & Heck, 1998) and, importantly, that leadership effects on student achievement appear stronger for relatively lower-SES schools (Hallinger & Heck, 1996). Reviews of studies conducted over the past twenty years concluded that principals' influences on student outcomes were primarily indirect, but measurable (Hallinger & Heck, 1996), and that the total direct and indirect effects of leadership on student outcomes account for approximately 25% of the total school effects, after controlling for individual student characteristics (Leithwood, Louis, Anderson, & Wahlstrom, 2004). Studies have shown that school leaders influence the quality of their schools and, more specifically, student performance, through the creation of learning environments that foster achievement and by focusing improvement efforts on the practices most likely to result in improved student outcomes, including the development of teachers' instructional skills (Brenninkmeyer & Spillane, 2004; Crow, Hausman, & Scribner, 2002; Leithwood, & Kington, 2008; Hallinger et al., 1996; Hallinger & Heck, 1996; Marks & Nance, 2007; Mulford, 2005; Nettles & Herrington, 2007).[68]

[68] Lang, L., Gaboardi, M., & Johnson, C. (2010). *Education Link Report*. Tallahassee, FL: Florida State University, Florida Center for Research in Science, Technology, Engineering and Mathematics. Retrieved February 23, 2010, from http://www.lsi.fsu.edu/centers/fcrstem/resources/documents/education_link.pdf. p. 39.

Appendix I: Acronyms

ACE: Architecture, Construction, Engineering

AP: Advanced Placement

CCSS: Common Core State Standards

CFEF: Consortium of Florida Education Foundations

CPALMS: http://www.floridastandards.org/

CTE: Career Technical Education

DFW: Drop, Fail, Withdraw

EFI: Enterprise Florida, Inc.

ePEP: electronic Personal Education Planner

ESE: Exceptional Student Education

ESL: English as a Second Language

FCAT: Florida Comprehensive Achievement Test

FCI: Force Concept Inventory

FCR-STEM: Florida Center for Research in Science, Technology, Engineering, and Mathematics

FIU: Florida International University

FL DOE: Florida Department of Education

FRL: Free and Reduced Lunch

FSU: Florida State University

GDP: Gross Domestic Product

iCPALMS: http://www.icpalms.org/

ICUF: Independent Colleges and Universities of Florida

MESA: Mathematics Engineering Science Achievement

NAEP: National Assessment of Educational Programs

NCSU: North Carolina State University

NGSSS: Next Generation Sunshine State Standards

NSF GK-12: National Science Foundation Teaching Fellows in K-12 Education

NSF: National Science Foundation

PISA: Programme for International Student Assessment

PSAT: Pre-SAT Reasoning Test

RET: Research Experiences for Teachers

RFP: Request for proposals

RTTT: Race to the Top

SAT: SAT Reasoning Test

SCALE-UP: Student-Centered Active Learning Environment for Undergraduate Programs

SECME: Southeastern Consortium for Minorities in Engineering

SES: Socioeconomic status

SET: Science, Engineering, and Technology

SMART: Science and Mathematics Access to Retain Talent

SSTRIDE: Science Students Together Reaching Instructional Diversity and Excellence

STEM: the integration of fields of Science, Technology, Engineering, and Mathematics

SUS: State University System

TIMSS: Trends in International Mathematics and Science Study

TRDA: Technological Research and Development Authority

UBMS: Upward Bound Math-Science

UCF: University of Central Florida

UF: University of Florida

UMBC: University of Maryland-Baltimore County

USF: University of South Florida

VPK: Voluntary Prekindergarten

WFI: Workforce Florida, Inc.