Future-Ready Tennessee: Developing STEM Talent for 2018 and Beyond

A Strategic Plan
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August 2012
Executive Summary

Will Tennessee have the competitive and skilled workforce it needs to prosper in a STEM-driven economy? That’s the looming question. This strategic plan seeks to make certain that the answer is “yes” by offering state, regional and local policy leaders and STEM stakeholders clear direction on aligning STEM policies, practices and partners – from K-12, higher education and business – to cultivate, attract and retain STEM-capable talent. Outlined within this plan are four strategic goals, each with a set of supporting strategies and corresponding metrics, which will catapult Tennessee forward as a national leader in STEM talent production and economic prosperity.

The Significance of STEM Education

STEM is everywhere around us and STEM professionals impact almost every aspect of our lives. They invent our medicines and smart phones, engineer our planes and bridges and design the architecture of our buildings and even the Internet – all developments that have forever changed our lives.

STEM literacy is a foundational skill that matters for all careers, not just STEM-related fields or jobs. STEM prepares students who are critical and creative thinkers, innovators, problem solvers, collaborators, team workers and strong communicators. Put simply, students who are prepared to tackle the challenges of a fiercely competitive and constantly changing 21st century economy.

STEM education is one of the most effective tools we have to prepare students for tomorrow’s workforce and success in college and career. Why? At its foundation, STEM is focused on building critical and creative thinking and analysis skills by addressing how students view and experience the world around them. Strong STEM teaching and learning opportunities rest on inquiry-, technology-, and project-based learning activities and lessons that are tied to the real world; a diverse, interdisciplinary curriculum where activities in one class complement those in other classes; robust partnerships that reach beyond the walls of the classroom to include higher education and business; and strong school leaders who understand the “STEM approach” and fully use it to transform the delivery of education.

Today’s students – Tennessee’s future workforce – must be comfortable with ideas, abstractions, analysis and synthesis. STEM literacy and proficiency provides the foundation for these skills, and helps students build the flexibility to adapt quickly to changes in the labor market caused by frequent global shifts.

An Exciting STEM Jobs Forecast for Tennessee

Currently, two forces are on a path to converge and cause an explosion of future STEM jobs in Tennessee. First, Anthony Carnevale, one of the nation’s most celebrated authorities on education, training and employment based at the Georgetown University Center on Education and the Workforce, predicts that by 2018 Tennessee will have more than 100,000 STEM jobs, nearly 14,000 more STEM jobs than the state had in 2008. Carnevale’s prediction, driven by data from the Bureau of Labor Statistics, does not consider the state’s aggressive new policies to invest in innovative jobs through Governor Haslam’s Jobs4TN Plan. These bold investments, on top of natural STEM labor trends, will guarantee an abundance of STEM jobs over the next six years and beyond. Tennessee must be poised to fill these jobs with home-grown talent.

Ensuring a Future-Ready Tennessee

To improve student success in STEM, which results in increased postsecondary and career success, and ensure that Tennessee can capitalize on future STEM jobs, this plan builds from already strong K-12, higher education, economic growth and talent goals, many of which were anchored to the state’s winning First to the Top proposal. The plan also leverages the state’s commitment of $14.7 million in First to the Top funds to establish the Tennessee STEM Innovation Network (TSIN or Network), which will serve as the state’s lead driver of aligned and coordinated STEM policies, practices and partners.

1 STEM is an acronym for science, technology, engineering and mathematics.
This strategic plan calls for the alignment and coordination of STEM education policies, practices and partners across Tennessee so that all efforts can work efficiently to achieve the same outcomes. Tennessee is blessed with an abundance of STEM assets – from institutions of higher education to high-tech health and research organizations and global businesses – and these assets should be used to enhance the STEM teaching and learning process for students across the state. To steer this work, this strategic plan proposes the following guiding statements:

**Vision for STEM in Tennessee:** Tennessee students will lead the nation in STEM knowledge, skills and practices as critical and creative thinkers, problem solvers, innovators and collaborators to compete and succeed in the state’s emerging innovation economy.

**Theory of Change for STEM in Tennessee:** If Tennessee fully coordinates and aligns STEM policies, practices and partners to increase student interest, participation and achievement in STEM, expands student access to effective STEM teachers and leaders, reduces its STEM talent and skills gap and builds community awareness and support for STEM, then it will lead the nation in STEM-talent development.

These guiding statements set up the four goals and supporting strategies identified in Figure 1. Each goal and strategy has a corresponding metric to gauge progress, as described in the full report.

**Figure 1– Four Goals and Supporting Strategies**

**GOAL #1**: Increase student interest, participation, & achievement in STEM

**STRATEGIES:**
- Establish Regional STEM Innovation Hubs
- Launch STEM Platform Schools
- Ensure all students have access to rigorous STEM courses
- Identify, develop & share STEM curriculum tools

**GOAL #2**: Expand student access to effective STEM teachers & leaders

**STRATEGIES:**
- Increase effective STEM teachers & leaders
- Replicate proven STEM teacher training programs
- Use STEM Schools as learning labs
- Boost STEM teacher supply
- Enhance STEM Teacher capacity & reach
- Increase quality STEM professional development
- Support school leaders

**GOAL #3**: Reduce the state’s STEM talent and skills gap

**STRATEGIES:**
- Increase accelerated STEM learning opportunities
- Increase partnerships between business and education
- Increase STEM postsecondary degree production

**GOAL #4**: Build community awareness and support for STEM

**STRATEGIES:**
- Build communication tools, develop messages and identify delivery channels
- Conduct media outreach
- Identify and showcase STEM public events
- Increase STEM stakeholder engagement

Combined, these goals and strategies will guarantee enhanced student achievement in STEM across the education continuum – from K-12 to higher education and the workforce – and, ultimately, an ample supply of future workers for the state of Tennessee.
Introduction

This is a momentous point in time for human-talent development in the state of Tennessee. Consider the following hallmarks that distinguish it from other states:

- First-round winner of Race to the Top (one of two states) and now implementing a $500 million First to the Top plan aimed at transforming student performance, developing great teachers and leaders and using STEM, by establishing the Tennessee STEM Innovation Network, as a vehicle for ensuring college and career readiness.
- Leader in national education reform initiatives including Common Core State Standards, Partnership for Assessment of Readiness for College and Careers (PARCC) and Complete College America.
- Aggressive approach to innovative job creation through Governor Haslam’s and Economic and Community Development (ECD) Commissioner Hagerty’s Jobs4TN plan to recruit target industries, assist existing businesses and support regional and rural economic growth.
- Implementation of the Complete College Tennessee Act to overhaul public higher education by funding completion over enrollment with a special emphasis on STEM degree completion.
- Comprehensive four-point plan to transform the Tennessee Department of Education to “expand kids’ access to effective teachers and leaders, expand families’ access to good schools, expand educators’ access to resources and best practices and expand public access to information and data” – ensuring that the state continues its pace to become the first to the top.
- Charter member (one of 13 states) of STEMx, the newly developed multi-state STEM network aimed at connecting state STEM networks to generate and share new knowledge, promote clear indicators of quality, develop high-quality tools and connect innovative policies and practices across the country.

This strategic plan is designed to complement and enhance the talent development initiatives already in place and to push further with a laser-like focus on STEM. Such a focus is essential because, as explained in the next section, Tennessee is expected to see a 15 percent increase in new and replacement STEM jobs by 2018.

This plan recommends four interlocked goals and a suite of corresponding strategies that seek to enhance STEM core cognitive competencies for all students in Tennessee, with a special emphasis on those in the state’s rural areas. It also initiates a coordinated, long-term process of preparing skilled and trained STEM-ready talent who can easily step into future jobs resulting from Jobs4TN and other similar initiatives. Lastly, it promotes strategies aimed at changing the perceptions and behavior of students, educators, families, policymakers and leaders so that they recognize the importance and necessity of STEM.

This plan has been developed over a six-month period and represents the best thinking of key STEM stakeholders across the Volunteer State from K-12, higher education, business and government. It is rooted in research from the Department of Economic and Community Development, the Department of Education and the state’s higher education entities. The plan is comprehensive and multifaceted, recognizing that success in preparing tomorrow’s STEM worker requires coordination on multiple fronts, an array of diverse partners and a new and different way of preparing our students.
Why STEM?

Benefits of STEM Literacy and STEM Education

Look around. STEM is everywhere. And STEM-capable professionals impact almost every aspect of our lives. They invent our medicines and smart phones, engineer our planes and bridges and design the architecture of our buildings and technology platforms, including the Internet. Our lives are STEM dependent. Furthermore, our economy is STEM-dependent.

But STEM literacy is not just a necessity for our scientists, engineers, technologists and mathematicians. Rather, it is a foundational skill that matters for all careers. This point is best articulated by Anthony Carnevale of Georgetown University’s Center on Education and the Workforce. Carnevale’s October 2011 National STEM report concludes that the nation’s education system is not producing enough STEM-capable students to keep up with demand both in traditional STEM occupations and other sectors across the economy that demand similar competencies. STEM literacy and education are the keys to preparing a competitive and highly-skilled workforce. STEM education is also one of the most effective college- and career-readiness tools that policy and education leaders have at their disposal.

STEM education\(^2\), when implemented with fidelity:

- Is for all students – not just the top-performing students.
- Builds critical thinking and analysis skills by addressing how our students view and experience the world around them. These skills have proven to be an important tool for student success.
- Prepares our students to succeed in college, in careers and as responsible citizens.
- Fosters the creativity and innovation that all Tennessee students – and the state as a whole – need to compete and prosper in a global economy.
- Engages the whole community, through robust partnerships that reach beyond the walls of the classroom including higher education and business, to educate the whole child.
- Is taught by content-knowledgeable educators who implement inquiry-, technology-, and project-based learning activities and lessons that are tied to the real world.
- Is brought to life through a diverse, interdisciplinary curriculum where activities in one class complement those in other classes, including social studies and the arts.
- Thrives from strong school leaders who fully understand the “STEM approach” and fully use it to transform the delivery of education.
- Stands as a key strategy for Tennessee’s economic future – for stimulating economic development in our state and creating economic opportunity for our citizens.

Today’s students – Tennessee’s future workforce – must be comfortable with ideas and abstractions, analysis and synthesis. Gaining STEM literacy and proficiency provides the foundation for these skills, and also helps build the flexibility to adapt quickly to changes in the labor market caused by frequent global shifts.

In the end, STEM-literate students are critical and creative thinkers, innovators, problem solvers, collaborators, team workers and strong communicators, students who are ready to tackle Tennessee’s challenges – and the world’s challenges.

Tennessee’s Need for STEM Talent

Critical and creative thinkers, innovators, problem solvers, collaborators, team workers and strong communicators: these are the students and future workers that Tennessee needs to effectively meet its impending jobs forecast. As a companion to his national STEM report, Carnevale also released a STEM State-

\(^2\) See Section 1 of the Appendix for a full list of STEM education benefits.
Level Analysis, which examines the STEM jobs expected across states through 2018. The report predicts that Tennessee will experience significant growth in STEM jobs over the next seven years.

- The Volunteer State will demand more than 100,000 STEM jobs by 2018. That's nearly 14,000 more STEM jobs than the state had in 2008, or a 15 percent increase in STEM jobs over a 10 year period.
- 88 percent of those jobs will require postsecondary education or training by 2018.
- 47 percent of STEM jobs in Tennessee will be in computer occupations by 2018.

There is no question that this forecast is welcomed. It comes at a time when the state’s August 2011 unemployment rate was 9.7 percent, which was 0.6 percent higher than the national unemployment rate. There is concern, however, about whether the state can capitalize on this opportunity by preparing enough qualified workers to step into those available jobs.

Data suggest that Tennessee is not currently awarding, and is not anticipated to award, enough STEM postsecondary degrees to meet the impending STEM job demand. Table 1 below identifies Tennessee’s top-10 fastest growing postsecondary award categories, known as Classification of Instructional Programs or CIPs, according to the Academic Program Supply and Occupational Demand Projections from 2008-2018. No STEM degree award category appears on the state’s top-10 list of fastest growing postsecondary awards. (While several of the award categories are STEM-related, including nursing, medical/clinical assistant, pharmacy technician/assistant and surgical technology/technologist, none are defined as “STEM categories” by the Tennessee Higher Education Commission.)

Table 1: Top 10 Fastest Growing Postsecondary Award Categories in TN

<table>
<thead>
<tr>
<th>Program</th>
<th>Average Graduates Per Academic Year</th>
<th>Average Annual Award Growth 2000-08 to 2008-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing – Registered Nurse Training</td>
<td>2,251</td>
<td>2,280</td>
</tr>
<tr>
<td>Liberal Arts and Sciences/Liberal Studies</td>
<td>3,317</td>
<td>1,862</td>
</tr>
<tr>
<td>Medical/Clinical Assistant</td>
<td>948</td>
<td>1,535</td>
</tr>
<tr>
<td>Business Administration and Management, General</td>
<td>4,092</td>
<td>1,625</td>
</tr>
<tr>
<td>Educational Leadership and Administration, General</td>
<td>1,064</td>
<td>826</td>
</tr>
<tr>
<td>Educational Administration and Supervision, Other</td>
<td>673</td>
<td>678</td>
</tr>
<tr>
<td>Elementary Education and Teaching</td>
<td>555</td>
<td>440</td>
</tr>
<tr>
<td>Pharmacy Technician/Assistant</td>
<td>196</td>
<td>397</td>
</tr>
<tr>
<td>Teacher Education, Multiple Levels</td>
<td>242</td>
<td>375</td>
</tr>
<tr>
<td>Surgical Technology/Technologist</td>
<td>174</td>
<td>340</td>
</tr>
</tbody>
</table>

Looking at Table 2, eight of the top ten fastest growing STEM postsecondary award categories are expected to double by 2018. However, it should be noted that graduates in STEM fields are growing from a small base in Tennessee. For instance, the category of “Computer Systems Networking and Telecommunications” is the fastest growing identified STEM postsecondary award program, ranking 20th overall. But, while the number of graduates in Computer Systems and Networking and Telecommunications is expected to double by 2018, it is not growing as quickly as the top postsecondary award categories, listed in Table 1. The same can be said for

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4 Georgetown University Center on Education and the Workforce, STEM State-Level Analysis (2011), data sources include nonfarm payroll employment at the state level from U.S. Bureau of Labor Statistics (BLS), information on growth rate of self-employed from BLS, and education within occupation from the American Community Survey.
all identified STEM postsecondary award categories reported in Tennessee. So, the question is: **Will this supply accommodate the expected occupational demand for STEM jobs in 2018?**

Table 2: Top 10 Fastest Growing STEM Postsecondary Award Categories in TN

<table>
<thead>
<tr>
<th>STEM Program</th>
<th>Average Graduates Per Academic Year</th>
<th>Average Annual Award Growth 2000-08 to 2008-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Systems Networking and Telecommunications</td>
<td>129</td>
<td>294</td>
</tr>
<tr>
<td>Web Page, Digital/Multimedia &amp; Information Resources Design</td>
<td>54</td>
<td>200</td>
</tr>
<tr>
<td>Biology/Biological Sciences, General</td>
<td>972</td>
<td>147</td>
</tr>
<tr>
<td>Computer and Information Systems Security</td>
<td>35</td>
<td>136</td>
</tr>
<tr>
<td>Engineering/Industrial Management</td>
<td>40</td>
<td>121</td>
</tr>
<tr>
<td>Engineering Science</td>
<td>55</td>
<td>103</td>
</tr>
<tr>
<td>Engineering Technology, General</td>
<td>189</td>
<td>98</td>
</tr>
<tr>
<td>Heating, Air Conditioning &amp; Refrigeration Technology/Technician</td>
<td>23</td>
<td>92</td>
</tr>
<tr>
<td>Information Technology</td>
<td>100</td>
<td>76</td>
</tr>
<tr>
<td>CAD/CADD Drafting and/or Design Technology/Technician</td>
<td>35</td>
<td>72</td>
</tr>
</tbody>
</table>
An Economic Growth Initiative That is Sure to Increase STEM Jobs

Tennessee’s economic growth and job creation policies pursued by Governor Haslam and Economic and Community Development (ECD) Commissioner Hagerty are aggressive and focused on driving innovation. It stands to reason that these policies will guarantee Carnevale’s STEM job forecast for 2018 – if not exceed it.

Jobs4TN Plan

One component of the Governor’s jobs plan is Jobs4TN\(^7\), announced in April 2011 and designed to encourage investment in new and existing business in Tennessee. The plan includes four targets:

1. Prioritizing the strategic recruitment of target industries
2. Assisting existing Tennessee businesses in expansions and remaining competitive
3. Supporting regional and rural economic development strategies
4. Investing in innovation and reducing business regulation

In prioritizing the strategic recruitment of industries, the plan identifies six target industry clusters in which the state has a competitive advantage for business recruitment efforts. These clusters are highlighted in Figure 2.

Figure 2: Tennessee’s Six Industry Target Clusters for Business Recruitment

It’s worth noting that each of these six industry target clusters is STEM related. In fact, STEM knowledge, skills and abilities cut across each of the six targeted industries and would most likely be required of any worker who steps into one of these occupations.

INCITE

The Jobs4TN Plan is supported by a newly launched program known as INCITE. This $50 million initiative is solely focused on spreading innovation across the state. Called INCITE because of its focus on innovation, commercialization, investment, technology and entrepreneurship, the program’s ultimate goal is to raise Tennessee’s profile in innovation-based economic development. INCITE has four areas of focus:

1. Innovation Coordination: ECD will work with each of the state’s nine economic development regions to develop a strategic plan for economic development, based on the region’s unique assets.
2. Commercialization: ECD will launch initiatives that move new products and technologies from the research lab to the marketplace faster.
3. Entrepreneurship: ECD will fund a new or existing business incubator in each of the nine economic development regions. ECD will also create a statewide incubator network to share best practices and support efforts to raise private capital.
4. Co-Investment Funds: Tennessee will target $30 million to create early stage, seed, and mezzanine capital co-investment funds. This will complement the state’s TNInvestco and Pathway Lending programs.

My top priority is for Tennessee to be the No. 1 location in the Southeast for high-quality jobs.... We will also be making significant investments in innovation in positioning Tennessee as a national leader well into the future.

Governor Haslam, April 2011
Among the 50 states and the District of Columbia, Tennessee’s innovation output ranks 38th in patents per 10,000 employees. However, the state’s focused investment in Jobs4TN is sure to increase the state’s innovation output ranking by increasing the state’s supply of STEM jobs.

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Recognizing a Gap between Projected Supply and Demand for STEM

As the Jobs4TN plan matures and begins to spawn highly innovative, highly skilled jobs, it will be essential that the state also strategically invests in growing and preparing its workforce. If Tennesseans are not prepared to step into those positions, then employers will buy and import talent from outside of the state—a practice already underway in several companies based in Tennessee. The supply of a high-quality, highly-skilled, technical and STEM-literate workforce could ultimately make or break the success of state-level initiatives to grow innovative jobs.

An analysis in the Academic Program Supply and Occupational Demand Projections: 2008-2018 suggests that there is reason to be concerned. Currently, four of the top-10 under-supplied career pathways in the state are STEM focused, as noted in Table 3 below. Those career pathways include: Programming and Software Development, Environmental Service Systems, Construction and Biotechnology Research and Development.

Table 3: Top-10 Under-Supplied Career Pathways through 2018

<table>
<thead>
<tr>
<th>Career Pathway</th>
<th>STEM</th>
<th>Average Graduates Per Academic Year*</th>
<th>Average Openings**</th>
<th>Average Annual Graduate Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming and Software Development Pathway</td>
<td>Yes</td>
<td>131</td>
<td>281</td>
<td>678</td>
</tr>
<tr>
<td>Marketing Pathway</td>
<td>9</td>
<td>37</td>
<td>397</td>
<td>-360</td>
</tr>
<tr>
<td>Human Resources Pathway</td>
<td>73</td>
<td>140</td>
<td>447</td>
<td>-307</td>
</tr>
<tr>
<td>Business Financial Management and Accounting Pathway</td>
<td>1,319</td>
<td>1,192</td>
<td>1,376</td>
<td>-184</td>
</tr>
<tr>
<td>Environmental Service Systems Pathway</td>
<td>Yes</td>
<td>7</td>
<td>0</td>
<td>149</td>
</tr>
<tr>
<td>Construction Pathway</td>
<td>Yes</td>
<td>19</td>
<td>88</td>
<td>200</td>
</tr>
<tr>
<td>Correction Services Pathway</td>
<td>14</td>
<td>24</td>
<td>104</td>
<td>-80</td>
</tr>
<tr>
<td>Business Financial Management Pathway</td>
<td>2</td>
<td>1</td>
<td>79</td>
<td>-78</td>
</tr>
<tr>
<td>Administrative and Information Support Pathway</td>
<td>183</td>
<td>113</td>
<td>181</td>
<td>-68</td>
</tr>
<tr>
<td>Biotechnology Research and Development</td>
<td>Yes</td>
<td>8</td>
<td>23</td>
<td>70</td>
</tr>
</tbody>
</table>

Note: *Award levels less than an associate’s degree are excluded; **Job openings with educational requirements lower than an associate’s degree are excluded

The primary concern is that the under-supplied STEM career pathways are expected to emerge at the same time Carnevale forecasts 13,600 net new and replacement STEM jobs for Tennessee, for a total of 101,830 STEM jobs. Those new STEM jobs are expected to be distributed by the following occupations listed in Table 4. The area of greatest growth, computer occupations, which will demand more than 47,000 jobs in 2018, is closely related to the Programming and Software Development Pathway identified in Table 3 as one the top under-supplied career pathways in 2018.

Table 4: Occupational Distribution of STEM Jobs through 2018

<table>
<thead>
<tr>
<th>Computer Occupations</th>
<th>Engineers &amp; Engineering Technicians</th>
<th>Life &amp; Physical Science Occupations</th>
<th>Architects, Surveyors &amp; Technicians</th>
<th>Mathematical Science Occupations</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Jobs</td>
<td>47,380</td>
<td>30,790</td>
<td>12,120</td>
<td>9,050</td>
<td>2,490</td>
</tr>
<tr>
<td>% of all STEM Jobs</td>
<td>47%</td>
<td>30%</td>
<td>12%</td>
<td>9%</td>
<td>2%</td>
</tr>
</tbody>
</table>

The majority of those STEM jobs will require some type of postsecondary education and training. The specific breakdown is included in Table 5:
<table>
<thead>
<tr>
<th>Educational Level</th>
<th># of Jobs</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school or less</td>
<td>12,730</td>
<td>12%</td>
</tr>
<tr>
<td>Some College/No Degree</td>
<td>17,440</td>
<td>17%</td>
</tr>
<tr>
<td>Associate’s degrees</td>
<td>12,830</td>
<td>13%</td>
</tr>
<tr>
<td>Bachelor’s degrees</td>
<td>41,500</td>
<td>41%</td>
</tr>
<tr>
<td>Master’s degrees</td>
<td>14,180</td>
<td>14%</td>
</tr>
<tr>
<td>Doctoral degrees</td>
<td>3,150</td>
<td>3%</td>
</tr>
</tbody>
</table>

This raises the stakes for Tennessee’s education system. The convergence of Carnevale’s projected increase in STEM jobs, coupled with state investments in initiatives to create high-skill, highly innovative jobs, increases the need for a comprehensive and holistic plan that increases students’ interests, values, knowledge, skills and abilities in STEM.
Building on a Bedrock of Higher Education and K-12 Goals and STEM Assets

Fortunately, thanks to a series of strategic and bold moves over the past few years in higher education and K-12, Tennessee is on a path to ensuring its students are prepared for tomorrow’s jobs.

State Higher Education Goals

In January 2010, Tennessee passed the Complete College Tennessee Act (CCTA), which overhauled academic, fiscal and administrative higher education policies at the state and institutional levels. The CCTA is driven by The Public Agenda for Tennessee Higher Education 2010-2015, the state’s five year master plan for higher education.

Specifically, the plan calls for increasing “the number of degrees awarded 3.5 percent annually so that undergraduate degree production (associate’s and bachelor’s degrees) grows by 26,000 by 2015 and 210,000 by 2025, bringing Tennessee to the national average for undergraduate degree attainment by 2025.”

To accomplish this goal, the plan identifies the following strategies:

- Improve efficiency including students’ time to degree and overall graduation rates, while also increasing overall degree production
- Recognize the Tennessee Technology Centers for student success and efficiency measures
- Target underserved students and undersupplied occupations
- Improve the quality of programs and services even as volume increases
- **Close gaps in the supply of graduates in high demand fields that require a postsecondary credential, particularly STEM fields**
- Fund institutions and pursue academic policies in a manner consistent with desired ends
- Enhance the research achievements of institutions in accord with their individual missions

Additionally, the state’s new funding formula includes an incentive for institutions of higher education that increase STEM degree completion. This focus on STEM degree completion places Tennessee among the vanguard of states in recognizing the importance of not only postsecondary STEM degree enrollment, but also actual degree completion. Such incentives at the postsecondary level are sure to prime the pump for STEM workers as the state gears up to meet future projections for available STEM jobs.

K-12 Education Goals

Student Achievement Goals

Tennessee has approximately 950,000 elementary, middle and high school students, whose academic achievement is the greatest priority of the Tennessee Department of Education (the Department). With nearly 40 percent of those students attending public school districts in rural counties, consistent and high-quality delivery is sometimes challenging, particularly in STEM.

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Through its First to the Top Initiative and reinforced by Commissioner Huffman’s Strategic Plan\(^9\) (see Section 2 of the Appendix for an outline of strategic plan goals), the Department has embraced a set of ambitious student achievement goals. Specifically, the Department will:

- Increase 3rd grade reading proficiency from 42 percent (2009-2010) to 60 percent (2014-15).
- Reduce the achievement gap by at least 6 percent each year through 2018-2019.

**Figure 4: Student Achievement Goals Identified in First to the Top, as measured by TCAP***

Raising Expectations and Standards in Mathematics and Science

To propel the state toward its ambitious student achievement goals, the Department is pursuing a variety of inter-related initiatives,\(^10\) including:

- Raising academic standards in mathematics through the adoption of the Common Core State Standards and is participating in the development of the Next Generation Science Standards with Achieve and other states
- Setting new graduation requirements to help guarantee that students leave high school prepared for college and career
- Recalibrating student proficiency rates based on NAEP to paint a realistic picture of college- and career-readiness
- Using data and qualitative assessments to evaluate teachers and principals
- Creating an Achievement School District to support the state’s chronically lowest performing schools
- Launching STEM Platform Schools and Regional STEM Innovation Hubs (as discussed in more detail in the section below, *Tennessee STEM Innovation Network*).

Raising academic standards in mathematics through the Common Core and stands as one of the most powerful levers for enhancing STEM teaching and learning on a mass scale. On the Common Core front, Tennessee is slated to begin partial implementation of mathematics standards for grades 3-8 in 2012-13 and full implementation of the remaining mathematics standards for grades 3-8 in 2013-14. That same year, the state


plans to also fully implement mathematics standards for grades 9-12. In 2014-15, it will transition to aligned assessments.

Tennessee is one of 26 states participating in the development of the Next Generation Science Standards, positioning the state well to fully adopt the standards once released in the Fall of 2012. The standards are based on the Framework for K-12 Science Education, which identifies practices, cross-cutting concepts and core ideas for science education that all students need to learn from kindergarten through high school graduation, including engineering.

This strategic plan complements Tennessee’s timeline for implementing the Common Core State Standards and aims to give the state a major boost in these efforts by proliferating high-quality, on-the-ground STEM teaching and learning opportunities.

**Leveraging a Rich Array of STEM Assets**

Tennessee is blessed with an abundance of STEM resources and assets. Until recently, no state-level organization in Tennessee had the mission, capacity and reach to coordinate and organize these assets. The establishment of the Tennessee STEM Innovation Network will soon change that.

Through multiple interviews, discussions and meetings, stakeholders across Tennessee pointed out that the state has strong STEM assets in education, research, business and industry. Example responses follow *(please note that this is not a comprehensive list of all of Tennessee’s STEM assets)*.

Regarding research, a cross-section of stakeholders referenced Vanderbilt, University of Tennessee, University of Memphis, Oak Ridge Associated Universities, St. Jude Children’s Research Hospital and the Tennessee Board of Regents, among others.


Other major STEM assets referenced include BioTN Foundation, Millard Oakley STEM Center at Tennessee Tech University, BioMimetic Therapeutics, Inc., Bridgestone Americas, Smith & Nephew, Nashville Health Care Council and Tennessee Biotechnology Association.

Finally, nearly every stakeholder noted the promise that lies behind the recently created Tennessee STEM Innovation Network. This state-level STEM network has the potential to lead the state in aligning STEM policies, practices and partners.

**The Tennessee STEM Innovation Network**

The Tennessee STEM Innovation Network is a public-private collaborative between the Tennessee Department of Education and Battelle Memorial Institute (Battelle), designed to promote and expand the teaching and learning of STEM education in K-12 public schools across Tennessee by bringing together stakeholders from K-12 education, postsecondary education, and business or private sector communities in a collaborative effort to identify, leverage and spread STEM education practices, programs and partnerships.

Funded through a $14.7 million allocation from Tennessee’s Race to the Top proposal, the TSIN will:

- Generate and share new knowledge of what works in STEM education
- Promote clearly articulated indicators of quality
- Develop quality STEM tools with partners
- Offer interactive, on-going access to tools, exemplars and partners through an on-line presence
- Connect state STEM partners to innovative policies and practices across the country

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11 Refer to Section 3 of the Appendix for a full report of the interviews, discussions and meetings.
Structurally, the critical components of the TSIN are STEM Platform Schools and Regional STEM Innovation Hubs. In the state’s Race to the Top application, the Department committed to fund six STEM Platform Schools (including a virtual program) and up to six Regional STEM Innovation Hubs. The first two STEM Platform Schools are operating in Knoxville and Nashville: L&N STEM Academy and Stratford STEM Magnet High School (and cluster), respectively. The first two Regional STEM Innovation Hubs have also been established in Knoxville and Nashville to work in conjunction with and in support of those first two schools and connect the regions’ STEM assets, programs and partners. Through a competitive RFP process, the TSIN has named three more STEM Platform Schools and Regional STEM Innovation Hubs, operating in Chattanooga, Cookeville and the Tri-Cities area of Northeast Tennessee. The TSIN is expected to name a STEM Platform School and Regional STEM Innovation Hub in West Tennessee by the end of 2012. Thus, by the 2013-2014 school year, the TSIN will have a well connected, geographically diverse series of STEM education programs and partnerships in place across the state.

This strategic plan recognizes the direction of the TSIN and promotes many of its structural components through its four goals and supporting strategies. The plan also assumes that the TSIN will lead the coordination and alignment of STEM policies, practices and partners across the state. Finally, it leverages the state’s engagement in the emerging multi-state STEM network, or STEMx.

**STEMx**
The TSIN’s work will be enhanced by its engagement and charter membership in Battelle’s newly developing multi-state STEM network known as STEMx. STEMx will connect state networks and partners to accelerate the growth of policies, practices and partnerships needed to expand the numbers of STEM teachers, increase student achievement in STEM and grow tomorrow’s innovators.

By participating in this national-level network, Tennessee will be poised to share its best practices and innovative approaches with other states and partners across the country. The result is that Tennessee’s national STEM leadership position will increase dramatically. Perhaps the greatest benefit is the direct counsel and strategy the state will receive from other member states like North Carolina, Ohio, Texas and Washington – states with a longer track record of implementing STEM policies and practices.

**Framing Tennessee’s STEM Strategic Plan**
This strategic plan is built on a foundation of the state’s economic growth, higher education and K-12 education goals and leverages the work of the TSIN. But the plan has also been heavily influenced by key STEM stakeholders. Ultimately, we spoke with more than 50 stakeholders in formal interviews, informal discussions and meetings, to understand their perceptions of the state’s STEM education landscape, including its strengths, weaknesses, opportunities and threats (SWOTs) in STEM. A full listing of interview questions and responses can be found in Section 3 of the Appendix. Table 6 below offers a snapshot of what we learned, with responses listed in order of frequency.

Table 6: Stakeholder Responses

<table>
<thead>
<tr>
<th>STEM Interview Question</th>
<th>Responses listed in order of frequency – from most common to least common</th>
</tr>
</thead>
</table>
| Define “STEM” in your own words | • Project based  
• Integrated  
• Multi-disciplinary  
• For all students  
• Grounded in “real world” concepts  
• Partnership to education involving K-12, higher education and business and industry  
• Just science, technology, engineering and mathematics |
<table>
<thead>
<tr>
<th>STEM Interview Question</th>
<th>Responses listed in order of frequency – from most common to least common</th>
</tr>
</thead>
</table>
| Describe the current condition of STEM in Tennessee | • Disconnected and uncoordinated  
• Inequitable, particularly for students in rural areas  
• Greater STEM opportunities in East Tennessee  
• Promising because of First to the Top, the Tennessee STEM Innovation Network, and other strong assets in K-12, higher education and business |
| Rate the condition of STEM in Tennessee: “5” being highest; “1” being lowest | • Average ranking across the board was a “2”. Scores varied from 1 (lowest ranking) to 3.5 (highest ranking) |
| Identify Tennessee’s greatest STEM strengths | • Strong assets in:  
  o Research  
  o Business  
  o Industry  
  o Committed and innovative K-12 teachers across the state |
| Identify Tennessee’s greatest STEM weaknesses | • Weaknesses specific to educators:  
  o STEM educator preparation and training  
  o Middle school and high school STEM teacher content knowledge  
  o Short supply of highly effective STEM teachers  
  o Lack of high-quality STEM teacher professional development opportunities  
  o School administrators who do not understand “true” STEM education  
  • Lack of coordination of programs and efforts across the state  
  • No strong leadership for STEM education at the state-level  
  • Lack of funding and resources for STEM |
| Identify Tennessee’s greatest STEM opportunities | • Potential of the Tennessee STEM Innovation Network  
• Potential engagement of business, industry and other community partners to advance STEM  
• Potential of aligning and coordinating resources across the state for STEM |
| Identify Tennessee’s greatest STEM threats | • Future resources and potential lack of funding  
• “Bureaucracy” of the teaching profession  
• Getting first round of STEM platform schools right – with strong leadership in place  
• Impatience of policymakers and stakeholders who demand instant results  
• Lack of understanding what future STEM jobs will be available and what jobs won’t be |
| Discuss STEM’s relationship to the Economy, K-12 and higher education | • STEM and the Economy:  
  o “STEM is a driver of the economy”  
  o STEM training results in job attainment  
• STEM and K-12:  
  o A strong foundation for STEM is built in K-12  
• STEM and higher education:  
  o STEM should be more integrated in higher education  
  o Department funding should not drive competition among STEM departments and disciplines |
<p>| Identify the top statewide STEM | • Increasing STEM teacher quality, ensuring that teachers are well-trained in cross-disciplinary and project-based approaches to learning |</p>
<table>
<thead>
<tr>
<th>STEM Interview Question</th>
<th>Responses listed in order of frequency – from most common to least common</th>
</tr>
</thead>
<tbody>
<tr>
<td>goals you would enact</td>
<td>• Strategically aligning STEM education opportunities and efforts across the state</td>
</tr>
<tr>
<td></td>
<td>• Increasing students’ levels of scientific literacy – teaching and modeling the scientific process</td>
</tr>
</tbody>
</table>

We took these findings and merged them with the state-level economic growth and job creation, higher education and K-12 goals to develop the following strategic plan for STEM in Tennessee.
STEM Vision Statement, Theory of Change and Preamble

What follows are guiding statements for the state’s STEM strategic plan.

**Vision Statement**
Tennessee students will lead the nation in STEM knowledge, skills and practices as critical and creative thinkers, problem solvers, innovators and collaborators to compete and succeed in the state’s emerging innovation economy.

**Theory of Change**
If Tennessee fully coordinates and aligns STEM policies, practices and partners to increase student interest, participation and achievement in STEM, expands student access to effective STEM teachers and leaders, reduces its STEM talent and skills gap and builds community awareness and support for STEM, then it will lead the nation in STEM-talent development.

Figure 5: Tennessee’s STEM Theory of Change

**Preamble to STEM Goals and Strategies**
Tennessee’s cross-cutting goals and strategies must:

- Be multi-disciplinary, project-based, and tied to the real world
- Leverage all of Tennessee’s STEM assets
- Engage a broad and diverse base of partners from K-12, higher education and business and industry
- Recognize high-demand economic clusters
- Prepare students who have strong interest, values, knowledge, skills and abilities in STEM
**Four STEM Goals**

This plan identifies four strategic goals designed to build STEM talent for Tennessee. The goals capitalize on the state’s strengths, neutralize its weaknesses, seize on its opportunities and mitigate potential threats. The goals coincide with the state’s K-12 and higher education goals and ECD’s job creation initiatives. They strive to position Tennessee to fill available STEM jobs in 2018.

Together, the goals also significantly complement the state’s efforts to implement the Common Core State Standards over the next three years.

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**Goal #1**
Increase student interest, participation and achievement in STEM

**Goal #2**
Expand student access to effective STEM teachers and leaders

**Goal #3**
Reduce the state’s STEM talent and skills gap

**Goal #4**
Build community awareness and support for STEM

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*Figure 6 – Four Goals for Tennessee STEM Talent Development*
A Closer Look at the Goals, Strategies and Metrics

Each of the four goals is supported by a set of strategies that pull key STEM policy levers already in place or arriving soon as a result of First to the Top or other similar statewide policies. The goals and strategies are tied to key metrics designed to measure if the state is moving the needle in each specific STEM strategy, thus impacting achievement of the ultimate goal.

Increase student interest, participation and achievement in STEM

Goal #1 – Increase student interest, participation and achievement in STEM – places greatest priority on Tennessee’s STEM learners. Specifically, this goal will be reached by coordinating, implementing and scaling innovative, rigorous and inspiring STEM experiences that have the greatest promise of piquing student interest, securing student participation and boosting student achievement in STEM.

Goal #1 relies heavily on the TSIN and its ability to lead in the coordination of STEM policies, practices and partners to spread quality STEM education opportunities throughout the state.

Supporting Strategies: The following four interlocked strategies seek to achieve the goal of increasing student interest, participation and achievement in STEM.

1.1. Establish Regional STEM Innovation Hubs. As part of Tennessee’s First to the Top plan, the Tennessee STEM Innovation Network will establish six STEM Innovation Hubs in key economic regions across the state. The Regional STEM Innovation Hubs will be built on unique partnerships that cut across K-12, higher education and business and leverage those partnerships to increase formal and informal STEM learning opportunities for students and accelerate the production of STEM talent.

1.2. Launch STEM Platform Schools. As part of Tennessee’s First to the Top plan, the Tennessee STEM Innovation Network will launch six cross-disciplinary, project-based STEM Platform Schools across Tennessee, designed to serve as laboratories for innovative practices in STEM education and dramatically boost student achievement.

1.3. Expand Student Access to Rigorous and Advanced STEM Courses. Work closely with the Tennessee Department of Education and other K-12, post-secondary and business partners to support and build capacity for continued implementation of the state’s adopted high school graduation requirements (four years of mathematics, including Algebra II, and three years of lab-based science), implementation of the Common Core State Standards (for mathematics). Use Regional STEM Innovation Hubs and STEM Platform Schools as key partners to promote innovations in this expansion and in promoting other advanced STEM courses and learning opportunities.

1.4. Identify, Develop and Share STEM Curriculum Tools. Through the Regional STEM Innovation Hubs, identity existing and/or develop open source curriculum tools that are aligned to the Common Core State Standards and designed to boost student interest and achievement in the STEM disciplines and student success in STEM postsecondary and career programs. This should leverage the state’s previously launched (www.stemresources.com) online tool.

Direct Metrics: Metrics 1.1 through 1.4 below correspond directly to the four Supporting Strategies above. While basic, these metrics emphasize the importance of completing each of the four supporting strategies above by a specific timeframe. Listing the metric individually helps ensure that no box goes unchecked. The Direct Metrics lead to a set of Broad Metrics that gauge impact on student interest, participation and achievement in STEM.
1.1. By the 2013-2014 School Year, at least six Regional STEM Innovation Hubs have been identified and are up and running with unique K-12, higher education and business partnerships in place.

1.2 By the 2013-2014 School Year, at least six STEM platform schools are opened. Each school exhibits authentic and active K-12, higher education and business partnerships.

1.3 Strategically support the Tennessee Department of Education in achieving its key goals of implementing high school graduation requirements with regard to math and science and the implementation of the Common Core State Standards with regard to math:
   • High school graduation goal: By the 2012-2013 School Year, all graduating seniors will have completed four years of mathematics, including Algebra II, and three years of a lab-based science.
   • Common Core State Standards: By the 2011-2012 School Year, implement the Common Core State Standards for mathematics in grades K-2. By the 2013-2014 School Year, implement all mathematics standards for grades 3-12.

1.4 By the 2013-2014 School Year, at least two open source curriculum tools have been developed and shared with other Regional STEM Innovation Hubs. By 2014, each of the six Hubs has developed an open source curriculum tool that has been shared with the Network and uploaded to the state’s STEMResources.com online tool.

**Broad Metrics:** Metrics 1.5, 1.6 and 1.7 below emphasize the expected impact of the *Direct Metrics* above. These metrics are ambitious and send a signal that Tennessee is serious about increasing student interest, participation and achievement in STEM.

1.5 Through the six Regional STEM Innovation Hubs, determine a baseline and then double the number of students engaged in formal and informal STEM learning opportunities, ultimately having impact on student interest, participation and achievement in STEM. Learning opportunities include:
   • STEM Platform Schools or programs
   • Advanced STEM courses
   • STEM activities, clubs or groups, competitions and exhibitions
   • Dual enrollment in STEM courses
   • Internships, externships and co-op opportunities with STEM-based industry partners.

1.6 Through the six Regional STEM Innovation Hubs, the six STEM Platform Schools and the open-source curriculum tools, directly support the Tennessee Department of Education’s state-level student achievement goals in mathematics, high school graduation and post-secondary going rates.

1.7 STEM Platform Schools are expected to have a concentrated impact on student interest, participation and achievement in STEM. Thus, two years after opening, STEM Platform Schools should demonstrate an increase in student achievement at a rate above the statewide average OR outperform the statewide average in student performance benchmarks for STEM courses. Key indicators could include performance on End Of Course examinations, EXPLORE, PLAN, ACT or TCAP.
Expand student access to effective STEM teachers and leaders

**Goal #2 – Expand student access to effective STEM teachers and leaders** – recognizes that educators have the greatest impact on student achievement. Therefore, students must have access to effective STEM educators who are considered content experts and make use of engaging, integrated, inquiry-and project-based curricular and instructional approaches in the classroom.

Goal #2 takes on increased importance since Tennessee adopted the Common Core State Standards. Educators must now be prepared to effectively integrate and teach those standards in their lessons.

Similarly, this goal works to alleviate the strain on the state’s supply of STEM teachers, which is under intense pressure since the state increased graduation requirements in 2008. Today’s junior class (2011-2012 school year) will be the first class held to the new graduation requirements, requiring completion of four years of mathematics, including Algebra II and a third year of laboratory science.

Strategies 2.1 to 2.7 are aimed at positioning Tennessee for smooth implementation of the Common Core State Standards and mitigating STEM teacher shortages by increasing the supply of highly effective educators and using them creatively to touch the learning experiences of many more students.

**Supporting Strategies:** Seven strategies support the goal of expanding student access to effective STEM teachers and leaders:

1. **Increase Effective STEM Teachers and Leaders.** Through the Regional STEM Innovation Hubs, which include valuable partners such as STEM Centers, teacher training programs and professional development providers, provide relevant support and strengthen programs to emphasize the integration of subjects and increase the number of effective STEM teachers and leaders, particularly those dedicated to serve in rural and struggling schools.

2. **Replicate Proven Models and Disseminate Characteristics of Effective STEM Teacher Training Programs.** Guided by the objectives of the UTeach program (present in four universities across the state), work with Network partners to redesign teacher training programs to emphasize content expertise and clinical residency opportunities and increase the overall selectivity of teacher training programs.

3. **Use STEM Schools as Learning Labs.** Use STEM Platform Schools as laboratories for innovative programs that prepare and help develop excellent STEM educators and administrators.

4. **Boost STEM Teacher Supply.** Work with the Tennessee Higher Education Commission, the University of Tennessee, and the Tennessee Board of Regents to align the financial incentives within the Complete College Act of Tennessee (CCAT) Outcome Based Formula with the outcomes that meet the state’s needs, including placing a premium on the production of STEM educators.

5. **Enhance STEM Teacher Capacity and Reach.** Through the Regional STEM Innovation Hubs, and in partnership with Tennessee’s colleges and universities, attract more professionals into STEM teaching, build capacity of those already in STEM teaching and extend the reach of STEM educators to high-demand, hard-to-staff subject and geographical areas.

6. **Increase and Disseminate Quality STEM Professional Development.** In collaboration with the STEM Leadership Academy, Regional STEM Innovation Hubs will work with partners in K-12, higher education and STEM businesses to create, deliver and disseminate evidence-based STEM educator professional development experiences that link the classroom to local STEM business and industry, integrate subjects and courses and bridge formal and informal learning for students. These efforts will be complemented by the STEM professional development grants awarded
by the Tennessee Higher Education Commission and funded through the state’s First to the Top proposal.

2.7 Support School Leaders. Support administrators in their teacher evaluation work so they can identify and promote effective STEM instruction.

Direct Metrics: Metrics 2.1 to 2.7 correspond directly to the Supporting Strategies above. Their significance is to ensure that Supporting Strategies 2.1-2.7 have been executed and that no box goes unchecked.

| 2.1 | By the 2013-2014 School Year, each STEM Innovation Hub has an established relationship with at least one educator preparation program and uses that relationship to improve STEM teacher preparation and inform STEM teacher supply in the region. |
| 2.2 | Use the Tennessee Report Card on the Effectiveness of Teacher Training Programs to evaluate the number of teachers endorsed in STEM fields and the effectiveness of individual training programs in preparing highly-effective STEM teachers. Provide targeted support to programs producing a high number of STEM teachers and disseminate best practices based on the programs producing highly-effective STEM teachers. |
| 2.3 | By their third year in operation, in coordination with its Regional STEM Innovation Hub, each STEM Platform School has an established relationship with at least one teacher preparation program and the program uses the school as a primary tool for preparing future educators. |
| 2.4 | By 2018, the number of STEM educators has sufficiently increased to meet the state’s need as a result of the financial incentives within the CCAT’s Outcome Based Formula. |
| 2.5 | By the 2013-2014 School Year, each Regional STEM Innovation Hub maximizes the use of technology to expand the reach of high-demand STEM teachers across the Hub and into areas of need across the state. By 2014, each STEM Innovation Hub is engaged in a partnership(s) that facilitates the delivery of virtual STEM courses to in-need districts. |
| 2.6 | A) By their third year in operation, each STEM Platform School has at least two established relationships with STEM professional development providers (Institutions of Higher Education and/or private/not-for-profit providers) that, in turn, use the best practices from the STEM school to sharpen and refine their STEM professional development offerings.  
B) By Summer 2012, THEC will have established targeted, intentional and aligned STEM professional development programs across the state, using content experts to provide content-rich and innovative professional development to K-12 STEM educators. These programs are funded through THEC’s First to the Top STEM grant and will be aligned to the state’s newly integrated Common Core State Standards and informed by student achievement and teacher evaluation data. |
| 2.7 | By the 2013-2014 School Year, Regional STEM Innovation Hubs have established plans to work closely with school leaders to help them understand the components of “true” STEM teaching and learning and the significance of using educator evaluations as a tool for gauging how STEM is taught in the classroom. |

Broad Metrics: Metrics 2.8-2.12 below represent the expected impact resulting from the Direct Metrics above (2.1-2.8).

| 2.8 | By their second year in operation, all educators teaching in each of the six STEM Platform Schools will be classified as either effective (a “3”) or highly effective (a “4” or “5”) according to their district’s teacher evaluation system. |
| 2.9 | Over the next three years, increase the number of newly STEM endorsed teachers by 150 through the four
UTeach replication sites.

<table>
<thead>
<tr>
<th>2.10</th>
<th>On the 2014-15 Report Card for Teacher Training Programs, no teacher training program will have a statistically significant negative difference in student achievement in STEM fields as compared to veteran teachers. This is a reflection of the strength of the teacher training program and its newly prepared candidates.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.11</td>
<td>By 2014-15, over 800 K-12 STEM teachers will have participated in targeted, intentional and aligned STEM professional development opportunities funded by THEC’s First to the Top STEM professional development grants, focused on innovation, cross-disciplinary curriculum and deep content knowledge. These participants should achieve expected levels of student growth, based on student growth measures from End of Course examinations, EXPLORE, PLAN, ACT or TCAP.</td>
</tr>
</tbody>
</table>
3 Ensure a well-prepared, ready-made STEM workforce by reducing the STEM talent and skills gap

Goal #3 – Ensure a well-prepared, ready-made STEM workforce for Tennessee by reducing the STEM talent and skills gap – acknowledges the imminent STEM talent and skills gap that the state of Tennessee will face by 2018. Given the state’s documented tracking of available STEM jobs and numbers of STEM-credentialed candidates coming from the state’s institutions of higher education, it is clear to see where the state’s future gaps exist and the steps necessary to close those gaps.

Supporting Strategies: Three strategies have been identified to support the goal of ensuring a well-prepared, ready-made STEM workforce for the state by reducing the STEM talent and skills gap.

3.1 Increase Accelerated STEM Learning Opportunities. Increase student opportunities for accelerated STEM learning and dual enrollment in STEM courses, while maintaining or raising program standards. Begin measuring and reporting the numbers of students who participate in accelerated STEM learning and dual enrollment options.

3.2 Continue to Develop Meaningful Partnerships between Business and Education. Regional STEM Innovation Hubs will work with ECD Regional Directors and regional business and industry leaders to develop strong private-public partnerships aimed at increasing real-world connections for students to STEM career pathways through STEM internships, co-ops and externships offered to K-12 and post-secondary students. Begin measuring and reporting the numbers of students who participate in real-world learning experiences throughout K-12 and higher education.

3.3 Dramatically Increase STEM Postsecondary Degree Production. Explore the possibility of launching a Tennessee-specific STEM scholarship program that attracts undergraduates into STEM majors and pays for their undergraduate STEM degree as long as they stay in Tennessee to work after graduation. The program might be modeled after the Choose Ohio First STEM Scholarship program or Texas’s T-STEM Challenge Scholarship initiative.

Direct Metrics: The following Direct Metrics correspond to the three Supporting Strategies identified above.

3.1 By the 2014-2015 School Year, all 11th graders in STEM Innovation Hub partner-districts should have an opportunity to engage in accelerated STEM learning and dual enrollment in STEM courses. Students attending STEM Platform Schools should have an option for accelerated learning and dual enrollment by the time they are in 10th grade.

3.2 Within their first year of opening, every Regional STEM Innovation Hub and STEM Platform School has an established relationship with its corresponding ECD regional director(s) and regional chamber leaders.

3.3 By the 2013-2014 School Year, work with the Governor’s Office, the Tennessee STEM Education Caucus, higher education leaders and other key state-level stakeholders to decide whether to launch a Tennessee-specific STEM scholarship program.

Broad Metrics: These Broad Metrics represent the expected impact resulting from the Direct Metrics above.

3.4 Within their second year of opening, and leveraging their partnerships with ECD regional directors and regional...
chamber leaders, every Regional STEM Innovation Hub and STEM Platform School should have established partnerships with key business and industry leaders that result in increased real-world learning opportunities for K-12 and postsecondary students. To that end, students in Regional STEM Innovation Hub partner-districts and STEM Platform Schools will have opportunities to participate in a variety of real-world learning opportunities, such as internships, externships or co-ops throughout their K-12 and postsecondary experiences.

3.5 Using 2012 as a baseline, double STEM postsecondary degree production by 2018 and use research from University of Tennessee Knoxville Center for Business and Economic Research, Academic Program Supply and Occupational Demand Projections: 2008-2018 to help inform student choices when determining majors.
Goal #4 – Build community awareness and support for STEM – is aimed squarely at building a base of diverse partners and supporters to communicate the rising importance of STEM education in workforce development and job creation to all Tennesseans, beginning at the grassroots level and working up.

Supporting Strategies: The fourth and final goal is supported by the following four strategies.

4.1 Build Communication Tools, Develop Messages and Identify Delivery Channels. Build basic communication tools, including easy-to-understand messages and delivery channels to promote effective communication regarding the importance of STEM education in the often-cluttered arena of K-12 education reform.

4.2 Conduct Media Outreach. Communicate to Tennessee’s key economic and education reporters the STEM strategies of the Tennessee STEM Innovation Network and the Tennessee Department of Education.

4.3 Identify and Showcase Exciting STEM Public Events. To further engage the media and build general awareness for STEM, conduct public events featuring students that leverage the STEM Innovation Hub partnerships. This should be done in conjunction with other exciting STEM opportunities that feature students including FIRST Robotics and the Intel International Science and Engineering Fair.

4.4 Increase STEM Stakeholder Engagement. Build community awareness and support for STEM by working across the public and private sectors to pursue business outreach campaigns, coordinate advocacy efforts and generally increase state-level awareness and support for STEM.

Direct Metrics: The following metrics will be used to measure progress toward achieving the goal of building community awareness and support for STEM.

4.1 By the 2012-2013 School Year, the Tennessee STEM Innovation Network will have a logo, a clear set of STEM education messages and materials and a strong digital presence.

4.2 Leveraging announcements surrounding the Regional STEM Innovation Hubs and Platform Schools, the Tennessee STEM Innovation Network should cultivate relationships with the state’s and nation’s education reporters so they fully understand the guiding STEM strategies and Hub concept. Each Hub and School represents a unique public relations opportunity.

4.3 By the 2014-2015 School Year, the Tennessee STEM Innovation Network will have identified and participated in major STEM real-world, public events that feature students, including FIRST Robotics, the Intel International Science and Engineering Fair, and others, to raise awareness for STEM education.

Broad Metrics:

4.4 By 2013, the Tennessee STEM Innovation Network, in conjunction with other leading STEM organizations in Tennessee like the STEM Education Caucus and the STEM Leadership Council, will coordinate all STEM education partners across the state to advocate for STEM education with one voice.

4.5 By 2014, the Tennessee STEM Innovation Network will have established partnerships with organizations like the Tennessee Mathematics Teachers Association and the Tennessee Science Teachers Association to ensure that there are periodic conferences and gatherings across the state that bring together STEM classroom partners and
showcase new web-based platforms.
Appendix

Section 1: Benefits of STEM Literacy and STEM Education
The following points delve deeper into the benefits of STEM literacy and STEM education, as bulleted on page 6 of this report.

**STEM education builds critical thinking and analysis skills by addressing how our students view and experience the world around them. It has proven to be an important tool for student success.**

- STEM prepares students who are critical and creative thinkers, innovators, problem solvers, collaborators, team workers and strong communicators... students who are ready to tackle Tennessee’s challenges – and the world’s challenges.

*These students are prepared to succeed in college, in careers and as responsible citizens.*

- STEM is about educating the “whole” child – not just training scientists, engineers and technology professionals.
- STEM curriculum is challenging, relevant, student-centered, cross disciplinary and performance-based.
- STEM education emphasizes collaboration, problem solving, critical thinking and creativity – it’s about identifying solutions.

*STEM education fosters the creativity and innovation that all Tennessee students – and the state as a whole – need to compete and prosper in a global economy.*

- STEM develops the capacity for creative, innovative thinking that is a key differentiating attribute for individuals seeking opportunity in a world where the talent pool for business and industry is increasingly global.
- STEM supports economic growth and enhanced quality of life by developing individuals who can integrate a solid foundation of core knowledge with creative and analytical skills to develop innovative solutions to complex problems.
- By unleashing students’ creativity, STEM nurtures and inspires the innovators who will conceive and develop the revolutionary products and processes that will shape the future of Tennessee’s economy and drive sustained economic growth.

*STEM education engages the entire community, through robust partnerships that reach beyond the walls of the classroom including higher education and business, to educate the whole child.*

- A truly distinguishing and transformative feature of STEM education is the vital role the broader community plays in actively supporting the development of STEM resources.
- The Tennessee STEM Innovation Network stands positioned to help regions attract and coordinate partners to transform and maximize the STEM teaching and learning experience – by making it more relevant and connected to the real world.

*STEM education is taught by content-knowledgeable educators who implement inquiry-, technology- and project-based learning activities and lessons that are tied to the real world.*

*STEM education is brought to life through a diverse, interdisciplinary curriculum where activities in one class complement those in other classes, including social studies and the arts.*

*STEM education thrives from strong school leaders who fully understand the “STEM approach” and fully use it to transform the delivery of education.*
• School leaders must be visionary, bold and willing to use STEM as a tool to disrupt previous approaches to teaching and learning and transform educational delivery.

**STEM education is for all students – not just a select, privileged few.**

• STEM is not highly specialized education for an elite group of students; when fully realized, STEM will impact all students in schools across Tennessee.
• By definition, Regional STEM Innovation Hubs and STEM Platform Schools are designed to deliver broad benefits to large numbers of students. This is critical because STEM literacy is the foundation for success in a “solutions” economy.
• STEM education is a transformative way to think about teaching and learning, recognizing that not all students learn in the same way or at the same pace. For that reason, STEM places a strong emphasis on personalizing educational experiences to best suit students’ individualized learning styles and interests.

**STEM education stands as a key strategy for Tennessee’s economic future – for stimulating economic development in our state and creating economic opportunity for our citizens.**

• STEM is a direct response to the realization that Tennessee’s future will be built on technological leadership, knowledge creation and innovation, not on making bigger and better widgets.
• Because STEM education produces exactly the kind of thinkers a global economy demands, it is the key to positioning Tennessee for future success.
• A sustained focus on STEM will deepen Tennessee’s talent pool and spur additional investment, growth and job creation in the state. A competitive workforce will attract investment and jobs, and good jobs and economic opportunity will, in turn, retain world-class talent (that is hopefully home-grown).
Section 2: Tennessee Department of Education Strategic Plan Goals

The following chart elaborates further on the guiding strategic plan goals of the Tennessee Department of Education, as referenced on pages 13-14 of this report.

<table>
<thead>
<tr>
<th>Expand kids’ access to effective teachers and leaders</th>
<th>Expand families’ access to good schools</th>
<th>Expand educators’ access to resources and best practices</th>
<th>Expand public access to information and data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Create marketplaces and supports for districts to hire effective teachers and principals</td>
<td>• Turn around the lowest-performing schools in the state through the Achievement School District</td>
<td>• Ensure effective implementation of Common Core standards and provide aligned resources and best practices to educators</td>
<td>• Build transparent data and communication structures that consistently communicate results to districts, families and the public</td>
</tr>
<tr>
<td>• Strengthen certification criteria and link licensure more clearly to effective teaching</td>
<td>• Help districts and schools that are not meeting goals to create plans to improve</td>
<td>• Expand districts’ access to strong formative and summative assessments in tested and non-tested subjects</td>
<td>• Drive higher volume of research through internal studies, build open-source data capacity, and encourage outside researchers to analyze our work</td>
</tr>
<tr>
<td>• Expand effective teacher preparation programs</td>
<td>• Support and incent districts to build strong schools</td>
<td>• Through field service centers, help educators access best practices from high performing schools and content experts to enhance their overall effectiveness and to improve their content delivery</td>
<td>• Communicate consistently and effectively with educators and families about the state of reforms, future plans and results</td>
</tr>
<tr>
<td>• Expand the reach of effective teachers and leaders to access more kids</td>
<td>• Increase families’ access to high-quality options through inter- and intra-district choice, distance learning, and strong charter schools</td>
<td>• Ensure that Tennessee has a world-class Career &amp; Technical Education program that graduates all high school students ready to succeed in college and tomorrow’s careers</td>
<td></td>
</tr>
</tbody>
</table>
Section 3: Detailed Results of SWOTs Interviews

More than 50 stakeholders participated in the development of this plan, through formal interviews, discussions or meetings. In interviews, stakeholders were asked a battery of questions designed to shed light on their perceptions of the current STEM education environment in Tennessee. A total of 12 interview questions were asked to candidates – nine specific to STEM strengths, weaknesses, opportunities, threats (SWOTs) and goals and three specific to communicating the importance of STEM to Tennesseans. Questions are listed below:

**SWOTs and Goals**

- In your own words, how would you define STEM? (While basic, this question helped calibrate the interview and gauge the variations of STEM definitions across stakeholders.)
- How would you describe the current condition of STEM in Tennessee?
- On a scale of 1 (being lowest) and 5 (being highest), how would you rate the condition of STEM in Tennessee?
- What are Tennessee’s greatest strengths or assets in STEM?
- What are Tennessee’s greatest weaknesses in STEM?
- What are Tennessee’s greatest opportunities in STEM?
- What are Tennessee’s greatest threats in STEM?
- Describe STEM’s relationship to the economy, K-12 and higher education?
- If you had complete control, what statewide STEM goals would you enact?
- What local, state and national best-in-class practices would you identify in STEM?

**STEM Communications**

- What messages do you think are most critical to advancing STEM?
- Whom would you target to get those messages out?
- What vehicles would you use to get those messages out?

A synthesis of the results of the interviews follows. A full distillation of the SWOTs interview discussions can be found in Tables 7 and 8 below.

**Defining STEM**

Interview respondents overwhelmingly used the following words to define STEM as an approach to education: project-based, integrated, multi-disciplinary, for all students and grounded in “real world” concepts. Many also discussed it as a partnership involving K-12, higher education and business and industry. Several respondents defined STEM as just Science, Technology, Engineering and Mathematics.

**Current condition of STEM in Tennessee**

The majority of respondents indicated that STEM education in Tennessee is disconnected, uncoordinated and inequitable, particularly when it comes to access for students living in rural areas. Many respondents observed that students in the state’s metropolitan areas have more access to STEM opportunities than students in rural areas. Many noted the differences in STEM opportunities between West Tennessee and East Tennessee, indicating the STEM opportunities are more abundant in East Tennessee, largely as a result of the STEM assets present in the East. Numerous respondents noted a “promising” future of STEM because of First to the Top, the Tennessee STEM Innovation Network and other strong assets in K-12, higher education and business.

**Rating the condition of STEM in Tennessee**
The average ranking among interviewees was “2.” Scores varied from 1 (lowest ranking) to 3.5 (highest ranking).

**Tennessee’s greatest strengths**

Overwhelmingly, respondents noted the state’s strong assets in research and business and industry. Specifically, they referenced research assets such as Vanderbilt, University of Tennessee, University of Memphis, and Oak Ridge Associated Universities, St. Jude Children’s Research Hospital and the Tennessee Board of Regents and others. Noted business and industry assets included ORNL, Memphis Biotech, Volkswagen, FedEx, Nissan, Eastman Chemical, GTX, Medtronic, Buckeye Cellular, FedEx, International Paper and AutoZone. A number of respondents recognized the committed and innovative K-12 corps of teachers who can be found across the state.

**Tennessee’s weaknesses**

Almost all respondents indicated the following weaknesses specific to classroom educators:

- STEM educator preparation and training
- Middle school and high school STEM teacher content knowledge
- Short supply of highly effective STEM teachers
- Lack of high-quality STEM teacher professional development opportunities

A majority of interviewees said the state’s weakness is the coordination of efforts across the state. Numerous interviewees noted that K-12 school administrators do not understand and fully use STEM to transform the education experience for students. Many noted a lack of general leadership in STEM. A number of interviewees identified funding and resources for STEM as a weakness. Finally, a lack of STEM awareness and general apathy toward STEM education emerged as a frequently cited weakness.

**Tennessee’s greatest opportunities**

Most respondents recognized the potential of the Tennessee STEM Innovation Network and its work to promote Regional STEM Innovation Hubs and STEM Platform Schools as a significant opportunity. Many respondents noted the potential opportunities that exist in engaging business, industry and other community partners in STEM education. Several recognized the opportunities that could be gained from aligning resources and coordinating STEM efforts.

**Tennessee’s greatest threats**

Almost all interviewees noted that resources and potential lack of funding represent the greatest threats over the next several years. Numerous respondents identified the “bureaucracy” of the teaching profession as a threat. Several interviewees stressed the importance of selecting strong initial sites for the new platform schools with strong leadership in place. They noted that this first round of schools sets the mold and poor selection could pose a threat the quality of future schools. Several identified the potential impatience of policymakers and stakeholders who demand instant results and are not willing to wait on systems to change. Some noted the lack of understanding of what future STEM jobs will be available and what jobs won’t be available.

**STEM’s relationship to the economy, K-12 and higher education**

Almost every respondent discussed STEM as an agent of growth for regional economies. “STEM is a driver of the economy,” was a common response. “STEM training results in job attainment,” was another frequently noted response.
Regarding STEM’s relationship to K-12, nearly every interviewee noted the importance of laying a strong STEM foundation early in K-12.

In terms of higher education, many noted that STEM should be more integrated in higher education. Several noted that department funding should not drive competition among the STEM disciplines, which results in the “siloed” approach to STEM at the postsecondary level, particularly on research campuses.

**Statewide STEM goals for STEM**

The most frequently cited goal dealt with increasing teacher quality to ensure that all teachers are highly knowledgeable in STEM content areas and well trained in cross-disciplinary and project-based approaches to teaching. “Don’t teach with the text at the chest,” noted one interviewee. Many articulated the goal of aligning STEM education opportunities and efforts across the state (particularly those in the state’s metropolitan areas) but allowing flexibility for regional economic growth needs. Several noted the goal of increasing students’ level of scientific literacy and ability to demonstrate the scientific process.

**Local, state and national best-in-class practices in STEM**

Responses varied dramatically for this question, if the respondent was able to answer the question. One program was mentioned twice and represents the only overlap for this question: Denver School of Science and Technology. One respondent mentioned the partnership between ORNL and the neighborhood schools. Another referenced the higher education partnerships between Chattanooga State Community College and Volkswagen and Austin Peay and Hemlock Semiconductor. Project Lead the Way and the Ford Academy of Manufacturing were also mentioned as strong stand-alone programs.

**Critical STEM Messages**

Most responded that the message should focus on four types of questions:

1) What’s in it for me?
2) What should I know about STEM to get a job?
3) What skills should I have?
4) What’s the earning power of a job in STEM?

**Target audience**

Respondents identified the following audiences in order of frequency:

1) Educators (administrators, teachers and counselors)
2) Parents
3) Students
4) General population (communities, business and media)

**Vehicles for moving the message**

Interviewees identified the following vehicles in order of frequency:

- Educators (teachers & counselors)
- TV (news stories about successful schools) and use respected public figures, not government officials as spokespersons
- Parents
- Public campaign/Use of local chambers
<table>
<thead>
<tr>
<th></th>
<th>K-12 Educators</th>
<th>Higher Education</th>
<th>Government</th>
<th>Business</th>
</tr>
</thead>
</table>
| **Defining STEM**             | • Hands-on, project-based  
• Interacting with business, enabling students to be a part of research and the “real-world”  
• Integration of math and science curriculum, using technology and engineering as a tool  
• Students drive the learning process | • Cross-disciplinary/multi-disciplinary— the interaction among the disciplines  
• Understanding of science as a process  
• A common way of generating knowledge about the world | • Technical subjects taught in technology centers to fill workforce needs  
• Integrated curricular approach that unifies skill sets learned through individual disciplines of STEM  
• Application-based approach to learning  
• Application of technology to learning | • Simply as science, technology, engineering and mathematics and giving students the option to study those disciplines  
• Act of acquiring analytic skills, studying and understanding trends and interpreting data specific to those trends  
• Integrated teaching and learning across subjects and disciplines |
| **STEM Rating**               | AVERAGE RATING: 2 | AVERAGE RATING: 2 | AVERAGE RATING: 2 | AVERAGE RATING: 2 |
| **Weaknesses**               | • Not where it needs to be, but promise because of FTTT | • Disconnected, with an incoherent path for students, who have weak performance on standardized tests and college entrance | • Promising because of strong assets, but disconnected, siloed and plagued by low awareness | • Promising thanks to the creation of the TSIN, but inconsistent across the state, ineffective in reaching poor, rural students and deficient in funding |
| **Strengths**                | • Excellent engineering schools – STEM training in higher education seems strong  
• Committed K-12 STEM teacher corps | • First to the Top and its focus on STEM  
• Committed and innovative K-12 STEM teacher corps | • Strong research assets including institutions of higher education (Vanderbilt, UT, UM) and businesses/organizations (ORNL, Memphis Biotech, St. Jude, VW, FedEx, Nissan, Eastman Chemical, etc.)  
• First to the Top focus on STEM | • Strong research assets including institutions of higher education (UT, Vanderbilt, TBR) and business (GTX, St. Jude, Medtronic, Buckeye Cellular, FedEx, International Paper, AutoZone, Nissan, Eastman Chemical, etc.)  
• Strong alignment across systems: K-12, higher education and business/industry to move the needle in STEM education  
• Growing momentum for STEM – people seem to be grasping the concept and goals |
| **Opportunities**            | • Getting all stakeholders of the community involved: parents, students, educators, business, etc. | • Platform schools, Project WET, Biology in a Box  
• TSIN | • Generate and develop a corps of high-quality STEM teachers.  
• Alternative teacher certifications to bring more professionals with real-world experience into the classroom  
• Aligning all resources toward a common goal  
• Communicate success stories | • Better, fuller engagement of business partners in STEM  
• Bring STEM to every student, school district and locale in TN  
• Our metropolitan areas  
• Funding: STEM must be a priority  
• TSIN |

**Table 7: Distillation of SWOTs and Goals**
<table>
<thead>
<tr>
<th></th>
<th>K-12 Educators</th>
<th>Higher Education</th>
<th>Government</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Threats</strong></td>
<td>• Poor launch of the platform schools – especially poor selection of the teachers&lt;br&gt;• Stakeholders who want instant results in STEM – district policies are cumbersome for STEM</td>
<td>• STEM funding going to districts that aren’t using it effectively&lt;br&gt;• Lack of community value for mathematics and science&lt;br&gt;• Inertia: lack of recognizing and spreading excellent programs</td>
<td>• Bureaucracy in the teaching profession, low-standards in the teaching profession&lt;br&gt;• Lack of leadership, lack of clear goals, lack of accountability for outcomes&lt;br&gt;• Funding – what happens after First to the Top?&lt;br&gt;• Satisfaction with the current education system – lack of will to change</td>
<td>• Funding and resources&lt;br&gt;• Confusion about available future STEM jobs and what training is necessary&lt;br&gt;• Perceptions around job availability&lt;br&gt;• Lack of understanding what STEM is</td>
</tr>
<tr>
<td><strong>STEM: Econ. K-12 &amp; HE</strong></td>
<td>• Connect to real world experiences&lt;br&gt;• Authentic partnerships between K-12, higher education and business</td>
<td>• STEM underlies the success of the economy&lt;br&gt;• STEM must become a part of the general core of skills</td>
<td>• Strong STEM teaching and learning in K-12 is where it all begins&lt;br&gt;• Improve STEM teacher quality&lt;br&gt;• Thinking about the requirements necessary for future jobs&lt;br&gt;• STEM drives the economy</td>
<td>• STEM is a tangible asset. It leads to brick and mortar enterprises that result in jobs&lt;br&gt;• STEM = talent production and job creation&lt;br&gt;• STEM = tool to strengthen the economy&lt;br&gt;• STEM foundation must be built in K-12</td>
</tr>
<tr>
<td><strong>STEM Goals</strong></td>
<td>• Focus on teacher training and select teachers carefully&lt;br&gt;• All teachers trained and qualified in their subject areas&lt;br&gt;• Collaborative planning time for teachers; flexibility in system</td>
<td>• Require that STEM teachers receive training in cross disciplinary teaching&lt;br&gt;• Encourage teachers to deploy project-based, hands-on lessons&lt;br&gt;• Overall goal of scientific literacy: the general populace must be literate enough to make informed decisions on scientific issues</td>
<td>• Align TSIN (and schools and hubs) with Regional Innovation-Based Economic Development Initiatives (INCITE)&lt;br&gt;• Teacher talent and training&lt;br&gt;• Remove impediments to college completion (reverse articulation – to award degrees to students who may have accumulated hours but don’t have the credentials)</td>
<td>• Experiential learning opportunities are available for all students&lt;br&gt;• Engagement goal: parents, students and teachers – also employers&lt;br&gt;• Reinventing and reinvigorating STEM at the middle school&lt;br&gt;• Require all schools to teach integrated STEM across the state and to every student&lt;br&gt;• Consolidation and coordination of STEM efforts across every major metro area</td>
</tr>
<tr>
<td><strong>Notable Programs</strong></td>
<td>• Program demonstrated by a “national engineering group”</td>
<td>• Partnership between ORNL and the city schools</td>
<td>• Higher Ed partnerships between Chattanooga State Community College and VW and Austin Peay and Hemlock Semiconductor&lt;br&gt;• STEM Academy at Stratford High School – promising&lt;br&gt;• PTLW and Ford Academy of Manufacturing</td>
<td>• Denver School of Science and Technology</td>
</tr>
</tbody>
</table>
## Distillation of STEM Communication

<table>
<thead>
<tr>
<th>Critical Messages</th>
<th>Audience</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>• STEM = learn to “think critically”&lt;br&gt;• STEM = a true partnership to learning</td>
<td>• Educators, school districts, State Board of Education and parents&lt;br&gt;• Communities, businesses, families and teachers</td>
<td>• Inform then deploy parents and teachers&lt;br&gt;• Spotlight STEM success stories across the state</td>
</tr>
</tbody>
</table>

### Defining STEM
- Project-based, integrated, multi-disciplinary, for all students and real world
- Partnership of K-12, higher education and business

### STEM Rating
- Disconnected and inequitable (opportunities between rural and urban areas), but promising thanks to FTTT, TSIN and strong assets
- Consistently rated a 2 out of 5

### Strengths
- Strong research assets
- Strong business assets
- Committed and innovative K-12 STEM teacher corps

### Weaknesses
- Teacher training/lack of qualified STEM teachers
- Teacher professional development
- K-12 school administrators/managing STEM human capital

### Summary of Results and Possible Application

Table 8: Summary of SWOTs and Goals

<table>
<thead>
<tr>
<th>Category</th>
<th>High Frequency &amp; Intensity (listed in order)</th>
<th>Notably Lower Frequency &amp; Intensity</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining STEM</td>
<td>• Project-based, integrated, multi-disciplinary, for all students and real world&lt;br&gt;• Partnership of K-12, higher education and business</td>
<td>• Simply as science, technology, engineering and mathematics and giving students the option to study those disciplines</td>
<td></td>
</tr>
<tr>
<td>STEM Rating</td>
<td>• Disconnected and inequitable (opportunities between rural and urban areas), but promising thanks to FTTT, TSIN and strong assets&lt;br&gt;• Consistently rated a 2 out of 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strengths</td>
<td>• Strong research assets&lt;br&gt;• Strong business assets&lt;br&gt;• Committed and innovative K-12 STEM teacher corps</td>
<td></td>
<td>• Strong alignment across systems&lt;br&gt;• Growing momentum for STEM</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>• Teacher training/lack of qualified STEM teachers&lt;br&gt;• Teacher professional development&lt;br&gt;• K-12 school administrators/managing STEM human capital</td>
<td></td>
<td>• Lack of collaboration across the state</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Threats</td>
<td>STEM: Economy, K-12 and Higher Education</td>
<td>STEM Goals</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
<td>------------------------------------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>
| • Lack of leadership in STEM  
• Funding and resources  
• Awareness, apathy and complacency | • Resources and lack of funding  
• Bureaucracy of the teaching profession  
• Poor launch of platform schools  
• Stakeholders who want instant results  
• Understanding the future job market in STEM | • STEM is a driver of the economy  
• STEM foundation is built in K-12 – part of the general core  
• STEM training results in job attainment (real world experiences)  
• STEM teacher quality is essential | • Increase teacher quality (highly knowledgeable in content areas and well-trained in cross-disciplinary approaches), encourage project-based lessons and enable more collaborative teacher planning time  
• Align STEM education opportunities with state and regional economic growth opportunities and needs – and coordinate STEM opportunities across Metro areas  
• Increase students’ level of scientific literacy  
• Remove impediments to college completion | • Partnership between ORNL and the city schools  
• Higher education partnerships between Chattanooga State Community College and VW and Austin Peay and Hemlock Semiconductor  
• PTLW and Ford Academy of Manufacturing  
• Denver School of Science and Technology | • Stratford – listed as “promising” |

### Communication

<table>
<thead>
<tr>
<th>Category</th>
<th>High Frequency &amp; Intensity</th>
<th>Lower Frequency &amp; Intensity</th>
<th>Notes/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Messages</td>
<td>• What's in it for me? What should I know about STEM to get a job? What skills should I have? What's the difference in earning power?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Audience | • Educators (administrators, teachers, counselors)  
• Parents  
• Students  
• General population (communities, business, media) | | |
| Vehicles | • Educators (teachers & counselors)  
• TV (news stories about successful schools) and use respected public figures, not government officials as spokespersons  
• Parents  
• Public campaign/Using local chambers | |