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# A Foundation for the Future:

## Massachusetts' Plan for

## Excellence in STEM Education

*Science, Technology, Engineering and Mathematics*

*(Version 1.0)*

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Building the pipeline of STEM professionals to fuel  
Massachusetts' innovation economy

September 28, 2010



A Plan from the Governor's STEM Advisory Council

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LIEUTENANT GOVERNOR

September 28, 2010

Dear All,

On behalf of the Governor's STEM Advisory Council, I am pleased to submit "A Foundation for the Future: Massachusetts' Plan for Excellence in STEM Education" at the 7<sup>th</sup> Annual STEM Summit. Over the last year, we have formed a strong partnership to work towards shared goals as we make significant improvements in STEM fields. I thank every single person involved in this process, ranging from professionals in academia, workforce training, and economic development to our partners in the private sector and community organizations. Strengthening and improving education for our future generations is a key priority of mine, the Patrick-Murray Administration, and the Governor's STEM Advisory Council. Once implemented, this plan will serve as a guide as we move forward in our efforts to make long-lasting and critical strides in STEM that will positively impact communities across the Commonwealth.

Developing a pipeline of STEM graduates is not only important for Massachusetts, it is critical to the success of our nation as a whole. With baby boomer retirements expected to deplete the science and technology workforce by 50% over the next decade, we are at risk of losing our leadership in technology and innovation. Eighty percent of jobs created in the next decade will require math and science skills. Creating this new plan is a generational responsibility for the future of our children and the Commonwealth.

This plan includes the operational infrastructure to review best practices with the intention to also scale and sustain them. Additionally, this plan sets five goals with key benchmarks to work towards over the next five years, details new recent partnerships with the National Governors Association's Center for Best Practices, the Innovate+Educate Initiative, and the Massachusetts

Life Sciences Center, and describes how funding from the STEM Pipeline Fund and federal funding from the Race to the Top Award will support STEM.

On October 14, 2009, Governor Deval Patrick signed Executive Order #513 creating the STEM Advisory Council. In less than a year, we have built a diverse statewide coalition among educators, workforce development professionals, economic development specialists, cabinet members, non-profit partners and interagency leaders from state agencies to coordinate and work together on this comprehensive plan. The creation of this Council within the Executive Branch was recognized by the U.S. Department of Education as one of the reasons Massachusetts' Race to the Top application received a 100% score on the STEM component. The Council's collaborative work was also recognized by NASA who selected the Massachusetts Space Grant Consortium as one of only four state consortiums and was awarded \$1.5 million from NASA's Summer of Innovation Program. I am proud of these accomplishments and know many more will come because of the Council's future hard work and dedication.

I want to thank all members of the Council and its six Subcommittees and the staff who supported them. A special thank you to the subcommittee co-chairs for their leadership. I also want to recognize two important leaders in our state and members of the STEM Advisory Council who are moving on to new careers. University of Massachusetts President Jack Wilson and State Representative Daniel Bosley are key leaders whose legacy in and around STEM will live on in our work. I also want to thank Adam Freudberg in the Lt. Governor's Office, David Cedrone and Keith Connors in the Department of Higher Education, and Marissa Cole in the Executive Office of Education for seeing this plan through to completion.

Yours truly,

A handwritten signature in black ink, appearing to read "Timothy P. Murray". The signature is fluid and cursive, with the first name "Timothy" and last name "Murray" being the most prominent parts.

Timothy P. Murray  
Lieutenant Governor  
Chairman, Governor's STEM Advisory Council

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## Executive Summary

Massachusetts has a rich tradition of invention and ingenuity in the areas of scientific discovery and technological innovation. However, our world leadership position is being challenged as a result of rapidly developing global competition. To assert and maintain leadership in knowledge-based and innovation-driven industries, Massachusetts must develop a highly educated and skilled workforce, internationally benchmarked, that is deeply grounded in the subject knowledge and application of science, technology, engineering and mathematics (STEM).

To establish and maintain a diverse, robust and dynamic pipeline of future STEM professionals who are globally competitive, it is necessary to:

- nurture students' innate curiosity at a young age and spark student interest and excitement in STEM subjects through authentic experiential learning, beginning in early childhood and sustained throughout PreK-16 education and beyond;
- further improve Massachusetts' already nationally recognized system of standards, curriculum and assessments to ensure excellence, rigor and coherence in the framework for STEM education;
- effectively prepare teachers to support ALL students as they develop a baseline fluency in STEM subjects as 21<sup>st</sup> century citizens and engage *significantly* more students in pursuit of STEM-based higher education and careers

This challenge must be addressed through the commitment, leadership, and provision of resources by the entire community and be embraced at every level of the system – from state government, to schools, community-based organizations, associations and institutions of informal education. As well as by students, their parents and families, educators (PreK-12, including vocational-technical schools to post secondary university faculty), STEM employers and practicing STEM professionals from *all* industry sectors, as well as state and local government officials.

### ***A Foundation for the Future: Massachusetts' Plan for Excellence in STEM Education (Version 1.0)***

To achieve breakthrough results in the long-standing challenge of preparing *all* students to be fluent in STEM subjects and to engage and prepare a significantly larger and more broadly representative population of students for STEM professional careers requires a commitment to whole-system transformation.

The framework for this transformation is defined by:

1. A Theory-of-Action
2. Quantitative and Qualitative Goals
3. A System of Public/Private Governance
4. STEM Education Policy and Best Practice Initiatives
5. A Timeline for Results
6. Funds and Resources

The **Theory-of-Action** for this plan describes core elements of the PreK-16 education system aligned and integrated with applied “real world” learning opportunities to excite, and sustain student awareness, interest and motivation for STEM applications, and to promote and support rigorous academic preparation for STEM post-secondary education and careers. These elements include: Community Engagement, Academic Coherence, Educator Development and STEM Employer and Professional support.

Five **Quantitative Outcome Goals** frame the intended results of this plan including: Student Interest Student Achievement, College STEM Readiness, STEM College Graduation and Educator Effectiveness. In addition, for each of the five goals, subordinate objectives focus on specific and critical areas that will require targeted program attention.

| Massachusetts STEM Key Goals  |
|---|
| <b>1. Increase student interest in STEM.</b>  |
| <b>2. Increase STEM achievement of PreK-12 students.</b>  |
| <b>3. Increase the percentage of students who demonstrate readiness for college-level study in STEM fields.</b>         |
| <b>4. Increase the number of students who graduate from a post-secondary institution with a degree in a STEM field.</b> |
| <b>5. Increase the number/percentage of STEM classes led by effective educators, from PreK-16.</b>                      |

This whole-system transformation of STEM education requires distributed yet coordinated efforts of everyone involved in STEM education and programming from across the Commonwealth. To provide the necessary coordination of funding and institutional resources, a **System of Public/Private Governance** will prioritize, assess and recommend STEM education policies and selected best practice programs for regional or statewide implementation. The Governor’s STEM Advisory Council provides overarching leadership for the plan and will take-up STEM education policy and initiative recommendations for consideration. A subcommittee of the Governor’s STEM Advisory Council – the Statewide STEM Operations Board, will coordinate “best practice” program vetting, funding and implementation evaluation through the Regional STEM Collaboratives. Local adaptations of best practice programs and new innovations led by front-line educators will complete the portfolio of initiatives. Finally, the Goddard Council will oversee a STEM Fundraising Task Force that will pursue federal, corporate and foundation funding sources to support critical initiatives of the plan.

During the months leading up to the announcement of this plan, a number of thoughtful and focused recommendations for **STEM Education Policies and Best Practice Programs** were developed through the work of broadly representative subcommittees convened by the Governor’s STEM Advisory Council. These recommendations and more provide the starting agenda of action initiatives to be taken-up for consideration by the Governor’s STEM Advisory Council in the days ahead.

The **Timeline for Results** highlights currently approved and funded STEM initiatives for this, the first version (V1.0) of the five-year plan. Annual versions of the plan will include phased

implementations of policies, best practice programs and initiatives based upon available funding and resources.

The **Funds and Resources** necessary to support and compliment this initial version of plan include: the STEM Pipeline Fund, the Race to the Top award, a new equipment and supplies program from the Massachusetts Life Science Center, and a grant from Innovate+Educate as part of a new partnership with the National Governors Association's Center for Best Practices.

### ***Education Improvement and Reform: Race to the Top***

With the leadership and support of Governor Patrick and Lieutenant Governor Murray, Massachusetts submitted a robust Race to the Top (RTTT) plan that includes bold and innovative strategies for addressing four required reform assurances and four ambitious objectives:

- Attract, develop, and retain an effective, academically capable, diverse, and culturally competent educator workforce to ensure that every student is taught by a great teacher and every school and district is led by a great leader;
- Provide curricular and instructional resources to ensure that every educator has the tools necessary to promote and support student achievement;
- Concentrate great instruction and supports for educators, students, and families in the Commonwealth's lowest-performing schools to create the conditions needed for improved student achievement; and
- Dramatically increase the number of students who graduate from high school ready for college and career.

The Theory-of-Action and strategies described in the state's RTTT plan now represents the core of the next generation of education improvement and reform in Massachusetts and are aligned with the Theory-of-Action, Quantitative and Qualitative Goals, and recommendations described in the STEM plan. Massachusetts will utilize the RTTT funding over the next four years to implement systemic initiatives that reach every sector within the public education system – which mirrors the importance of utilizing a whole-systems and coherent approach to improve the quality of STEM education for all students. Massachusetts' comprehensive RTTT plan and the funding – coupled with the momentum and new partnerships created by the Governor's STEM Advisory Council – provides Massachusetts with the tools necessary to advance STEM education and achieve multiple goals for PreK-16 students, educators, STEM partners, and communities.

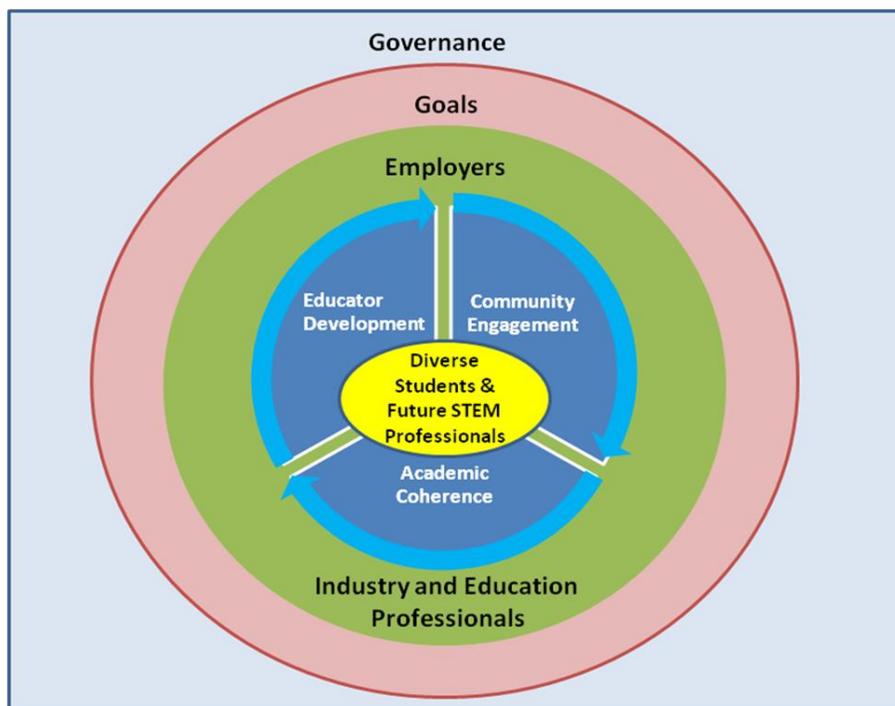
# Theory-of-Action

Massachusetts **Theory-of-Action** for STEM education and workforce development represents a new approach to address the need for whole-system transformation beginning in Pre-Kindergarten and continuing through post-secondary programs leading to STEM careers. This is an important departure from what often has been characterized as the “thousand points-of-light” strategy. In this previous case, many projects, each individually representing good work focused on important challenges, were largely uncoordinated, rarely if ever designed for regional or statewide scale and often not funded for sustained operation. The result was little measurable impact on the diversity and overall quantity of students both interested in and academically prepared to pursue STEM post-secondary programs and careers.

As depicted in Figure 1 the central focus of this Theory-of-Action is to encourage and support a **diverse body of Massachusetts students** to become future STEM professionals. These students will find careers in a wide array of fields - from practicing scientists, technologists, engineers and mathematicians to health professionals, technicians in healthcare, life sciences and renewable energy and in a wide range of information technology jobs including finance, communications media, bioinformatics and in jobs and careers that we cannot envision today. In addition, the Theory-of-Action recognizes that every student, in preparation for 21<sup>st</sup> century citizenship, must be fluent in STEM concepts to make important personal choices and contribute to societal decisions, even though not every student will work in a formally defined STEM profession.

## STEM Theory-of-Action

Figure 1



To engage *all* students in STEM subjects it is necessary to first raise their awareness of how STEM affects their everyday lives via strong **community engagement**. Once aware, individual interest can be sparked and, when properly supported, can spur the self-motivation necessary for students to pursue and succeed in rigorous academic and vocational studies. Developing student awareness, interest and motivation (AIM) requires regular and appropriate experiential learning opportunities, often best supported by practicing professionals in industry and through informal education and community-based programming. To provide this support for *all* students will require a substantial commitment from every STEM employer and every STEM professional.

Student AIM is important but alone is insufficient; **academic coherence** refers to the need to connect and reinforce experiential learning through classroom curriculum, instruction, standards and assessments. Curriculum and instruction must not only integrate and align to experiences that interest and excite students; they must also incorporate the latest pedagogical practices and articulate among grade levels across STEM subjects. As with student AIM, STEM professionals (employers and faculty) can and should inform curriculum and instruction through the perspective of current industry practice and academic research to strengthen the coherence of theory and knowledge with practice.

Experiential learning, combined with academic coherence does not complete the formula to ensure student success. **Educator development** will address the need to prepare all STEM educators with the content knowledge and pedagogy supported by classroom resources to align experiential learning, coherent standards, content rich curriculum and effective assessments to support student learning and motivation.

**Quantitative qualitative goals** frame the expected and measurable student outcomes while describing the scope and character of change that is necessary to achieve whole-systems transformation.

Finally, through the combination of locally distributed and regionally scaled best practice initiatives, a **system of public/private governance** will ensure STEM maintains a heightened priority for the Commonwealth and will complement efforts underway in the Secretariats and Departments to implement aspects of the plan.

## Quantitative Outcome & Qualitative Transformation Goals

### **1. Quantitative Outcome Goals**

To measure progress toward the mission and charge of this plan, several quantitative outcome measures have been established. These goals and the indicators used to measure progress toward achieving them are outlined below. For each of the five goals, subordinate objectives focus on specific and critical areas that must be highlighted or may require unique programmatic attention (for example, academic achievement of student subgroups).

#### **Goal 1: Increase student interest in STEM.**

- a. *Standard:* Increase interest in STEM college majors among college-going MA public school graduates to 35% by 2016 (from 25% in 2009).
  - Increase interest among the underrepresented gender in fields with a gender-based gap in interest.
  - Increase interest among underrepresented races/ethnicities in fields with a race/ethnicity-based gap in interest.
  - Increase interest in fields where there are anticipated gaps in future employment (from industry growth and/or from retirement of current employees).
  - Increase interest in STEM fields at early ages (including preschool and elementary school) to assist in increasing student motivation to attain higher levels of STEM academic achievement/performance.
- b. *Tool:* SAT Registration Questionnaire
- c. *Reference Data:* SAT Registration Questionnaire. Data Prepared by UMass Donahue Institute.

(Table on next page)

| <b>Goal 1: Increase Student Interest in STEM</b>   |            |               |             |                         |              |                 |              |
|--|------------|---------------|-------------|-------------------------|--------------|-----------------|--------------|
| <b><i>Student Reported Interest in STEM-Related College Majors on the 2009 SAT and SATII – MA Public School Students</i></b> |            |               |             |                         |              |                 |              |
|  | <b>All</b> | <b>Female</b> | <b>Male</b> | <b>African-American</b> | <b>Asian</b> | <b>Hispanic</b> | <b>White</b> |
| # SAT & SATII Test-Takers  | 44,517     | 23,655        | 20,862      | 3,232                   | 2,843        | 3,316           | 31,968       |
| # Interested in Agriculture & Natural Resources  | 348        | 215           | 133         | *                       | *            | 12              | 302          |
| # Interested in Architecture   | 610        | 185           | 425         | 27                      | 45           | 66              | 439          |
| # Interested in Biological & Biomedical Sciences   | 1,606      | 987           | 619         | 102                     | 225          | 83              | 1,101        |
| # Interested in Computer & Information Sciences  | 873        | 91            | 782         | 63                      | 88           | 57              | 613          |
| # Interested in Engineering & Engineering Technology/Technicians   | 2,480      | 341           | 2,139       | 173                     | 234          | 188             | 1,775        |
| # Interested in Health Professions   | 4,567      | 3,660         | 907         | 456                     | 407          | 424             | 3,045        |
| # Interested in Mathematics & Statistics   | 335        | 132           | 203         | 18                      | 45           | 28              | 229          |
| # Interested in Physical Sciences  | 321        | 115           | 206         | 16                      | 22           | 13              | 256          |
| # Interested in All STEM Majors  | 11,140     | 5,726         | 5,414       | 858                     | 1,075        | 871             | 7,760        |
| <b>% Interested in Agriculture &amp; Natural Resources</b>   |            |               |             |                         |              |                 |              |
| % Interested in Agriculture & Natural Resources  | 0.8%       | 0.9%          | 0.6%        | *                       | *            | 0.4%            | 0.9%         |
| <b>% Interested in Architecture</b>  |            |               |             |                         |              |                 |              |
| % Interested in Architecture   | 1.4%       | 0.8%          | 2.0%        | 0.8%                    | 1.6%         | 2.0%            | 1.4%         |
| <b>% Interested in Biological &amp; Biomedical Sciences</b>  |            |               |             |                         |              |                 |              |
| % Interested in Biological & Biomedical Sciences   | 3.6%       | 4.2%          | 3.0%        | 3.2%                    | 7.9%         | 2.5%            | 3.4%         |
| <b>% Interested in Computer &amp; Information Sciences</b>   |            |               |             |                         |              |                 |              |
| % Interested in Computer & Information Sciences  | 2.0%       | 0.4%          | 3.7%        | 1.9%                    | 3.1%         | 1.7%            | 1.9%         |
| <b>% Interested in Engineering &amp; Engineering Technology/Technicians</b>  |            |               |             |                         |              |                 |              |
| % Interested in Engineering & Engineering Technology/Technicians   | 5.6%       | 1.4%          | 10.3%       | 5.4%                    | 8.2%         | 5.7%            | 5.6%         |
| <b>% Interested in Health Professions</b>  |            |               |             |                         |              |                 |              |
| % Interested in Health Professions   | 10.3%      | 15.5%         | 4.3%        | 14.1%                   | 14.3%        | 12.8%           | 9.5%         |
| <b>% Interested in Mathematics &amp; Statistics</b>  |            |               |             |                         |              |                 |              |
| % Interested in Mathematics & Statistics   | 0.8%       | 0.6%          | 1.0%        | 0.6%                    | 1.6%         | 0.8%            | 0.7%         |
| <b>% Interested in Physical Sciences</b>   |            |               |             |                         |              |                 |              |
| % Interested in Physical Sciences  | 0.7%       | 0.5%          | 1.0%        | 0.5%                    | 0.8%         | 0.4%            | 0.8%         |
| <b>% Interested in All STEM Majors</b>   |            |               |             |                         |              |                 |              |
| % Interested in All STEM Majors  | 25.0%      | 24.2%         | 26.0%       | 26.5%                   | 37.8%        | 26.3%           | 24.3%        |

\*Numbers are too low to report

**Goal 2: Increase STEM achievement among PreK-12 students.**

- a. *Standard:* Increase the percentage of all students scoring *Proficient* or *Advanced* on the MCAS mathematics and science & technology/engineering assessments:
- Increase the percentage of all 5<sup>th</sup> and 8<sup>th</sup> grade students scoring *Proficient* or *Advanced* on mathematics and science & technology/engineering MCAS assessments by 20 percentage points by 2016.
  - Increase the percentage of all high school students scoring *Proficient* or *Advanced* on mathematics and science & technology/engineering MCAS assessments by 10 percentage points by 2016.
  - Reduce the achievement gaps of 5<sup>th</sup> grade, 8<sup>th</sup> grade, and high school students on the mathematics and science & technology/engineering MCAS assessments by 25% between 2010 and 2014, and another 25% between 2014 and 2016.
- b. *Tool:* Massachusetts Comprehensive Assessment System (MCAS) assessments in mathematics and science & technology/engineering.
- c. *Reference data:* MCAS assessment data from DESE.

| Goal 2: Increase STEM achievement among PreK-12 students               |      |  |                    |                 |
|--|------|--|--------------------|-----------------|
| % of Students Scoring Proficient or Advanced (P/A) on the MCAS in 2009 |      |  |                    |                 |
| MCAS DATA  | Math | Math - Goal 2016                         | Sci/Tech/Eng (STE) | STE - Goal 2016 |
| <b>Grade 5</b>   | 54%  | 74%                                      | 49%                | 69%             |
| <b>Grade 8</b>   | 49%  | 70%                                      | 39%                | 59%             |
| <b>High School</b>   | 74%  | 85%                                      | 62%                | 72%             |
| <b>All Student (inclusive of the 3 grades)</b>                         | 59%  | 76% (this matches the RTTT goal for '16) | 50%                | 67%             |

**Goal 3: Increase the percentage of students who demonstrate readiness for college-level study in STEM fields.**

- a. *Standard:* Increase the percentage of MA public high school students who report taking at least 4 years of math (from 69% in 2009 [SAT]) and 3 years of lab-based science (from 79% in 2009 [SAT]) to 100% in 2016,<sup>1</sup> consistent with MassCORE, as well as increase the percentage of MA public high school students who report taking advanced mathematics (pre-calculus and above) to 55% (from 44% in 2009 [SAT]) by 2016.

<sup>1</sup> This goal also aligns with the goals of Race to the Top.

- Increase STEM course-taking among the underrepresented gender in courses with a gender-based gap in participation.
- Increase STEM course-taking among underrepresented races/ethnicities in courses with a race/ethnicity-based gap in participation.

b. *Tool:* SAT Registration questionnaire and SIMS

c. *Reference Data:* SAT Registration Questionnaire. Data Prepared by UMass Donahue Institute.

| <b>Goal 3: Increase the percentage of students who are STEM college-ready</b> |            |               |             |                         |              |                 |              |
|---|------------|---------------|-------------|-------------------------|--------------|-----------------|--------------|
| <b>2009 Reported Course-Taking in STEM fields</b>                             |            |               |             |                         |              |                 |              |
| <b>MA Public School Students</b>  |            |               |             |                         |              |                 |              |
|   | <b>All</b> | <b>Female</b> | <b>Male</b> | <b>African-American</b> | <b>Asian</b> | <b>Hispanic</b> | <b>White</b> |
| # SAT & SATII Test-Takers   | 44,517     | 23,655        | 20,862      | 3,232                   | 2,843        | 3,316           | 31,968       |
| # Who report taking at least 4 years of math                                  | 30,788     | 16,383        | 14,405      | 1,772                   | 1,747        | 1,792           | 23,513       |
| # Who report taking at least 3 years of science                               | 34,977     | 18,954        | 16,023      | 2,177                   | 1,948        | 2,106           | 26,360       |
| # Who report taking at least pre-calculus                                     | 19,702     | 10,777        | 8,925       | 1,051                   | 1,759        | 1,113           | 14,783       |
| # Who report taking chemistry and/or physics                                  | 33,069     | 18,140        | 14,929      | 2,111                   | 2,281        | 2,225           | 24,653       |
| % Who report taking at least 4 years of math                                  | 69.2%      | 69.3%         | 69.0%       | 54.8%                   | 61.4%        | 54.0%           | 73.6%        |
| % Who report taking at least 3 years of science                               | 78.6%      | 80.1%         | 76.8%       | 67.4%                   | 68.5%        | 63.5%           | 82.5%        |
| % Who report taking at least pre-calculus                                     | 44.3%      | 45.6%         | 42.8%       | 32.5%                   | 61.9%        | 33.6%           | 46.2%        |
| % Who report taking chemistry and/or physics                                  | 74.3%      | 76.7%         | 71.6%       | 65.3%                   | 80.2%        | 67.1%           | 77.1%        |

**Goal 4: Increase the number of students who graduate from a post-secondary institution with a degree in a STEM field.**

- a. *Standard:* Increase the number of students who complete STEM post-secondary degrees at MA public and private institutions by 50% from 2008 to 2016.
- Increase the number of Bachelor's degrees granted in all STEM majors to all students by 50% by 2016.
  - Increase the number of Bachelor's degrees granted in all STEM majors to the underrepresented gender in majors with a gender-based gap in degrees.
  - Increase the number of Bachelor's degrees granted in all STEM majors to the underrepresented gender in majors with a gender-based gap in degrees.
- b. *Tool:* Integrated Postsecondary Education Data System

c. *Reference data:* Integrated Postsecondary Education Data System. Data Prepared by UMass Donahue Institute.

| <b>Goal 4: Increase the number of STEM college graduates</b>                               |            |               |             |                         |              |                 |              |
|--|------------|---------------|-------------|-------------------------|--------------|-----------------|--------------|
| <b>2009 Bachelor's Degrees Granted in STEM Areas by MA Public and Private Institutions</b> |            |               |             |                         |              |                 |              |
|  | <b>All</b> | <b>Female</b> | <b>Male</b> | <b>African-American</b> | <b>Asian</b> | <b>Hispanic</b> | <b>White</b> |
| # Bachelor's Degrees Granted in All Subjects   | 54,686     | 31,559        | 23,127      | 2,484                   | 3,607        | 2,522           | 33,595       |
| # Bachelor's Degrees Granted in Agriculture & Natural Resources                            | 471        | 219           | 252         | 7                       | 19           | 14              | 359          |
| # Bachelor's Degrees Granted in Architecture   | 421        | 170           | 251         | 9                       | 20           | 19              | 313          |
| # Bachelor's Degrees Granted in Biological & Biomedical Sciences                           | 2,567      | 1,620         | 947         | 124                     | 400          | 100             | 1,425        |
| # Bachelor's Degrees Granted in Computer & Information Sciences                            | 1,077      | 182           | 895         | 42                      | 123          | 36              | 627          |
| # Bachelor's Degrees Granted in Engineering & Engineering Technology/Technicians           | 2,851      | 642           | 2,209       | 92                      | 319          | 141             | 1,685        |
| # Bachelor's Degrees Granted in Health Professions   | 3,354      | 2,860         | 494         | 152                     | 170          | 96              | 1,941        |
| # Bachelor's Degrees Granted in Mathematics & Statistics                                   | 904        | 400           | 504         | 22                      | 102          | 21              | 516          |
| # Bachelor's Degrees Granted in Physical Sciences  | 966        | 451           | 515         | 20                      | 109          | 31              | 570          |
| # Bachelor's Degrees Granted in All STEM Majors  | 12,611     | 6,544         | 6,067       | 468                     | 1,262        | 458             | 7,436        |
| % Bachelor's Degrees Granted in Agriculture & Natural Resources                            | 0.9%       | 0.7%          | 1.1%        | 0.3%                    | 0.5%         | 0.6%            | 1.1%         |
| % Bachelor's Degrees Granted in Architecture   | 0.8%       | 0.5%          | 1.1%        | 0.4%                    | 0.6%         | 0.8%            | 0.9%         |
| % Bachelor's Degrees Granted in Biological & Biomedical Sciences                           | 4.7%       | 5.1%          | 4.1%        | 5.0%                    | 11.1%        | 4.0%            | 4.2%         |
| % Bachelor's Degrees Granted in Computer & Information Sciences                            | 2.0%       | 0.6%          | 3.9%        | 1.7%                    | 3.4%         | 1.4%            | 1.9%         |
| % Bachelor's Degrees Granted in Engineering & Engineering Technology/Technicians           | 5.2%       | 2.0%          | 9.6%        | 3.7%                    | 8.8%         | 5.6%            | 5.0%         |
| % Bachelor's Degrees Granted in Health Professions   | 6.1%       | 9.1%          | 2.1%        | 6.1%                    | 4.7%         | 3.8%            | 5.8%         |
| % Bachelor's Degrees Granted in Mathematics & Statistics                                   | 1.7%       | 1.3%          | 2.2%        | 0.8%                    | 3.0%         | 1.2%            | 1.7%         |
| % Bachelor's Degrees Granted in Physical Sciences  | 1.8%       | 1.4%          | 2.2%        | 0.8%                    | 3.0%         | 1.2%            | 1.7%         |
| % Bachelor's Degrees Granted in All STEM Majors  | 23.1%      | 20.7%         | 26.2%       | 18.8%                   | 35.0%        | 18.2%           | 22.1%        |

**Goal 5: Increase the number/percentage of STEM classes led by effective educators, from PreK-16.**

a. *Standard:* TBD

- Future measure of STEM qualifications of Pre-K-16 educators (TBD; likely will vary by level: elementary, secondary, post-secondary)
- Future measure of STEM effectiveness of Pre-K-16 educators (TBD; likely will vary by level: elementary, secondary, post-secondary)

b. *Tool:* TBD, includes DESE’s integrated EPIMS & ELAR databases

Comparison of teacher qualifications to class assignments requires the integration of what are currently two separate ESE databases: EPIMS (the Education Personnel Information Management System) and ELAR (Educator Licensing and Recruitment). DESE has been planning on merging the two systems.

c. *Reference Data:* TBD

**2. Qualitative Goals for Transformation**

The intent of the following qualitative goals is to provide a context for the scope of the change and the increased capacity required to achieve the intended whole-system transformation.

a. Community Engagement

Every Massachusetts community will foster increased student interest in STEM through programming and spreading awareness. To spark and sustain student awareness of, interest in and motivation to pursue advanced STEM education and related careers...

- In every community parents, educators, employers, student leaders and STEM professionals will be informed and enlisted as advocates to influence, support and sustain student commitment to STEM from Pre-K through post-secondary education.
- PreK-16 students will have access to rigorous academic and technical preparation in the STEM subjects and be encouraged to engage in experiential and applied learning opportunities.
- Collaboration is critical. Effective collaboration can enhance existing opportunities and bolster the development of systems at the community level to engage students at various points along the STEM pipeline – from preschool to career.

## b. Academic Coherence

Massachusetts STEM standards, curriculum frameworks, instruction and assessments will...

- Incorporate a balanced focus on deep content knowledge, mathematical and scientific inquiry and problem solving/design, reflecting post-secondary faculty expectations for college and career readiness and employer expectations for STEM careers.
- Align vertically across grade levels and horizontally across subject strands to ensure coherent subject progressions among schools, across districts and through college.
- Connect community-based experiential and project-focused learning resources to PreK-12 curricula and/or through collaborative use of STEM related laboratories in the vocational technical schools.

## c. Educator Development

Every student will learn from highly effective educators in every STEM subject area at every grade level, PreK-16. Massachusetts educators will...

- Possess deep subject matter knowledge that spans grade levels; be skilled in the pedagogy of inquiry and problem solving; and be prepared to incorporate experiential and applied learning that integrates science, technology, engineering and mathematics into coherent classroom instruction.
- Make effective use of technology as a tool for learning, recognizing its application as an essential resource for every 21<sup>st</sup> century STEM profession.
- Seek out innovative ways to further improve their understanding of their student's strengths and weaknesses, through data analysis and the creation of active assessments.

## d. STEM Employers and STEM Professionals

Employers and the community of STEM professionals (from industry and education) can provide an array of opportunities for experiential learning, both inside and outside the classroom by...

- Participating in educator professional development and communicating their expectations for students wishing to pursue a career in their sector. Employers and STEM professionals will serve as mentors, internship/co-op supervisors, leaders of community-based after-school and expanded learning time programs and partner with schools to offer new programming and expand existing programming such as the already state approved STEM programs in vocational technical schools.
- Sponsoring university laboratory research and industry-based teacher externships. They will also serve as collaborative partners in high quality professional development and pre-service programs.

## 1. Governance Structure Outline

The **System of Public/Private Governance** in Figure 2 will serve as a structural framework to prioritize, align and recommend funding for STEM education policy proposals and best practice programs to ensure whole-system transformation, regional adaptations and high quality implementation to achieve the goals of this plan.

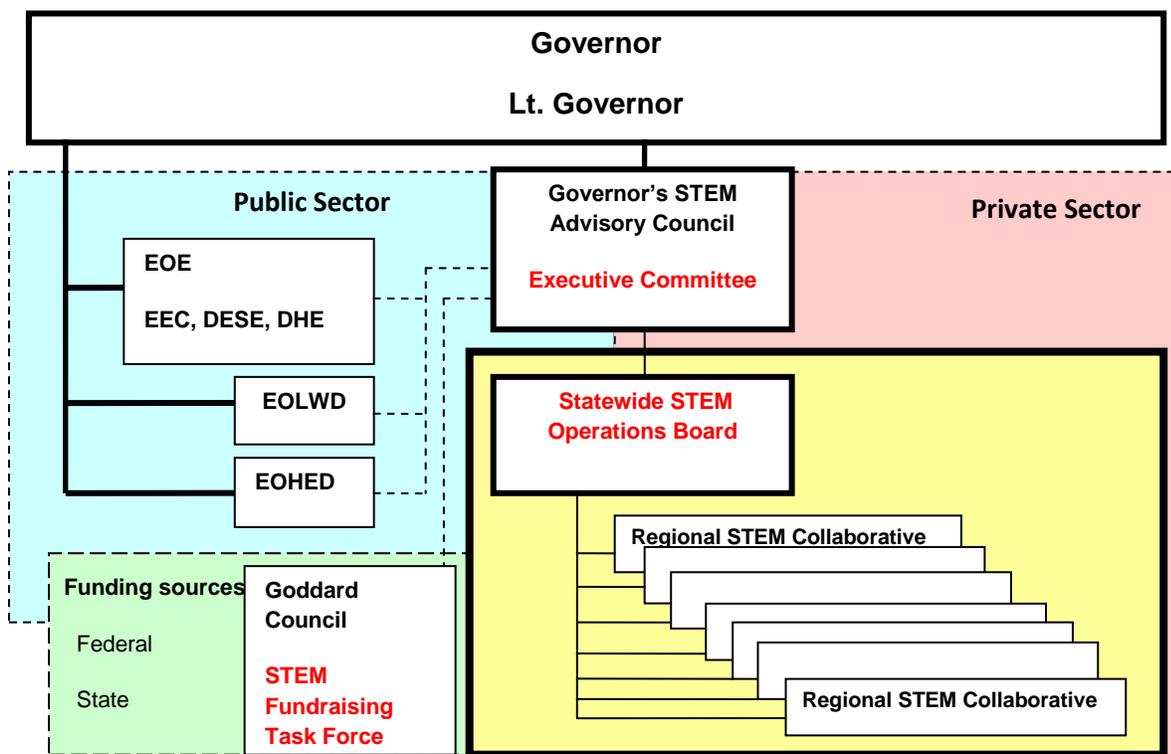


Figure 2

The **Governor's STEM Advisory Council** provides overarching leadership for the development of this plan, and now turns to implementation. As authorized in Governor Deval Patrick's Executive Order #513, an **Executive Committee** of the Council will be formed with voting authority to provide STEM education policy and initiative recommendations. The Secretaries of Education, Labor & Workforce Development and Housing and Economic Development as well as the Commissioners of Early Education, Elementary and Secondary Education and Higher Education are members of the Advisory Council and will work in concert with the Council, along with their respective governing boards to achieve progress toward the aforementioned goals.

A subcommittee of the Governor’s STEM Advisory Council – the **Statewide STEM Operations Board** – will coordinate the review and expansion of “best practice” programs: vetting, funding and evaluating these programs throughout the Regional STEM Collaboratives (formerly known as the Regional STEM Networks). The **Regional STEM Collaboratives**, which are responsible for regional adaptation and implementation of “best practice” programs, and for local program innovations, will now have a central body of representation and participation on the Council – through the Operations Board. This structure will allow the Collaboratives to pursue joint initiatives, share promising practices, and offer programs across multiple regions. This structure is to encourage partnerships and sustained success toward fulfilling the quantitative and qualitative goals. Operators of STEM programs have the ability to choose to partner within the regional system to make shared progress and real impacts in scalable and sustainable ways.

The **Robert H. Goddard Council** will continue to manage the STEM Pipeline Fund as outlined in statute, and will also serve as a fundraising entity to support aspects of this plan. The Goddard Council will seek funding from federal, corporate and foundation sources as part of a newly formed **STEM Fundraising Task Force**.

## ***2. Governance Structure - Roles and Responsibilities***

### **a. The Governor’s STEM Advisory Council:**

- Provides statewide STEM policy direction encompassing the Secretariats of Education, Labor and Workforce Development, and Housing and Economic Development and their respective Commissioners;
- Incorporates input from industry members of the Council to address both workforce pipeline and educational attainment needs;
- Confers with participants and parties from the public and private sector involved with STEM planning and programming;
- Assesses how best to dramatically increase student interest in, and preparation for, careers in STEM;
- Approves establishment criteria and membership for the Statewide STEM Operations Board;
- Approves the five-year STEM Plan, annually updated, that will establish clear goals and objectives for the Commonwealth's STEM efforts over the next five years, including the creation of benchmarks for improvements;
- Provides recommendations regarding a public awareness campaign; helps parents, students, employees and community leaders understand why the STEM disciplines are critical to individual success; and forms subcommittees to focus on particular challenges facing STEM education;
- Investigates and makes funding recommendations to the Governor regarding similar programs throughout the state to eliminate duplication and provide for a coordinated, consolidated statewide network of STEM programs for in-state students;
- Holds an annual public forum to bring together regional STEM Collaboratives and school districts engaged in scale-up efforts.

b. The **Statewide STEM Operations Board:**

- Functions as the operational entity of the Governor’s STEM Advisory Council to provide the regional STEM Collaboratives with a central structure to pursue joint initiatives across all regions;
- Develops a rubric in partnership with state agencies for evaluating potential best practice programs and initiatives;
- Establishes uniformly high performance standards for regional STEM Collaboratives;
- Provides ongoing technical assistance to the regional STEM Collaboratives to insure high performance;
- Screens and recommends evaluators for each best practice program area (Community Engagement; Academic Coherence; Educator Development and STEM Employers and STEM Professionals support);
- Posts a semi-annual report to the Governor’s STEM Advisory Council and the public at-large on [www.mass.gov/governor/stem](http://www.mass.gov/governor/stem) highlighting the progress in achieving the Commonwealth’s STEM goals and the outcomes for each “best practice” program;
- Collaborates with the Executive Office of Education the Department of Elementary and Secondary Education and Department of Higher Education to assure coordination among Regional Readiness Centers, District and School Assistance Centers (DSACs), Institutes of Higher Education and regional STEM Collaboratives.

c. The **Regional STEM Collaboratives:**

- Brings together PreK-16 including vocational and technical schools, early education and care, public and independent higher education colleges and universities, businesses, regional organizations, and community organizations across the spectrum to address the need for systemic change in STEM education;
- Identifies potential best practice programs in each region appropriate to scale up regionally or statewide;
- Submits a detailed plan outlining the role of all state and local partners, and upon approval by the Operations Board, implements the “best practice” program plans in each region;
- Develops new innovative initiatives to meet local needs;
- Secures additional local contributions and funding to expand the number of students, teachers and schools engaged in these expanded programs;
- Provides semi-annual reports to the STEM Operations Board at the Governor’s STEM Council’s annual forum;

d. The **Robert H. Goddard Council:**

- Recommends the awarding of funds held in the STEM Pipeline Trust Fund as administered by DHE and intended to support the scaling of best practice programs.
- Through a designated STEM Fundraising Task Force of the Goddard Council, leads the effort to identify resources from the federal, government, corporations, and foundations (both local and national) to support scaling “best practice” programs and STEM policies;
- Prepares proposals in partnership with state agencies, as well as corporations, seeking funding to support the scaling of best practice programs.

## STEM Education and Workforce Development: Recommendations for Policies, Programs and Initiatives

### Background

In March 2010, the Governor’s STEM Advisory Council convened six broadly representative subcommittees to research key areas of STEM education and recommend education and workforce policies and “best practice” programs to inform *A Foundation for the Future: Massachusetts’ Plan for Excellence in STEM Education (Version 1.0)*. Initial recommendations from the six subcommittees have been categorized to reflect these priority areas included in the Theory-of-Action (Figure 3).



Figure 3

## Shaping the Plan

The work described in the following section of the plan represents the beginning of a critically important statewide conversation to determine the infrastructure, policies and practices that need to be in place to meet the Council's goals for STEM education in the Commonwealth.

Recommendations from the Council's six subcommittees, coupled with additional feedback from the field will help inform the work of the newly developed **STEM Operations Board**. The Council's subcommittee recommendations are organized by the subject areas that match the qualitative goals for transformation. They are:

1. Diverse Students and Future STEM Professionals
2. Community Engagement
3. Academic Coherence
4. Educator Development

Once formally established, this Operations Board will determine a fair and transparent process for vetting the recommendations in these subject areas for policies, programs and initiatives that align with the priority areas outlined in the Theory-of-Action, considering both the quantitative outcome goals and qualitative goals for transformation. The Operations Board will also assess the impact of implementation on various levels of the system – from the state departments to the Regional Collaboratives to individual school districts. Final recommendations for approval and funding will be brought before the Governor's STEM Advisory Committee and voted on by the Executive Committee.

While comprehensive, the recommendations included in the subcommittee section do not represent the totality of proposals and do not limit the development of further recommendations from any source, including the Secretariats and Departments, Regional STEM Collaboratives, and members of the STEM community (industry professionals, educators, etc.).

For further background, detail and the full text of the recommendations submitted by the subcommittees, please refer to the reports which can be accessed online at: [www.mass.gov/governor/stem](http://www.mass.gov/governor/stem).

### ***1. Diverse Students and Future STEM Professionals***

The following recommendations emanate from the belief that encouraging and supporting the engagement of all students and especially underrepresented minorities throughout every aspect of *Massachusetts Plan for Excellence in STEM Education* requires an "all-hands-on-deck" approach.

#### **a. Partnerships**

- Expand upon existing successful partnerships between higher education institutions and industry that promote coordination and collaboration among STEM programs to serve girls and underrepresented minority youth; creating programs whose design is based on evidence of success.
- Engage partners to advocate for public policies and federal resources that support the education and career preparation of students from underrepresented groups.

- Base funding and support on the principle of equity, and make investments to create materials and programs that are multilingual, culturally sensitive and accessible to people with disabilities.

#### **b. Exposure and Awareness**

- Engage employees in the STEM fields to serve as role models and mentors to underrepresented minorities and women.
- Increase outreach and provide culturally relevant materials to guidance counselors, teachers and parents that highlight STEM careers and college majors.

#### **c. After-School Programs and Enrichment**

- Provide high quality after-school and out-of-school time opportunities for girls and minority students with clear program goals, strong leaders, effective managers, skilled and qualified staff, and low adult-to-child ratios, in addition to:
  - **Hands-on learning:** Students learn best through hands-on experiences. This is particularly true with science and technology education, which comes to life when students can conduct their own experiments, do their own programming, and test their own designs.
  - **Working with experts:** In order to inspire students to pursue STEM careers, students must have the opportunity to work directly with experts at the forefront of their fields. By building relationships with real scientists, students are able to envision themselves in STEM careers, and discover the excitement of working in the innovation economy.
  - **Teaching through public displays of learning:** Students learn and retain skills the most powerfully when they have the opportunity to teach what they have learned to others. In addition, presenting their work to an audience inspires students to work hard, and boosts their confidence.
  - **Deeply engaging students and families:** In addition to inspiring students to choose STEM careers, it is also important for parents to learn about the promise of STEM careers so that they can encourage their children to pursue these growing fields.
  - **Ongoing professional development:** Additional development opportunities for after school and out-of-school time staff should be sought after in order to build on capacities to engage students in, and increase their interest in STEM.

#### **d. Mentorship & Role Modeling**

- Support mentorship programs that have a cultural relevancy component and that provide a close working relationship between mentor and student to combat years of negative media depictions of STEM professionals, peer pressure from those that are unable to meet the rigor of STEM educational programs, and proficiency deficits that many students will face even when their interest is high and best intentions are at hand.

- Work towards a design where mentoring and role-modeling is part of a systemic process that is both consistent and long-term thereby creating trust through the building of personal relationships.

## 2. *Community Engagement*

Key to these recommendations is a campaign to build better understanding of the STEM fields by highlighting some of the talented individuals who live in Massachusetts and work in STEM fields. The campaign is designed around a word that is frequently associated with inventions and discoveries in the areas of science, technology, engineering and math and with the people responsible for these remarkable achievements. The word is WOW and the public awareness subcommittee recommends a WOW campaign.

### a. **WOW Campaign**

- Identification and promotion of **12-15 individuals who exemplify the WOW of STEM**. These individuals should be from diverse ethnic backgrounds, diverse regions of the state, and diverse STEM sectors. They should also include both men and women. These STEM professionals are to be interviewed/ videotaped and their pictures and biographies used in a variety of ways to promote awareness of and excitement about STEM.
- **Creation of a WOW YouTube Channel** and student video competition. The Governor/Lt. Governor would be featured in the introductory video. Video interviews of the 12-15 STEM exemplars would also be posted. Students in the target audience – Grades 5-8 - would be challenged to post their own STEM WOW moments or activities (science fairs projects, robotic/Lego league accomplishments, etc.) The videos would be judged and student winners would be highlighted on a periodic basis and given prizes.
- **Implementation of a WOW Campaign**. All content about the 12-15 STEM exemplars would be repurposed for promotional use in both traditional and online media. A Student Advisory Board would be created to work with the Campaign and links would be made to existing campaigns such as the Massachusetts Executive Office of Housing and Economic Development’s “It’s All Here” campaign and NASA’s “Summer of Innovation” camps and activities. Finally, the Subcommittee recommended a sustained effort over the coming years to build on the STEM brand and ensure efforts reach the students of today and the students of tomorrow.

### b. **Engage STEM Employer and Education Professionals**

- Increase relevant internship opportunities for students in an array of STEM fields and encourage greater participation in teacher externship programs.
- Encourage partnerships among industry and institutions of higher education with public schools and afterschool and out of school time community programs to promote STEM careers and STEM majors to all students regardless of background.

### 3. Academic Coherence

To adequately prepare all students, there is a need to implement curricula and instructional practices that develop content knowledge, promote its application in thoughtful ways, enhance the progress of all students in STEM fields, increase students' interest and success in post-secondary study in STEM, and increase the appeal of STEM-related careers.

#### a. Frameworks and Standards:

- In addition to addressing content knowledge, the standards should be studied in collaboration with the National Research Council to improve and promote mathematical and scientific inquiry, engineering design, higher order thinking, and the real-world application of science, technology, engineering and mathematics.
- The STEM Frameworks need to be expansive in their identification of community-based resources that can be of assistance to schools in their pursuit of a high quality STEM experiences for students in and outside of school.

#### b. Curriculum and Instruction:

- The Department of Elementary and Secondary Education (DESE) should identify criteria that help districts map the local curricula to the learning standards.<sup>2</sup> The principles expressed by Grant Wiggins' and Jay McTigue model articulated in *Understanding by Design*" should guide this work. For example, the curricula should:
  - Identify what students will understand, know and be able to do at the conclusion of each unit and lesson (the standards-aligned outcomes/objectives).
  - Identify the performance tasks and other assessments that will be administered to generate evidence of students' understanding/mastery of the outcomes/objectives.
  - Identify the learning experiences, related materials and instruction that will promote students' mastery of the outcomes/objectives.
  - Utilize Bloom's taxonomy to create assessments that incorporate 21<sup>st</sup> century skills to measure higher order thinking.
- The DESE should provide districts with sample scope, sequence and pacing guides to help the districts organize their STEM curricula, and any in-district assessment programs, within and across school years.<sup>3</sup>
- Massachusetts colleges and universities, including schools of engineering, should prepare K-12 technology/engineering teachers to address the needs and circumstances of elementary and secondary schools.

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<sup>2</sup> This aligns with planned activities in Race to the Top.

<sup>3</sup> This aligns with planned activities in Race to the Top.

- Data systems should be developed to track the impacts of PreK-12 STEM education (including After-School and Out-of-School Time) on student engagement, STEM literacy, and interest in STEM fields as a possible career.
- Standards-based, high school Technology/Engineering courses that generate high school credits in science should be considered by the Board of Higher Education as laboratory science courses that can be used to meet state college and university admissions requirements.
- School districts should partner with After-School and Out-of-School Time programs to implement activities that serve as additional tools to complement local schools' STEM efforts and reinforce classroom STEM learning.

**c. Assessment:**

- Consistent with planned activities in the Commonwealth's Race to the Top application, broaden and deepen the Massachusetts Comprehensive
- Assessment System (MCAS) mathematics and science & technology/engineering exams to incorporate discipline-specific practices in addition to content.
- Additionally include one or more performance assessments in the assessment system to provide students opportunities to apply STEM concepts and utilize STEM practices.

#### ***4. Educator Development***

A focus on training, recruitment, and retention are necessary to build and maintain a talented workforce in schools and universities throughout the Commonwealth.

**a. Teacher Training**

- Expand Teacher Residency Programs for Post-baccalaureate Secondary Teacher Preparation in STEM. Support the redesign of secondary teacher preparation programs to align with the national model for Teacher Residency described in the state's Race to the Top application and the US Department of Education (USED) Teacher Quality Partnership Program. This model includes the following features:
  - Post graduate 15 month cohort model resulting in initial MA licensure and masters degree.
  - Practice based residency model built on partnerships with school districts and higher education institutions that places licensure candidates in classrooms full time with high quality mentor teachers and includes authentic performance evaluation.
  - Rigorous coursework that includes emphasis on using data to inform teaching and assessment.
  - One year of post license induction followed by two years of mentoring in partnership with districts and higher education. Online-content specific mentoring is a feature of this phase.
  - Support for candidates through private and public funds such as Noyce Scholarships and USED Teacher Quality Partnership grants, Math for America and the Woodrow Wilson Teaching Fellowship.

- Develop UTeach type programs as an incentive for undergraduate STEM majors to complete teacher licensure programs. UTeach includes the following features:
  - Early credit based mini-courses/internships to explore the teaching profession.
  - Flexible efficient licensure requirements to enable students to earn a teaching license in STEM undergraduate program.
  - Scholarship support for those who teach for at least two years.
  - UTeach expansion was funded in the Race to the Top award.
  
- Strengthen STEM requirements for elementary teacher preparation programs
  - Support the Department of Elementary and Secondary Education recommendation for at least 3 courses (nine credits) of rigorous math for the teacher license at the elementary level (Elementary and SPED).
  - Support the Department of Higher Education recommendation for math diagnostic assessment tests for post baccalaureate elementary license programs.
  
- Begin alignment of Teacher Preparation program curriculum with the national Common Core Standards in STEM (mathematics to be completed by the Department of Elementary and Secondary Education in fall, 2010; science and technology/engineering in progress as of fall, 2010). Strengthen the STEM background of EEC teachers and care providers.
  - Support the Foundation for the Future (Wheelock College) recommendation for two math, two science and two STEM pedagogy courses for all Early Education and Care teacher preparation programs.
  - Recommend that EEC set MassCore as the minimum preparation for child care teachers/providers that do not have postsecondary degrees.
  - Consider providing the equivalent of MassCore preparation for currently employed child care providers through professional development.
  - Consider professional development partnerships between After-School and Out-of-School Time programs and public schools that include mentoring, coaching, and modeling for cross-alignment, complementary learning and transition support.

**b. Teacher Recruiting:**

- Develop and implement a Marketing Campaign to recruit STEM Teachers. Such a campaign must be linked to easily accessible information, efficient licensure pathways, for potential STEM teachers
  - Target undergraduate and graduate students and professionals in STEM fields.
  - Conduct an extensive campaign to raise awareness and attract potential STEM teachers using comprehensive media and social network outlets.
  - Link to the Federal Government's newly developed teacher recruitment campaign and other national campaigns, including: Tapping America's Potential, the INDIA/AIA Initiative, Business and Industry STEM Coalition, Change the Equation.

- Building on the existing database systems, GEM and the Massachusetts Education Career Center (MECC), maintained by the Department of Elementary and Secondary Education, create a one-stop clearinghouse for potential and current STEM teachers. Race to the Top includes recommendations on revamping and revising the current system.
  - Widely advertise database.
  - Develop interactive capacity for potential STEM teachers and school systems to be linked directly.
  - Include relevant information about STEM job openings, communities, salary, licensure pathways. Encourage potential teachers to submit resumes and accompanying materials.

### **c. Teacher Retention**

- Create and provide support for teacher mentoring programs within school districts.
  - Develop mentorship programs for new and novice teachers (0-3 years experience teaching) in school districts across the Commonwealth. This type of program would pair more experienced teachers (with 5 years or more experience) as mentors who can identify and connect with newer teachers. Mentoring programs would provide support for 0-3 year teachers in a non-evaluative way, focusing on assisting new teachers with developing techniques for managing classrooms and becoming grounded in STEM curricula.
- Create a structure that recognizes teachers as professionals in their field and provides opportunities for networking among schools, school systems, novice, experienced and veteran teachers.
  - Designate exemplary teachers as model teachers, showcasing their classrooms for other teachers, community members and representatives from other districts to visit.
  - Develop mechanisms for recognizing teachers as important professionals within the community. For example, create Professional Affinity Groups that pair teachers with support groups in their community that can provide resources to build local community relationships.
  - For all teachers provide either district sponsored or DESE sponsored regional discussion groups that model and share best practices being used on the local, regional, state and national levels and opportunities to keep up with new technology and content
  - Use veteran teachers as resources for teaching professional development seminars for other teachers. This could include creating a teacher recognition program and have regional awards with the benefit being able to have a year sabbatical to travel around the district or state as mentor/Professional Development provider.
- Develop a state-wide system of recognition through a career ladder for STEM teachers.

- Provide highly effective veteran teachers with opportunities to assume instructional leadership positions.
- Provide quality professional development programs and opportunities for teachers.
  - Support opportunities for professional development on using new technology, content information, cutting edge best practices and web sites.
  - Provide professional development courses and programs that are designated as best practices. These Professional Development programs need to be appropriate for the level of a teacher's certification, being heavier on STEM content for middle and high school teachers and a combination of methodology and content for elementary teachers. There should be guidelines for what constitutes quality STEM Professional Development programs. These programs may be offered through different venues including institutes of higher education, educational collaboratives, informal education institutions such as museums and technology centers or partnerships between businesses, non-profits and institutes of higher education.
  - Increase relevant internship opportunities for students in an array of STEM fields and encourage greater participation in teacher externship programs.

# Action Timeline and Implementation Plans for Existing Appropriations

## PHASE I - IMPLEMENTATION

### **1. Initial Governance Policy Recommendations:**

- a. Form the Executive Committee of the Governor’s STEM Council.
- b. Form the Statewide STEM Operations Board.
- c. Form the STEM Fundraising Task Force

### **2. Allocation of Race to the Top Funding:**

Massachusetts will receive \$250 million to implement the RTTT plan: 50% will be utilized by the state to support the implementation of systemic initiatives and district activities; and 50% will be allocated to 276 participating districts, those that are committed to implementing RTTT strategies, in proportion to their Title I allocations (these districts include 1,375 schools, serve 74% of K-12 students, and also serve 88% of students living in poverty). The state funding will be allocated as follows:

|  |                |
|--|----------------|
| ▪ Standards and Assessments (including college and career readiness) | \$14.2 million |
| ▪ Building an Exceptional Educator Workforce                         | \$46.7 million |
| ▪ Turning Around Lowest-Performing Schools                           | \$18.1 million |
| ▪ Robust Data Systems  | \$28.1 million |
| ▪ Program Management and Evaluation                                  | \$16.6 million |

This funding will strengthen Curricula, Standards, and Assessments, Prepare Students for Career and College Readiness, and Increase the Number of Effective Educators:

- a. Curricula, Standards, and Assessments
  - i. Enable more students to meet high standards by creating an aligned, standards-based teaching and learning system.
  - ii. Design a plan to align state standards with the Common Core Standards that Massachusetts helped to develop and review to ensure rigor and high expectations
  - iii. Develop curriculum maps and units that include curriculum-embedded performance tasks and aligned interim assessments.
  - iv. Create a Digital library that includes engaging, high quality, and relevant resources coded to standards and curriculum maps.
  - v. Develop and implement rigorous interim and formative assessments so that educators can better monitor student progress.

- vi. Create extended performance tasks in multiple curricular areas including mathematics, science, and technology/engineering to build complex skills and elicit demonstrations of knowledge and skill development.
- b. College and Career Readiness
- i. Prepare more students for success after high school through exposure to rigorous curricula and college-level work, particularly in STEM fields.
  - ii. Strengthen the state’s Advanced Placement pipeline by offering pre-AP teacher training in math and science to middle and high schools with a high percentage of first generation, low-income and minority students.
  - iii. Establish STEM-focused Early College High Schools that will each serve approximately 400 students.
  - iv. Adopt MassCore as the default curriculum for all high school students in the Commonwealth and align public 4-year college entrance requirements with MassCore – which will mean that 85% of all students will be required to take at least 4 years of mathematics and 3 years of lab sciences by 2014, and all students will be required to meet these requirements by 2016.
- c. Effective Educators
- i. Increase the number of effective educators in hard-to-staff subjects and specialty areas, specifically STEM fields.
  - ii. Strengthen and expand effective educator preparation programs and improve or close ineffective ones by strengthening approval and accountability processes and providing competitive grants to expand successful programs.
  - iii. Provide high quality, targeted, and differentiated professional development and instructional services to educators using an aligned and coherent system that includes services provided through the Department of Elementary and Secondary Education and their District and School Assistance Centers, the six Readiness Centers, the Regional STEM Collaboratives, and professional learning communities.

In addition to allocating the above funding to support the enhancement of STEM curricula and aligned assessments, and also the development of additional instructional tools, approximately \$6 million will be allocated to support several activities directly in STEM fields such as:

a. **\$1.3 million to establish six STEM-focused Early College High Schools**

- Data from Jobs for the Future, a Boston-based organization focused on workforce development and education reform, indicate that these institutions are effective in preparing lower-income students and also students of color for postsecondary success. Each school will serve approximately 400 students, and three will model a successful institution, the Metro Early College High School, in Columbus, OH (these schools will also be located at public four-year colleges or universities). The other three schools will be located at community colleges or existing high school campuses.

- b. **\$1.1 million to better prepare students for success in STEM-related Advanced Placement courses**
- Massachusetts has one of the highest Advanced Placement enrollment rates in the nation, but there are significant participation and performance gaps for lower-income students and students of color. In order to better prepare students to enroll in these courses and strengthen the pipeline, the state will provide pre-Advanced Placement training to middle and high school teachers in mathematics, science, and English Language Arts. Training will be provided for teachers in schools with higher percentages of students of color and also first-generation and lower-income students (approximately 1,000 teachers in 65 schools will receive this training over the next four years).
- c. **\$2 million to establish a UTeach program site in Massachusetts to prepare 250 new STEM teachers**
- The UTeach model was developed at the University of Texas at Austin in 1997, and was designed to provide an innovative and systemic approach to preparing secondary science, mathematics, and computer science teachers. The model includes both content-rich learning opportunities and practical experience, and provides different types of students with flexible options for pursuing teacher certification or advanced degrees. In addition, the model is focused on building sustainability over time, so the Massachusetts site will prepare STEM educators beyond the grant period.
- d. **\$1.5 million for mathematics targeted assistance in regional District and School Assistance Centers**
- The District and School Assistance Centers are located at the six Readiness Centers, and they provide foundational professional development opportunities and targeted assistance to K-12 educators. Support and resources will include using curricular and assessment tools as well as using student data to improve the quality of instruction.

*Upon final approval of the RTTT budget, the U.S. Department of Education will allocate the state portion of funding to Massachusetts during the fall of 2010. Upon final approval of districts' implementation plans (which will be submitted to the U.S. Department of Education in late November 2010 per federal requirements), Massachusetts will receive the district portion of the RTTT award.*

### **3. STEM Pipeline Fund Planned Initiatives**

The Massachusetts state legislature established the Massachusetts Mathematics, Science, Technology and Engineering Grant Fund (known as the STEM Pipeline Fund) in 2003 under Economic Stimulus legislation and appointed the Department of Higher Education (DHE) as the administrator. The broad purpose of the STEM Pipeline Fund legislation (Section 30 of the Economic Stimulus Act) is to “increase the number of students who participate in programs that

support careers related to science, technology, engineering and mathematics.” This broad purpose has been translated into the following goals of the STEM Pipeline Fund:

- Increase the number of Massachusetts students who prepare for and enter STEM careers;
- Increase the number of qualified STEM teachers in the Commonwealth; and
- Improve the STEM educational offerings.

The STEM Pipeline Fund received an allocation of \$500,000 for fiscal year 2011. During the remainder of the fiscal year the Department of Higher Education, the fund administrator, plans to disburse the funds on these initiatives:

- Support PreK – 16 Regional STEM Networks:** \$40,000 was distributed to each of the six Regional STEM Collaboratives in 2010, with a potential disbursement of additional funding to support broad reach, low cost programming and afterschool learning.
- Develop a Boston PreK-16 Regional STEM Collaborative:** Boston is the only region without a state funded STEM collaborative. The DHE will provide seed money for the establishment of a network.
- Partner with UMass Donahue Institute:** The UMass Donahue Institute has been the statewide evaluator for STEM Pipeline Funded projects since the Fund began its work. The work of the Donahue Institute will be used by the STEM Governance System during the implementation stages outlined in this plan.

In FY 2011, the Fund relies on the Donahue Institute for the following services:

- To research and write a “Best Practices” report on the development, organization, and activities of Regional PreK-16 Networks. The report will be an in-depth, qualitative analysis of best practices in three regional networks (Berkshire, Central and MetroWest) with different pathways to success. The report will include individual interviews with project managers and other key people, a background review of information collected through mid-year and year-end reports, and a review of information captured in the annual online survey of network members.
- To research and write a “promising practices among projects” report focused on increasing student interest in STEM. The report will be an in-depth, descriptive analysis of projects that show promise for increasing student interest in STEM areas (from among both Student Interest grantees and Regional Network grantees). This report will also include a background review of information collected through mid-year and year-end reports as well as information gathered through a targeted questionnaire to project managers.
- To complete the Massachusetts Statewide STEM Indicators Project Report using 2009 data.
- To complete SAT template reports, and to complete academic research and report writing. The Institute will annually assess patterns of interest in STEM majors among Massachusetts public school students who take the SAT (between 45,000 and 50,000 students each year). Data will be analyzed not just at a statewide level, but also regionally (based on the geographic areas served by the Pipeline’s

Regional PreK-16 Networks) as well as locally. This project aims to assist policy-makers and education personnel at the state, regional, and school levels in making programming and other decisions that can increase the number of actual “STEM students.”

- To develop new measures of evaluation.
- d. **Seek Strategic Interventions with Minimal Funding:** Use remaining Pipeline funds to support important and visible STEM issues (math elementary teacher preparation) and pursue most cost-effective collaborations (DHE/EEC/WGBH).
- e. **Pursue Public and Private Grants:** A DHE grant writer will identify collaborative network funding opportunities.

#### ***4. Partnership Initiatives:***

The National Governors Association Center for Best Practices (NGA Center) and Innovate+Educate have committed to support Massachusetts to advance the important work of improving STEM education. Through the creation of a formal partnership, Innovate+Educate allocated \$50,000 in planning grant dollars to support the implementation of the STEM Council’s recommendations.

Over the next year, the NGA Center and Innovate+Educate will work closely with the Governor’s STEM Advisory Council and state agency staff to strengthen STEM education through the sharing of best practices and through leveraging industry investments.

The goals of this partnership are to highlight Massachusetts as a leader in strengthening STEM education; convene key state and business stakeholders to strategically align national and state level industry support to Massachusetts’ STEM plan; and disseminate best practices and lessons learned throughout Massachusetts’ implementation process across a wider range of states.

The National Governors Association Center for Best Practices (NGA Center) supports governors and their staff to strengthen STEM education with the end result of increased workforce and innovation capacity that translates into economic growth. Business and industry are dependent on a qualified workforce and have the intellectual resources needed to inform efforts to strengthen STEM education.

Innovate+Educate is a pre-competitive collaborative of business and industry partners dedicated to strengthening STEM education at the state level. The NGA Center and Innovate+Educate partner to provide a range of resources to comprehensively improve STEM education at the state level.

## ***5. MA Life Science Center Equipment and Supplies Program:***

On September 24, 2010 the Board of Directors of the Massachusetts Life Sciences Center (MLSC) approved the launch of the 2010 Equipment and Supplies Program for Skills Training and Education. Consistent with its commitment to the life sciences industry, the MLSC, through this solicitation, seeks to further the development and institution of life sciences training and education programs at vocational/technical high schools, community colleges, 2-year degree and certificate programs affiliated with 4-year private and public institutions of higher education, regional employment boards, community-based nonprofit organizations, and labor organizations. Members of the Regional STEM Collaboratives will be key organizations within each region to identify needs and work with their members to apply for grants.

By working with these Massachusetts entities and by providing funding up to \$250,000 per institution, with a total of \$2.5 million available for the purpose of purchasing life sciences demonstration and training equipment and supplies for practical laboratory and/or training space, the MLSC will support these institutions and further educate students, clients and trainees in real-world scenarios that will prepare them for opportunities in the life sciences sector. To be eligible for an award, applicants will be required to secure matching funds, in cash or as a donation, from an industry partner that supports the training program for which the equipment and supplies are needed.

Priority will be granted to proposals with an industry partner engaged in the development and implementation of training; regional collaborations between institutions in geographic proximity willing to share expensive equipment; and training programs with demonstrated success in placing students in skilled employment related to the curriculum and training.

## ***6. Federal and state STEM-focused funding***

There are additional federal and state funding programs for STEM. An initial listing includes:

- NCLB Title IIA and IIB: Supporting PreK-12 STEM teacher development (particularly content courses).
- MA Teacher Content Training Line Item (7061-9804): Supporting primarily elementary mathematics teacher training.

## **PHASE II - IMPLEMENTATION**

### ***1. Funding Strategies***

- a. Robert H. Goddard Council will oversee:
  - i. Development of federal funding strategies
  - ii. Development of corporate funding strategies
  - iii. Development of foundation funding strategies

### ***2. System to elevate Best Practices***

- a. Develop rubric for assessing policy/program recommendations
- b. Propose policy and best practice program recommendations for implementation approval
- c. Develop rubric to certify Regional STEM Collaboratives
- d. Certify Regional STEM Collaboratives

## Rollout Schedule

|   | FY 11 |    |    | FY 12 |    |    |    |
|---|-------|----|----|-------|----|----|----|
|   | Q2    | Q3 | Q4 | Q1    | Q2 | Q3 | Q4 |
| <b>STEM Summit</b>  |       |    |    |       |    |    |    |
| Announce/Release Statewide STEM Plan                                    |       |    |    |       |    |    |    |
| STEM Summit 2011  |       |    |    |       |    |    |    |
| <b>Governors STEM Advisory Council</b>                                  |       |    |    |       |    |    |    |
| Approve V1.0 of STEM Plan   |       |    |    |       |    |    |    |
| Form Executive Committee  |       |    |    |       |    |    |    |
| Form STEM Operations Board  |       |    |    |       |    |    |    |
| Form Fundraising Task Force   |       |    |    |       |    |    |    |
| Review/approve Policy Recommendations                                   |       |    |    |       |    |    |    |
| Approve V2.0 of STEM plan   |       |    |    |       |    |    |    |
| <b>Statewide STEM Operations Board</b>                                  |       |    |    |       |    |    |    |
| Develop rubric for assessing policy/program recommendations             |       |    |    |       |    |    |    |
| Propose policy and "best practice" program recommendations for approval |       |    |    |       |    |    |    |
| Develop rubric to certify Regional STEM Collaboratives                  |       |    |    |       |    |    |    |
| Certify Regional STEM Collaboratives                                    |       |    |    |       |    |    |    |
| <b>Funding Task Force</b>   |       |    |    |       |    |    |    |
| Develop Federal Funding Strategy  |       |    |    |       |    |    |    |
| Develop Corporate Funding Strategy                                      |       |    |    |       |    |    |    |
| Develop Foundation Funding Strategy                                     |       |    |    |       |    |    |    |

## Appendix

- 1. List of All STEM Council Members, Subcommittee Members, and Support Staff.**
- 2. Executive Order #513 Establishing the Governor's Science, Technology, Engineering, and Math Advisory Council.**

## Appendix 1: Governor's STEM Advisory Council Subcommittees

\* Indicates Full Council Member

### **Public Awareness Subcommittee: Creating and Maintaining Student Interest**

#### **Co- Chairs:**

- *Joyce Plotkin, Chair, The DIGITS Project; President Emerita, Massachusetts Technology Leadership Council\**
- *Barnas Monteith, Chair, MA State Science and Engineering Fair; Managing Partner and Co-Founder, Advanced Diamond Solutions, Inc.\**

#### **Members:**

- Christyanna Egun, Director of Boston Partnerships, Massachusetts General Hospital
- Dave Matheson, Massachusetts Technology Leadership Council, Robotics Cluster STEM Education Committee; Managing Partner, Split Rock Partners, Inc.
- Jane Burke, Founder and Executive Director, Flying Cloud Institute
- Joe Dorant, President, Massachusetts Organization of State Engineers and Scientists
- Jon Abbot, President and CEO, WGBH
- Larry Maier, President, Peerless Precision\*
- Marcy Reed, Senior Vice President, National Grid\*
- Mark DiNapoli, President and General Manager, Suffolk Construction\*
- Mary McLaughlin, Senior Vice President, Comcast Cable\*
- Michael Tamasi, Principal, Boston Centerless/AccuRounds\*
- Michael E. Pelletier, Northeast STEM Pipeline Network; Professor Emeritus of Computer Technology & Engineering, Northern Essex Community College
- Sandra Mayrand, Central MA STEM Pipeline Network; Director, Regional Science Resource Center, UMass-Medical School
- Steve Vinter, Engineering and Site Director, Google Inc.\*
- Ted Acworth, Founder and CEO, Artaic Innovative Mosaic\*

### **Teacher Development Subcommittee: Training, Recruitment, and Retention**

#### **Co- Chairs:**

- *Yvonne Spicer, Vice President for Advocacy & Educational Partnerships, Museum of Science\**
- *Lance Hartford, Executive Director, Massachusetts Biotechnology Education Foundation*
- *Janet Slovin, Former Member, Board of Higher Education and City of Worcester School Committee; Economic Development and Education Specialist*

#### **Members:**

- Bruce Johnson, Director, Technology and Innovation, MITRE\*
- Caroline Goode, MA Coordinator, NSTA Science Matters; Christa Corrigan McAuliffe Center for Education and Teaching Excellence, Framingham State College
- Dennis Berkey, President, WPI\*; and Designee: Martha Cyr, Director of K-12 Outreach, WPI
- Daniel Bosley, Massachusetts State Representative, First Berkshire District\*
- Larry Weathers, K-12 Director of Science, Health, and Technology Education, Belmont Public Schools

- Jack Wilson, President, University of Massachusetts\*; and Designee: Pat Plummer, Senior Advisor, University of Massachusetts President's Office
- J.D. Chesloff, Deputy Director, Massachusetts Business Roundtable\*
- Gary DiCamillo, Chairman, Massachusetts Business Roundtable's Education and Workforce Development Task Force; Partner, Eaglepoint Advisors, LLC\*
- Mary Ellen Rancourt, Northeast STEM Pipeline Network; Director of Curriculum, North Shore Technical Regional School District
- Mary Jo Carabatsos, Northeast STEM Pipeline Network; Science Program Advisor, Andover High School
- Sandra Ryack-Bell, Executive Director, Museum Institute for Teaching Science
- Sherri Killins, Commissioner, Massachusetts Department of Early Education and Care
- Richard Bisk, Chair and Professor of Mathematics, Worcester State College
- Rona Kiley, Boston Teacher Residency

### **Infrastructure Subcommittee: Grants, Strategic Partnerships, and Sustainability**

#### **Co- Chairs:**

- *Jim Stanton, Director, Technology Initiative, Metro South/West Regional Employment Board\**
- *Patrick Larkin, Director, John Adams Innovation Institute, Massachusetts Technology Collaborative*

#### **Members:**

- Deborah Andrews, Northeast STEM Pipeline Network; Youth Workforce Program Manager, Merrimack Valley Workforce Investment Board
- Elaine L. Webb, Advocacy Liaison, Reading School Committee
- Gary Kaplan, Executive Director, JFY NetWorks
- Isa Zimmerman, IKZ Advisors, STEM Education and Leadership\*
- James Brosnan, Superintendent, Northern Berkshire Vocational Regional School District\*
- John Werner, Managing Director & Chief Mobilizing Office, Citizen Schools
- Judith Boccia, Northeast STEM Pipeline Network; Assistant Professor and Director, Office of School Partnerships, UMass-Lowell
- Karen Spilka, Massachusetts State Senator, Second Middlesex and Norfolk District\*
- Kevin O'Sullivan, President and CEO, Massachusetts Biomedical Initiatives\*
- Laura Dauphinais, Director, Systems Engineering, Raytheon Company, Integrated Defense Systems
- Mike Looney, Teacher, Technology and Engineering Education, Mashpee Public Schools
- M.S. Vijay Kumar, Senior Associate Dean and Director, Office of Educational Innovation and Technology, MIT
- Sam Figler, Newton Schools Education Foundation
- Susan Gately, Executive Director, Blackstone Valley Chamber of Commerce Education Foundation
- Thomas Conroy, State Representative, Thirteenth Middlesex District\*

## **Data Collection Subcommittee: STEM Metrics, Indicators and Evaluation**

### **Co- Chairs:**

- *John Hodgman, Lecturer, Entrepreneurial Leadership Studies, Tufts Gordon Institute\**
- *Lynn Griesemer, Associate Vice President for Economic Development and Executive Director, UMass-Donahue Institute*

### **Members:**

- Alex Sanchez, Senior Manager, Global Supply Base Optimization, Raytheon Company\*
- Jean Supel, Research Manager, UMass-Donahue Institute
- Laura O'Dwyer, Northeast STEM Pipeline Network; Assistant Professor, Department of Educational Research, Measurement and Evaluation, Boston College
- MacCalvin Romain, Boston College Student, Information Systems & Communications
- Mary Grant, President, MCLA\*; and Designee: Monica Joslin, Dean of Academic Affairs, MCLA; Berkshire STEM Network
- Mary Kate Toomey, Civil Engineer, Jacobs Engineering
- Ronit Carter, Founder and President, The Promise of Excellence

## **Curriculum Framework and Standards Subcommittee: Alignment and Upgrades**

### **Co- Chairs:**

- *Christos Zahopoulos, Executive Director, Northeastern University Center for STEM Education\**
- *Sidney Smith, Superintendent, Malden Public Schools*

### **Members:**

- Charlie Corley, Retired Department Leader, Teacher, and Curriculum Developer, Winchester Public Schools
- Ioannis Miaoulis, President and Director, Museum of Science\*
- Larry Maier, President, Peerless Precision\*
- Marty Schecter, President, Retirees School Volunteer Organization
- Melinda Boone, Superintendent, Worcester Public Schools\*
- Ronit Carter, Founder and President, The Promise of Excellence
- Tracy Callanan, Community Lab Director, Biogen Idec

## **Diversity Subcommittee: Reducing the Achievement Gap and Pursuing Additional STEM Opportunities for Women and Minorities**

### **Co- Chairs:**

- *Zorica Pantić, President, Wentworth Institute of Technology\**
- *Ruth N. Bramson, CEO, Girl Scouts of Eastern Massachusetts*

## **Members:**

- Brenda L. Berube, Associate Professor of Science and Science Education & Interim Chair, Department of Science, Technology, Engineering and Mathematics, University of Massachusetts Dartmouth
- Claudia Alfaro, Chief Civic Engagement Officer, Citizen Schools
- Connie Chow, Executive Director, Science Club for Girls
- DiOnetta Jones, Associate Dean for Undergraduate Education and Director of the Office of Minority Education, MIT
- Edgar R. Cintron, Co-Founder, ENABLE Service Group; Former Region V Chairman, Regional United States Hispanic Chamber of Commerce
- Erika Ebbel, Founder and CEO, Science from Scientists (Formerly WhizKids)
- Julie Joyal Mowschenson, Director, Harvard Medical School Bioscience Program for High School Students
- Larisa Schelkin, CEO, President and Co-Founding Director, Diversity & Outreach in Math and Engineering
- Lisa Derby Oden, Project Director, STEM Career Pathways, Central Massachusetts Regional Employment Board
- Marc Abelard, Director of Partnerships and External Affairs, The Engineering School
- Ray McCarthy, President, MassTEC; Technology Education Teacher
- Rebecca Cusick, 4<sup>th</sup> Grade Teacher, Fall River Public Schools\*
- Reinier Moquete, Founder and President, Latino STEM Alliance
- Shantal Richards, Student, Tufts University
- Stephanie Lee, Regional Director of Public Affairs, Verizon
- Susan Windham-Bannister, President and CEO, Massachusetts Life Sciences Center\*
- Victoria Grisanti, Senior Manager, Community Involvement, EMC\*

## **Staff Support to Subcommittee Members**

- Benjamin Brier, Staff Manager, Massachusetts Technology Collaborative' Innovation Institute
- Carlos Martínez-Vela, Director of Innovation Policy, Massachusetts Technology Collaborative's Innovation Institute
- Claire Duggan, Center for STEM Education at Northeastern University
- Don Landing, MITRE
- Douglas McNally, Frosthollow Associates Educational Consultants
- Erin Bradley, Chief of Staff, Girl Scouts of Eastern Massachusetts
- Feby Kiragu, Center for STEM Education at Northeastern University
- Joyce Malyn-Smith, Director Strategic Initiatives Workforce & Human Development, Pathways to College and Careers, Education Development Center
- Kellyse Hood, Center for STEM Education at Northeastern University
- Rachel Grygorcewicz, Administrative Assistant, National Center for Technological Literacy
- Robert Kispert, Director of Cluster Development, Massachusetts Technology Collaborative's Innovation Institute
- Stephanie Crisp, Center for STEM Education at Northeastern University
- Stephen Herskovitz, President, Hammond Hill LLC

## **Executive Branch and Interagency Administration Staff**

- Adam Freudberg, Director of Operations and Assistant Director of Policy, Office of Lieutenant Governor Timothy P. Murray

- Barbara Libby, STEM Director, Office for Mathematics, Science, and Technology/Engineering, Massachusetts Department of Elementary and Secondary Education
- David Cedrone, Executive Director, Governor’s STEM Advisory Council; Associate Commissioner for Economic and Workforce Development, Massachusetts Department of Higher Education
- David McCauley, Former Deputy Chancellor for Workforce Development, Massachusetts Department of Higher Education
- Maxeme Tuchman, Harvard Fellow, Office of Lieutenant Governor Timothy P. Murray
- Eileen Lee, Director of Educator Policy, Massachusetts Department of Higher Education
- Elizabeth Losee, Massachusetts Department of Elementary and Secondary Education
- Eric Nakajima, Senior Innovation Advisor, Massachusetts Executive Office of Housing and Economic Development
- Jacob Foster, Ph.D., Director, Science & Technology/Engineering, Massachusetts Department of Elementary and Secondary Education
- Jonathan Palumbo, Communications Director, Massachusetts Executive Office of Education
- Keith Connors, STEM Pipeline Fund Program Manager, Massachusetts Department of Higher Education
- Maureen Lally, Massachusetts Department of Elementary and Secondary Education
- Marissa Goldberg Cole, Deputy Chief of Staff, Massachusetts Executive Office of Education
- Saeyun Lee, Ph.D., Policy Director, Massachusetts Executive Office of Education

**By His Excellency**

**DEVAL L. PATRICK**

**GOVERNOR**

**EXECUTIVE ORDER NO. 513**

**ESTABLISHING THE GOVERNOR'S SCIENCE, TECHNOLOGY,  
ENGINEERING AND MATH ADVISORY COUNCIL**

WHEREAS, the Commonwealth of Massachusetts is a worldwide leader in innovation;

WHEREAS, to compete in the global economy and with other states, Massachusetts needs to leverage more effectively its resources in the areas of science, technology, engineering and math ("STEM"); enhance the state's STEM workforce; increase the number of high-skills STEM jobs; and keep high school and college graduates living in the Commonwealth;

WHEREAS, additional coordination at the Executive level will help position Massachusetts for growth in the STEM fields and advocate for and foster increased investment in STEM education;

WHEREAS, it is important for the state to partner with the private sector to promote STEM education and careers; and voluntary cooperation among state agencies, elementary and postsecondary education systems and business and community members will contribute to the success of these efforts;

WHEREAS, the establishment of a STEM Council in the Commonwealth is an important step in creating the alignment that is essential to deliver the high quality education and workforce training needed to prepare each resident for life and work; and

WHEREAS, establishing a statewide STEM Council will increase coordination and efficiency, and enable the state to address more effectively the critical shortage of college graduates choosing a STEM field for their major and/or their profession;

NOW, THEREFORE, I, Deval L. Patrick, Governor of the Commonwealth of Massachusetts, by virtue of the authority vested in me by the Constitution, Part 2, c. 2, § 1, Art. I, hereby order as follows:

Section 1. There is hereby established the Governor's Science, Technology, Engineering, and Math (STEM) Advisory Council. The Council shall advise the Governor and assist in informing the work of the Secretaries of Education, Labor and Workforce Development, and Housing and Economic Development on issues relating to STEM education and STEM careers in the Commonwealth.

Section 2. The Council shall:

(a) Confer with participants and parties from the public and private sector involved with STEM planning and programming;

(b) Assess how best to dramatically increase student interest in, and preparation for, careers in STEM;

(c) Advise concerning the creation and implementation of a statewide STEM Plan that will establish clear goals and objectives for the Commonwealth's STEM efforts over the next five years, including the creation of benchmarks for improvements; and

(d) Provide recommendations regarding a campaign to build public support and help parents, students, employees and community leaders understand why the STEM disciplines are critical to individual success.

Section 3. The Council shall be chaired by the Lieutenant Governor of the Commonwealth or his designee (the "Chair") and shall consist of not more than 40 members, including the chair and ex officio members. Each member, other than the Chair, shall be appointed by the Governor and shall serve at the Governor's pleasure, without compensation, solely in an advisory capacity.

Section 4. Council members shall be persons with demonstrated interest, experience and expertise in STEM education and shall be selected by the Governor from the following groups:

The Massachusetts State Senate Co-Chair from the Robert H. Goddard Council on Science, Technology, Engineering and Mathematics Education (the "Robert H. Goddard Council");

The Massachusetts House of Representatives Co-Chair from the Robert H. Goddard Council;

One (1) member from the Massachusetts State Senate, recommended by the Senate President;

One (1) member from the Massachusetts House of Representatives, recommended by the Speaker of the House;

The following seven (7) state officials, or their designees, as ex officio members: Secretary of Education, Secretary of Labor and Workforce Development, Secretary of Housing and Economic Development, Commissioner of Elementary and Secondary Education, Commissioner of Higher Education, Commissioner of Early Education and Care, and President of the University of Massachusetts;

One (1) member from each of the following nine (9) fields: Biotechnology, Clean Energy, Engineering, Healthcare, Information Technology, Manufacturing, Elementary and Secondary Education, Higher Education, and Vocational Technical Education.

Up to nineteen (19) additional qualifying members as the Governor deems appropriate from the foregoing fields or from other STEM sectors, at least one of whom shall be an educator.

Section 5. The Council shall establish an Executive Committee comprised of up to seven (7) members who shall provide guidance on the recommendations of the Council and plan future meetings and initiatives.

The Chair shall determine the membership of the Executive Committee. Section 6. The administrative operations of the Council shall vest with an Executive Director, who shall be appointed by, and serve at the pleasure of, the Lieutenant Governor. The Executive Director shall be housed within the Executive Office of Education.

Section 7. The Council and its Executive Committee shall meet at such times and places as determined by the Chair.

Section 8. The Chair, or the Executive Director with the Chair's approval, may direct the Council to form subcommittees to focus on particular challenges facing STEM education and the STEM fields in the Commonwealth. The composition and nature of each committee shall be determined by the Chair.

Section 9. All agencies, departments and boards of the Commonwealth shall fully cooperate with the Council. The Council may call and rely upon the expertise and services of individuals and entities outside of its membership for research, advice, support or other functions necessary and appropriate to accomplish its mission.

Section 10. The Council shall report any findings or recommendations, including any recommendations for legislation or regulation(s), to the Governor at such periods as determined by the Chair.

Section 11. This Executive Order shall continue in effect until amended, superseded or revoked by subsequent Executive Order.

Given at the Executive Chamber in  
Boston this 14th day of October in the  
year two thousand and nine and of the  
Independence Of the United States, two  
hundred and thirty-four.

DEVAL L. PATRICK  
GOVERNOR

WILLIAM FRANCIS GALVIN  
Secretary of the Commonwealth

Commonwealth of Massachusetts

GOD SAVE THE COMMONWEALTH OF MASSACHUSETTS