A STEM Plan for Massachusetts
(Science, Technology, Engineering, Mathematics)

A Call to Action

Urgent and focused effort to strengthen and nurture Massachusetts' STEM talent is the only way the Commonwealth will remain a vibrant competitor in the global economy. In 2003, public and private sector leaders began to focus on this issue and in 2004, the STEM Pipeline Fund was created as the vehicle to lead and coordinate the Commonwealth's response to this challenge.[1] To date, $10.5 million has been appropriated, and $4.2 million has been spent or allocated to STEM talent initiative programs.[2] Substantial data and evidence are available from many sources, nationally, internationally and on a state basis.[3] The foundation has been laid.

Developing a state plan for STEM education is crucial for bringing successful independent STEM education initiatives together, providing a way to replicate and scale successful STEM education practices, and moving the state as a whole toward high STEM achievement for all students. It is time to accelerate STEM growth in a systemic and planned manner so that measurable progress can be seen within the next three to **five** years. Current initiatives have been funded without a strategic state plan. Further action is needed now but we should not duplicate efforts. We must use existing institutional assets and align what is already occurring across the state.[4] In short, an effective STEM plan will help coordinate all the resources that are needed to support PK-16 teachers and students to achieve STEM educational goals.

As we anticipate the fifth *STEM Summit: Implementing The Plan* on October 28, 2008, it is essential that Massachusetts have a plan to close the gap in the number of STEM-ready workers that the PK-16 education system is producing and the needs of the economy**.** Successful educational practice and public policy have to involve careful planning immediately, combining leadership and engagement of all stakeholders. A state plan to accelerate STEM education will:

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[1] In FY 08, 27 high-level representatives from business and industry, state government, and PK-12 and higher education were appointed to the Goddard Council, whose mandate is to advise the Commonwealth on STEM workforce development policy and programs.

[2] Another $1 million was allocated to CITI (Commonwealth Information Technology Initiative) for similar purposes. Furthermore in FY07 and FY08 $2 million was allocated to aid mathematics and science teachers who are on waiver to become certified and $2 million is allocated to teacher content training in mathematics and science. And the Commonwealth has just received $13.2M over five years for the development of pre-AP and AP mathematics and science teachers.

[3] As an example, see http://media.umassp.edu/massedu/stem/STEM%20SD.pdf.

[4] Starting with coordinating programs of the Department of Early Education and Care, Department of Education, and Board of Higher Education.

• Create a statewide information sharing/data bank that enables all parties to align and coordinate efforts
• Engage in a gap analysis to determine needed programs and services

• Provide a planning template for schools, districts and higher education institutions to improve their programs and to access funding

• Leverage public and private financial resources

• Use data to influence policy and decision-makers

Vision and Mission[5]

All Massachusetts students, starting in elementary school, receive a solid and high quality preparation in STEM subjects and an understanding of the impact of science, technology, engineering and mathematics on society, culture and their future.[6] In addition, it is critical to the economic health of the Commonwealth that more students are encouraged to prepare for and enter STEM based careers. The entire community and all stakeholders[7] have a significant role in achieving STEM educational goals.

[5] Agreement needs to be reached in the statement of the vision and the mission.

[6] **While the emphasis is on the economic reality, it is understood that being STEM competent is a necessity to being a cultured, well-educated citizen in the 21st century.**

[7] Including community groups and the Pipeline Regional networks

Massachusetts STEM Education Goal and Objectives[8]

The goal of an integrated STEM strategy for Massachusetts is to increase by 35% the number of high school students preparing for and entering STEM careers by 2012, as measured by SAT indication of STEM career choices and college applications in STEM disciplines.

The state strategic plan should incorporate strategies from pre-K through 12th grade to create a pipeline of students interested in, and qualified for, careers in the STEM fields.

To achieve this goal, the following objectives should be met:

1. Increase significantly the number of students, including females and culturally and linguistically diverse and underserved students, who are aware of, interested in, and motivated to study STEM from elementary school through higher education graduation;

2. Raise the level of STEM achievement of ALL Massachusetts students, from elementary school through completion of higher education, by 10% a year increase in performance as measured by a variety of methodologies and indicators of achievement, including MCAS, NAEP, TIMSS, and college course completion rates within the next five years;

3. Increase, by 10% a year, the number of qualified teachers of STEM (pre-k – 16) who can provide solid STEM education for all students, through both teacher preparation and professional development, as measured by number of teachers licensed in STEM and hired to teach STEM subjects within the next five year;

4. Increase by 10% a year the number of students entering as STEM college majors who then graduate in these fields.

5. Improve and provide equitable STEM instruction, curriculum, and programs from elementary school through higher education as indicated from an inventory to be prepared as part of the state plan.

[8] Based on the three goals articulated in the legislation that created the MA STEM Pipeline Fund (2003 Economic Stimulus Bill, c. 141 of the Acts of 2003 and refunded in 2006) and articulated at STEM Summits III and IV. **The exact wording of the goal and objectives and the percentages of increase need to be determined.**

Points of Consensus

• Public support must be generated for making science, technology, engineering and math improvement a statewide priority. This means educating parents specifically as well as the total community

• The Commonwealth needs to make a comprehensive, coherent, sustained effort to help Massachusetts' students meet rigorous standards for STEM knowledge and skills.

• Effective teachers and instructional leaders make the biggest difference in student achievement. All efforts must support and enhance the work of these educators.

• Achieving the goals will require a community-wide effort, involving policymakers, educators, business/community employer leaders, parents, and students.

Stakeholder Involvement and Support

In order for the STEM plan to be implemented successfully, it is necessary to **gain the support of all stakeholders**. The development of the STEM plan is intended to be a collaborative process, to involve all stakeholders who are impacted by such a plan, and to be adopted and adapted by organizations that want to contribute in a purposeful way. PK-12, higher education, law- and policy-makers, business and industry, professional associations and organizations, local leaders, community members and parents need to be engaged in the work of scaling STEM success in the Commonwealth.

It is not sufficient for just the K-12 educational system to develop STEM education and interest strategies. Institutions of higher education need to re-exam how they communicate STEM academic preparation expectations to K-12 educators, students and parents. Four year and two year programs need to develop effective partnering strategies to help guide and educate students who have a high degree of commitment to STEM fields of study, but need a stronger mathematics and science educational foundation. These are among the basic steps to help improve the retention of STEM entry students in these majors at the college and university level.

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Proposed Components of the State STEM Plan

To achieve the purposes and goals outlined above, **the state plan must delineate the role of and relationships among many elements.** To be manageable, a plan needs to establish measurable goals to be accomplished within the next five years, to prioritize several targets at the start and bring in other elements as the plan unfolds over time. Currently, discussion is underway to articulate the relationships among the following elements:

- Student learning experiences leading to
  - ✓ Development of creativity, "agency"[9] and initiative
  - ✓ Scientific and technological literacy for all[10]
  - ✓ Increased interest and motivation to study STEM
  - ✓ Core curriculum and effective instructional practices
  - ✓ Engaging, informal STEM education and enrichment opportunities outside the classroom
  - ✓ Preparation for and access to advanced courses for all qualified students leading to a culture of college readiness in all high schools
- PK-16 educator development and support
  - ✓ Quality pre-service and professional development for PK-16 teachers of STEM
  - ✓ Induction and mentoring programs, internships, coaching for retention and improvement of instruction
  - ✓ STEM specialists/curriculum leaders at the elementary and middle school level
  - ✓ Licensure requirements (for all educators) reflecting current/anticipated needs
- STEM pipeline experiences and opportunities
  - ✓ Aligned programs and activities
  - ✓ Guidance leading students into STEM career fields
  - ✓ Supplementary and out-of-school programs
- STEM planning

[9] Agency is a term used by Meadowbrook Junior High School in Newton, MA. in the early 1960's to describe students' taking responsibility for their decisions and actions in a constructive and productive ways.

√ Instructional program and improvement planning at all levels of schooling, with individual school plans as well as district plans

- Organizational alignment
  - √ PK-16 program alignment and articulation
  - √ Alignment with industry and career needs
  - √ Alignment with policy and regulatory requirements
  - √ Alignment of three education departments (see footnote 4 above)
- Leadership and governance
  - √ Instructional leadership support (coaches, principals, district staff)
  - √ Support from legislators and government staff
  - √ Engagement of STEM industry leaders
- Public support
  - √ Awareness and advocacy **at state and local levels**
  - √ Community education (parents, students and local government)
- Facilities and infrastructure needs
  - √ Science and technology/engineering space, equipment and materials
  - √ Instructional technology **(including one to one and broadband access)**
- Data collection, evaluation and assessment
  - √ Identifying successful, high quality programs to scale up
  - √ Identifying gaps and challenges and proposing solutions
  - √ Measuring progress at all levels through assessments that support and reflect what we value in quality STEM education
- Mechanism for investment
  - √ Targets and processes for investing resources, funds, personnel
  - √ Sources of financial support, public and private

Today there is an active STEM movement across the Commonwealth. With the fourth STEM Summit (2007) the movement directed its energy to developing a statewide STEM plan. By next year at STEM Summit V: Implementing The Plan, the STEM plan should be a reality.

This outline for the state STEM plan is the work of a large group of volunteer Massachusetts educational, business and professional leaders. Contact: Isa Zimmerman for more information izimmerman@umassp.edu

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Suggested STEM Methodology

- **Determine who the client is**. Is it the Goddard Council, the Secretary of Education, the Governor or the taxpayer? All are valid choices, but information will be structured differently based on who is the final recipient of the results.
- **Find out, first hand if at all possible, what the client expects as an end result.** If the client is the Goddard Council, interview a cross-section of members (public sector, private sector, etc)
- **Ascertain who will be responsible for taking end product forward.**
- **Develop at least one and not more than 5 goals to meet during plan development.**
- **Develop measurements to ensure goals are met.**
- **Review** STEM plan outline created by the working group of interested STEM champions.
- **Take advantage** of the knowledge of the STEM working group. They want you to succeed!
- **Ask the following questions** of those interested in the planning process (some in person, most by email):
  - What should the plan include?
  - Who should I talk to?
  - What resources should I know about?
  - If there were only one result from the plan, what would you want it to be?
- A proposed methodology is attached, with some suggested entries –really there more to show how the outline can be used.

Goal

The goal of this project is to develop a set of recommendations to inform the "CLIENT" in ensuring the Commonwealth remains a leader in STEM innovation.

Objectives

1. Use technology to develop and maintain a comprehensive list of STEM resources in the Commonwealth.
2. Recommend any additional resources needed .
3. Recommend how best to organize resources to ensure maximum efficiency.
4. Etc.

Methodology

1. Interview key constituents, including, but not limited to:
    - Legislators
    - Goddard Council Members
    - Working Group Members
    - Key business leaders
    - Key education leaders PK-16
    - NGO's (MassBioTech, Mass Technology Council, etc)
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2. Review working group outline.
3. Review materials from past STEM summits
4.
5.
6.

Implementation (Recommendations)

1. ** should serve as a central resource and web portal for all STEM Initiatives
2. The Secretary of Education should ……
3. Legislation should be introduced to….
4.
5.
6.

Evaluation

Using the objectives developed earlier, assess success at meeting those objectives.