



*Basic Questions and Answers about STEM in Massachusetts*

**Q 1:** *What is STEM?*

**A:** STEM refers to science, technology, engineering and mathematics education and career paths.

**Q 2:** *What does a statewide STEM initiative aim to accomplish?*

**A:** The Massachusetts STEM talent initiative has three broad objectives:

- 1) Increase the number of students planning on STEM majors and career paths;
- 2) Increase the number of qualified <sup>1</sup>STEM teachers; and
- 3) Improved overall education for all students in STEM

This initiative is based upon the need for Massachusetts to be competitive in the global economy with a highly skilled STEM workforce.

In addition, STEM skills are required to be a 21<sup>st</sup> literate person, whether the person decides to be a researcher or a clerk.

**Q 3.** *Does it require a special curriculum as a “stand alone” subject or is it like an octopus and has connections and tendrils into the basic curriculum of the math, science, engineering and technology courses of study?*

There are the stand alone disciplines: math, sciences, engineering. Technology can be both a discipline and an instructional/learning tool.

Reading and writing skills are essential in the STEM academic studies. Writing across the curriculum, as an approach, comes into play here. Technical writing can be offered as an additional value.

Studying careers (and how STEM skills are necessary in every job now and in the future) and the workplace is important as well. Thus, STEM educational programs should be designed to complement and extend existing curricula and instruction.

STEM is an umbrella for the stand-alone subjects, 21<sup>st</sup> century skills and career guidance.

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<sup>1</sup> Quality is defined by using the NCLB definition of content as well pedagogical competence and a period of experience such as student teaching or an internship.

*Q 4: As an individual classroom teacher how can I become part of this initiative?*

**A: There are several strategic ways that the classroom teacher can support STEM:**

- **become knowledgeable about the state's STEM learning standards which define the expectations for what students should know and be able to do in grades pre-12; offer programs and practices that help students understand and master these learning standards;**
- **learn about ways to bring STEM-related applications, instruction and experimentation into their classrooms, such as: robotics competitions, hands-on projects that help students make connections and STEM learning relevant to the real world;**
- **learn about STEM careers and convey to students how what they learn and do in the classroom will help prepare them to enter these fields; help students understand how STEM is necessary to their choice of a profession or occupation. In this area, collaboration with the Guidance Department is highly recommended.**

*Q 5: Who would have to be included to make this a systemic program?*

**A: In order to accomplish the three objectives mentioned above, it is imperative that the entire school district and community be involved. There are curriculum, instruction, personnel, facilities and budget issues underlying any efforts to accomplish these objectives. School leaders will need to work with classroom teachers, guidance counselors, parents and employer partners to develop three to five year plans that have quantifiable goals and ways to measure progress.**

*Q 6 How costly is this program for a school(s) or system to implement?*

**A: The program costs are comparable to those that are generally associated with core curriculum and instruction (e.g. teacher time, facilities, equipment and materials). However, they should be addressed by examining how current educational spending could be modified and where marginal additional resources could be secured and applied.**

**The major additional costs at the outset may be in the area of teacher professional development to help them address the opportunities mentioned above.**

**Capital expenditures may also be required, depending on the condition of science and technology infrastructure in the school system.**

*Q 7: Are there resources and/or area networks that work with individuals to help provide funding and training?*

**A: There are many STEM resources available in Massachusetts.**

- **The web site for the Massachusetts Board of Higher Education Pipeline Fund is located at: [www.mass.edu](http://www.mass.edu), click on Pipeline Fund. This site will give you the contact information for your respective regional pre-K to 16 Network, as well as general information about the STEM talent initiative.**

- The Massachusetts Department of Elementary and Secondary Education's STEM Office, provides a link to the state STEM Curriculum Frameworks, STEM policies, funding opportunities, resources, and professional development institutes. For policies related to College and Career Readiness, see <http://www.doe.mass.edu/hsreform/>.
- The Department of Elementary and Secondary Education has also partnered with the Massachusetts Board of Higher Education to create [readyssetgotocollege.com](http://readyssetgotocollege.com), an informational website detailing what students need to do to complete high school, prepare for college, apply for financial aid, and find the school that is right for them.
- The University of Massachusetts STEM Initiative web site, [www.massachusetts.edu/stem/](http://www.massachusetts.edu/stem/). This site provides background information about the Initiative, links to many resources and the annual STEM Summits.

Q 8: *Are some businesses already providing major support and how can we learn about them and replicate their actions?*

**A:** There are many employers who are engaged in supporting the STEM talent initiative. A collaboration by the Mass. Technology Leadership Council, MASS, MEDIC, MassBioED, The Engineering Center, and the Mass. Networks Communications Council has created a vehicle to identify employer school partnership best practices. *The web site is currently under construction and will be included as soon as it is available.*

**There are many supporters of the STEM Summit who can be seen on [www.massachusetts.edu/stem/](http://www.massachusetts.edu/stem/).**

Q 9: *What advice do you have on how to forge business links with the school and/or teachers and classes that want to participate?*

**A.** It is always important to identify individuals who can introduce schools to potential employer partners. Parents who work for companies in the community or region are often a good place to start. Community leaders can also be a good source.

Before approaching potential partners, it is important to develop an "inventory" of regional potential employer partners, including both large and small business, health care institutions, colleges and universities. In addition, there needs to be a "menu" of two to four ways schools want their employer partners to help. These should be practical and somewhat modest tactics that employers feel are "doable" in the short term. Knowledge of the particular companies is essential before approaching them.

Q 10: *Is this a program that increases the desirability of students who apply to college? Is it an advantage for college admission?*

**A:** Students who are successful in STEM subjects will have an advantage when applying to higher education programs which explicitly focus on STEM related studies.

If a student needs a stronger foundation in mathematics and science before entering an engineering major, it might be advisable for him/her to start with a community college program and then transfer to a bachelor's degree program.

Since there is a need for more women and minority students to enter computer science and engineering fields with those majors, it may be advantageous for these students to prepare for and apply to colleges and universities in these fields.

Guidance programs in schools have a responsibility to make such distinctions and challenges clear to students and help them become prepared with appropriate STEM courses.

*Q 11: Are the colleges working to connect their STEM fields/programs with those fields/programs in the high school and vice versa?*

**A: Some institutions in both arenas are working together to “seamlessly align “ or articulate their programs. The Pipeline Regions (see website in question above) have a number of those articulations.**

*.Q 12 : Is this a federal or state initiative and, if federal, how are the links made among the different states?*

**A: This is a Commonwealth of Massachusetts initiative, with many public agencies, businesses, higher education institutions, school districts, professional associations, cultural institutions, non-profit organizations, etc. who have joined together to support a collaborative and cohesive approach to STEM in the state. However, there are federal and many state efforts to address this issue. A major element of the Massachusetts initiative is to leverage the state and federal programs, such as those funded by the United States Department of Education: Title IIB, a national program and the National Science Foundation. Check the MA STEM Initiative website for the plans of several states which are working on STEM initiatives (<http://www.massachusetts.edu/STEM>)**

*Q 13: Are there any connections that apply to the standard AP classes in mathematics and science?*

**A: AP classes are offered in several STEM disciplines. These courses contain many challenging learning opportunities for students who want and are able to move ahead and more deeply.**

**There are some studies that indicate that AP course and test experience help students become more successful in college studies. To the degree these courses help strengthen students' preparation for STEM college majors, they might help with both admission and retention at the college level.**

**MassInsight received a significant grant from the Mathematics Science Initiative funded by Exxon-Mobil to support AP programs, the link is: <http://www.massinsight.org/initiatives/mathsci.aspx>**

*Q 14: Does this program address or enhance the introduction of minority students into the scientific professions, with a specific emphasis on women, African American and Latino students?*

**A: As mentioned above, there is a need for more people especially women and underrepresented groups of students to prepare for and enter STEM fields. This is driven by**

- A. The desire for equity**
- B. Demographic factors**
- C. The value added to the education of all students when they learn in a diverse community**
- D. The development of a high quality workforce**

Since our general high school graduating population is projected to begin to decline in 2010, we will need to attract to STEM every young person who is able and motivated.

Specific strategies to increase awareness and interest in STEM among these students need to be incorporated in school district plans. There are many best practices that can be used as models.

One of the PK-16 central purposes is to prepare students for citizenship and careers; today that preparation must take into account the growing diversity of people and cultures that comprise our global society.

The significant demographic change is that more than 80% of the new entrants to our labor force are women or minorities. Hispanic and Asian populations are increasing ten times faster than the white population. The African American population is growing more than five times faster than the white population. Diversity in the American workplace will not be a goal, it will be a reality.

Our challenge is not just to prepare enough women and minority students in this new environment. The challenge is to prepare students from all races and backgrounds to work effectively in more diverse workplace. Our future economic wellbeing and our global competitiveness depend on our STEM capacity.

*Q 15: On the practical level, what does this look like in grades prek-12 and into college or career?*

**A: At grades 3 through 6, it means teaching science in a hands-on manner, either by classroom teachers who have been trained in science or by specialists who teach those classes while the classroom teachers watch and learn. The same applies to engineering since the two are closely aligned at that level. It also means providing ubiquitous access to technology for both students and teachers. (This latter is certainly the case in grades 3-12). It means also supporting with the appropriate amount of attention, girls and minority students, whose attention and interest we need to capture at that time or it becomes too late later.**

At middle school, it means that every student should take math and science, again, with a hands-on approach, both as stand alone subjects and as interdisciplinary projects.

**At the high school, it means increasing the STEM requirements for graduation, ensuring that every student has four years of math and science, has the opportunity to take engineering courses and uses technology to learn**

**In community college, it means meeting the requirements for a certificate or associate degree in one of the STEM subject areas and if it is possible participating in ITAC (Information Technology Across the Curriculum). This approach gives students technology skills for any discipline or study.**

*Q 16: Why do we need a coordinated statewide plan?*

**A 21<sup>st</sup> century skilled employee starts in elementary school. Everyday you read or hear about the need for STEM trained workers—from researchers to clerks—to maintain the health of the MA economy.**

**For many years there has been an effort to improve education from elementary to graduate school through a variety of approaches and supports, *most of them independent of each other:***

- **NSF State Systemic STEM Initiative: PALMS(1992-2002)**
- **State Legislation: the Pipeline Fund (Economic Stimulus)**
- **CITI, BATEC, CAITE; STEM Teacher Content Training**
- **Policies: State Curriculum Standards, Student Assessments, and**
- **Accountability for School Districts; MassCore; Competency Determination**
- **Vendors and their associations: MassBioTeach, EDC, TERC**
- **Individual school district programs: Brookline HS and Andover MS engineering programs**
- **Institutions: Museum of Science, MITS**
- **Universities: UMass, Tufts, Northeastern, BU, WPI, etc.**
- **Sponsored competitions and supplementary programs such as: Design Camp, Robotics First, etc.**

**All this effort and attention, especially in Middle School where a number of recent legislative grants were focused, are beginning to pay off, although the big picture is still falling short compared to 1999.**

**A State STEM Plan would provide a common and accepted direction for all of us: a goal, specific strategies and outcomes and appropriate roles indicated for all of the stakeholders, private and public based on an analysis of what is currently being done**

**We still have a long way to go but we have made a good start. Many people have contributed and will want to continue to do so by working with every other interested party.**

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