

Associated Industries
of Massachusetts

Defense Technology
Initiative

Greater Boston Chamber
of Commerce

Massachusetts
Biotechnology Council

Massachusetts Business
Alliance for Education

Massachusetts Business
Roundtable

Massachusetts High
Technology Council

Massachusetts Network
Communications
Council

Massachusetts Technology
Leadership Council

MassBioEd Foundation

Mass MEDIC

Mass Insight Education
& Research Institute

TechNet New England

The Boston Foundation

495/MetroWest
Partnership



Tapping Massachusetts' Potential



The Massachusetts Employers' STEM Agenda

GOALS

Double the number of STEM bachelor's degrees by 2020,
with a special focus on currently underrepresented groups.

Double the number of STEM teachers, grade 7 through 12, by 2020.

SUMMER 2009



a statement by

Associated Industries of Massachusetts, Defense Technology Initiative, Greater Boston Chamber of Commerce, Massachusetts Biotechnology Council, Massachusetts Business Alliance for Education, Massachusetts Business Roundtable, Massachusetts High Technology Council, Massachusetts Network Communications Council, Massachusetts Technology Leadership Council, MassBioEd Foundation, Mass MEDIC, Mass Insight Education & Research Institute, TechNet New England, The Boston Foundation, 495/MetroWest Partnership


In July of 2005, 15 of America's most prominent business organizations formed the Tapping America's Potential (TAP) Coalition to voice the business community's deep concern about sustaining U.S. scientific and technological leadership into the future. The group identified the cultivation of skilled scientists and engineers to create tomorrow's innovations as a necessary strategy for the United States to maintain its competitiveness in the 21st century. The coalition endorsed a policy agenda designed to ensure that more American workers have strong backgrounds in science, technology, engineering and math (STEM) and set a specific, measurable goal: increase the annual number of U.S. science, technology, engineering and mathematics bachelor's-level graduates to 400,000 by 2015.

Similarly, the above-signed 15 business organizations have joined together in Massachusetts to echo this concern and set two statewide goals:

- Double the number of STEM bachelor's degrees by 2020, with a special focus on currently underrepresented groups.
- Double the number of STEM teachers, grade 7 through 12, by 2020.

These goals would double the number of annual STEM graduates from the current 10,000, consistent with the Tapping America's Potential goal, resulting in 20,000 annual Bachelor Degree recipients in Massachusetts by 2020. It would also increase the number of qualified STEM teachers to help meet the new capacity.

The STEM fields include Biological and Biomedical Sciences, Computer and Information Sciences, Engineering, Health Professions and Clinical Sciences, Mathematics and Statistics, and Physical Sciences. Given the underpinnings of the Massachusetts economy, and projections for its future growth, a public policy focus and investment in the STEM fields are of primary importance for many of the state's employers.



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1 Gaining Momentum, Losing Ground. TAP Progress Report, July 2008

The National Case for STEM

In its report, the TAP Coalition warns that “if we take our scientific and technological supremacy for granted, we risk losing it” and that the United States “risks a declining standard of living” if we postpone taking aggressive, strategic action. Yet, despite the efforts of the TAP coalition, a Progress Report issued in July of 2008 entitled “Gaining Momentum, Losing Ground” indicated that while there had been growing support for the TAP agenda, little real progress had been made toward the goal of doubling the number of students earning bachelor’s degrees in STEM subjects. While the number of STEM bachelor’s degrees remained relatively flat, projected demand for STEM graduates in the U.S. workforce is growing markedly, and economic competitors, such as China and India, are greatly increasing their output of STEM graduates.

The 2008 Progress Report conveys America’s business leaders’ frustration that while governments around the world are building their national innovation capacity through investments in research and STEM education, the United States is standing still. The Report goes on to warn that “failure to change the status quo places America’s future economic and technological leadership at risk.”

As the data show, America is not keeping pace with foreign competition. Other nations around the world are investing in education and research and challenging U.S. leadership. U.S. high school students ranked 21st in science literacy out of the 30 countries that participated in OECD’s 2006 Program on International Student Assessment.² And while countries such as China are graduating four times as many engineers as the United States, the number of engineering degrees awarded in the United States is down 20% from the peak year of 1985.³ In fact, from 1995 to 2005, the percentage of high school students in the U.S. who indicated interest in majoring in engineering dropped by nearly 35%.⁴

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And the trend is continuing downward. According to the Council on Competitiveness National Innovation Initiative (NII), only 5.5% of the 1.1 million high school seniors who took the college entry exam in 2002 planned to pursue an engineering degree—nearly a 33% decrease from the previous decade.

This is troubling given national projections. The Bureau of Labor Statistics forecasts that employment in science and engineering will increase about 70% faster than the overall growth rate for all occupations. In addition, the National Science Foundation predicts that nearly one third of science and engineering degree holders in the current workforce are more than 50 years

2 Gaining Momentum, Losing Ground. TAP Progress Report, July 2008

3 Tapping America’s Potential, July 2005

4 CEO Message Points, Business Roundtable, June 2006

old. Barring large reductions in retirement rates, the total number of retirements among these workers will increase dramatically over the next 20 years.⁵

Even more troubling is that the public—parents, students, employees and community leaders—are not grasping the enormity of the issue. A study by Raytheon in 2005 found that 84% of U.S. middle school students would rather clean their rooms, eat their vegetables, take out the garbage, or go to the dentist than do their math homework. Yet, in China, nearly all high school students study calculus, compared to 13% in America.⁶

The Massachusetts Case for STEM

In Massachusetts, the picture is a little brighter. On the 2007 Trends in International Mathematics and Sciences Study (TIMSS), fourth graders in Massachusetts ranked second in the world in science achievement and tied for third in math while eighth graders tied for first in science and ranked sixth in math.

However, while showing aptitude in STEM fields, Massachusetts students pursue studies in these fields at alarmingly low rates. According to the College Board, 20.5% of Massachusetts students who took the 2008 SAT indicated an interest in pursuing a career in the STEM fields, well below the national average of 26.3%. Among the competitor states, North Carolina was the only one with a significant increase in the number of its students choosing STEM fields.

In 1999, there were 15,229 and in 2008 the number had increased to 17,677, or 32%. In contrast, Massachusetts' numbers increased only slightly, from 12,480 in 1999 to 12,592 in 2008, a lower percentage than states such as Illinois, Minnesota, Virginia, Pennsylvania, New Jersey and New York. The number of students from Massachusetts colleges and universities studying in STEM fields declined from 1993 to 2008, while the numbers increased nationally.⁸

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This trend is causing concern among Massachusetts employers. Job vacancy data for Massachusetts from the state's Department of Workforce Development for the second quarter of 2008 confirm employers' concerns. During that quarter, the state had 74,790 job vacancies. There are three occupational groups which comprise elements of the STEM field—computer and mathematical (3,621), architecture and engineering (2,140), and life, physical and social sciences (1,901). So of the 74,790 statewide job vacancies during the 2nd quarter of 2008, roughly 10% fall into those three categories.

5 CEO Message Points, Business Roundtable, June 2006

6 Gaining Momentum, Losing Ground. TAP Progress Report, July 2008

7 John Hodgman, UMass Lowell

8 Ready for the 21st Century (The Readiness Project Report), June 2008

It is interesting to note that unlike other states, Massachusetts STEM graduates come primarily from private higher education institutions. Massachusetts public colleges and universities granted 26.6% of STEM Bachelor's Degrees in 2005-2006, compared to competitor states such as North Carolina and Virginia which granted 77% and 81% respectively. A study in 2000 conducted by the state's Board of Higher Education and the Department of Employment and Training found that 85% of public college students remain and work in Massachusetts after graduation.

Additionally, although our students' test scores are among the best in the country, the Commonwealth is below the national average when it comes to the number of African American and Hispanic students per 1,000 high school juniors and seniors that pass AP math and science exams. Additional measurement and benchmarking is currently being done by the UMass Donahue

Institute which has developed the Massachusetts Statewide STEM Indicators Project (MASSIP), an annual benchmarking of key education and economic indicators reflecting on the state of the STEM pipeline.

At a time when our economy is shifting to be more globally competitive and innovation based, these are troubling trends. The countries with whom we compete for workers, for ideas, and for new innovations are identifying their best math and science students, nurturing them, and educating them in STEM fields so they are prepared for the global marketplace. To remain competitive in the future, we need to be making similar investments in the United States and Massachusetts. Currently, we are not.

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Call To Action

As Tapping America's Potential notes, employers are increasingly interested in hiring people who not only can execute well but also can create the next wave of innovation. In Massachusetts, thousands of STEM related jobs are going unfilled, while employers locate or relocate to other states and nations where the workforce is both well-trained and plentiful. This threatens the state's future social and economic prosperity.

The business leaders who have co-signed this report are committed to the agenda it lays out and achieving the goals set by the coalition in Massachusetts. We pledge to work with the Administration, the Legislature, educators, colleges and universities, and our member companies to both support existing efforts and identify specific legislative, regulatory, programmatic and corporate philanthropic vehicles to move the agenda forward and meet the goals. And we will provide the leadership needed to help Massachusetts citizens realize the depth of the problem and the urgent need to implement solutions. Massachusetts must develop a forward-thinking, integrated strategy to build the talent infrastructure necessary to meet these expectations. We echo the TAP Coalition's sense of urgency in realizing that for the security and continued prosperity of our nation and state, we can no longer delay action.

Recommendations

Dozens of state and national reports have been issued during this decade as the alarm has been sounded by the TAP Coalition and other prestigious public and private groups about the need to inspire, recruit and train a larger domestic pool of STEM talent. From those reports, a core set of recommendations has emerged. The intent of this report is not to "reinvent the wheel," but to collect and compile those ideas and organize them into strategies to achieve our goal.

There are three broad categories of recommendations:

- Build public support for making improvement in STEM performance a statewide priority;
- Motivate Massachusetts students and adults, using a variety of incentives, to study and enter STEM careers and remain in the state after graduation, with a special effort geared to those in currently underrepresented groups; and
- Improve K-12 STEM teaching to foster student achievement and meet increased demand, including differentiated pay scales for mathematics and science teachers.

The TAP report also calls for reform of visa and immigration policies to enable the United States to attract and retain the best and brightest STEM students from around the world to study for advanced degrees and stay to work in the United States, and increased and sustained funding for basic research, especially in the physical sciences and engineering. Given that these are primarily federal issues, this report will not address them except to offer our collective support to the TAP Coalition in advocating for these items in Congress.

■ **Build public support for making improvement in STEM performance a statewide priority.**

RECOMMENDATIONS

- Create and disseminate a statewide STEM Plan which will clearly establish the goals and objectives of the Commonwealth's efforts for the next five years.
- Recommend and elevate a single STEM point person in the Administration by either creating a STEM Cabinet and/or an Undersecretary of STEM within the Secretary of Education
- Launch a campaign to help parents, students, employees and community leaders understand why the STEM disciplines are so important to individual success and national prosperity. (TAP)
- Provide role models and other real-world examples of the work that engineers and scientists do. (TAP)

CURRENT INITIATIVES

- In 2004, Massachusetts convened the "STEM Summit," a first-in-the-nation effort designed to bring STEM stakeholders together to determine and discuss the many STEM issue facing the Commonwealth. Now in its sixth year, STEM Summit VI will attract more than 500 statewide stakeholders from education and business. The Summits have been the State's signature STEM event by raising awareness, calling for a statewide STEM plan, and developing strategies to move the STEM agenda in Massachusetts.
- The State Scholars Initiative encourages students to take rigorous core academic courses in high school that will prepare them for careers in STEM related fields. (TAP)
- The STEM Tech Alliance, a collaboration of five Massachusetts technology trade associations, focuses on increasing STEM awareness in middle schools.

■ **Motivate Massachusetts students and adults, using a variety of incentives, to study and enter STEM careers and remain in the state after graduation, with a special effort geared to those in currently underrepresented groups.**

RECOMMENDATIONS

- Create more scholarships and loan forgiveness programs for students who pursue two-year, four-year and graduate degrees in STEM, including students who plan to teach math and science, particularly in high-poverty schools. (TAP)
- Encourage private-sector involvement in consortia of industries and universities that establish clear metrics to increase the number of graduates. (TAP)

- Create opportunities for high-achieving STEM students to stay in Massachusetts, such as immersion experiences and corporate internships. (TAP)
- Advocate for curricula that include rigorous content as well as real-world engineering and science experiences so that students learn what it means to do this work, what it takes to get there, and how exciting these fields are. (TAP)
- Annually increase the investment in and availability of dual enrollment opportunities for all students. Focus initially on first-generation college-goers, students interested in science, technology, engineering and mathematics disciplines, and concurrent enrollment programs for students with special needs. (RP)
- Encourage additional STEM degree programs at public colleges and universities whose graduates are more likely to stay and work in Massachusetts.

CURRENT INITIATIVES

- The Massachusetts Biotechnology Education Foundation provides links between STEM education and industry.
 - In March 2009, the Massachusetts High Technology Council launched TalentConnect, a comprehensive new workforce development program that will help generate a larger and better informed pool of skilled workers to feed the future growth of the state's diverse technology economy. The program uses data-rich, web-based technology to create seamless talent pipeline from high school through college and into the workforce.
 - The Commonwealth Covenant Fund provides tuition loan repayments to students who attend public universities or colleges in Massachusetts and stay to pursue careers in the STEM fields.
 - The Department of Higher Education Scholar Internship Match Fund provides up to a \$5,000 match for students studying a STEM field at a public higher education institution who receive a corporate scholarship and/or a paid internship.
 - The Massachusetts Life Sciences Center has launched the Life Sciences Internship Challenge, a workforce develop program focused on enhancing the talent pipeline for life science companies and research institutions in Massachusetts. The program's goal is to provide 100 internships to undergraduate STEM majors.
- **Improve K-12 STEM teaching to foster student achievement and meet increased demand, including differentiated pay scales for mathematics and science teachers.**

RECOMMENDATIONS

- Promote market and performance based compensation and incentive packages to attract and retain effective STEM teachers. (TAP)

- Provide the flexibility for high school teachers, retirees and other qualified professionals to teach these subjects part time. (TAP)
- Support cost-effective professional development and other technical assistance to fill gaps in teachers' content knowledge and prepare them to teach the content effectively. (TAP)
- Include incentives in state policies for colleges and universities to produce more STEM majors and to strengthen preparation programs for prospective STEM teachers. (TAP)
- Strengthen and enforce provisions for STEM teachers to ensure that they have the requisite knowledge in the subjects they are assigned to teach. (TAP)
 - Improve teaching in STEM disciplines by strengthening content knowledge and teaching strategies. (RP)
- Increase public and private capital investment in STEM infrastructure to ensure adequate equipment, space and technology are available to teachers and students.
- Support the establishment of the Readiness Science and Math Teaching Fellowship Program to increase the Commonwealth's supply of qualified STEM teachers. (RP)
- Provide high-quality online alternatives and post-secondary options for students in any middle school or high school that does not yet offer advanced STEM courses. (TAP)

CURRENT INITIATIVES

- The Mass Math & Science Initiative (MMSI) will increase Advanced Placement (AP) enrollment and performance and ultimately will increase college success. Though a \$13.2M grant from the National Math & Science Initiative, MMSI will implement an intensive training and support program for teachers and students in 90 MA public high schools by 2013.
- BioTeach provides professional development for STEM teachers reaching over 400 teachers in 162 high schools.
- Lift2 (Leadership Initiatives for Teaching and Technology) is an innovative professional learning program for middle and high school STEM teachers. It is designed to help experienced and developing teachers relate classroom curriculum to authentic and relevant applications in the 21st century workforce.
- The STEM Pipeline Fund, which is administered by the Department of Higher Education, is funding seven regional STEM networks across the state. It administers a competitive grant program to fund STEM student interest and learning projects and to assist in the implementation of state STEM policy initiatives. Since its inception in 2004, the Pipeline Fund has received \$10.5 million in state support.

Links

Associated Industries of Massachusetts	www.aimnet.org
Defense Technology Initiative	www.defensetech.net
Greater Boston Chamber of Commerce	www.bostonchamber.net
Massachusetts Biotechnology Council	www.massbio.org
Massachusetts Business Alliance for Education	www.mbae.org
Massachusetts Business Roundtable	www.maroundtable.com
Massachusetts High Technology Council	www.mhtc.org
Massachusetts Technology Leadership Council	www.masstlc.org
Massachusetts BioEd Foundation	www.massbioed.org
Massachusetts Medical Device Industry Council	www.massmedic.com
Mass Insight Education and Research Institute	www.massinsight.org
Massachusetts Network Communications Council	www.massnetcomms.org
Tech Net New England	www.technet.org
The Boston Foundation	www.tbf.org
495/MetroWest Partnership	www.arc-of-innovation.org

Other Resources

Tapping America's Potential	www.tap2015.org
Massachusetts STEM Initiative	www.massachusetts.edu/stem
State Scholars Initiative	www.mastatescholars.org
STEM Tech Alliance	www.masstlc.org/wor/stemtech
STEM Pipeline Fund (DHE)	www.mass.edu/pipeline
Talent Connect	www.mhtc.org
Commonwealth Covenant Fund	www.mass.gov/covenantfund
Scholar Internship Match Fund	www.mass.edu/currentinit/currentinitscholarintern.asp
Life Sciences Internship Program	www.masslifesciences.com
Massachusetts Math & Science Initiative	www.massinsight.org/initiatives/mathsci/asp
BioTeach	www.massbioed.org
Lift2	www.lift2.org



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