Transitioning to Revised Draft MA Science & Technology/Engineering Standards

C&I Summit
October 27-28, 2014
Agenda

istar What is critical for success after K-12?
istar How do the draft revised standards support this?
istar Strategies for district transition
Think-Pair-Share

- I hand you maple seed.
- Imagine you plant it in the ground and a tree grew.
- I hand you a piece of that tree.

Where did all that stuff come from?

- Write individually (1 min)
- Share with neighbor (2 min)

http://www.learner.org/vod/vod_window.html?pid=77
Think-Pair-Share

★ Did you cite…(raise your hand)
  ★ Water
  ★ Soil
  ★ Minerals/Nutrients
  ★ Air
  ★ Carbon Dioxide

★ Minds of Our Own (1997)
★ Also check out A Private Universe (1987)
  Annenberg Learner (www.learner.org)
Why is STE important?

★ Understanding science and engineering issues and decisions in our life
  ★ E.g., Climate change; Natural gas pipeline; Renewable energy designs

★ Readiness for post-secondary success (College and Career Readiness)

★ Note: *Science* includes technology/engineering (Science = STE)
Current MA STEM Jobs Data

For college bound students, the majority of jobs openings in MA require strong STEM skills.

Jobs posted in Massachusetts for 120 days ending September 25, 2014:

- 32% of all jobs posted are STEM jobs (regardless of pay or education level)
- 46% of all jobs in occupations with median pay at $40,000 or above are STEM jobs
- 60% of all jobs in occupations with median pay at or above $60,000 are STEM jobs

For this analysis, STEM jobs are jobs that require a high level of proficiency in at least one STEM discipline or to apply STEM knowledge routinely from a range of STEM disciplines. For example this STEM jobs number includes healthcare jobs requiring significant STEM knowledge, but not healthcare support professions requiring only modest STEM knowledge.

From Beth Ashman (DHE)
Students will be prepared to:

- Analyze scientific phenomena and solve technical problems in real-world contexts using relevant science and engineering practices and disciplinary core ideas.
- Use appropriate scientific and technical reasoning to support, critique, and communicate scientific and technical claims and decisions.
- Appropriately apply relevant mathematics in scientific and technical contexts.
Science & engineering practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Outcomes of integrating practices & content

- Better reflection of actual science and engineering
- Increased mastery of sophisticated subject matter
- Increased relevance through using practices in authentic contexts
- Increased interest in STEM

- America’s Lab Report (NRC, 2005)
What an STE standard looks like

<table>
<thead>
<tr>
<th>5-PS1</th>
<th>Matter and Its Interactions</th>
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<tr>
<td>5-PS1-1. <strong>Use a model of matter as made of particles too small to be seen to explain common phenomena involving gases, phase changes between gas and liquid, and dissolving.</strong> [Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]</td>
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- Articulates expected performance/demonstration
- Does not limit curriculum and instruction to the included practice
Core Ideas

★ Key understandings that allow students to interpret and explain the world around them
  ★ Natural phenomena (e.g., mass of a tree, carbon cycling, climate change)
  ★ Designed systems (e.g., energy systems, transportation systems)

★ Progress in sophistication K-12
Origin of tree mass?
2001/2006 STE

- Gr. 3-5, LS #11: Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.

- Gr. 6-8, LS #16: Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.

- HS, LS 2.4: Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration. Explain the interrelated nature of photosynthesis and cellular respiration in the cells of photosynthetic organisms.
Origin of tree mass?
Draft revised STE

★ 5-LS1-1. Support an argument with evidence that plants get the materials they need for growth and reproduction chiefly through a process in which they use air, water, and energy from the sun to produce sugars and plant materials.

★ MS-LS2-3. Develop a model to describe the cycling of matter among living and nonliving parts of an ecosystem including through the process of photosynthesis and cellular respiration.

★ HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform carbon dioxide and water into oxygen and chemical energy stored in the bonds of glucose and other carbohydrates.
Arrows highlight conceptual connections (needed for learning); not curricular connections.
PreK-8 grade-by-grade standards

Grade-specific standards support:

- Collaboration and sharing across districts on curriculum, district determined measures, etc
- Consistency when students move schools/districts
- Standards appropriate for students of each grade

All 4 disciplines in each grade encourage integrated curriculum

- Pre-K developed by EEC
- K-5 as consistent with NGSS as possible
- 6-8 generating discussion about school program
High school – no change in structure

★ “Introductory” gr. 9-10 courses

★ Maintain current model of course choices, flexibility for different pathways

★ Overall reduction in scope of HS standards

★ Continuing to work on practices for HS
  ★ Ensure all options lead to student development of science & engineering practices by end of 3 years of lab science (MassCore)
Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu
# Implications for curriculum and instruction

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<th>Shift in revised standards</th>
<th>Shift in curriculum &amp; instruction</th>
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<td><strong>Relevance</strong>: Organized around core explanatory ideas that explain the world around us</td>
<td>The goal of teaching needs to shift from facts and concepts to explaining phenomena</td>
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<td><strong>Rigor</strong>: Central role for science and engineering practices <em>with</em> concepts</td>
<td>Inquiry- and design-based learning is not a separate activity; all STE learning should involve engaging in practices to build and use knowledge</td>
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<tr>
<td><strong>Coherence</strong>: ideas and practices build across time and between disciplines</td>
<td>Teaching involves building a coherent storyline across time</td>
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Adapted from: Brian Reiser, Northwestern University, 2013
Staying up to date/FAQ

Science, Technology Engineering, and Mathematics (STEM)


The review of the Massachusetts Science and Technology/Engineering (STE) Curriculum Framework started in spring 2009, and is now anticipated to be completed SY 2015-16. This page is intended to provide an overview, timeline, and periodic updates on the review process, related documents, and drafts for public comment.

At the October ESE Board meeting the Department laid out the timeline for moving forward with revised Science and Technology/Engineering standards. The Department will make the draft revised standards public but will not be moving them forward to a public adoption process until the 2015-16 school year. This provides guidance on the key directions the revised STE standards will represent and illustrates that they support broader ESE initiatives, such as college and career readiness, while recognizing that many districts are already engaged in multiple major initiatives. Districts have the opportunity to do planning and curriculum work with the draft revised standards prior to formal adoption and implementation. It is important to note that the current STE standards remain in effect and the STE MCAS remains aligned to the current STE standards. Each district will make its own decision about whether and/or how to use the draft revised standards until formal adoption.

Draft Revised Science and Technology/Engineering Standards

- Frequently Asked Questions regarding the release of the MA Draft Revised Science and Technology/Engineering (STE) Standards
- MA Draft Revised Science and Technology/Engineering Standards (standards only)
- MA Draft Revised Science and Technology/Engineering Standards (with Foundation Boxes)
- Strand Maps of Draft Revised MA Science and Technology/Engineering Standards

Related Resources

- Matrix of the Science and Engineering Practices (from NGSS)
- Matrix of Disciplinary Core Idea Progressions
- Crosswalk of the 2001/2006 STE Standards and Draft Revised STE Standards: Organized by Current Standards
- Crosswalk of the 2001/2006 STE Standards and Draft Revised STE Standards: Organized by Draft Revised Standards
- The Case for an Integrated, Grade-by-Grade Approach PreK-8
- Value of Crosscutting Concepts & Nature of Science in Curriculum
- Presentation: Overview of the MA Draft Revised STE Standards (PPT)

www.doe.mass.edu/stem/review.html
# Next steps

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<th>Date</th>
<th>ESE action</th>
<th>District action</th>
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| Public draft through 2014-2015 | • STEM pathways; implications for upper-level HS courses  
• Edits based on input  
• Develop Framework resources  
• Post model curriculum units | Optional  
• Transition to standards in curriculum & instruction  
• Use to inform educator goals, district determined measures |
| Move to official public comment and adoption process 2015-16 |                                                                        |                                                                                 |
| Multi-year implementation & transition period (~3 yrs) | • Provide support for transition  
• Adjust MCAS | Transition to revised standards |

[www.doe.mass.edu/boe/docs/2013-10/item2.html](http://www.doe.mass.edu/boe/docs/2013-10/item2.html)
Approaches to district transition
ESE guidance

- Consider using just revised standards PreK-8
  - Significant content overlap current to draft revised
  - Unlikely to negatively impact accountability status

- HS courses which students take an MCAS should remain aligned to current standards
  - Competency determination/graduation implications

- All other HS courses can transition

[www.doe.mass.edu/stem/standards/faq.html](http://www.doe.mass.edu/stem/standards/faq.html)
District examples

⭐ 5 District Partnership
⭐ Cove Davis, Executive Administrator for Curriculum and Assessment
⭐ Sarah Kent, STEM Director, Chelsea Public Schools
⭐ Diane Perito, STEM Director, Malden Public Schools

⭐ North Reading
⭐ Michelle Giordano, High School Science Curriculum Leader
⭐ Paul Larsen, Elementary School Teacher
⭐ Patrick Daly, Assistant Superintendent
District examples

★ Fitchburg

★ Mike Koski, STEM Support Specialist

★ Newton

★ Amy Winston, Newton North High School, Science and Technology/Engineering Department Head

★ Jenny Craddock, Curriculum Coordinator, Science and Technology/Engineering K-8
Range of approaches

- Both feet in (e.g., PK-5)
- Phase in by grade (e.g., gr. 6 one year, gr. 7 the next, ...)
- Phase in units/topics (e.g., everyone change some units this year, a few more next year, ...)
- Phase in science & engineering practices first, then content later (e.g., HS)
- Plan for different structure (e.g., move to ES science specialists; MS science teacher looping)
Reflection & planning

- Do certain approaches make sense for us?
- Who should be at the table to plan for and make the transition?
- Are there differences in how we approach elementary, middle, and/or high school?
- How can we encourage explicit linkages between science, math and ELA?
- What resources do we have to support science (funding, partners, pd)? What do we currently draw on for math and ELA that can also include science?
Closing thoughts

- Transition plan based on what works for your district, teachers and students
- Likely differences for PK-5, 6-8, 9-12
- Analyze transition strategies and lessons learned from Math and ELA
- Resources available for school improvement, professional development, and student support can be used for science
- Think about the system; how individual grades or teachers contribute to transitioning the system
Thank you!

Questions, Comments, or Requests:

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