Transitioning to Revised Draft MA *Science & Technology/ Engineering Standards*

ABE Program, Harvard

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Massachusetts Department of
ELEMENTARY & SECONDARY
EDUCATION

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)

College & Career Readiness

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

What an STE standard looks like

5-PS1 Matter and Its Interactions
5-PS1-1. 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. [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.]

- 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.

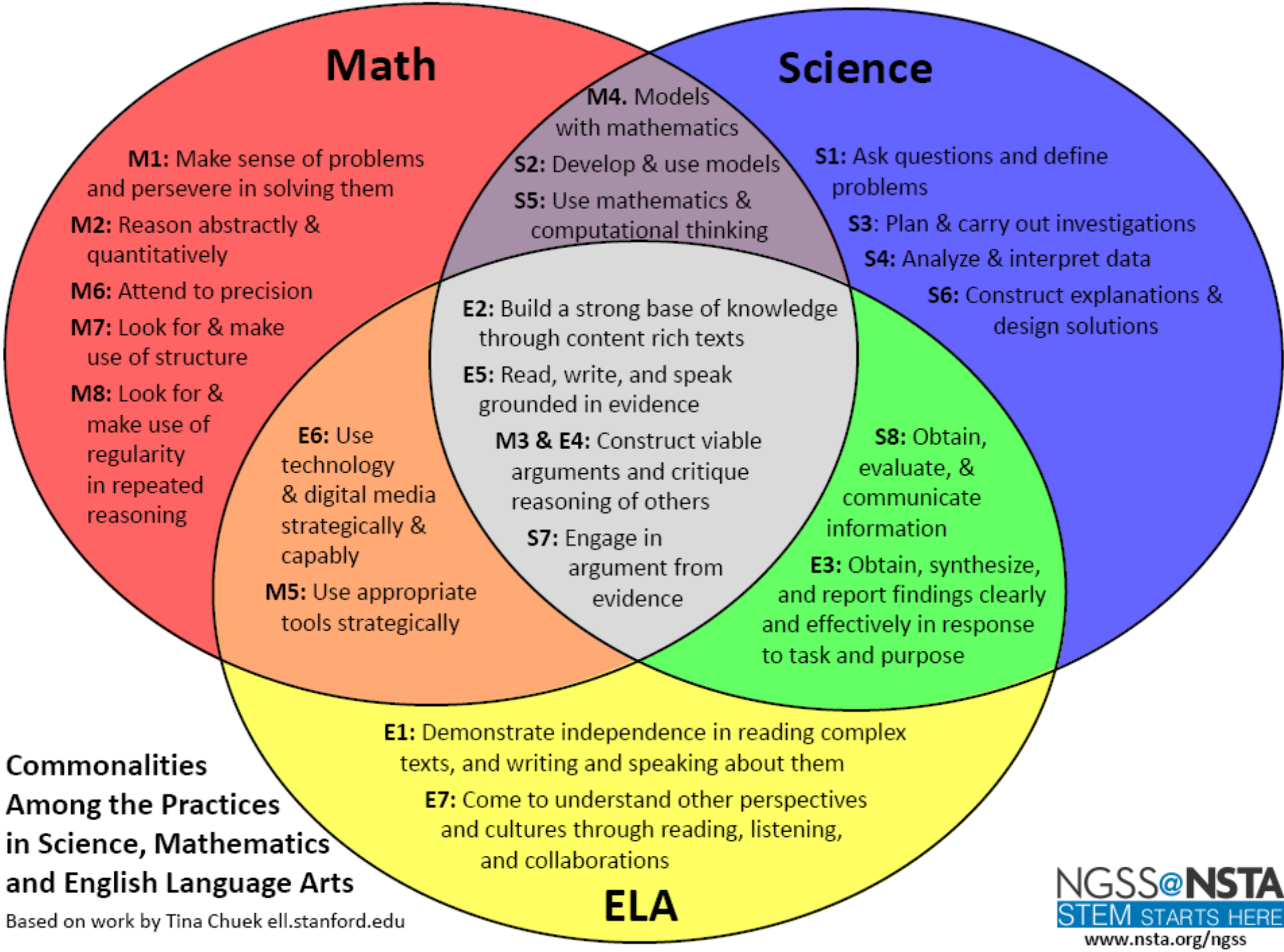
Origin of tree mass? Draft revised STE

- 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**.

Implications for curriculum and instruction

Shift in revised standards	Shift in curriculum & instruction
Relevance: Organized around core explanatory ideas that explain the world around us	The goal of teaching needs to shift from facts and concepts to explaining phenomena
Rigor: Central role for science and engineering practices *with* concepts	Inquiry- and design-based learning is not a separate activity; all STE learning should involve engaging in practices to build and use knowledge
Coherence: ideas and practices build across time and between disciplines	Teaching involves building a coherent storyline across time

Adapted from: Brian Reiser, Northwestern University, 2013



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

NGSS@NSTA
STEM STARTS HERE
www.nsta.org/ngss

Resources

- STE Model Curriculum Units and rubric
  - www.doe.mass.edu/candi/model/files.html
  - www.doe.mass.edu/candi/model/rubrics/STE.docx
- Characteristics of an STE Classroom
  - www.doe.mass.edu/STEM/Standards-BasedClassroom.docx
- Strand maps
  - www.doe.mass.edu/stem/standards/StrandMaps.html

+/- of NGSS

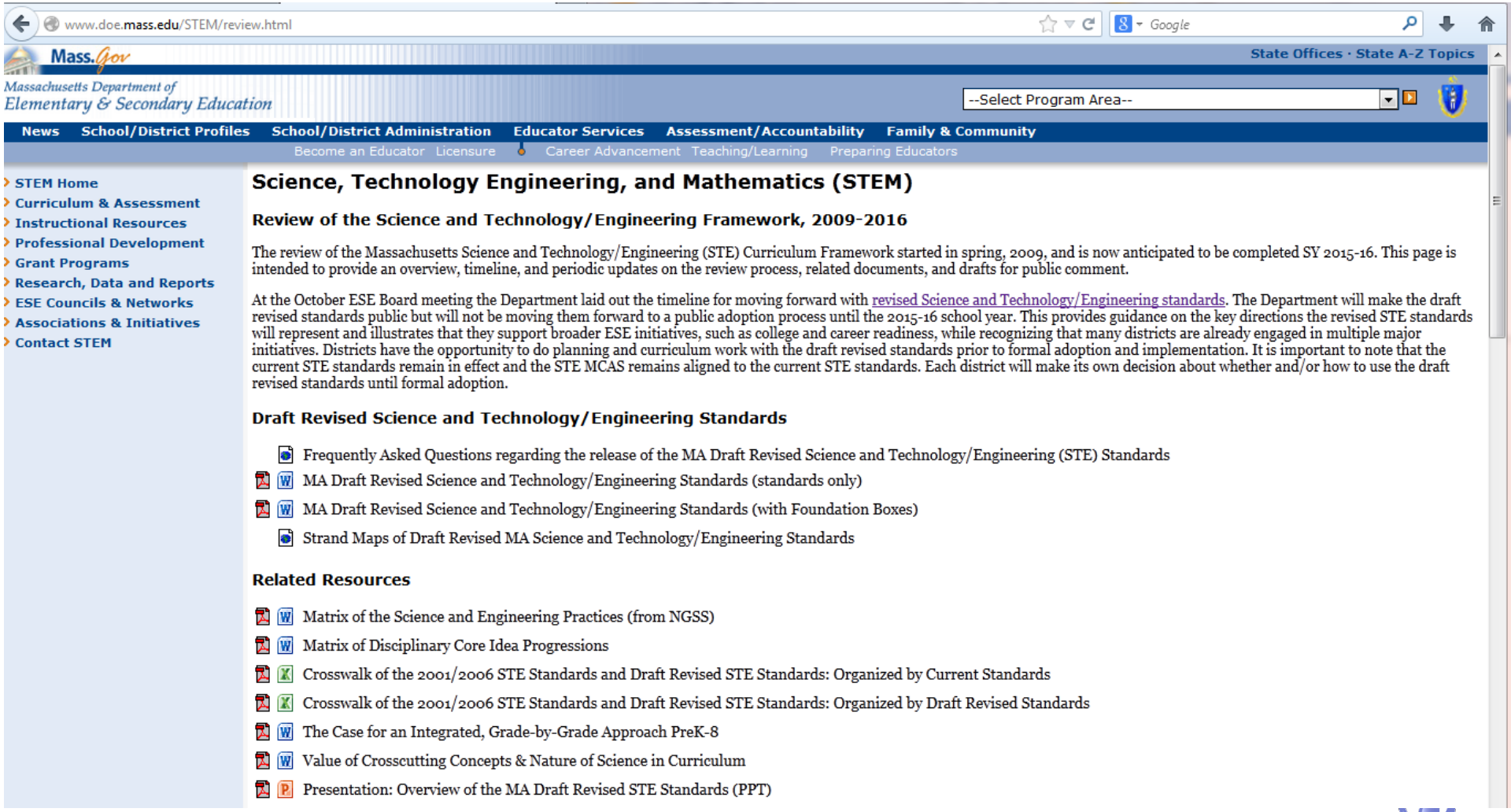
- Positives
  - Integration of practices and core ideas
  - Grade-by-grade K-5
  - Focus on scientific literacy
- Needed adjustment
  - Vague standards
  - Missing Pre-K
  - Weak representation of technology/engineering
  - Lack of attention to college and career readiness
  - High school assumptions 'requiring' 3 courses

Next steps

Date	ESE action	District action
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

Staying up to date/FAQ



www.doe.mass.edu/stem/review.html