Statement on the Need for a Grades 9-14 Mathematical and Statistical Sciences Framework

December 2024 Conclusion

Original Charge

Over the past decade many discussions about the mathematics that today's secondary students should experience and engage in have played out in various ways. Consensus is elusive as the issues are nuanced and positions can be based on individual experiences and beliefs as often as on reliable foundations and evidence. Indeed, there likely is no single best answer that works for all students in all places. **There is a need for a common message from the mathematical and statistical sciences community that clarifies agreements about equitable student access to developments in content, pedagogy, and technology.** In the current vacuum, chaos reigns, conflicts are amplified, and students suffer. **We hope to produce a statement that reflects a consensus among the CBMS organizations that may bring more coherence on these issues to the benefit of students nationwide.**

Result: A sort of “Call to Action”

- An urgency to address evolving needs in Grades 9-14 mathematics education.
- It requires the cooperation of wide-ranging groups, including many outside CBMS
- We call for the new Mathematical Sciences Education Board (MSEB) at the National Academies to prioritize a consensus study to create a Grades 9-14 mathematical and statistical sciences framework

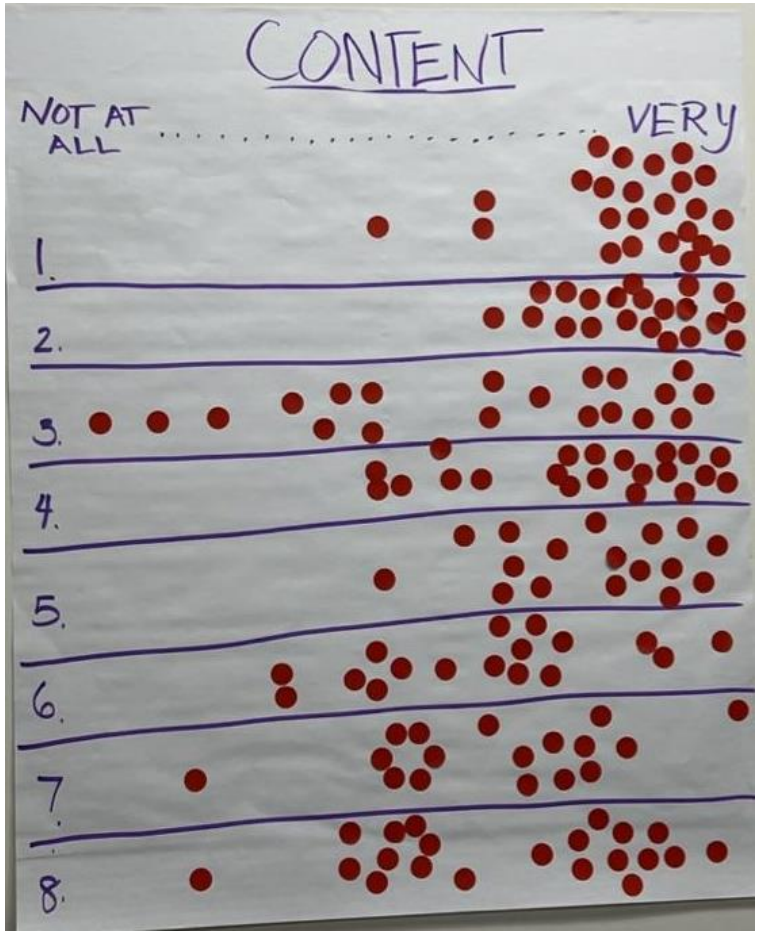
Ted Coe (Lead)	CBMS
Katey Arrington	NCSM
Kevin Dykema	NCTM
Eleanor (Lea) Jenkins	SIAM
Brendan Kelly	AMS
Yvonne Lai	MAA
Donna LaLonde	ASA
Mary Mooney	ASSM
Shari Stockero	AMTE
Erin Sylves	TODOS
Laura Watkins	AMATYC
Charlie Steinhorn	*CBMS
Joleigh Honey	*CBMS

**ex officio*

- May 2022: Brainstorming session on high-quality mathematical experiences

1. Students at all levels should have access to mathematical experiences that are genuine and aligned to student interests
2. Student should regularly construct argument: and engage in modeling
3. Not all students need to experience some of the mathematics required for calculus in high school (such as precalc or certain adv alg topics)
4. Students should have access to 21st century mathematical topics (such as…)
5. Mathematical experiences should connect to other disciplines
6. Segments (districts, HE, state) must work together to determine pathways/options (an the point at which student experiences shoul branch into different, rigorous* pathways) *Rigorous would need to be defined. What do w mean by rigorous?
7. Systems should enable the ability to accommodate a changing mathematical canon.
8. Attention should be given to the history and human stories in mathematics.

Dec 2022: Sticker activity to find agreement/disagreement



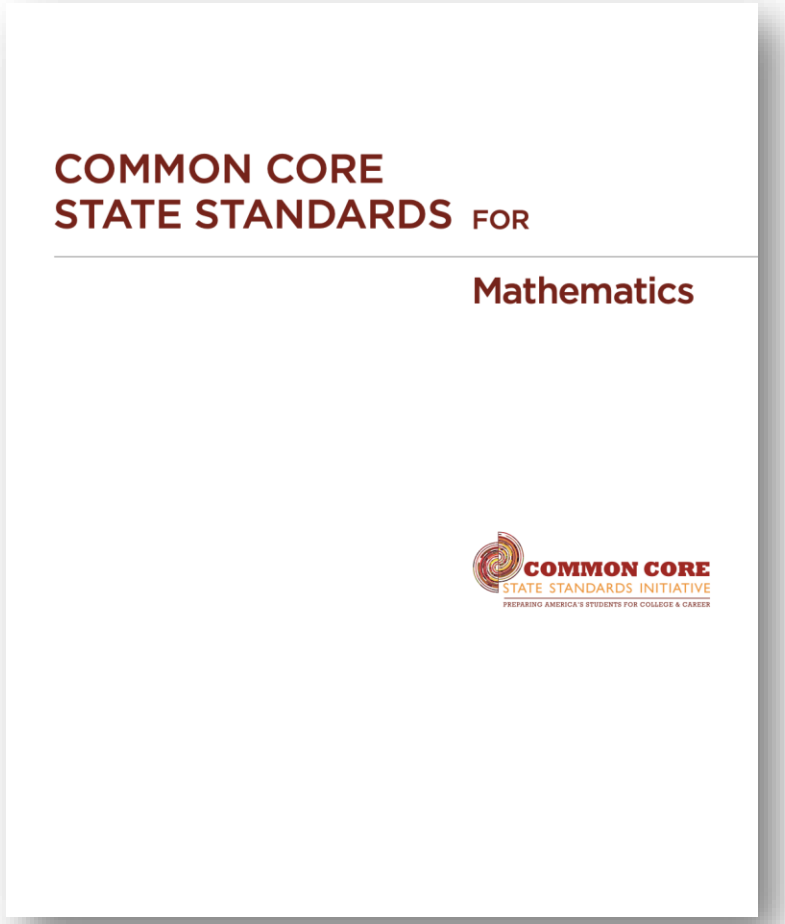
- March 2023: First team meeting
  - Apr, May, July, Aug, Sep, Oct*, Nov, Jan 2024, Feb, Mar
  - Debate, discussion, writing

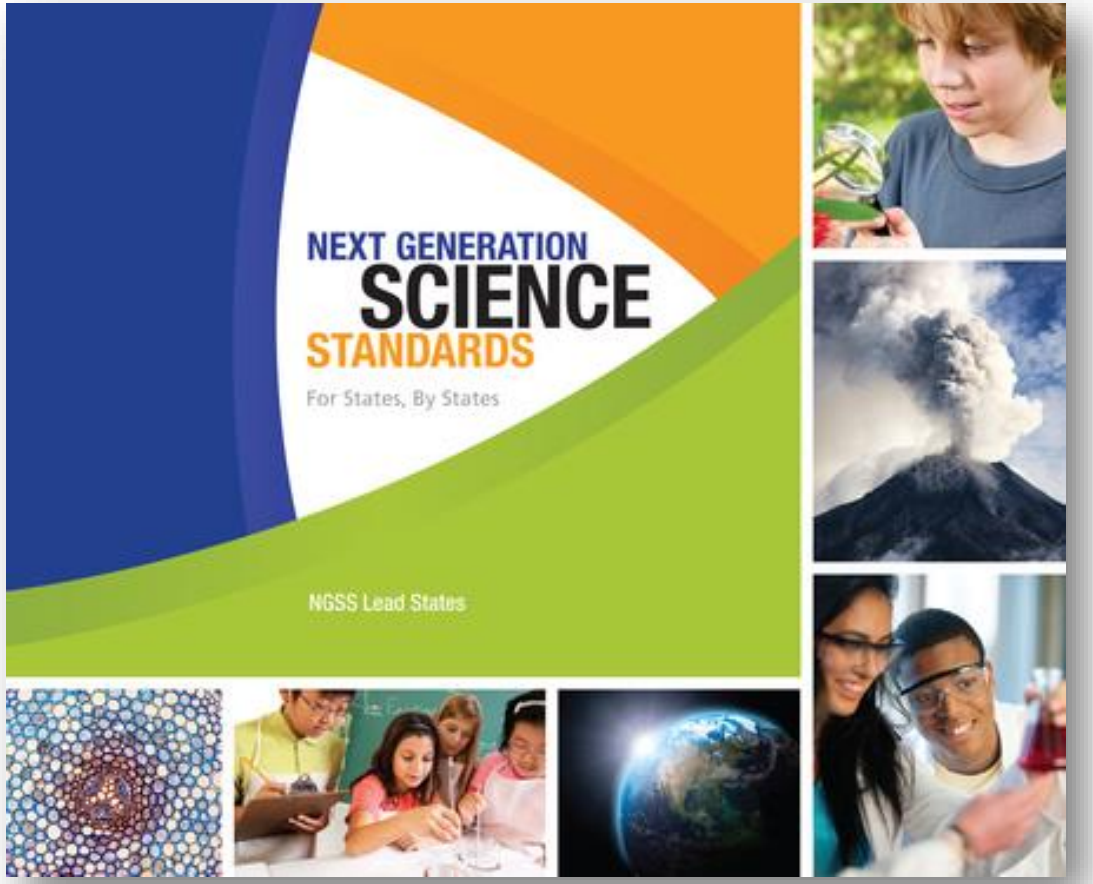
- May 2024: Shared draft with council
- Summer/Fall 2024: Edits and feedback from EC
- Dec 2024: Final version for approval

Audience?

- The Mathematical Sciences Education Board (MSEB) at the National Academies.

Common Core vs. Next Gen Science Standards



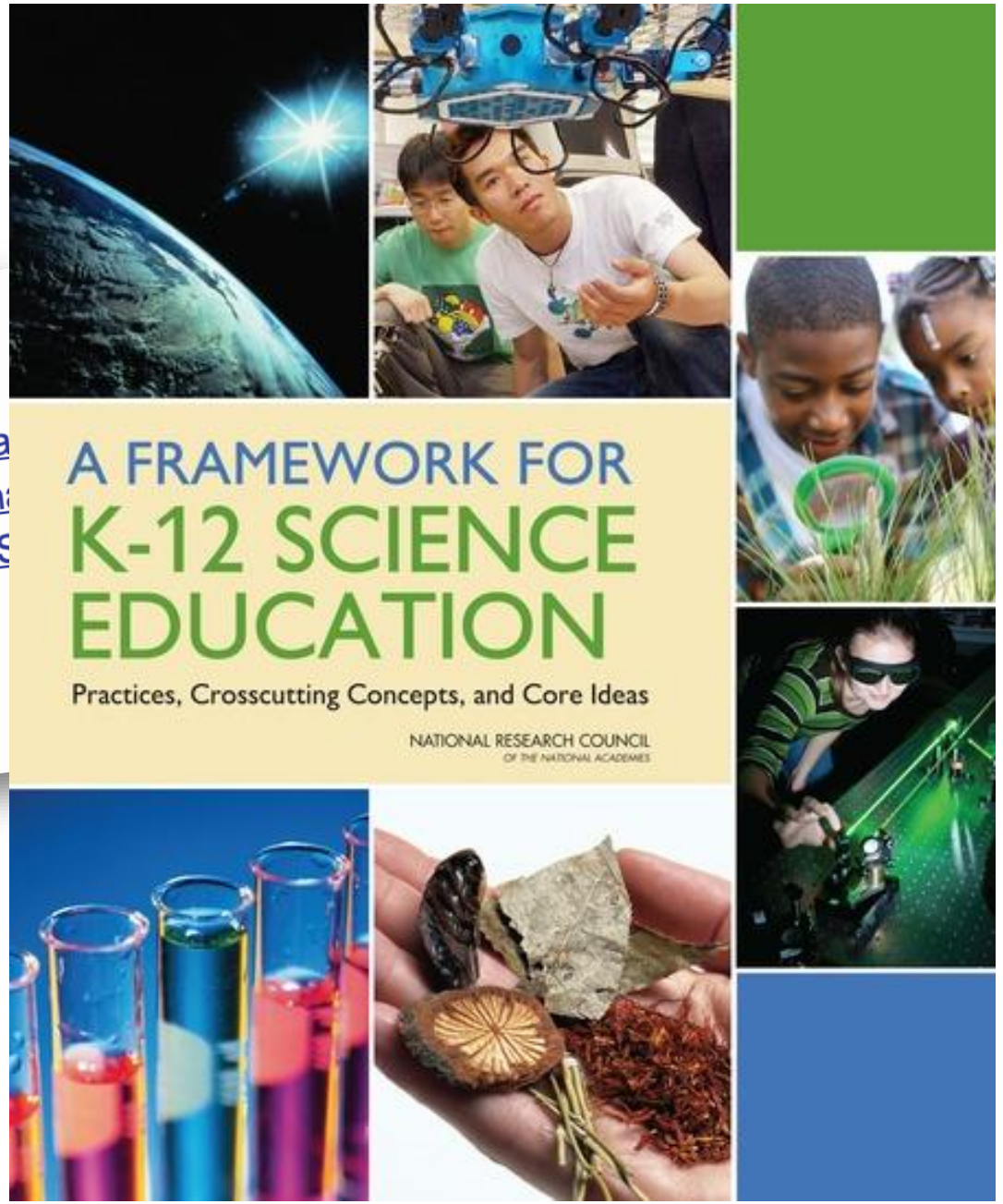


Developing the NGSS

Developing the Standards

Learn how Achieve coordinated the work of twenty-six Lead State Pa
critical partners, including the National Research Council, the Nation
Association, and the American Association for the Advancement of S
based on the *NRC*'s *K-12 Framework for Science Education*.

Click here for more information.



- Dimension 1 describes scientific and engineering practices.

- Dimension 2 describes crosscutting concepts—that is, those having applicability across science disciplines.

- Dimension 3 describes core ideas in the science disciplines and of the relationships among science, engineering, and technology.

THE THREE DIMENSIONS OF THE FRAMEWORK

1 Scientific and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
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 (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

2 Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

3 Disciplinary Core Ideas

Physical Sciences

PS1: Matter and its interactions
PS2: Motion and stability: Forces and interactions
PS3: Energy
PS4: Waves and their applications in technologies for information transfer

Life Sciences

LS1: From molecules to organisms: Structures and processes

The continuing expansion of scientific knowledge makes it impossible to teach all the ideas related to a given discipline in exhaustive detail during the K-12 years. But given the cornucopia of information available today virtually at a touch—people live, after all, in an information age—an important role of science education is not to teach "all the facts" but rather to prepare students with sufficient core knowledge so that they can later acquire additional information on their own.

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Need: A Framework for Grades 9-14 Mathematics Education

- We outline the need
- We suggest components and a charge for such work

Structure

- Overview/Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

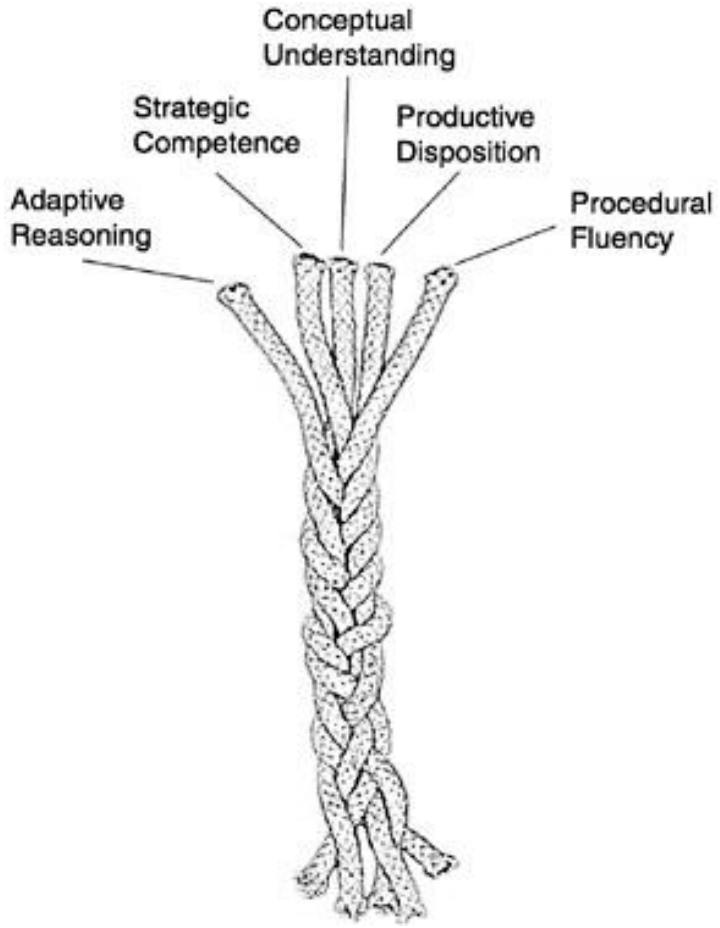
- Developments in mathematics
- Changes in higher education mathematics
- Lack of consistency
- Challenges for HS

Structure

- Overview/Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

- What we know/agree on/ believe
- Problematic aspects a framework could help resolve

- Disciplinary Literacies (Content):
  - Mathematical Modeling
  - Covariational Reasoning
  - Statistical Literacy
  - Computational Thinking
  - Abstract Reasoning



The Strands of Mathematical Proficiency, 2001

Structure

- Overview/Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

- Reasoning with quantities and their relationships
- Reasoning with uncertainty and data
- Computational reasoning
- Abstract reasoning through generalizing, specifying, and inference
- Model-based reasoning

- Also: vertical articulation, branching,

Structure

- Overview/Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

- There is wide agreement on some things (engagement, sense-making …)
- Many not given equitable opportunities to participate
- Mischaracterizations of either/or
- Clarify the sorts of experiences that all students should have

Structure

- Overview/Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

- There is currently no widely agreed upon guidance for incorporating technology into the curriculum
- The incorporation of digital technology into the classroom environment can no longer be viewed as a discretionary pedagogical choice
- Need guidance to meaningfully integrate technology into the learning environment

Structure

- Introduction
- Content
- Pedagogy
- Technology
- Sample Charge

  - What to address
  - Guiding questions

Discussion

bit.ly/cbms914dec

Look at the Sample Charge on the last page:

- Which elements are particularly important to your organization?
- What would be an ideal output from the MSEB?