PROBLEM SOLVING THROUGH ENGAGING TASKS

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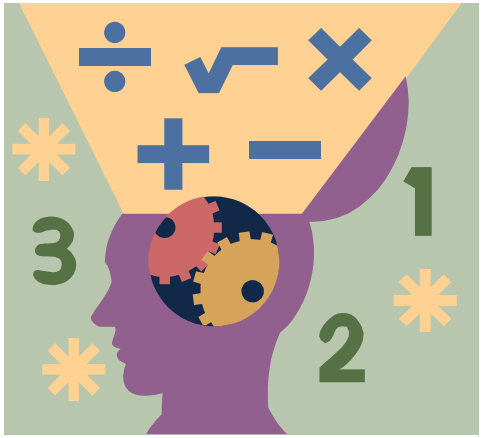
Goals of this Session

- Discuss the changes in Mathematics Education.
- Explain the key components of Problem Solving and a Performance Task.
- Review Smarter Balanced guidelines for Performance Task design.
- Analyze/Review Tasks sample Performance Tasks

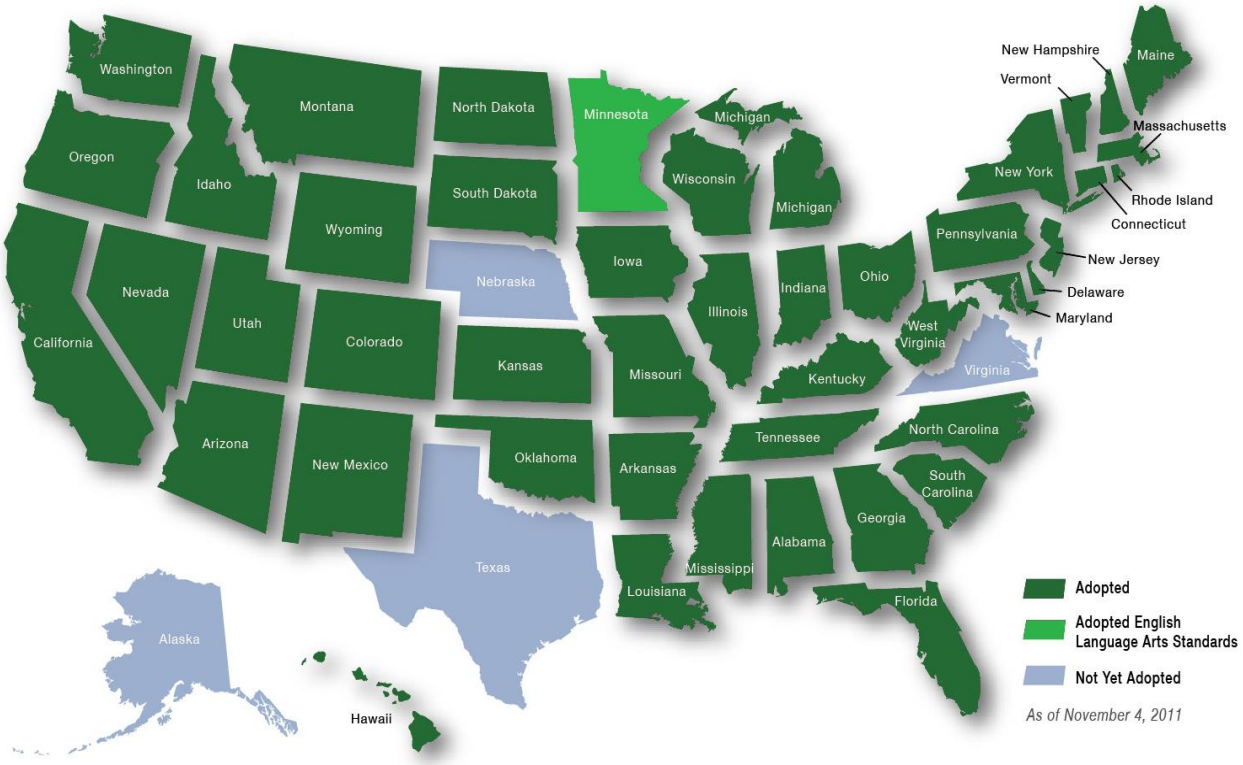


"The world is small now, and we're not just competing with students in our county or across the state. We are competing with the world," said Robert Kosicki, who graduated from a Georgia high school this year after transferring from Connecticut and having to repeat classes because the curriculum was so different. "This is a move away from the time when a student can be punished for the location of his home or the depth of his father's pockets."

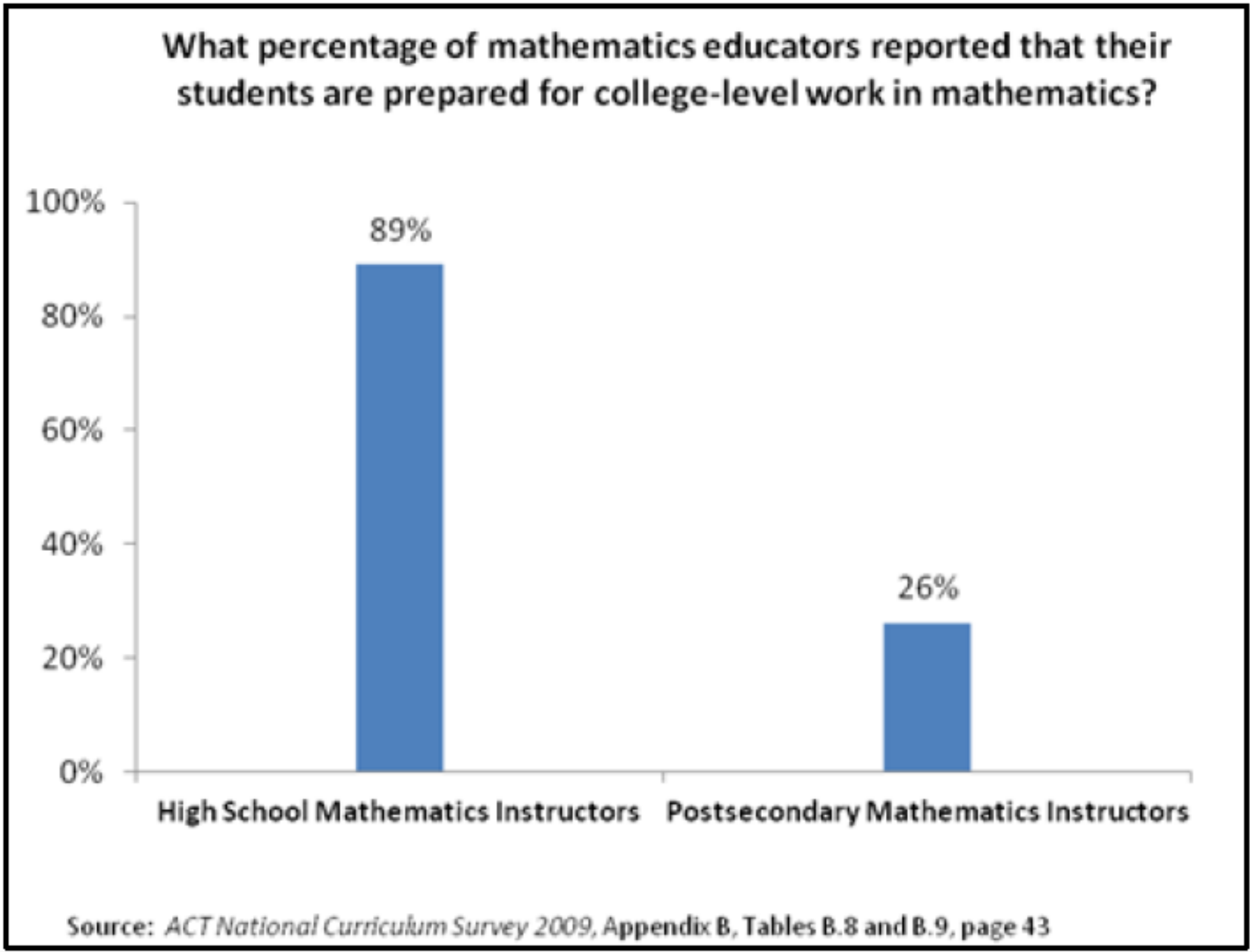
Excerpt from Fox News, Associated Press. (June 2, 2010) States join to establish 'Common Core' standards for high school graduation.

Common Core State Standards

- Define the knowledge and skills students need for college and career
- Developed voluntarily and cooperatively by states; more than 40 states have adopted
- Provide clear, consistent standards in English language arts/literacy and mathematics

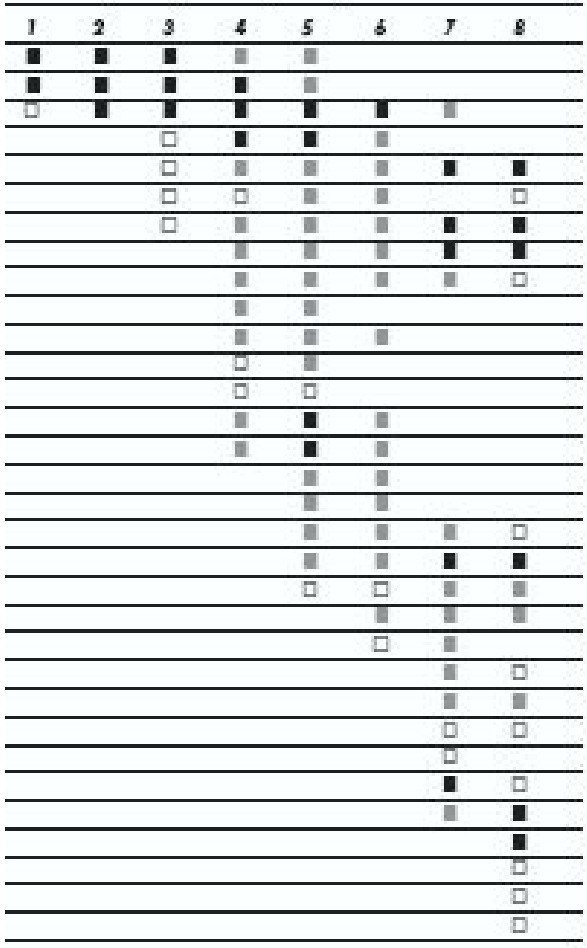


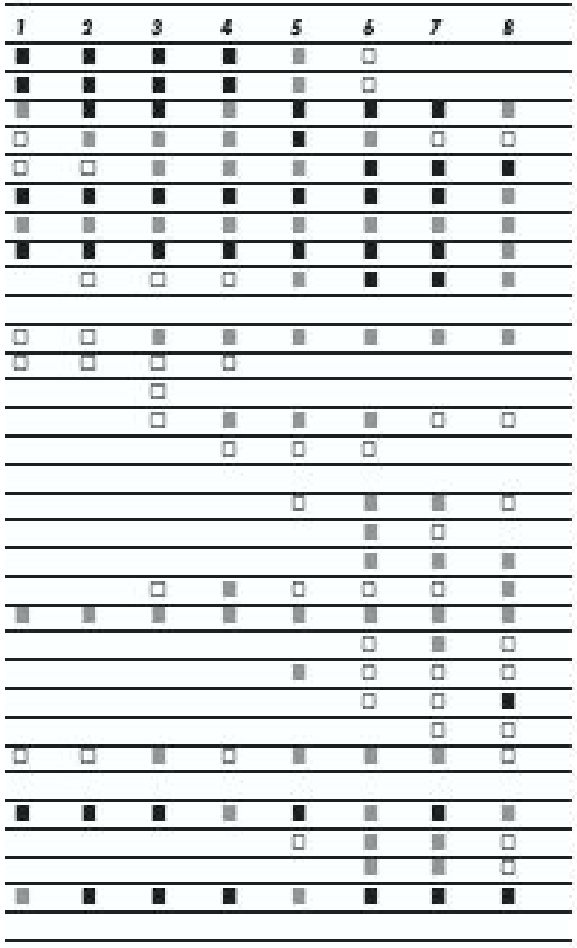
Source: www.corestandards.org


What percentage of mathematics educators reported that their students are prepared for college-level work in mathematics?
100%
80%
60%
40%
20%
0%
89%
26%
High School Mathematics Instructors
Postsecondary Mathematics Instructors
Source: ACT National Curriculum Survey 2009, Appendix B, Tables B.8 and B.9, page 43

The shape of math in A+ countries

Mathematics topics intended at each grade by at least two-thirds of A+ countries

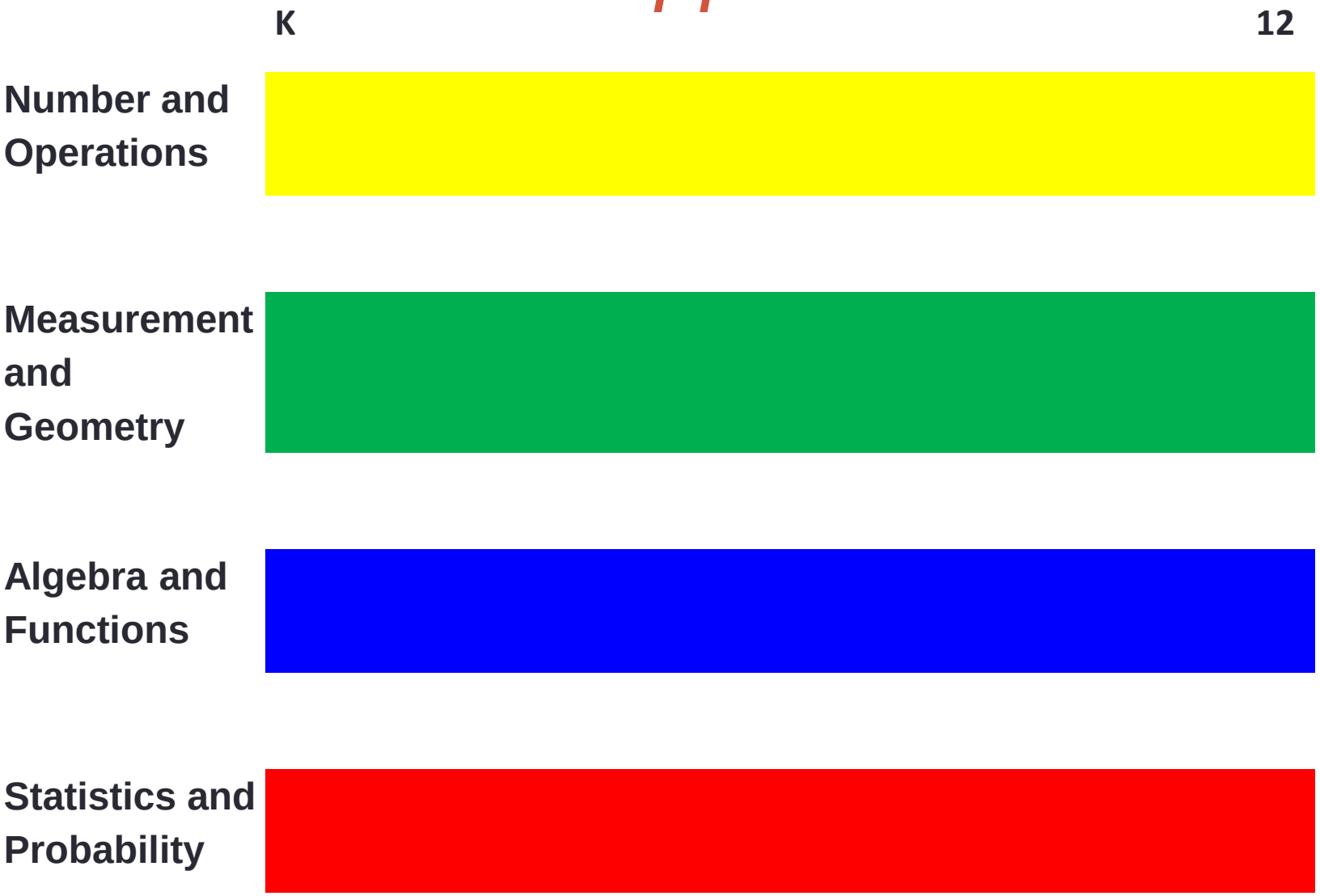




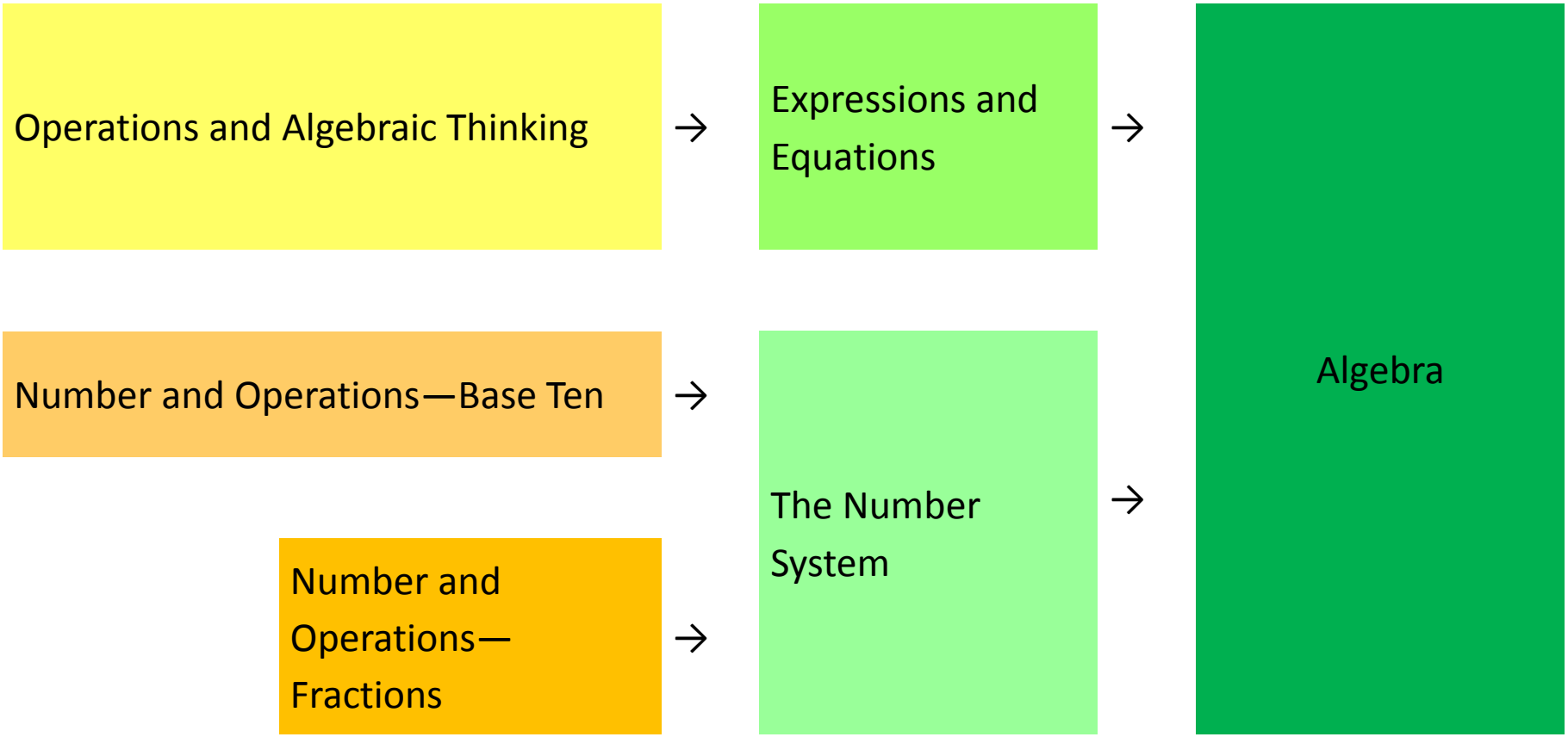
Mathematics topics intended at each grade by at least two-thirds of 21 U.S. states

[1] *Schmidt, Houang, & Cogan, "A Coherent Curriculum: The Case of Mathematics." (2002).*

Traditional U.S. Approach



Focusing Attention Within Number and Operations



K 1 2 3 4 5 6 7 8 High School

What The Disconnect Means for Students:

- Nationwide, many students in two-year and four-year colleges need remediation in math.
- Remedial classes lower the odds of finishing the degree or program.
- Need to set the agenda in high school math to prepare more students for postsecondary education and training. *(I would add K-12)*

Standards for Mathematical Practices

- 8 Practices for K-12 that are the heart of what students should be doing with mathematics (application and using mathematics).

- http://www.youtube.com/watch?v=m1rxkW8ucAI&list=UUF0pa3nE3aZAfBMT8pqM5PA

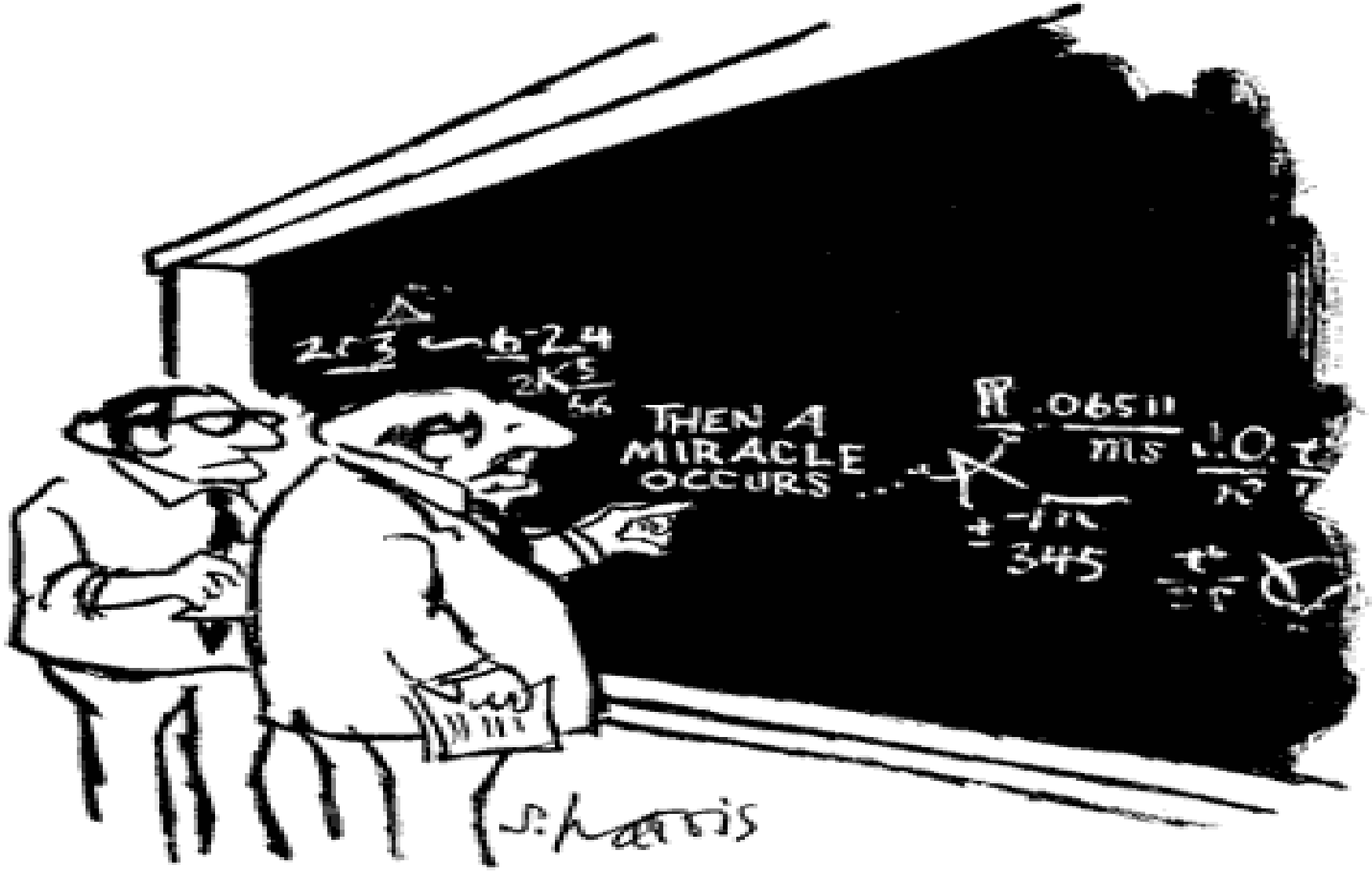
Standards for Mathematical Practice

- Standard 1: Make sense of problems and persevere in solving them
- Standard 2: Reason abstractly and quantitatively
- Standard 3: Construct viable arguments and critique the reasoning of others
- Standard 4: Model with mathematics
- Standard 5: Use appropriate tools strategically
- Standard 6: Attend to precision
- Standard 7: Look for and make use of structure
- Standard 8: Look for and express regularity in repeated reasoning
- http://www.insidemathematics.org/index.php/commmon-core-math-intro

Mathematical Problem Solving

- ***"The term "problem solving" refers to mathematical tasks that have the potential to provide intellectual challenges for enhancing student's mathematical understanding and development." NCTM Research Brief, April 8, 2010***

- http://www.nctm.org/uploadedFiles/Research_News_and_Advocacy/Research/Clips_and_Briefs/Research_brief_14_-_Problem_Solving.pdf



"I think you should be more explicit here in step two."

Engaging Tasks

- "A *mathematical task* is a problem or set of problems that focuses students' attention on a particular mathematical idea and/or provides an opportunity to develop or use a particular mathematical habit of mind."

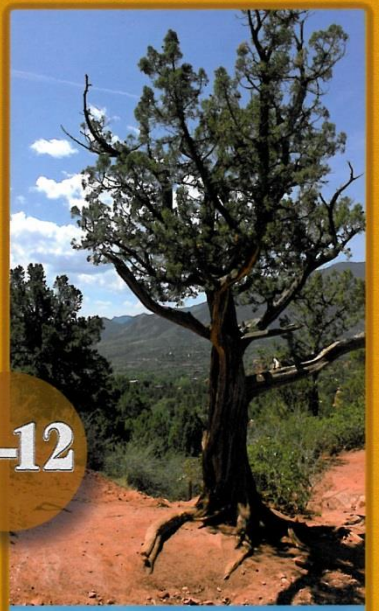
- www.commoncoretools.files.wordpress.com/...a_good_**task**_short.doc

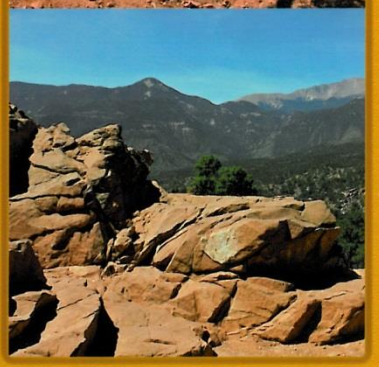
Engaging Task Resources:

- http://www.illustrativemathematics.org/
- http://insidemathematics.org/index.php/mathematical-content-standards
- http://map.mathshell.org/materials/tasks.php
- http://schools.nyc.gov/Academics/CommonCoreLibrary/TasksUnitsStudentWork/default.htm
- http://commoncoretools.me/illustrative-mathematics/
- http://illuminations.nctm.org/Activities.aspx?grade=all&srchstr=problem%20solving

NCSM Great Tasks for Mathematics 6–12

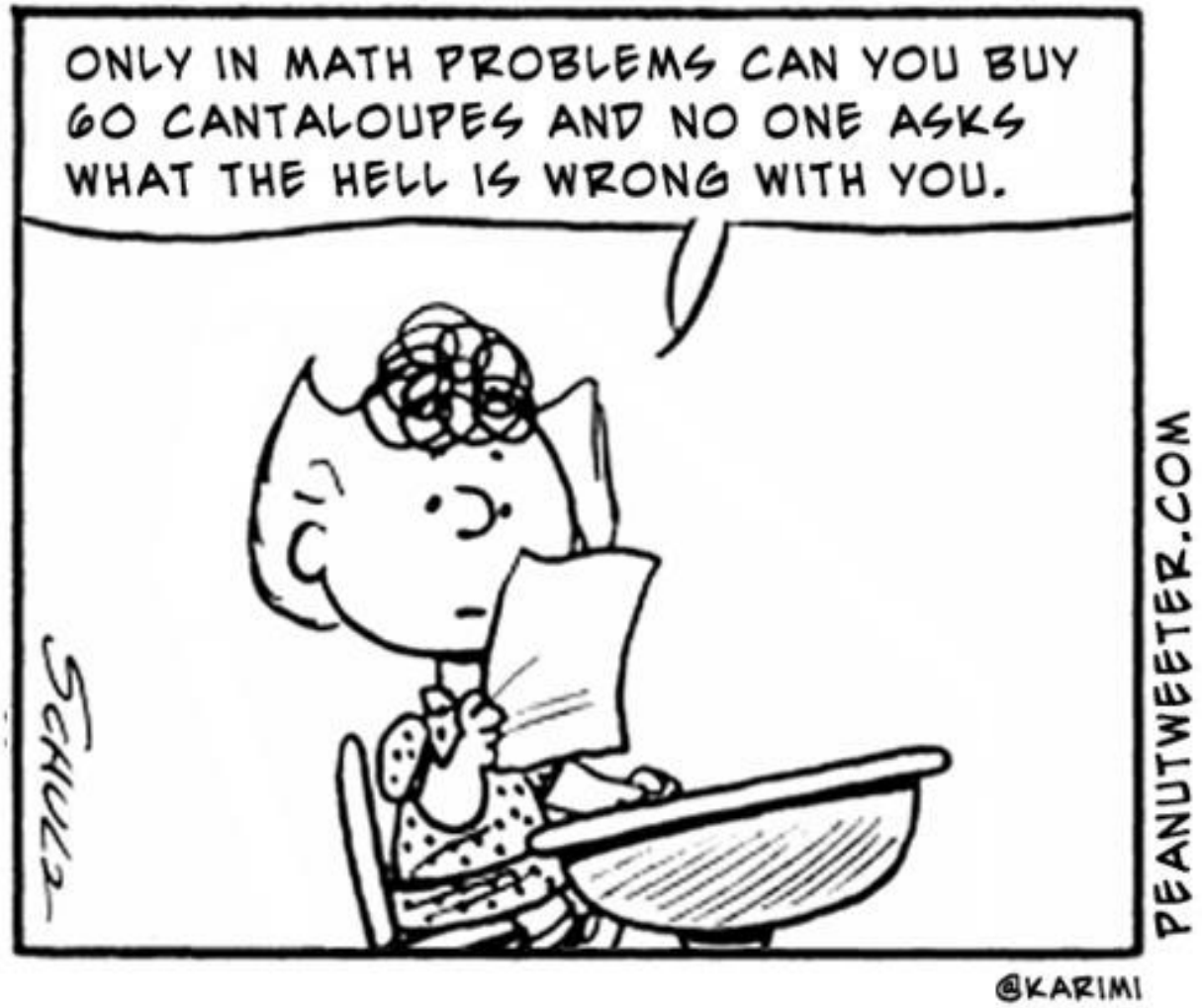
Engaging Activities for Effective Instruction and Assessment that Integrate the Content and Practices of the Common Core State Standards for Mathematics





CONNIE SCHROCK, KIT NORRIS,
DAVID K. PUGALEE, RICHARD SEITZ,
AND FRED HOLLINGSHEAD

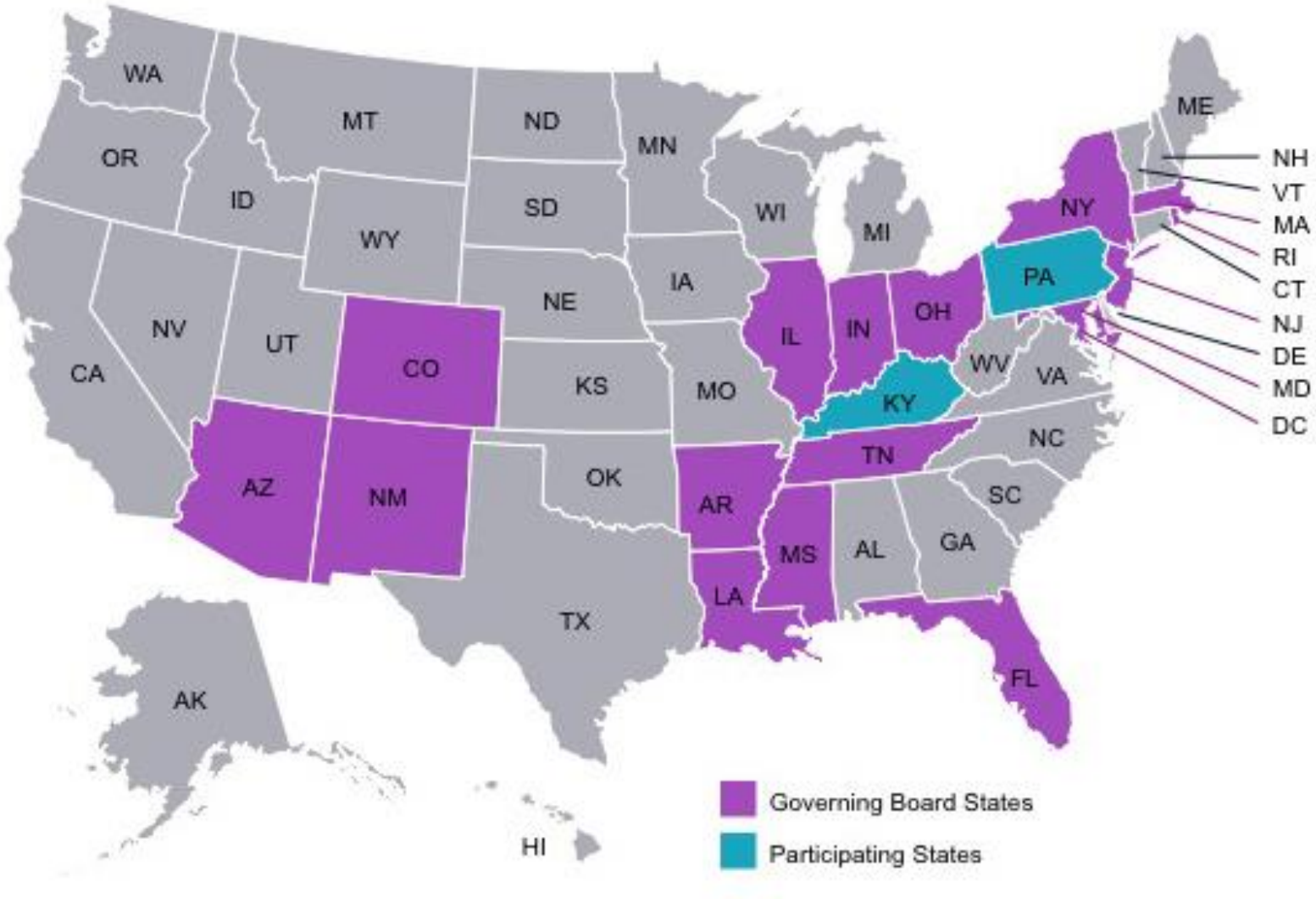
LEADERSHIP IN MATHEMATICS EDUCATION
NCSM
NETWORK
COMMUNICATE
SUPPORT
MOTIVATE


ONLY IN MATH PROBLEMS CAN YOU BUY 60 CANTALOUPES AND NO ONE ASKS WHAT THE HELL IS WRONG WITH YOU.
SCHULZ
PEANUTWEETER.COM
@KARIMI

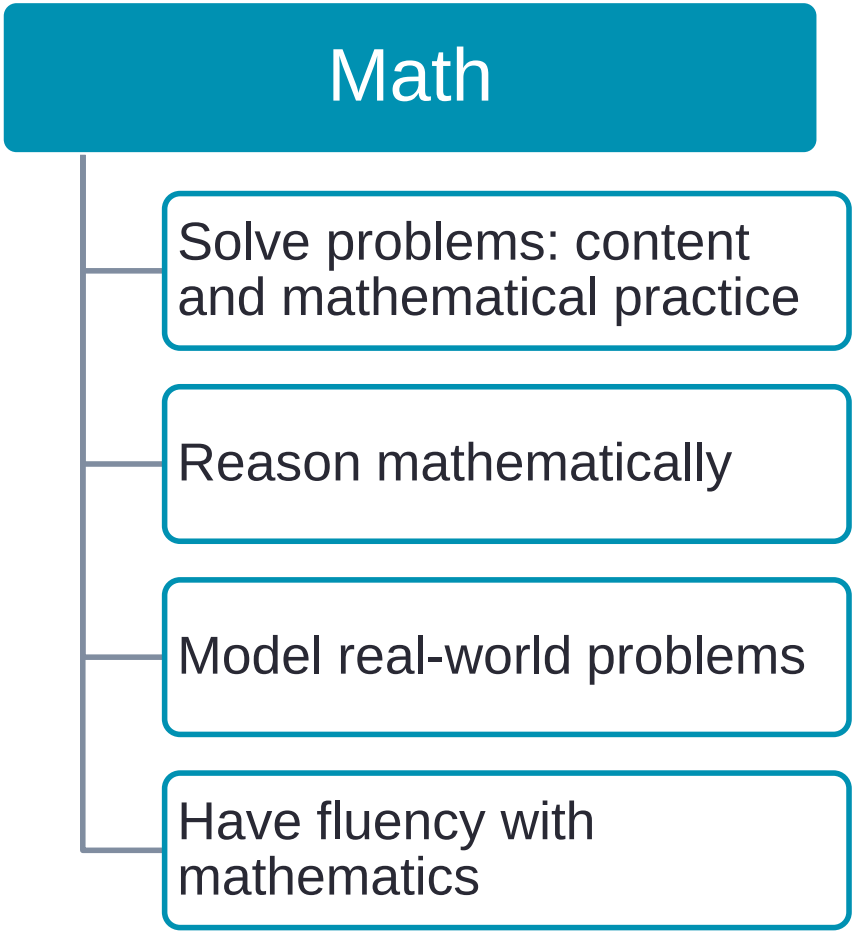
State Summative Assessments

- Smarter Balanced
- PARCC

Partnership for Assessment of Readiness for College and Careers (PARCC)

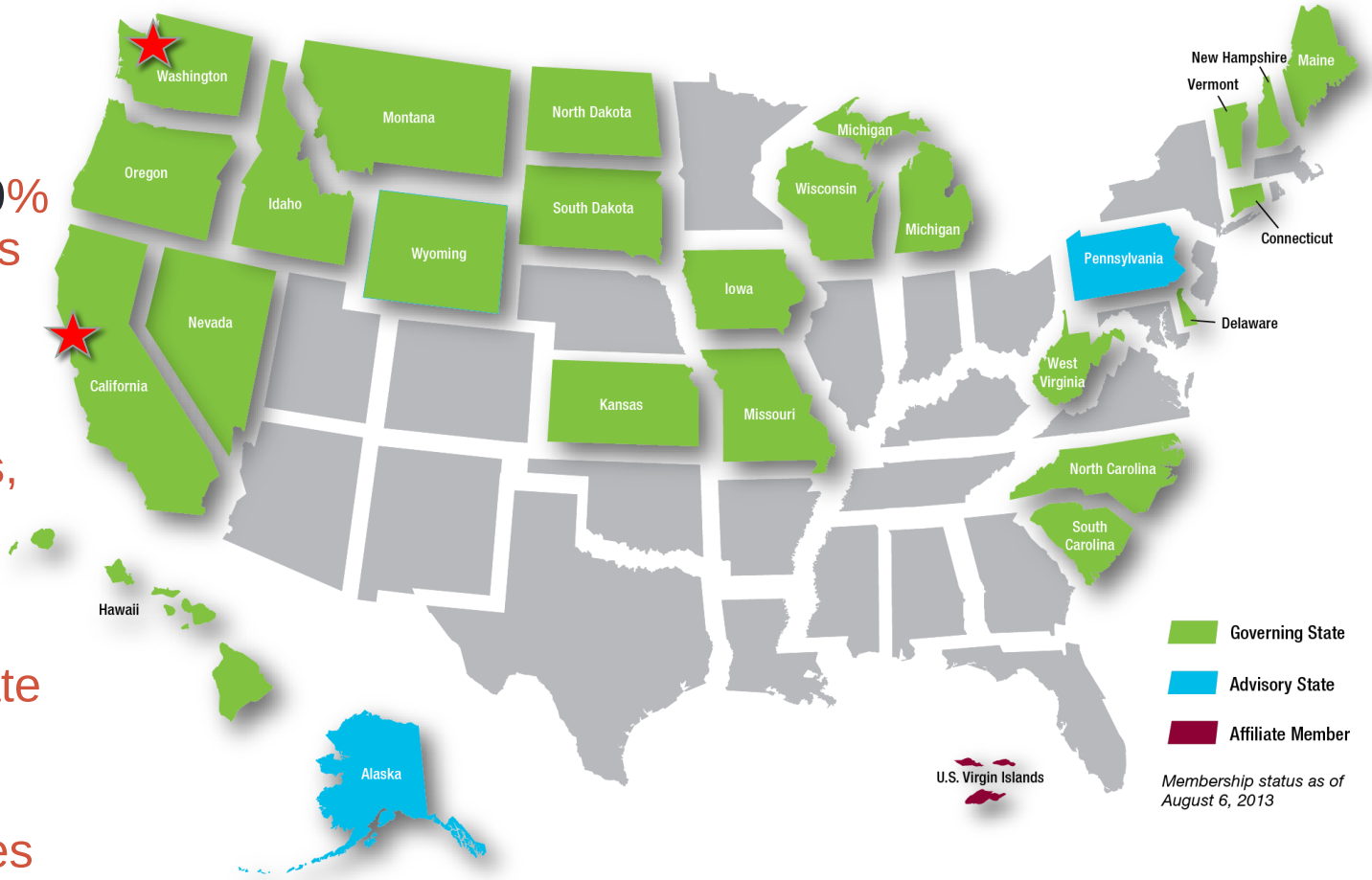


Higher Expectations (PARCC)



Smarter Balanced

- 26 member states and territories representing 39% of K-12 students
- 23 Governing States, 2 Advisory States, 1 Affiliate Member
- Washington state is fiscal agent
- WestEd provides project management services



Structure of the Common Core State Standards for Mathematics

- Research-based learning progressions
- Internationally benchmarked
- Focused and coherent
- Standards for Mathematical Practice
  - Identify important processes and proficiencies
- Standards for Mathematical Content
  - Grade specific expectations

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Cognitive Rigor and Depth of Knowledge (DOK)

The level of complexity of the cognitive demand.

- Level 1: Recall and Reproduction

  Requires eliciting information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula.

- Level 2: Basic Skills and Concepts

  Requires the engagement of some mental processing beyond a recall of information.

- Level 3: Strategic Thinking and Reasoning

  Requires reasoning, planning, using evidence, and explanations of thinking.

- Level 4: Extended Thinking

  Requires complex reasoning, planning, developing, and thinking most likely over an extended period of time.

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Smarter Balanced Claims

- Claim 1: Concepts and Procedures
  - Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency
- Claim 2: Problem Solving
  - Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies
- Claim 3: Communicating Reasoning
  - Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others
- Claim 4: Modeling and Data Analysis
  - Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Claims 2, 3, and 4

- A general set of assessment targets applicable across grade levels.
- Performance Tasks focus on Claims 2, 3 and 4.

Claim/Score Reporting Category	PT Items
1. Concepts and Procedures	0
2. Problem Solving	1–2
3. Communicating Reasoning	2
4. Modeling and Data Analysis	2–3
Total	6 items

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Claim 2 (Problem Solving)

- Claim 2 (Problem Solving) items set the foundation for students to model and analyze data.
- The first 2 items of a Performance Task generally address Claim 2 to allow entry to the task.
- Looking at the sample Performance Task, what do you notice about the Claim 2 items?

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Assessment Targets
Claim 2 – Problem Solving

Claim 2: Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies.

A. Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. (DOK 2, 3)

B. Select and use tools strategically. (DOK 1, 2)

C. Interpret results in the context of the situation. (DOK 2)

D. Identify important quantities in a practical situation and map their relationships. (DOK 1, 2, 3)

PT Item Framework

Smarter Balanced Content Specifications (Claims and Depth of Knowledge)

Common Core State Standards and Mathematical Practices

Item Number:	3
Claim:	3
Assessment Target(s):	3A
Content Domain(s):	Geometry
Standard(s):	7.G.6 8.G.9 G.GMD.4; G.MG.1
Mathematical Practice(s):	3, 4
DOK:	2
Response Type:	Short Text
Machine Scorable:	No, Hand
Score Points:	2
Difficulty:	Medium
Notes:	

What is a Performance Task?

- A performance task (PT) is an item type designed to provide students with an opportunity to demonstrate their ability to apply their knowledge and higher-order thinking skills to explore and analyze a complex, real-world scenario.
- A mathematics performance task elicits evidence of students' ability to "bring it all together" to develop a solution plan to the central challenge of the task.

Smarter Balanced Performance Task Specifications and Engagement Framework

Performance Tasks…

- Reflect a real-world task and/or scenario-based problem.
- Represent content that is relevant and meaningful to students.
- Measure capacities such as depth of understanding, research skills, and/or complex analysis with relevant evidence.
- Require student-initiated planning, management of information/data and ideas, and/or interaction with other materials.
- Allow for multiple approaches.

Performance Tasks…

- Need to be feasible for the school/classroom environment.
- Allow for demonstration of important knowledge and skills, including those that address 21st-century skills, such as critically analyzing and synthesizing information presented in a variety of formats, media, etc.
- Integrate knowledge and skills across multiple Claims and Targets – a key component of college and career readiness.
- Require scoring that focuses on the essence of the Claim(s) and Targets for which the task was written.

Coherence and Purpose of Task

- All items of the Performance Task should be coherent and connected to the context of the classroom activity.
- While the first 2 items cannot be interdependent with the final 4 items, they are intended to give students an opportunity to gain entry into the task. (The final 4 items should be interdependent.)
- There should be a clear purpose for students' engagement with the task. Ask yourself, "Why would a student of this age/grade level care about this task/topic?"

Developmentally Appropriate, Engaging, and Accessible

- The Performance Task should be developmentally appropriate.
- The Performance Task should assess mathematics content standards up to the grade level of the target task (can draw on content standards from earlier grades).
- Students of the target age group should have had experience in the context of the task.