Measuring Math that Matters: The PARCC and Smarter Balanced Approaches to Assessment

Today's Webinar will begin shortly

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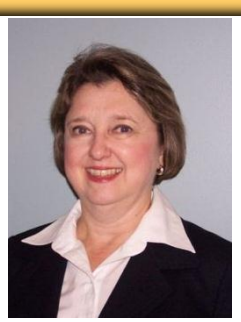
National Council of Supervisors of Mathematics

Measuring Math that Matters: The PARCC and Smarter Balanced Approaches to Assessment

www.mathedleadership.org

Presenters



Suzanne Mitchell, NCSM President

Carrie Piper-Senior Mathematics Advisor, Partnership for Readiness for College and Career (PARCC)

Shelbi Cole, Director of Mathematics, Smarter Balanced Assessment Consortium

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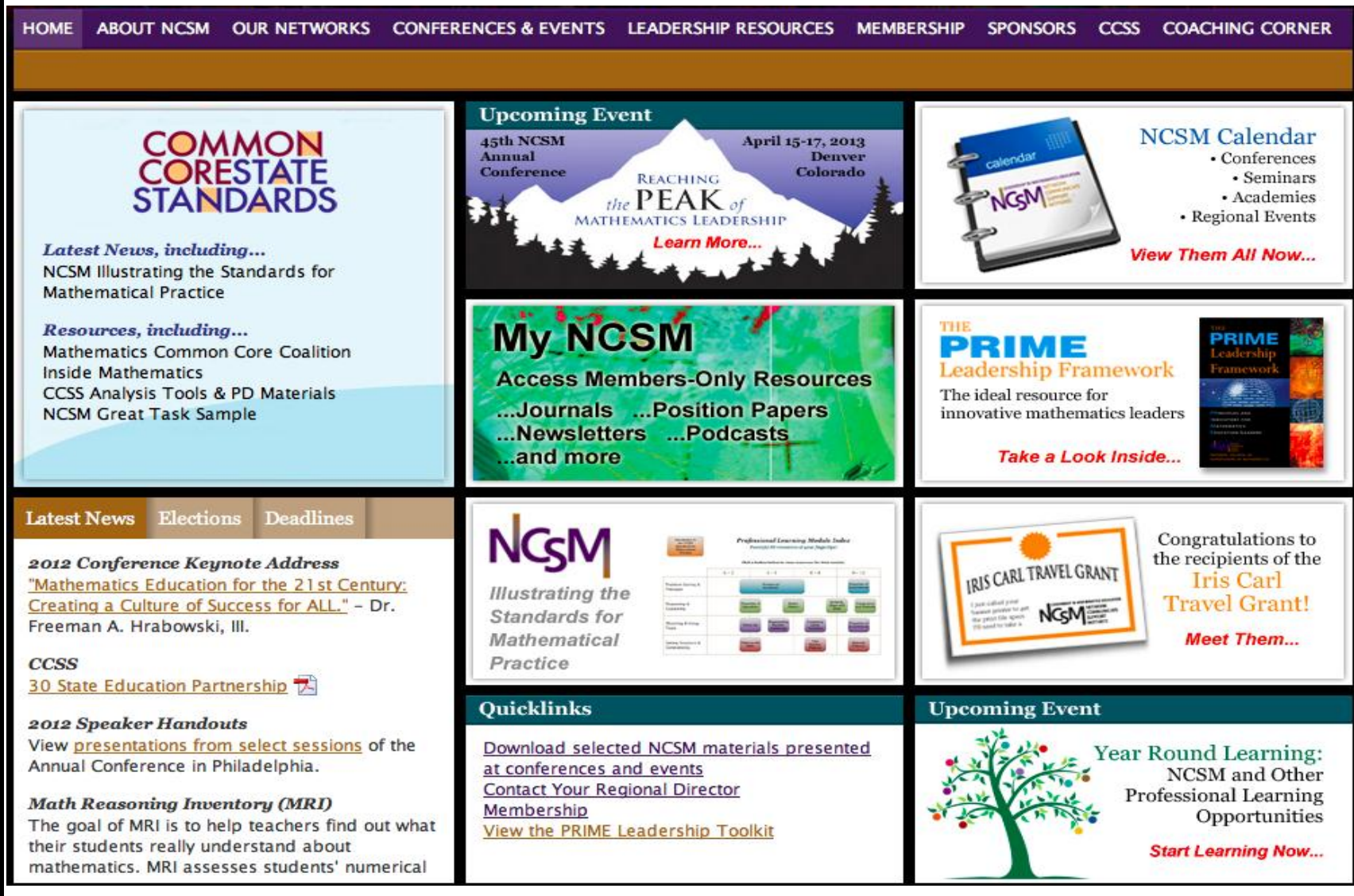

NCSM Professional Development Opportunities

- **NCSM Annual Conference**
  - **April 15-17, 2013, Denver, CO**
- **NCSM Summer Leadership Academy**
  - **July 23-25, 2013 Los Angeles, CA**
  - **July 29-31, 2013, Columbus, OH**
- **NCSM Fall One-Day Leadership Seminars**
  - **October 16, 2013, Baltimore, MD**
  - **October 23, 2013, Las Vegas, NV**
  - **November 6, 2013, Louisville, KY**

Briars, October 2011

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1. Effective and Collaborative Teams
2. Sustained Professional Learning
3. Equity
4. Students with Special Needs
5. Assessment
6. English Language Learners
7. Positive Self-Beliefs
8. Technology
9. Mathematically Promising Students
10. Mathematics for the Young

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Today's Goals

- **Discuss PARCC Assessment Design and Model Content Framework**
- **Discuss an overview of PARCC Task Types and Evidence Statements**
- **Discuss the differences in formative, interim and summative assessment**
- **Discuss K-12 teacher and higher education involvement**
- **Review Smarter Balanced Sample Test Items**

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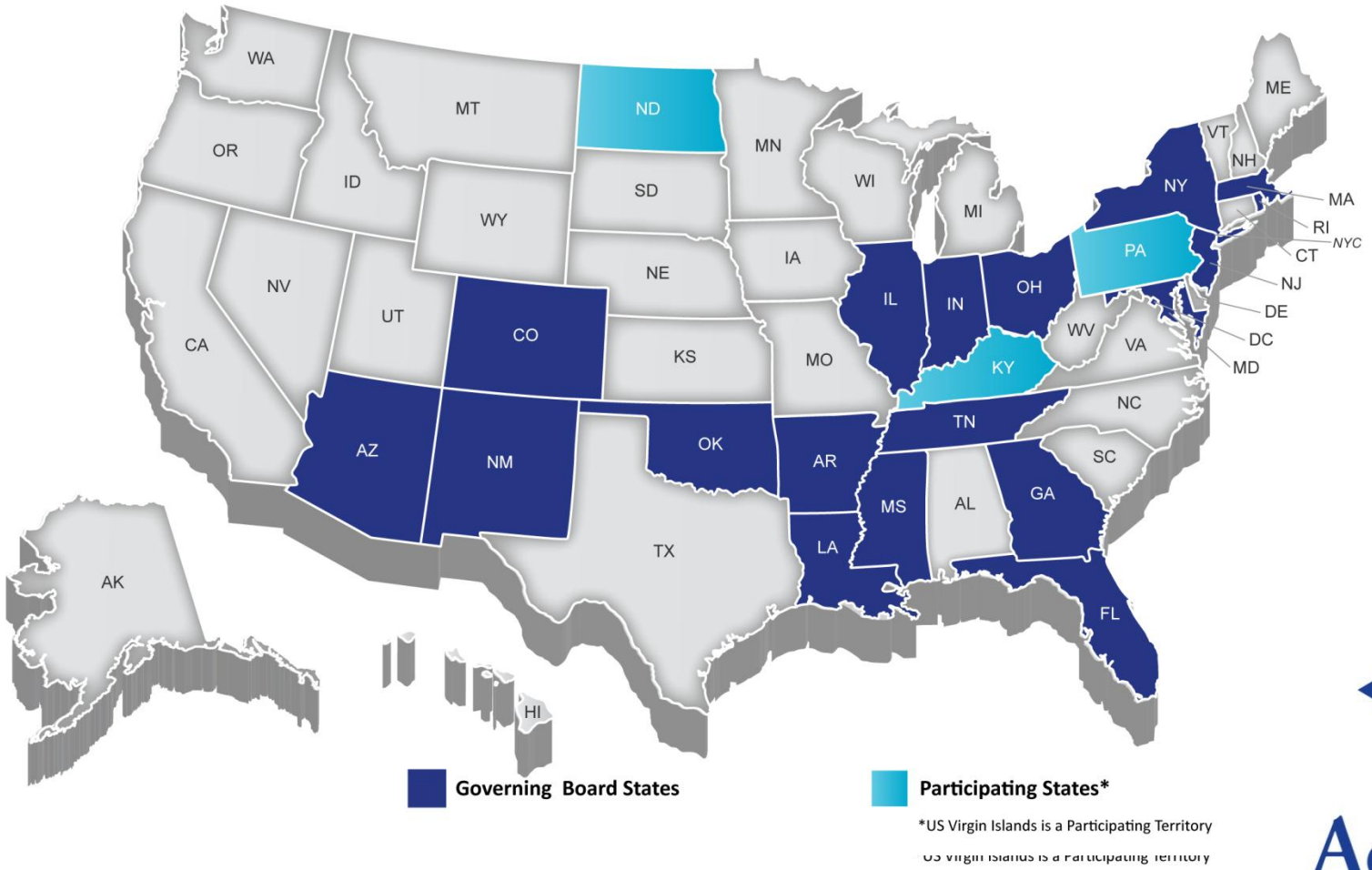
PARCC Mathematics Update

February 2013

Presenter:
Carrie Piper, Senior Advisor, Mathematics

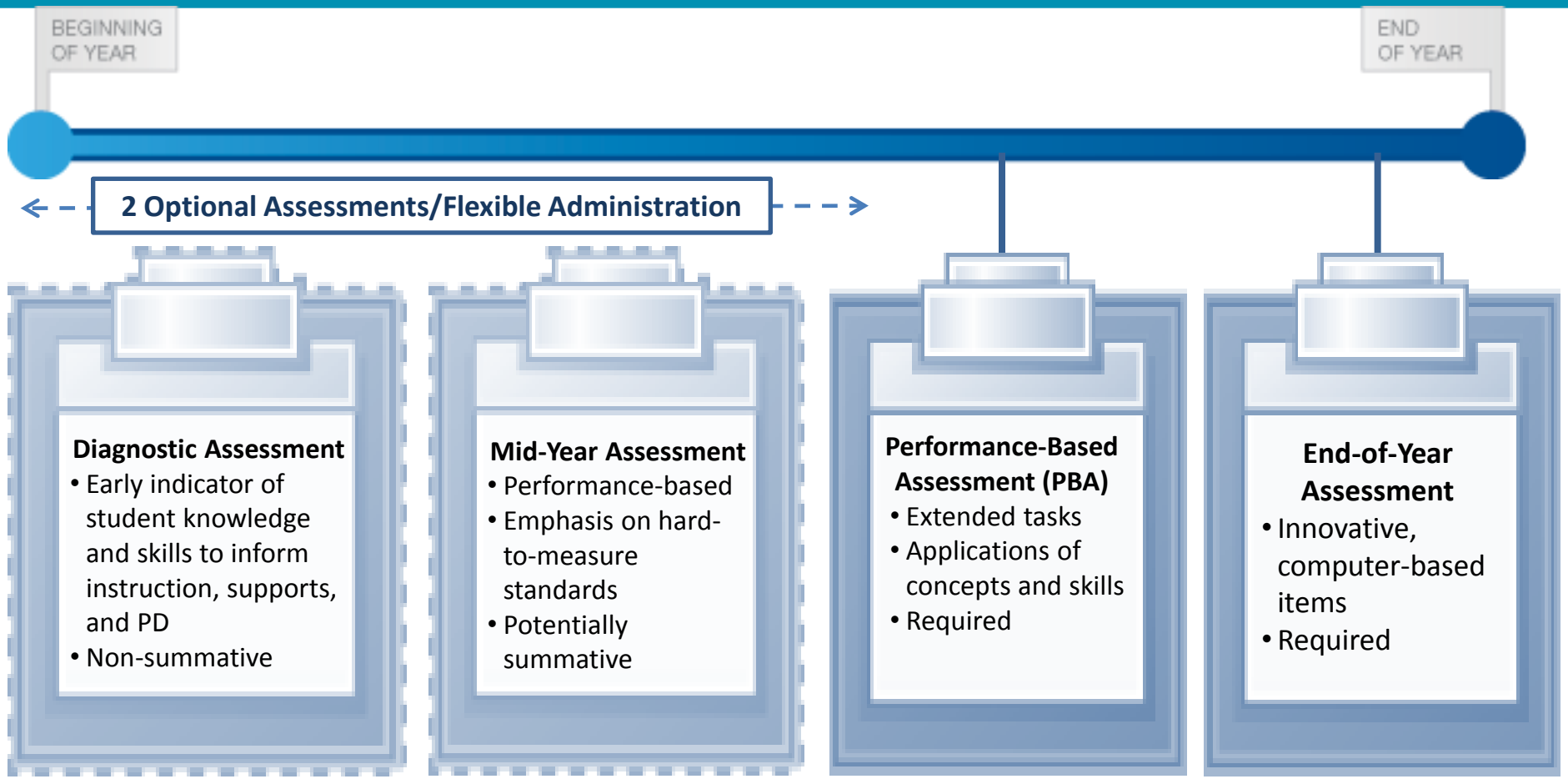
Partnership for Assessment of Readiness for College and Careers (PARCC)



Achieve

Assessment Design

Mathematics, Grades 3-8 and High School End-of-Course



A Little History of PARCC Mathematics

- PARCC states developed Claims for Mathematics based on the CCSSM.
- PARCC states developed the Model Content Frameworks to provide guidance to key elements of excellent instruction aligned with the Standards.
- The blueprints for the PARCC Mathematics Assessments have been developed using the CCSS, Claims and Model Content Frameworks.
- Cognitive Complexity Framework development in partnership with item development contractors.
- Performance Level Descriptors are in the process of being drafted.
- Phase 1 of items development is well on its way.

Claims Driving Design: Mathematics

Students are on-track or ready for college and careers

Sub-claim A: Students **solve problems involving the major content** for their grade level with connections to practices

Sub-Claim B: Students **solve problems involving the additional and supporting content** for their grade level with connections to practices

Sub-claim C: Students **express mathematical reasoning** by constructing mathematical arguments and critiques

Sub-Claim D: Students solve real world problems engaging particularly in the **modeling practice**

Sub-Claim E: Student **demonstrate fluency** in areas set forth in the Standards for Content in grades 3-6

PARCC Model Content Frameworks

Approach of the Model Content Frameworks for Mathematics

- PARCC Model Content Frameworks provide a deep analysis of the CCSS, leading to more guidance on how focus, coherence, content and practices all work together.
- They **focus on framing the critical advances in the standards:**
  - Focus and coherence
  - Content knowledge, conceptual understanding, and expertise
  - Content and mathematical practices
- Model Content Frameworks for grades 3-8, Algebra I, Geometry, Algebra II, Mathematics I, Mathematics II, Mathematics III

Model Content Frameworks
Grade 3 Example

Key: ■ Major Clusters; ◘ Supporting Clusters; ○ Additional Clusters

Operations and Algebraic Thinking

- ■ Represent and solve problems involving multiplication and division.
- ■ Understand properties of multiplication and the relationship between multiplication and division.
- ■ Multiply and divide within 100.
- ■ Solve problems involving the four operations, and identify and explain patterns in arithmetic.

Number and Operations in Base Ten

- ○ Use place value understanding and properties of operations to perform multi-digit arithmetic.

Number and Operations — Fractions

- ■ Develop understanding of fractions as numbers.

Measurement and Data

- ■ Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.
- ◘ Represent and interpret data.
- ■ Geometric measurement: understand concepts of area and relate area to multiplication and addition.
- ○ Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Geometry

- ◘ Reason with shapes and their attributes.

How we have been presenting Evidence-Centered Design (ECD)

Claims

Design begins with the inferences (**claims**) we want to make about students

Evidence

In order to support **claims**, we must gather **evidence**

Task Models

Tasks are designed to elicit specific **evidence** from students in support of **claims**

ECD is a deliberate and systematic approach to assessment development that will help to **establish the validity** of the assessments, **increase the comparability** of year-to year results, and **increase efficiencies/reduce costs**.

Claims Structure: Mathematics

Master Claim: On-Track for college and career readiness. The degree to which a student is college and career ready (or "on-track" to being ready) in mathematics. The student solves grade-level /course-level problems in mathematics as set forth in the Standards for Mathematical Content with connections to the Standards for Mathematical Practice.

Total Exam Score Points:
92 (Grades 3-8), 107 (HS)

Sub-Claim A: Major Content[1] with Connections to Practices

The student solves problems involving the Major Content[1] for her grade/course with connections to the Standards for Mathematical Practice.

~40 pts (3-8),
~50 pts (HS)

Sub-Claim B: Additional & Supporting Content[2] with Connections to Practices

The student solves problems involving the Additional and Supporting Content[2] for her grade/course with connections to the Standards for Mathematical Practice.

~18 pts (3-8),
~25 pts (HS)

Sub-Claim C: Highlighted Practices MP.3,6 with Connections to Content[3] (expressing mathematical reasoning)

The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.

14 pts (3-8),
14 pts (HS)

Sub-Claim D: Highlighted Practice MP.4 with Connections to Content (modeling/application)

The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), *engaging particularly in the Modeling practice*, and where helpful making sense of problems and persevering to solve them (MP. 1),reasoning abstractly and quantitatively (MP. 2), using appropriate tools strategically (MP.5), looking for and making use of structure (MP.7), and/or looking for and expressing regularity in repeated reasoning (MP.8).

12 pts (3-8),
18 pts (HS)

Sub-Claim E: Fluency in applicable grades (3-6)

The student demonstrates fluency as set forth in the Standards for Mathematical Content in her grade.

7-10 pts (3-6)

[1] For the purposes of the PARCC Mathematics assessments, the Major Content in a grade/course is determined by that grade level's Major Clusters as identified in the *PARCC Model Content Frameworks v.3.0* for Mathematics. Note that tasks on PARCC assessments providing evidence for this claim will sometimes require the student to apply the knowledge, skills, and understandings from across several Major Clusters.
[2] The Additional and Supporting Content in a grade/course is determined by that grade level's Additional and Supporting Clusters as identified in the *PARCC Model Content Frameworks v.3.0* for Mathematics.
[3] For 3 – 8, Sub-Claim C includes only Major Content. For High School, Sub-Claim C includes Major, Additional and Supporting Content.

Overview of Task Types

- The PARCC assessments for mathematics will involve three primary types of tasks: Type I, II, and III.
- Each task type is described on the basis of several factors, principally the purpose of the task in generating evidence for certain sub-claims.

 Source: Appendix D of the PARCC Task Development ITN on page 17

Overview of PARCC Mathematics Task Types

Task Type	Description of Task Type
I. Tasks assessing *concepts, skills and procedures*	• Balance of conceptual understanding, fluency, and application • Can involve any or all mathematical practice standards • Machine scorable including innovative, computer-based formats • Will appear on the End of Year and Performance Based Assessment components • Sub-claims A, B and E
II. Tasks assessing *expressing mathematical reasoning*	• Each task calls for written arguments / justifications, critique of reasoning, or precision in mathematical statements (MP.3, 6). • Can involve other mathematical practice standards • May include a mix of machine scored and hand scored responses • Included on the Performance Based Assessment component • Sub-claim C
III. Tasks assessing *modeling / applications*	• Each task calls for modeling/application in a real-world context or scenario (MP.4) • Can involve other mathematical practice standards • May include a mix of machine scored and hand scored responses • Included on the Performance Based Assessment component • Sub-claim D

For more information see PARCC Task Development ITN Appendix D.

Design of PARCC Math Summative Assessment

- Performance Based Assessment (PBA)
  - Type I items (Machine-scorable)
  - Type II items (Mathematical Reasoning/Hand-Scored – scoring rubrics are drafted but PLD development will inform final rubrics)
  - Type III items (Mathematical Modeling/Hand-Scored and/or Machine-scored - scoring rubrics are drafted but PLD development will inform final rubrics)
- End-of-Year Assessment (EOY)
  - Type I items only (All Machine-scorable)

Overview of Evidence Statements: Types of Evidence Statements

Several types of evidence statements are being used to describe what a task should be assessing, including:

- Those using **exact standards language**
- Those transparently **derived from exact standards** language, e.g., by splitting a content standard
- **Integrative evidence statements** that express plausible direct implications of the standards without going beyond the standards to create new requirements
- **Sub-claim C & D evidence statements**, which put MP.3, 4, 6 as primary with connections to content

Overview of Evidence Statements: Examples

Several types of evidence statements are being used to describe what a task should be assessing, including:

1. Those using **exact standards language**

Key	Evidence Statement Text	Clarifications, limits, emphases, and other information intended to ensure appropriate variety in tasks	Relationship to Mathematical Practices
8.EE.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 1/3^3 = 1/27$.	i) Tasks do not have a context. ii) Tasks center on the properties and equivalence, not on simplification. For example, a task might ask a student to classify expressions according to whether or not they are equivalent to a given expression.	MP.7

Overview of Evidence Statements: Examples

Several types of evidence statements are being used to describe what a task should be assessing, including:

2. Those transparently **derived from exact standards** language, e.g., by splitting a content standard

Key	Evidence Statement Text	Clarifications, limits, emphases, and other information intended to ensure appropriate variety in tasks	Relationship to MP
8.F.5-1	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear).	i) Pool should contain tasks with and without contexts.	MP.2, MP.5
8.F.5-2	Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	i) Pool should contain tasks with and without contexts.	MP.2, MP.5, MP.7

Overview of Evidence Statements: Examples

Several types of evidence statements are being used to describe what a task should be assessing, including:

3. **Integrative evidence statements** that express plausible direct implications of the standards without going beyond the standards to create new requirements

Key	Evidence Statement Text	Clarifications, limits, emphases, and other information intended to ensure appropriate variety in tasks	Relationship to MP
4.Int.1	Solve one-step word problems involving adding or subtracting two four-digit numbers.	The given numbers are such as to require an efficient/standard algorithm (e.g., 7263 + 4875, 7263 – 4875, 7406 – 4637). The given numbers do not suggest any obvious *ad hoc* or mental strategy (as would be present for example in a case such as16,999 + 3,501 or 7300 – 6301, for example). i) Grade 4 expectations in CCSSM are limited to whole numbers less than or equal to 1,000,000; for purposes of assessment, both of the given numbers should be limited to 4 digits.	MP.1

Overview of Evidence Statements: Examples

Several types of evidence statements are being used to describe what a task should be assessing, including:

4. **Sub-claim C & Sub-claim D Evidence Statements**, which put MP.3, 4, 6 as primary with connections to content

Key	Evidence Statement Text	Clarifications, limits, emphases, and other information intended to ensure appropriate variety in tasks	Relationship to MP
HS.C.5.11	Given an equation or system of equations, reason about the number or nature of the solutions. Content scope: A-REI.11, involving any of the function types measured in the standards.	i) For example, students might be asked how many positive solutions there are to the equation $ex = x+2$ or the equation $ex = x+1$, explaining how they know. The student might use technology strategically to plot both sides of the equation without prompting.	MP.3

PARCC Cognitive Complexity Framework

- Blooms?
- Webb's DOK?
- CCSS demand a new type of cognitive complexity framework.
- PARCC partnered with the Item Development contractors to develop a new cognitive complexity framework.
- New framework is based on multiple dimensions.
  - Mathematical Content
  - Mathematical Practices
  - Stimulus Material
  - Response Mode
  - Processing Demand

What's Next for PARCC Mathematics?

- Continue with Phase 1 of item development (50% of item bank)
- Conduct Research Studies on functionality and student interaction with items in Spring 2013
- Begin Phase 2 of item development
- Conduct Field Testing in Spring 2014

PARCC
Partnership for Assessment of Readiness for College and Careers

Resources

- Any publicly released assessment policies, item prototypes, Model Content Frameworks can be found at www.PARCConline.org

- Additional item prototypes can be found at http://www.ccsstoolbox.com/parcc/PARCCPrototype_main.html

PARCC Mathematics Update

February 2013

Presenter:
Carrie Piper, Senior Advisor, Mathematics
cpiper@achieve.org

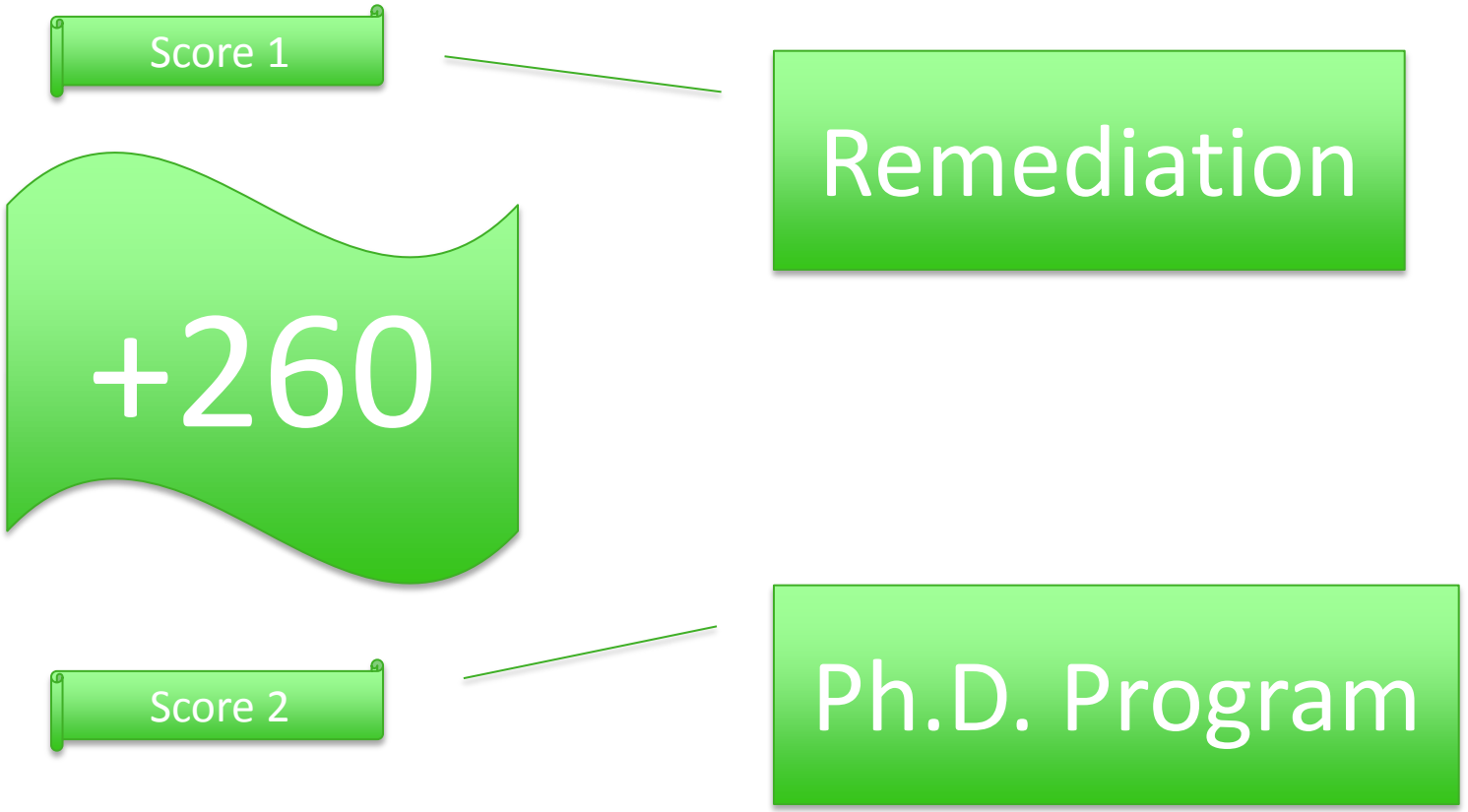
A Smarter Balanced System for Improving Mathematics Teaching and Learning

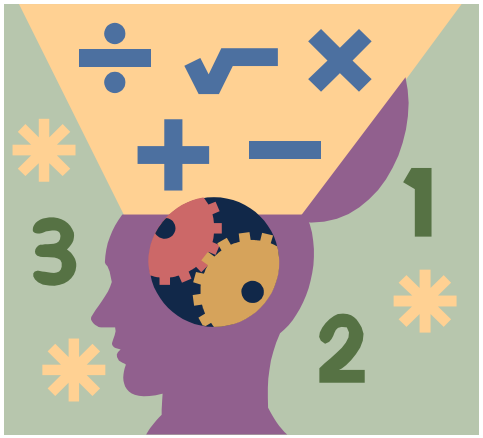
Shelbi K. Cole
Director of Mathematics
Smarter Balanced Assessment Consortium

NCSM
February 26, 2013

Smarter Balanced Assessment Consortium

Assessment Literacy is a Priority



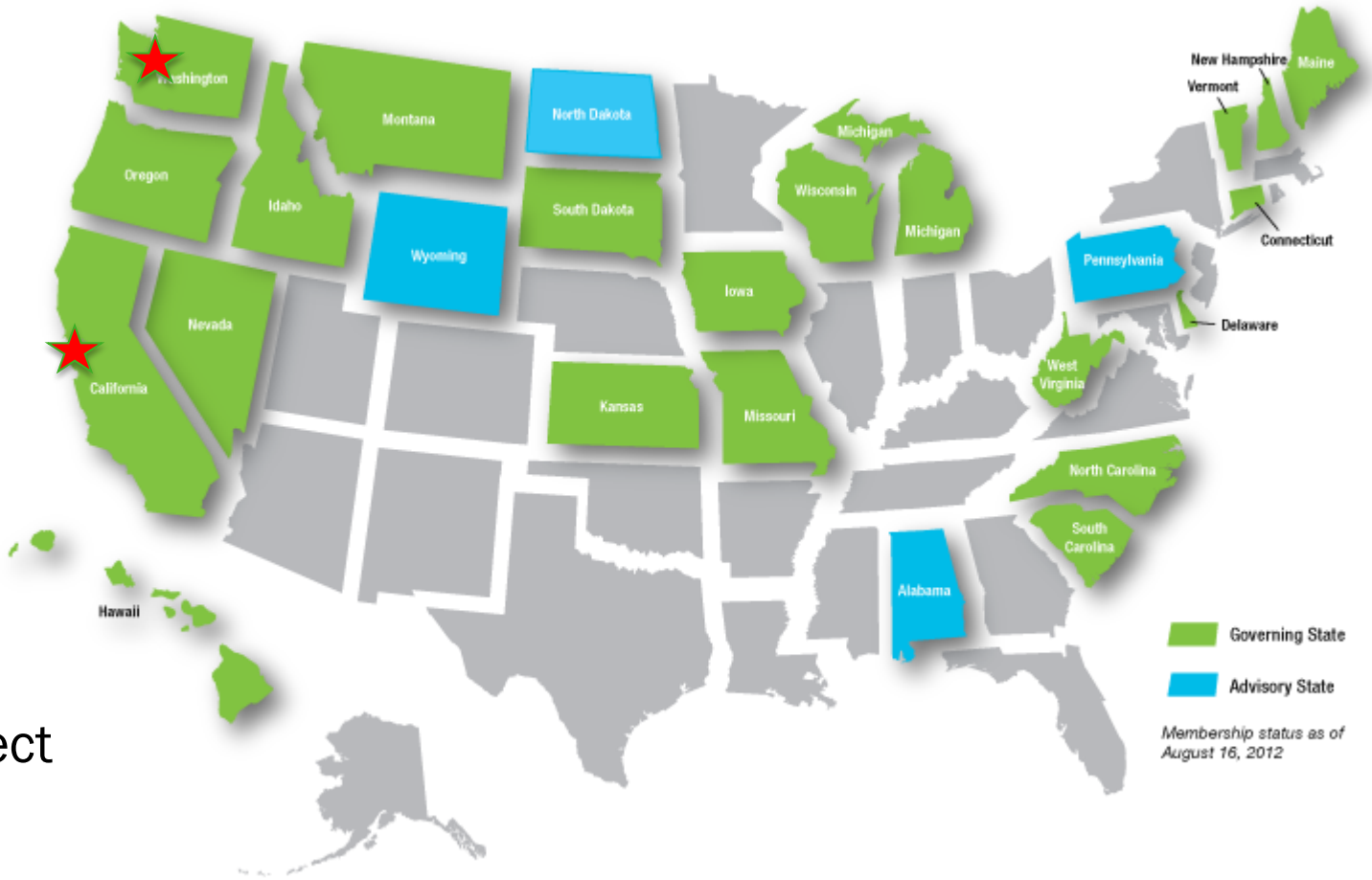


"The world is small now, and we're not just competing with students in our county or across the state. We are competing with the world," said Robert Kosicki, who graduated from a Georgia high school this year after transferring from Connecticut and having to repeat classes because the curriculum was 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.

A National Consortium of States

- 25 states representing 40% of K-12 students
- 21 governing, 4 advisory states
- Washington state is fiscal agent
- WestEd provides project management services



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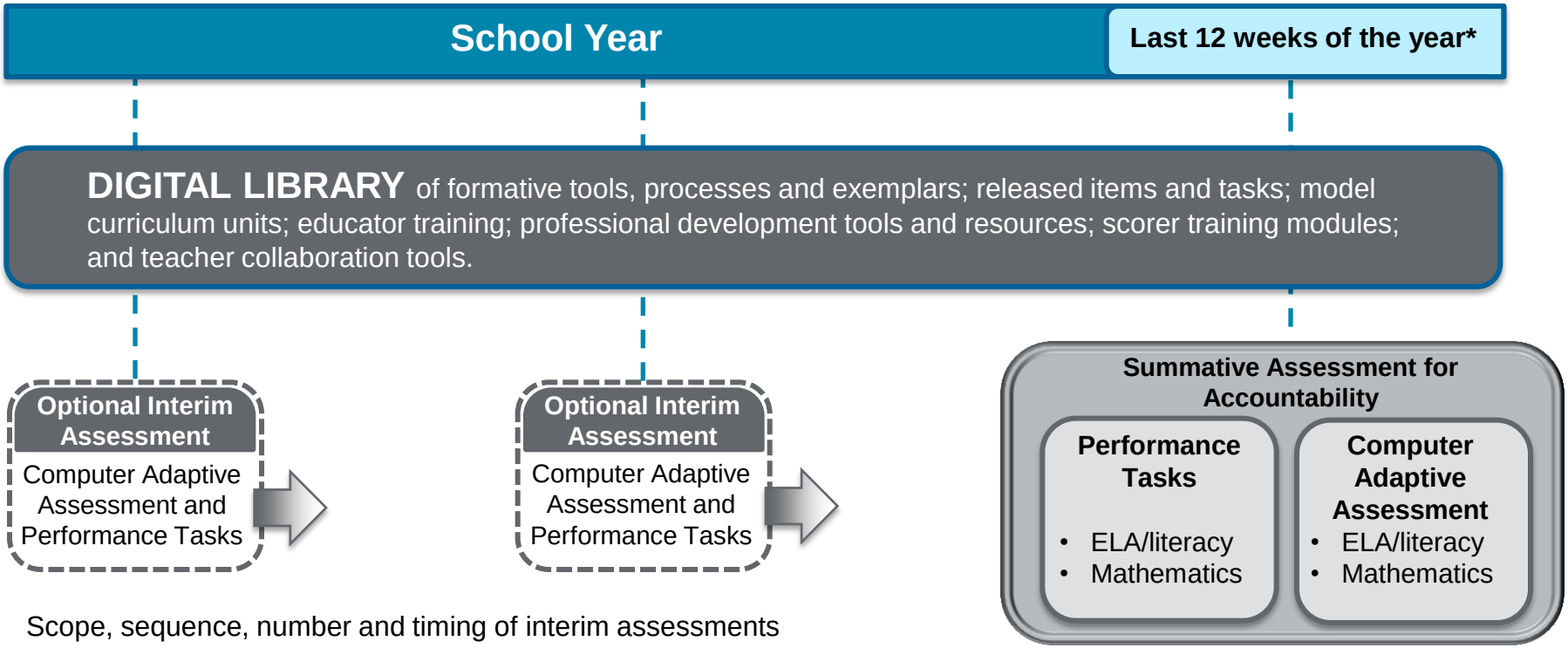
A Balanced Assessment System

ELA/Literacy and Mathematics, Grades 3-8 and High School



Scope, sequence, number and timing of interim assessments locally determined

Re-take option available

*Time windows may be adjusted based on results from the research agenda and final implementation decisions.

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Summative Assessment: Purpose, Benefits and Limitations

Purpose	Benefits	Limitations
• Accountability for K-12 at the state, district, school and classroom/teacher levels • Accurate Information about individual students' achievement, growth over time, and (in 11th grade) readiness for college in English and math.	• Far more sophisticated and comprehensive measure of student knowledge and skills than most existing K-12 accountability or placement exams. • Linked to known, high-quality content standards (Common Core). • Early warning for students not yet college ready.	• Summative exams are not diagnostic in nature. • Will not measure readiness for advanced mathematics (Calculus) requiring 12th grade instruction.

Formative, Interim or Summative?

What is 18 divided by 3?

Summative Assessment: Two-pronged Approach

Computer Adaptive Test

- Assesses the full range of Common Core in English language arts/literacy and mathematics for students in grades 3-8 and 11 (interim assessments can be used in grades 9 and 10)
- Measures current student achievement and growth across time, showing progress toward college and career readiness
- Includes a variety of question types: selected response, short constructed response, extended construction response, technology enhanced

Performance Tasks

- Extended projects demonstrate real-world writing and analytical skills
- May include online research, group projects, presentations
- Require 1 to 2 class periods to complete
- Included in both English language arts/literacy and mathematics assessments
- Applicable in all grades being assessed
- Evaluated by teachers using consistent scoring rubrics

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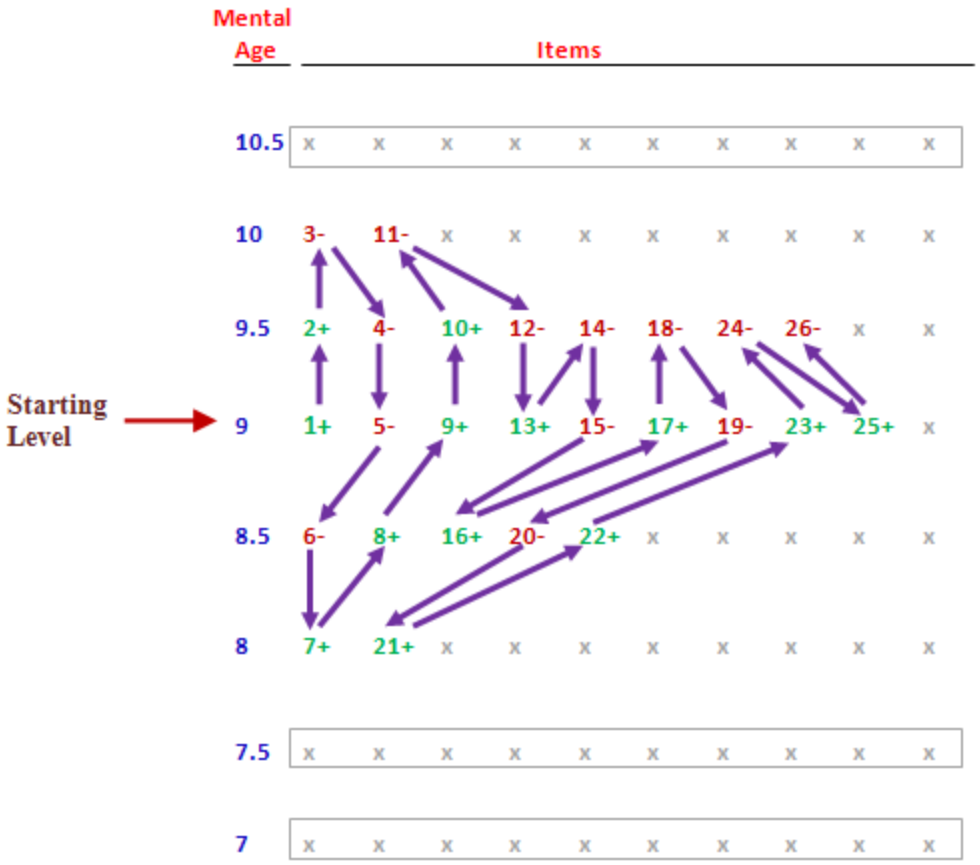
How CAT Works (Binet's Test)



Number of items administered = 26

Number Correct = 13

Proportion correct = .50

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Using Computer Adaptive Technology for Summative and Interim Assessments

Increased precision	• Provides accurate measurements of student growth over time
Tailored for Each Student	• Item difficulty based on student responses
Increased Security	• Larger item banks mean that not all students receive the same questions
Shorter Test Length	• Fewer questions compared to fixed form tests
Faster Results	• Turnaround time is significantly reduced
Mature Technology	• GMAT, GRE, COMPASS (ACT), Measures of Academic Progress (MAP)

K-12 Teacher Involvement

- Support for implementation of the Common Core State Standards (2011-12)
- Write and review items/tasks for the pilot test (2012-13) and field test (2013-14)
- Development of teacher leader teams in each state (2012-14)
- Evaluate formative assessment practices and curriculum tools for inclusion in digital library (2013-14)
- Score portions of the interim and summative assessments (2014-15 and beyond)

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Higher Education Collaboration

- Involved 175 public and 13 private systems/institutions of higher education in application
- Two higher education representatives on the Executive Committee
- Higher education lead in each state and higher education faculty participating in work groups
- Goal: The high school assessment qualifies students for entry-level, credit-bearing coursework in college or university

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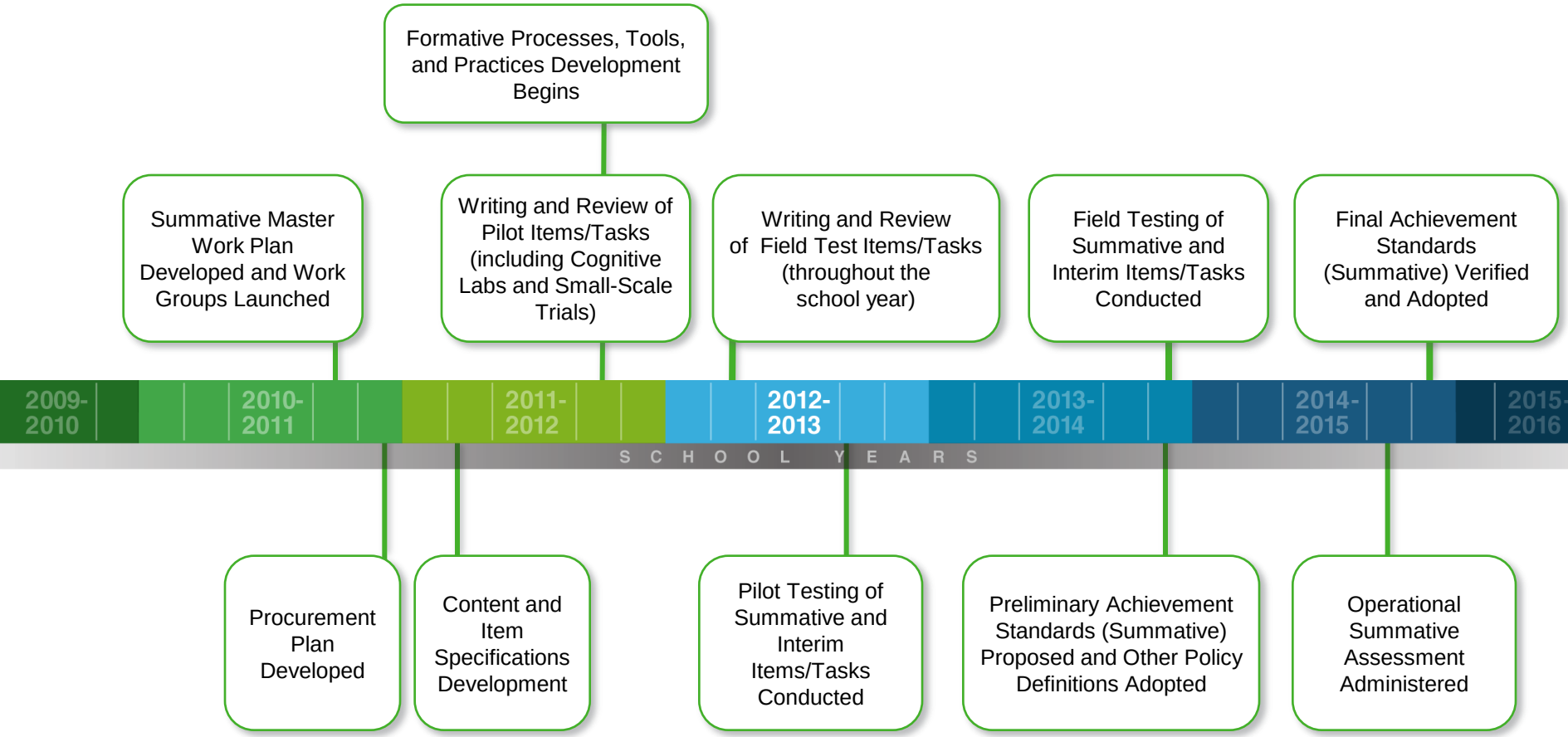
Timeline



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The Mathematics

What is Changing?

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Claims for the Mathematics Summative Assessment

Overall Claim for Grades 3-8	"Students can demonstrate progress toward college and career readiness in mathematics."
Overall Claim for Grade 11	"Students can demonstrate college and career readiness in mathematics."
Claim #1 - Concepts & 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."

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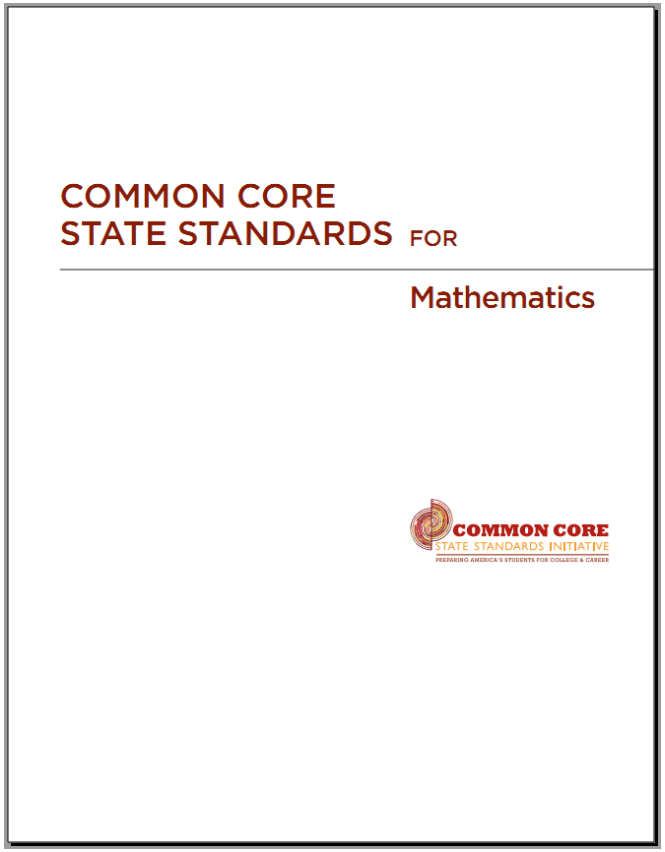
The CCSS Require Three Shifts in Mathematics

- **Focus** strongly where the standards focus
- **Coherence**: **Think** across grades and **link** to major topics within grades
- **Rigor**: In major topics, pursue **conceptual understanding**, procedural skill and **fluency**, and **application** with equal intensity



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Coherence: Some Standards from Early Grades are Critical Through Grade 12

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.*

What it Looks Like in Grade 3

True or False:

$3 \times 8 = 20 + 4$	T	F
$50 \div 10 = 5 \times 1$	T	F
$9 \times 9 = 8 \times 10$	T	F

What it Looks Like in Grade 5

True or False:

$$\frac{1}{2} \times \frac{1}{3} = \frac{3}{6} \times \frac{1}{3}$$

$$\frac{2}{2} \times \frac{1}{3} = \frac{3}{6} \times \frac{1}{3}$$

What it Looks Like in Grade 8

Tell how many solutions:

$3x + 17 = 3x + 12$

What it Looks Like in High School

$X^4 - 5x^3 + x^2 + 2x + 1 =$

Drag the correct expression to make a true equation.

$x^3 + (x + 1)^2 + X^4 - 6x^3$

$X^4 - 3x^3 + 2x^3 + x^2 + 2x + 1$

$X^4 - 5x^3 + x + x + 2x + 1$

...

How Can Assessments Deliver on the Promise of Focus, Coherence and Rigor?

- ***FOCUS: Assessments focus where the standards focus.***

  Major content represents the majority of points and problems on assessments.

- ***COHERENCE: Assessments honor the coherence in the standards.***

  Balance of tasks assessing individual standards and related standards within the context of the grade and, as relevant, the progressions.

- ***RIGOR: Assessments reflect the rigor of the standards.***

  Balance of tasks assessing conceptual understanding, procedural skill and fluency, and application of mathematics to solve problems.

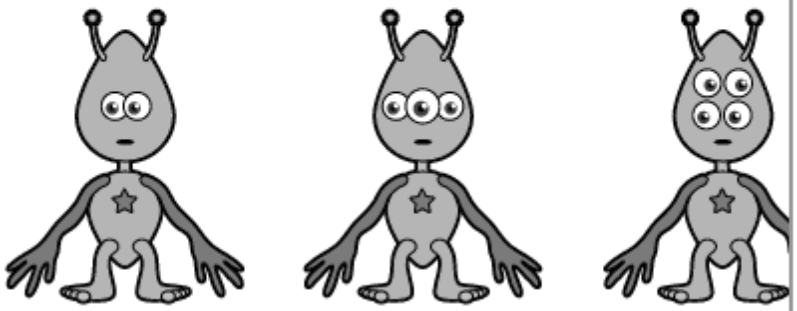
Smarter Balanced Sample Items

http://sampleitems.smarterbalanced.org/itempreview/sbac/

Key Talking Points for Item 43083: The Contest

- This is a “line item” that shows how the content of grade 3 progresses up to grade 4, from multiplication and division within 100 to understanding the factors of a number and interpreting the remainder in a division problem

The two-eyed space creatures, three-eyed space creatures, and four-eyed space creatures are having a contest to create a group with 24 total eyes.

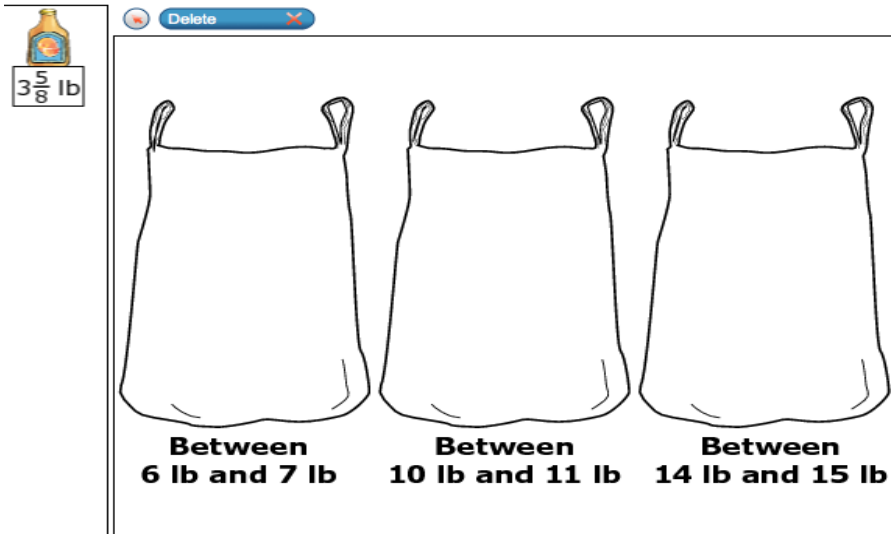


Part C: How many four-eyed space creatures are needed to make a group with 24 total eyes? (grade 3)

Part D: Somebody told the five-eyed space creatures that they could not join the contest. Explain why five-eyed space creatures cannot make a group with 24 total eyes.

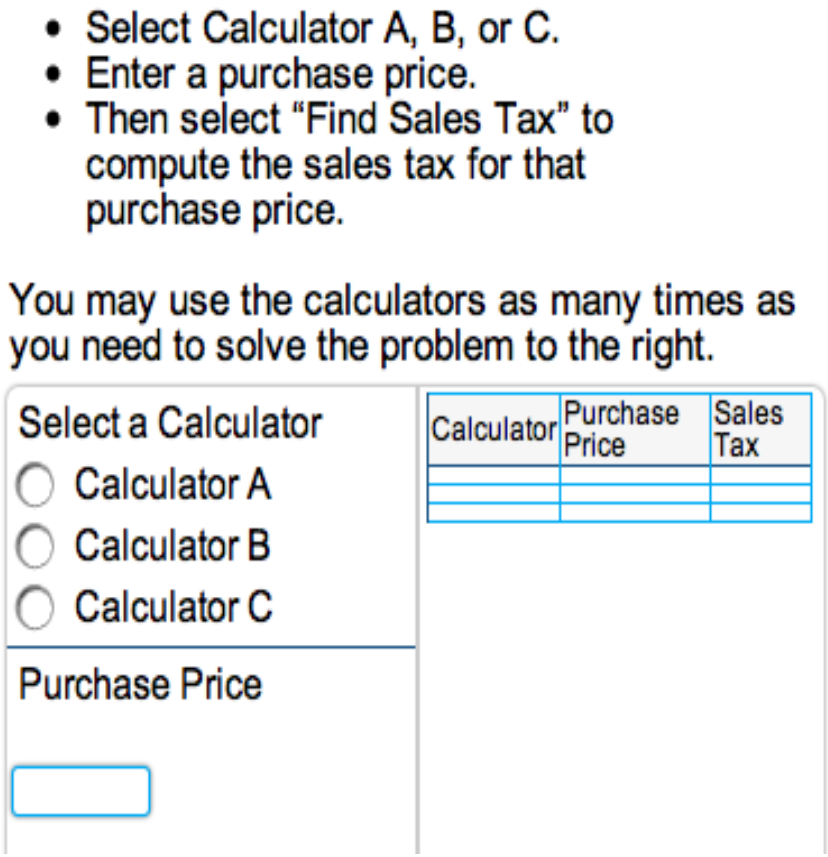
Key Talking Points for Item 43328: Fractions 2a

- This item is one of a set of four in the domain “Fractions” across grades 3-5
- Although part of the focus of this item is on operations with fractions (either multiplication of a mixed number by whole number or addition with mixed numbers), the response format asks students to “understand” that the resulting number is between two whole numbers, which is a more global goal of the standards in this domain
- Although the item has text with it, the set-up allows for students to easily understand what it is asking them to do, a nice feature for assessing mathematics of struggling readers and English Learners



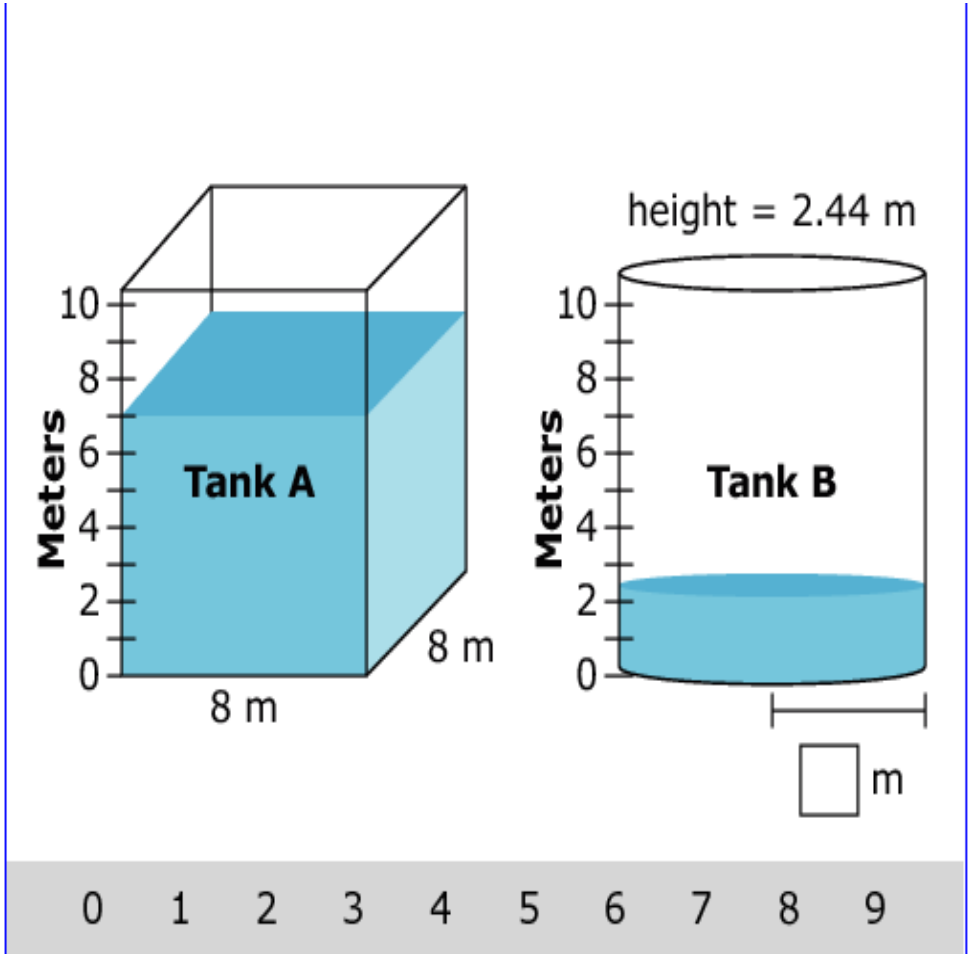
Key Talking Points for Item 42933: Calculator

- This item maps the 21st century onto the standards, acknowledging that students use apps, applets, and other tools – and determining whether these tools are functioning (or calculating) as intended is a critical skill
- This item type will be very useful in assessing students ability to create explicit formulas based on input and resulting output (while giving the student some control over the input)



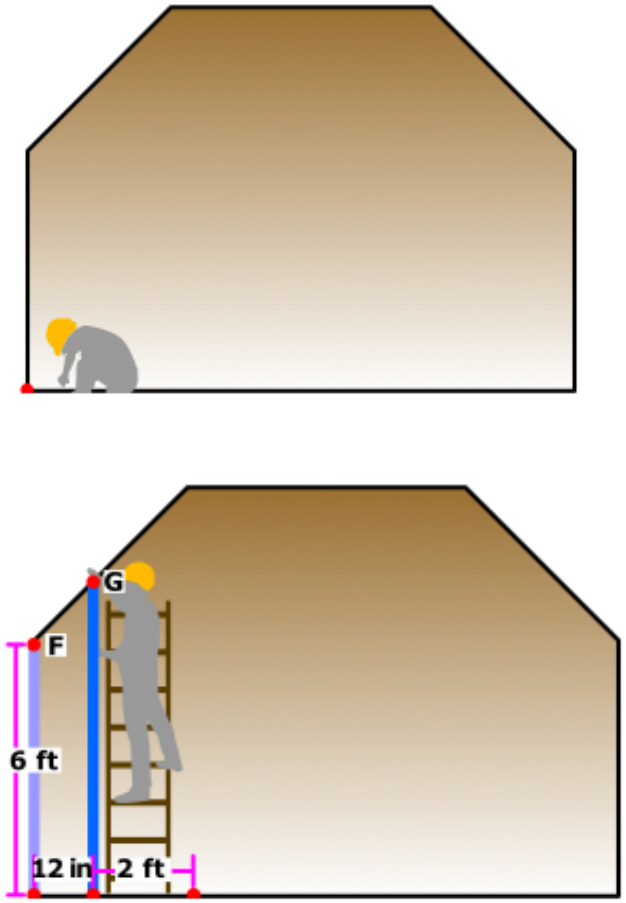
Key Talking Points for Item 42968: Water Tank

- This item allows some student choice in how much water is moved from Tank A to Tank B to derive the radius of Tank B.
- The set-up allows students to deduce what is being asked even if they struggle to read the item text
- The item draws on the content of earlier grades, but calling for more sophisticated use of that mathematics



Key Talking Points for Item 43057: Room Wall

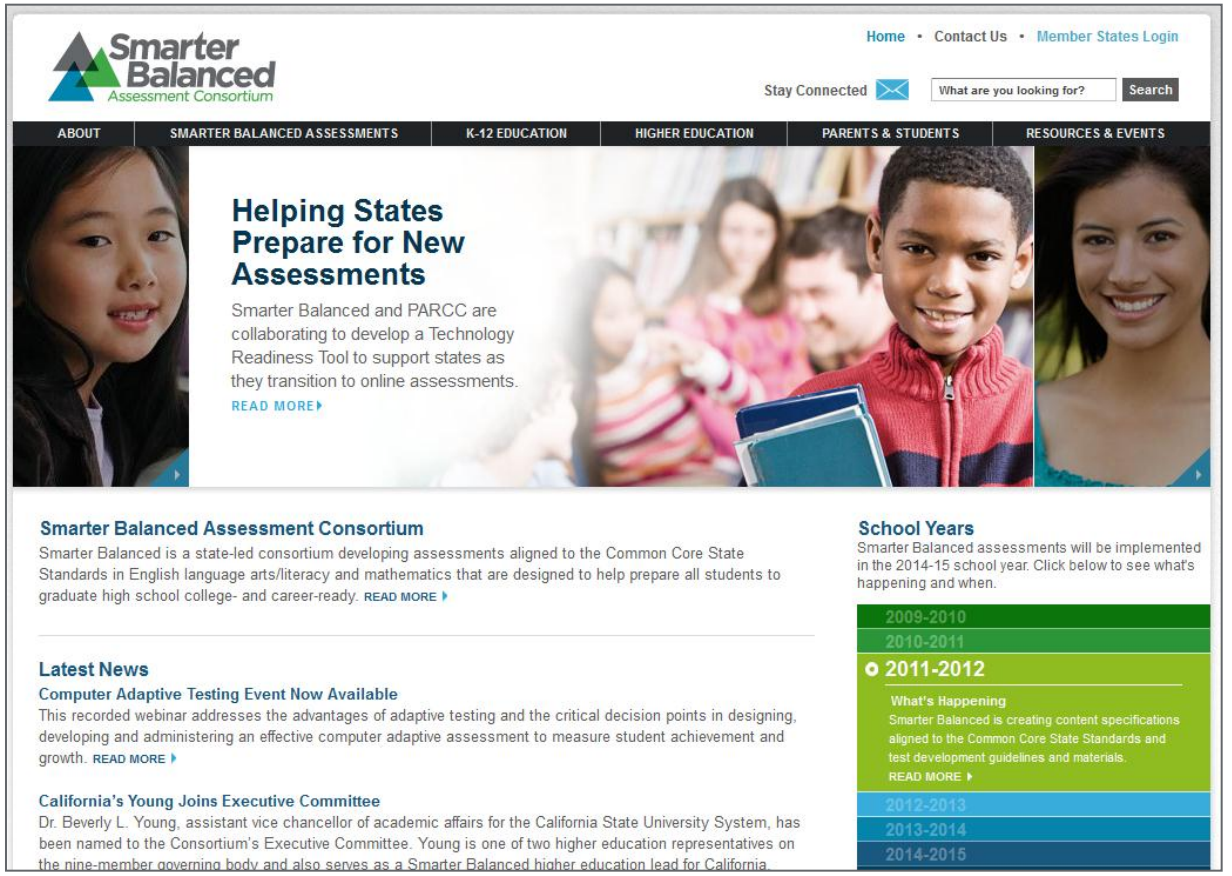
- The animation shows how the relationship between slope and angle measure (using slope to determine congruence) is used in real life, a concept that would be difficult to portray with a static image
- This item attempts to push the field forward in terms of response capture and scoring capabilities

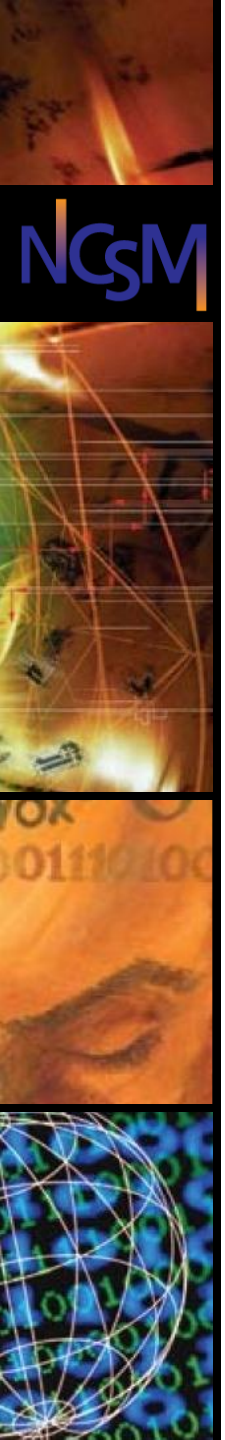


Find Out More

Smarter Balanced can be found online at:

SmarterBalanced.org





Measuring Math that Matters

Thank You!

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