



# Incorporating the Math Shifts into Teacher Preparation Programs

# Agenda

- Introduction to the Math Shifts
- Helping pre-service teachers understand what they know about mathematics (Focus)
- Helping pre-service teachers recognize how they came to know what they know (Coherence)
- Helping pre-service teachers understand the role of different math tasks (Rigor)



What does the  
phrase  
“standards based  
instruction”  
mean to you?

What indicators  
could be used to  
identify that the  
instruction is  
standards based?

## PROTOCOL

Quiet

Add as many ideas as  
you want

If you see something  
you agree with, draw a  
line to it.

Read. Think. Reflect.

# Key Shifts in Mathematics



**Focus:** *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*.

## Shift #1 – Focus strongly where the Standards focus

- Significantly narrow the scope of content and deepen how time and energy is spent in the math classroom.
- Focus deeply on what is emphasized in the Standards, so that students gain strong foundations.



## Shift #1 – Focus strongly where the Standards focus

- Move away from "mile wide, inch deep" curricula identified in TIMSS.
- Learn from international comparisons.
- Teach less, learn more.
- “Less topic coverage can be associated with higher scores on those topics covered because students have more time to master the content that is taught.”

K

12

Number and  
Operations



Measurement  
and Geometry



Algebra and  
Functions

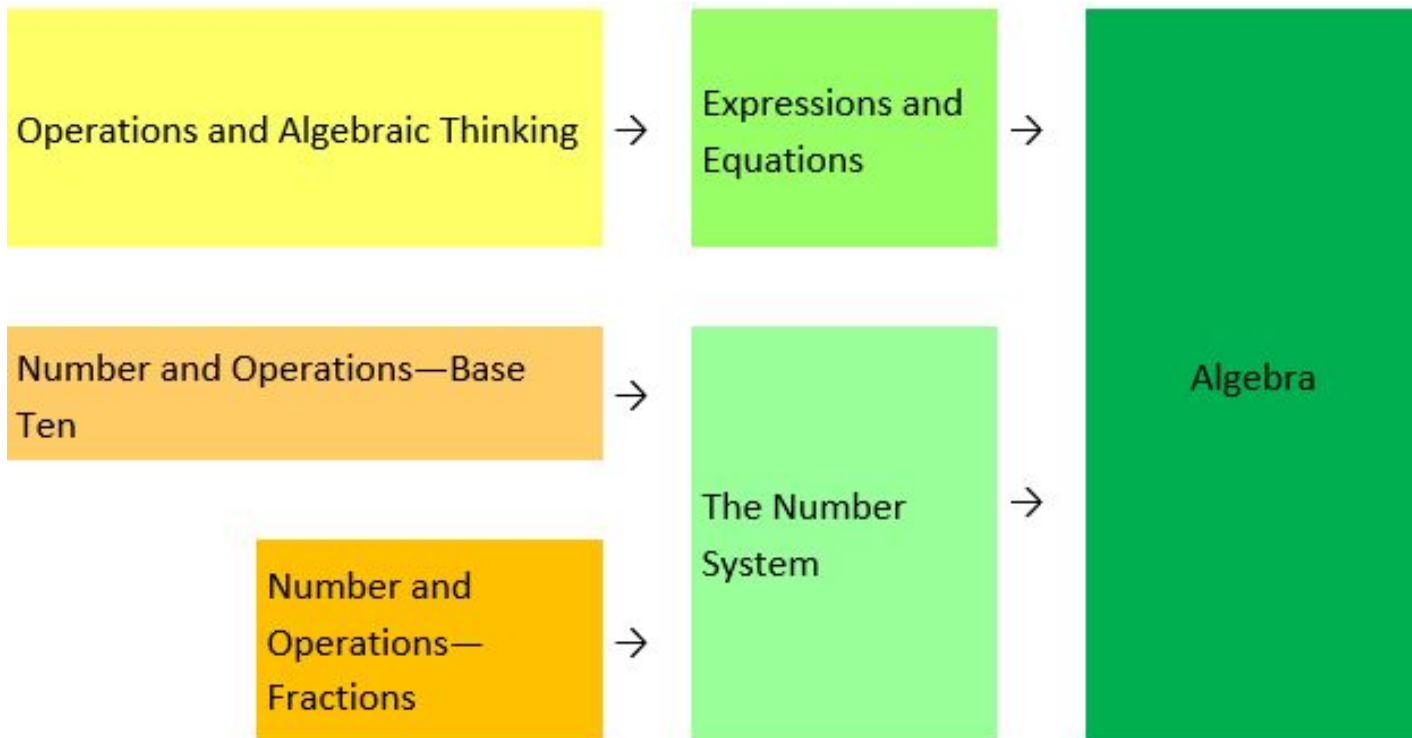


Statistics and  
Probability



# Traditional US Approach

# Focusing Attention within Number and Operations



K

1

2

3

4

5

6

7

8

High School



# Key Areas of Focus in Mathematics

Grade	Focus Areas in Support of Rich Instruction and Expectations of Fluency and Conceptual Understanding
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- |     |  |
|-----|--|
| K–2 | Addition and subtraction - concepts, skills, and problem solving; place value                      |
| 3–5 | Multiplication and division of whole numbers and fractions – concepts, skills, and problem solving |
| 6   | Ratios and proportional relationships; early expressions and equations                             |
| 7   | Ratios and proportional relationships; arithmetic of rational numbers                              |
| 8   | Linear algebra and linear functions  |

# Focus in High School

Number and Quantity	Algebra	Functions	Geometry	Statistics and Probability	Applying Key Takeaways from Grades 6–8**
<p><b>N-RN, Real Numbers:</b> Both clusters in this domain contain widely applicable prerequisites.</p> <p><b>N-Q*, Quantities:</b> Every standard in this domain is a widely applicable prerequisite. Note, this domain is especially important in the high school content standards overall as a widely applicable prerequisite.</p>	<p><b>Every domain in this category</b> contains widely applicable prerequisites.<sup>o</sup></p> <p>Note, the <b>A-SSE</b> domain is especially important in the high school content standards overall as a widely applicable prerequisite.</p>	<p><b>F-IF, Interpreting Functions:</b> Every cluster in this domain contains widely applicable prerequisites.<sup>o</sup></p> <p>Additionally, standards <b>F-BF.1</b> and <b>F-LE.1</b> are relatively important within this category as widely applicable prerequisites.</p>	<p>The following standards and clusters are relatively important within this category as widely applicable prerequisites:</p> <p><b>G-CO.1</b>  <b>G-CO.9</b>  <b>G-CO.10</b>  <b>G-SRT.B</b>  <b>G-SRT.C</b></p> <p>Note, the above standards in turn have learning prerequisites within the Geometry category, including:</p> <p><b>G-CO.A</b>  <b>G-CO.B</b>  <b>G-SRT.A</b></p>	<p>The following standards are relatively important within this category as widely applicable prerequisites:</p> <p><b>S-ID.2</b>  <b>S-ID.7</b>  <b>S-IC.1</b></p> <p>Note, the above standards in turn have learning prerequisites within 6-8.SP.</p>	<p>Solving problems at a level of sophistication appropriate to high school by:</p> <ul style="list-style-type: none"> <li>• Applying ratios and proportional relationships.</li> <li>• Applying percentages and unit conversions, e.g., in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m<sup>3</sup>, acre-feet, etc.).</li> <li>• Applying basic function concepts, e.g., by interpreting the features of a graph in the context of an applied problem.</li> <li>• Applying concepts and skills of geometric measurement e.g., when analyzing a diagram or schematic.</li> <li>• Applying concepts and skills of basic statistics and probability (see 6-8.SP).</li> <li>• Performing rational number arithmetic fluently.</li> </ul>

## Shift #2 – Coherence: Think Across Grades and Link to Major Topics Within Grades

- Carefully connect the learning within and across grades so that students can build new understanding on foundations built in previous years.
- Begin to count on conceptual understanding of core content and build on it. Each standard is not a new event, but an extension of previous learning.
- Coherence in K-8 standards prepares students for success in high school.
- Coherence within courses provides focus for high school
- Coherence in high school provides focus within courses.



## Shift #3 – Rigor: In Major Topics, Pursue Conceptual Understanding, Procedural Skill and Fluency, and Application

- The CCSSM require a balance of:
  - Conceptual understanding
  - Procedural skill and fluency
  - Application of concepts and skills in problem solving situations
- Pursuit of all three requires equal intensity in time, activities, and resources.



# Conceptual Understanding

- Teach more than “how to get the answer” and instead support students’ ability to access concepts from a number of perspectives
- Students are able to see math as more than a set of mnemonics or discrete procedures
- Conceptual understanding supports the other aspects of rigor (procedural skill and fluency and application)

## Procedural Skill and Fluency



The Standards require quick and accurate calculation. Does that mean speed?

Teachers structure class time and/or homework time for students to practice core functions (such as single-digit multiplication) so that they are more able to understand and manipulate more complex concepts and procedures

# Application

- Students can use appropriate concepts and procedures for application even when not prompted to do so.
- Teachers provide opportunities at all grade levels for students to apply math concepts in “real world” situations, recognizing this means different things in K-5, 6-8, and HS.
- Teachers in content areas outside of math, particularly science, ensure that students are using grade-level-appropriate math to make meaning of and access science content.



# Unpacking a Standard

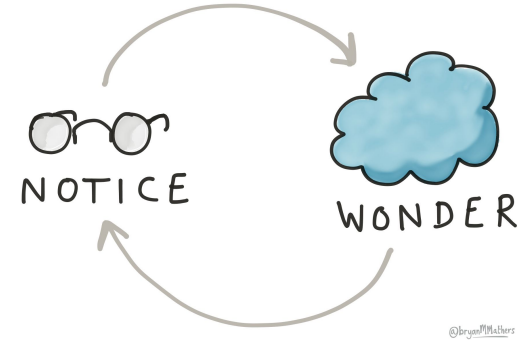
1. Analyze the cards detailing a standard
2. Develop criteria for what “unpacking” a standard includes



**What are the benefits for pre-service teachers?**  
**What are the obstacles?**

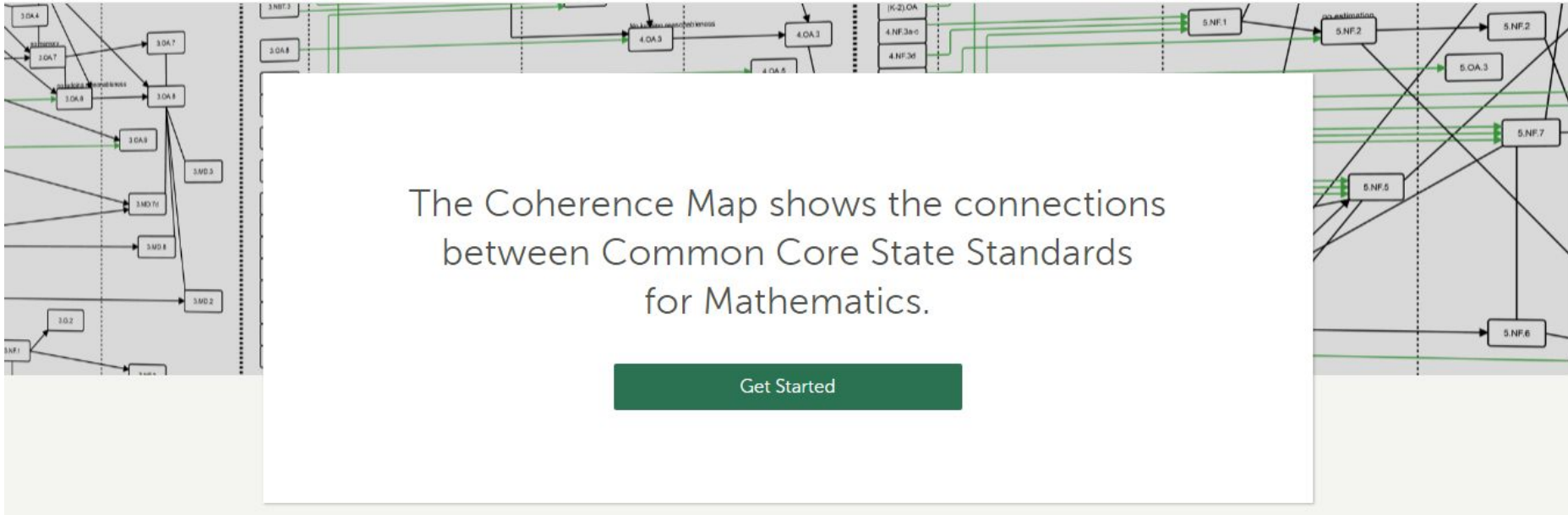
# Progressions

Select one of the progressions provided  
Complete an “I notice / I wonder” chart  
Share with other groups



**What are the benefits for pre-service teachers?**  
**What are the obstacles?**

# Coherency Map



# Task Sort

Sort the task cards into groups based on the primary purpose

Conceptual  
Understanding

Procedural  
Fluency

Application



What are the benefits for pre-service teachers?  
What are the obstacles?

# Lesson Planning Tool





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# Contact Information

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