The Common Core State Standards from Transition to Implementation

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21st Century Partnership for STEM Education
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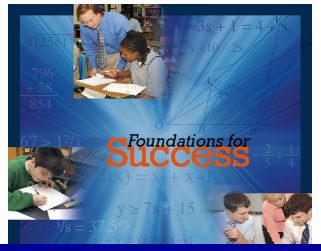
Driving the CCSS



LEADERSHIP, ADVOCACY, SERVICE
CCSSO
THE COUNCIL OF CHIEF STATE SCHOOL OFFICERS

NATIONAL GOVERNORS ASSOCIATION

OECD
PISA

IEA
TIMSS
·2007·

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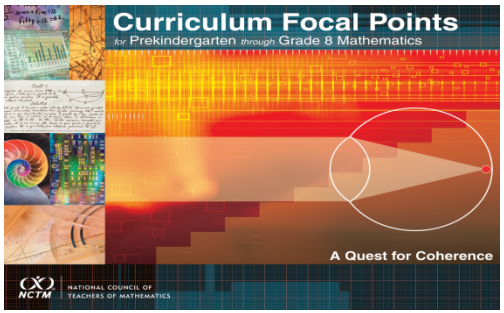
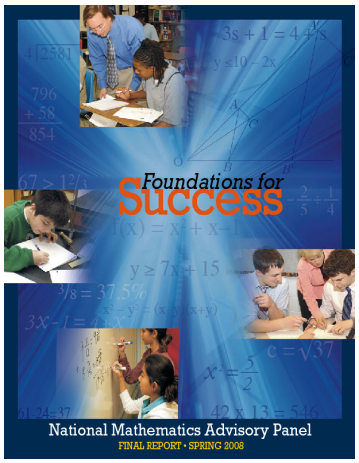
Why Focus and Coherence?

- Long lists of state learning expectations
- "Mile wide, inch deep"
- Mobility
- **International Comparisons**
- **Common Curriculum Clamoring – both sides of the aisle – *really!***
- **National Math Advisory Panel Recommendations**





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One year ago…, ok 1.5++

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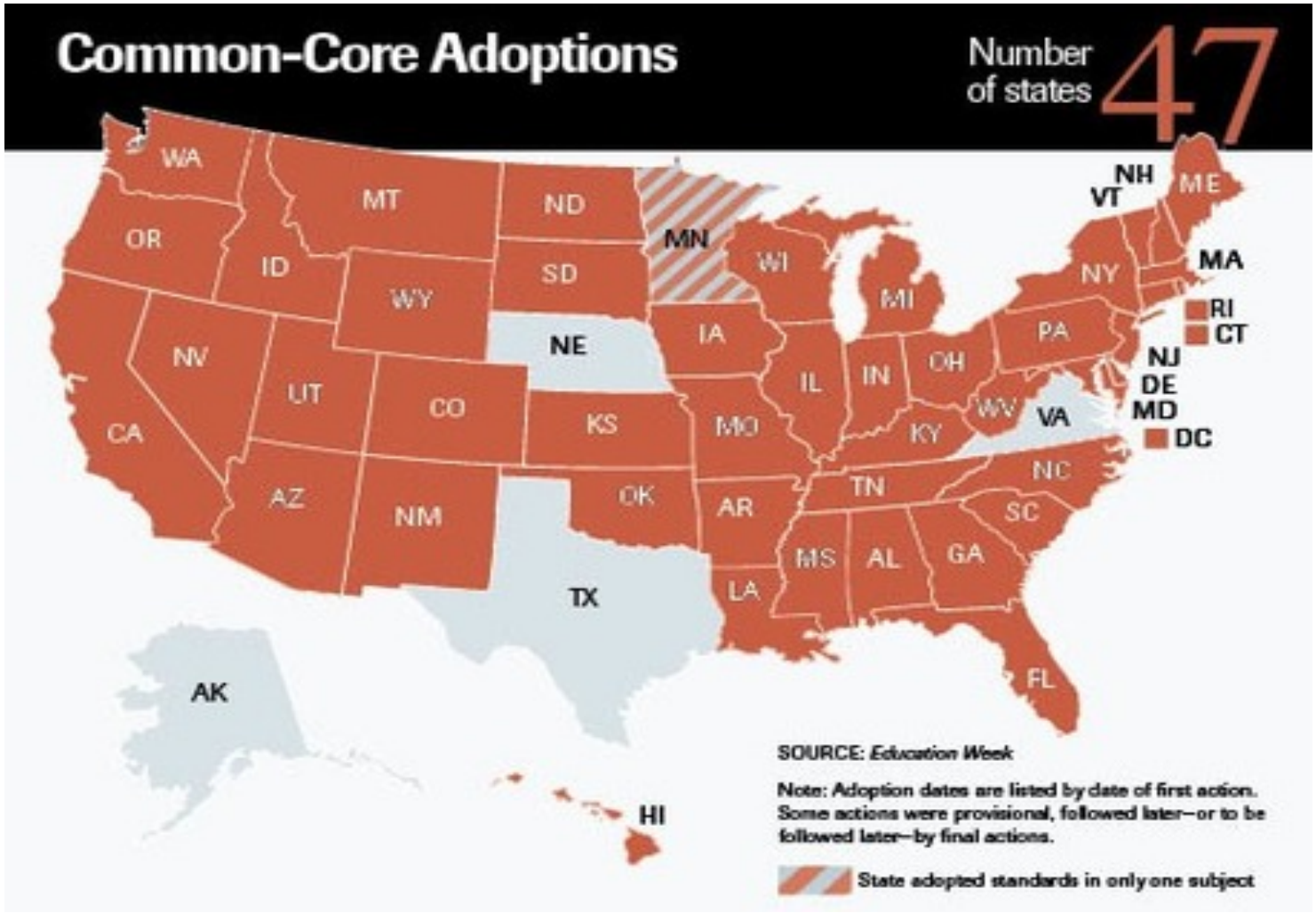

And now…

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Why?

- Common standards will help in improving mathematics education more broadly;
  - ✓ Economies of scale
  - ✓ Sharing best practices
  - ✓ Greater incentive to collaborate
  - ✓ Materials more broadly applicable
  - ✓ Concentration of expertise in developing resources and the capacity for implementation of rigorous standards

Source: Heck, Weiss, Pasley, 2011

CCSS Progress and Challenges

- Almost **three-fifths** of the districts in states that have adopted the CCSS viewed the standards as more rigorous and expected the CCSS to improve student learning.
- **Two-thirds** of the districts have begun to develop an implementation plan or intend to do so in 2011-2012; Sixty-one percent of the districts are developing and/or purchasing curriculum materials.
- Adequate funding is a major challenge.
- About **two-thirds** of the adopting districts cited inadequate or unclear guidance from the state.
- Districts appear to face little resistance from parents, community members, or educators.
- Districts or school-level staff have participated in a variety of state, regional, or district activities in 2010-2011 to become informed about the CCSS

Center on Ed Policy

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Preparing for Change

- All but one of the 47 CCSS-adopting states reported having developed some type of formal implementation plan for transitioning to the new, common standards (Wyoming).
- The majority of states reported that they have at least begun the process of developing plans to align their systems to the CCSS by: providing professional development to teachers (45 states), changing or devising curriculum guides and other instructional materials (35 states), and revising their teacher-evaluation systems (38 states).

Questions Emerging
Research Needs

- How is the mathematics education system responding to the introduction of the CCSS?
  - ✓ States, school districts and schools
  - ✓ Preservice teacher education – all types
  - ✓ Professional development
  - ✓ Professional societies
- Distinguishing between alignment and quality
- ***The influence of the CCSS will be strongly mediated by the consortial assessments.***

Heck, Weiss, Pasley, 2011

A Common Challenge:

Developing Understanding of Critical Content Areas, but…

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First…

appropriately

The Starting Point…

NCTM Processes	*CCSS – Standards for Mathematical Practice*	*Adding it Up – Strands of Mathematical Proficiency*
Problem Solving	***Make sense of problems and persevere in solving them.***	Strategic competence
Reasoning and Proof	***Reason abstractly and quantitatively.***	Adaptive reasoning
Reasoning and Proof	***Construct viable arguments and critique the reasoning of others.***	Adaptive reasoning
Connections	***Model with mathematics.***	Strategic competence
Representation	***Use appropriate tools strategically.***	Strategic competence Conceptual understanding
Communication	***Attend to precision.***	Procedural fluency.
Connections	***Look for and make use of structure.***	Strategic competence
Reasoning and Proof	***Look for and express regularity in repeated reasoning.***	Adaptive reasoning
		*Productive disposition

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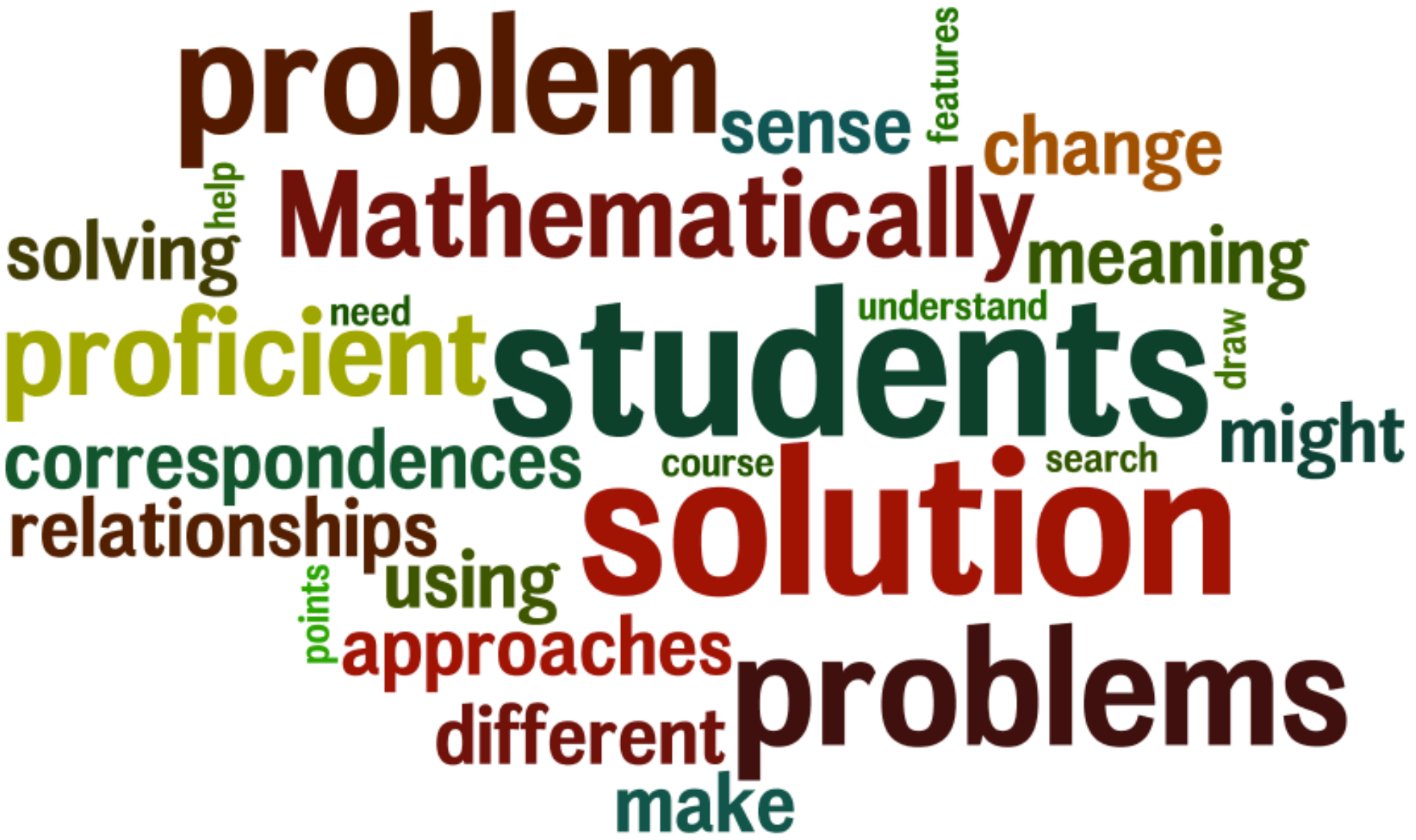
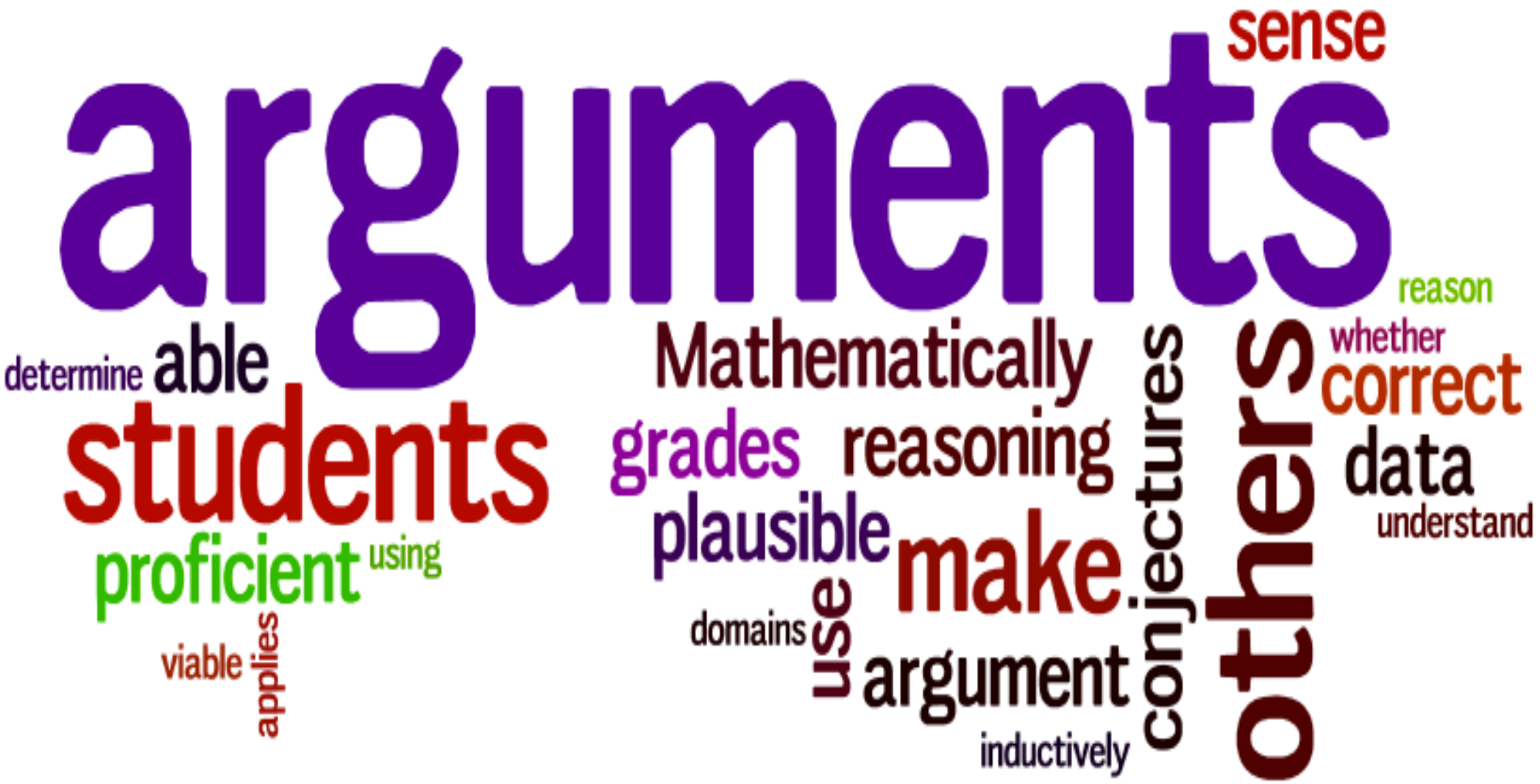
The Practices – What do we know

- Well accepted as a starting point…
- Derived from NCTM Process and Adding it Up…
- Observable…
- Planning and pedagogy related…
- Some more than others
  - ✓Mathematics
  - ✓Developmental levels
- See the next slides

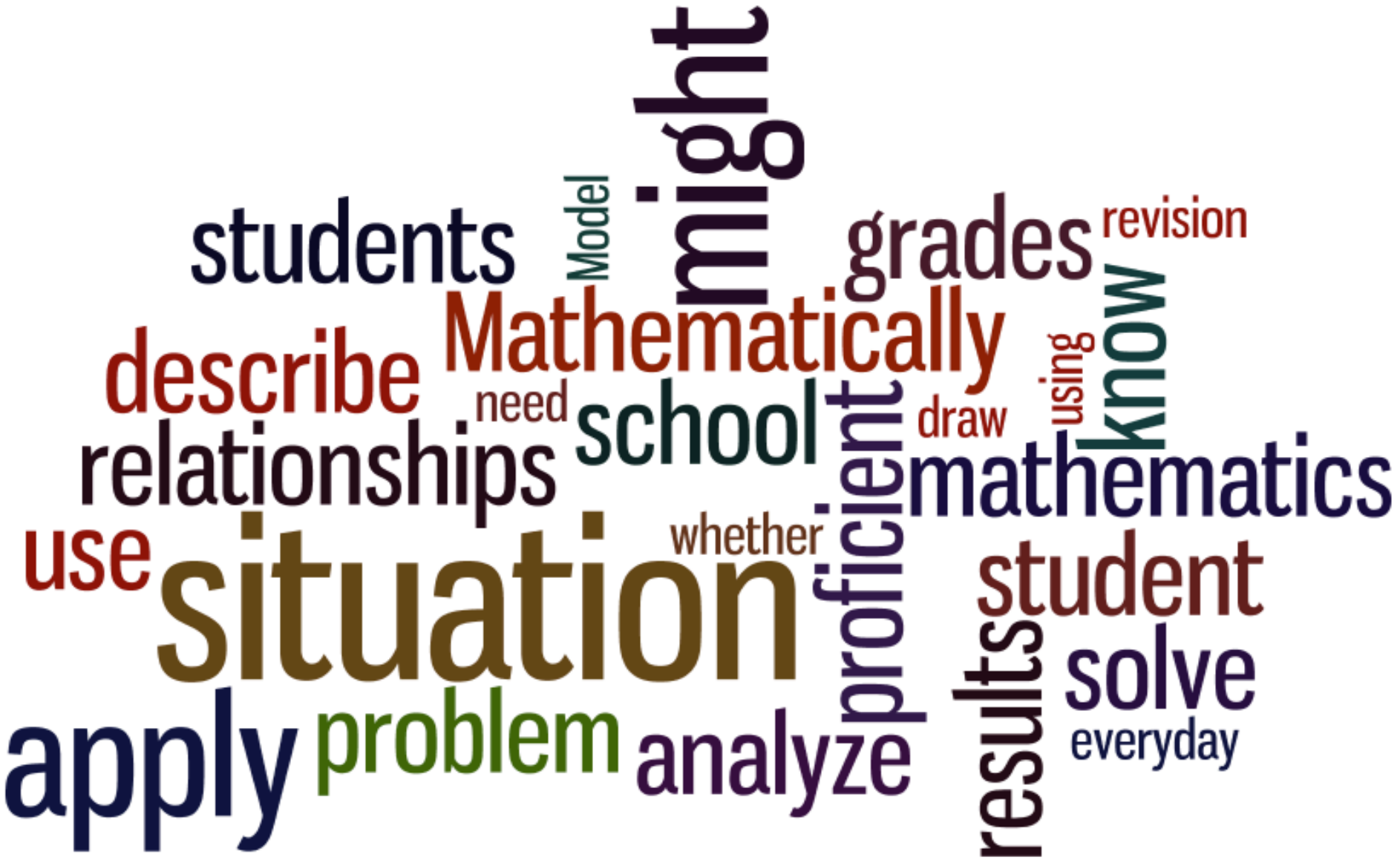
1. Make sense of problems and persevere in solving them



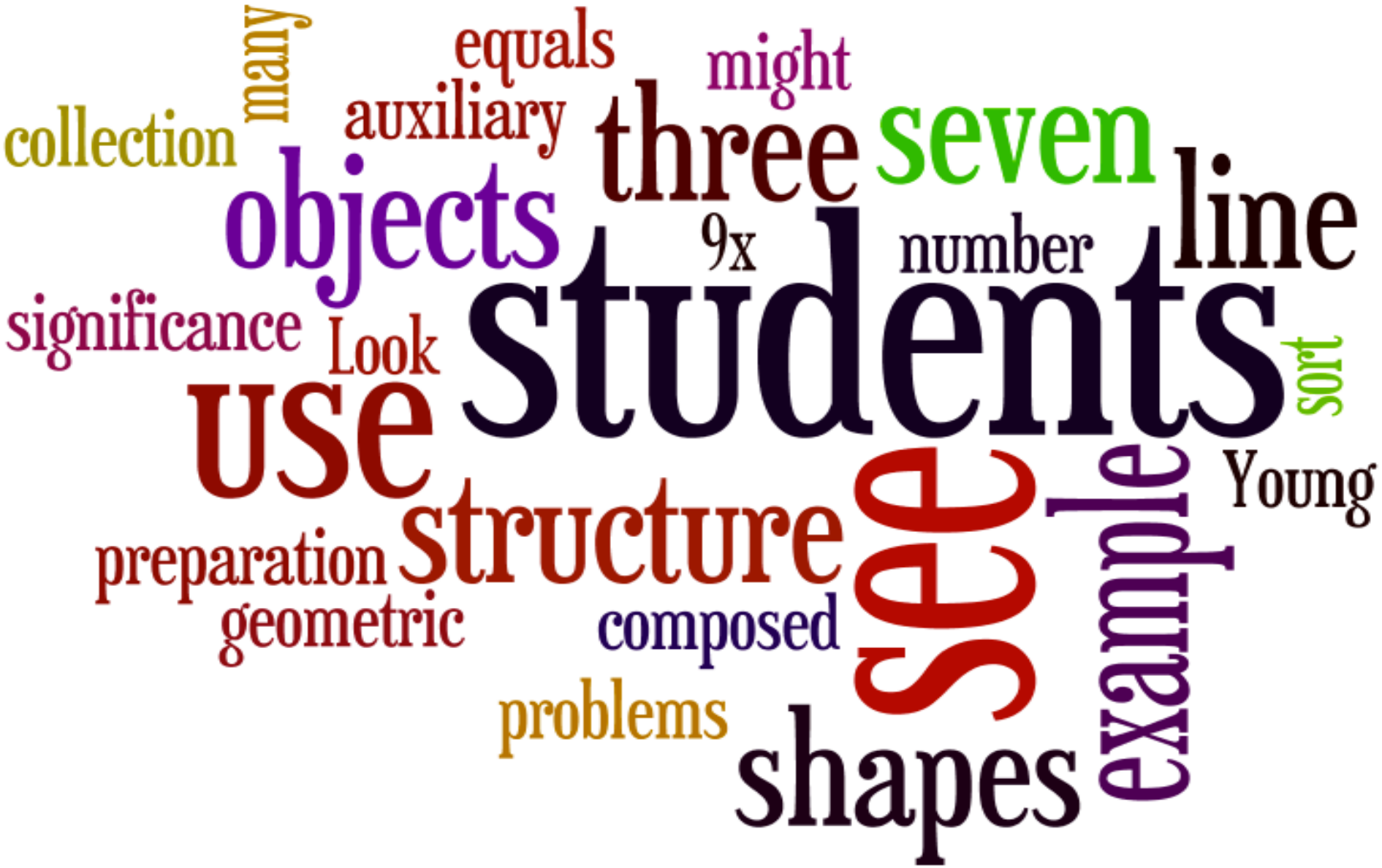
3. Construct viable arguments and critique the reasoning of others



4. Model with mathematics



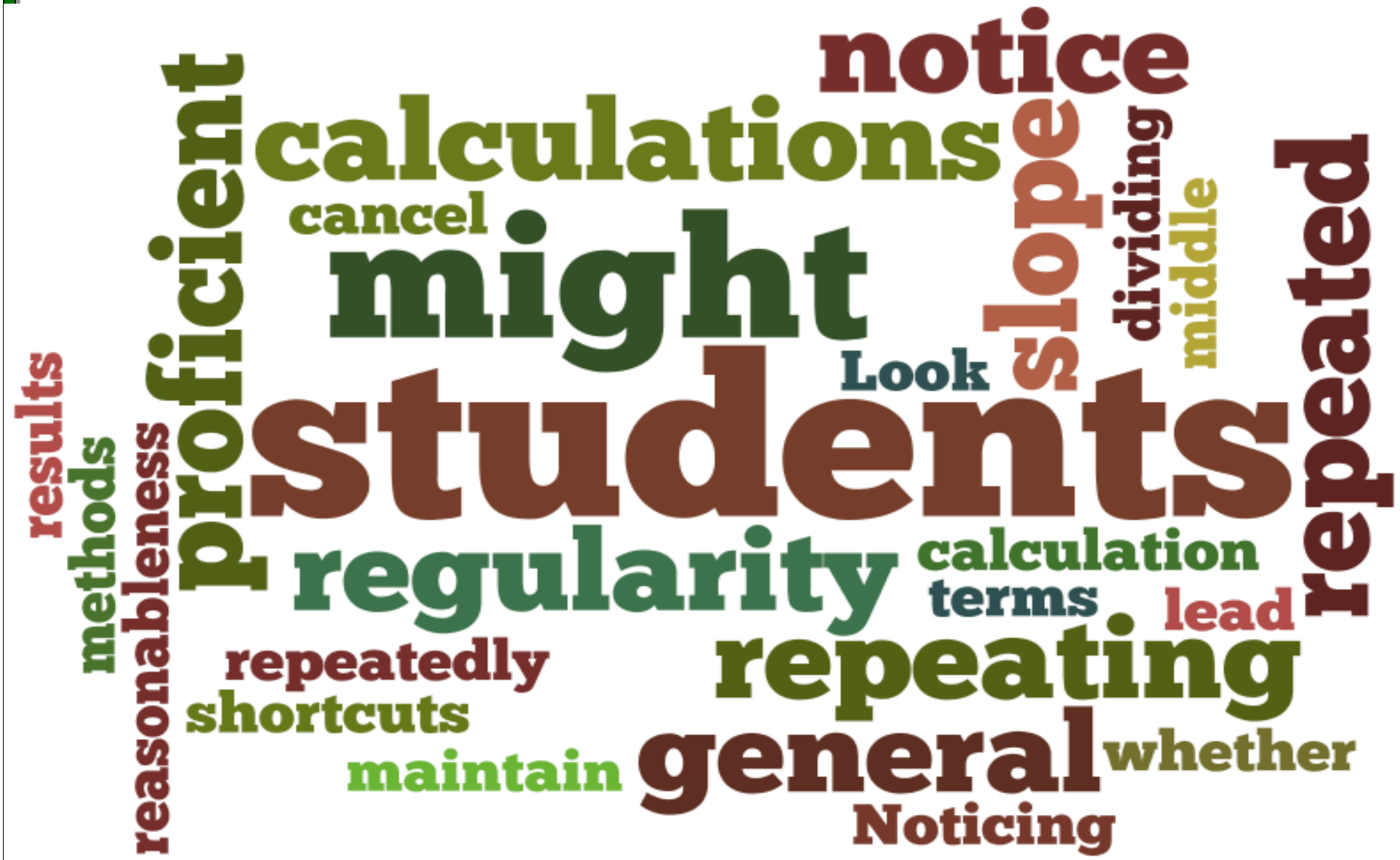
7. Look for and make use of structure



Look for and make use of structure – Wow, did we struggle here! Ok, the teachers can read and see this is about a pattern and structure, but it wasn't until I did a pencast that we ALL saw the richness of this Practice. More than that, here is my connection, my hook, to number sense, and seeing how patterns can relate and connect nicely to structure. See what you think about Maya's response. She is a third grader.

http://www.livescribe.com/cgi-bin/WebObjects/LDApp.woa/wa/MLSOverviewPage?sid=r6Hkjn0xzFPB

8. Look for and express regularity in repeated reasoning



Look For's

Make sense of problems and persevere in solving them (e.g.):

1.Students: Are actively engaged in solving problems

2.Teacher: Provides time for and facilitates the discussion of problem solutions

Reason abstractly and quantitatively (e.g.):

1.Students: Use varied representations and approaches when solving problems

2.Teacher: Provides a range of representations of mathematical ideas and problem situations and encourages varied solution paths

Construct viable arguments and critique the reasoning of others (e.g.):

1.Students: Understand and use prior learning in constructing arguments

2.Teacher: Provides opportunities for students to listen to or read the conclusions and arguments of others

Model with mathematics (e.g.):

1.Students: Apply mathematics learned to problems they solve and reflect on results

2.Teacher: Provides a variety of contexts for students to apply the mathematics learned

Use appropriate tools strategically (e.g.):

1. Students: Use technological tools to deepen understanding
2. Teacher: Uses appropriate tools (e.g. manipulatives) instructionally to strengthen the development of mathematical understanding

Attend to Precision (e.g.):

1.Students: Based on a problem's expectation, students calculate with accuracy and efficiency.

2.Teacher: Emphasizes the importance of mathematical vocabulary and models precise communication.

Look for and make use of structure (e.g.):

1.Students: Look for, develop, and generalize arithmetic expressions

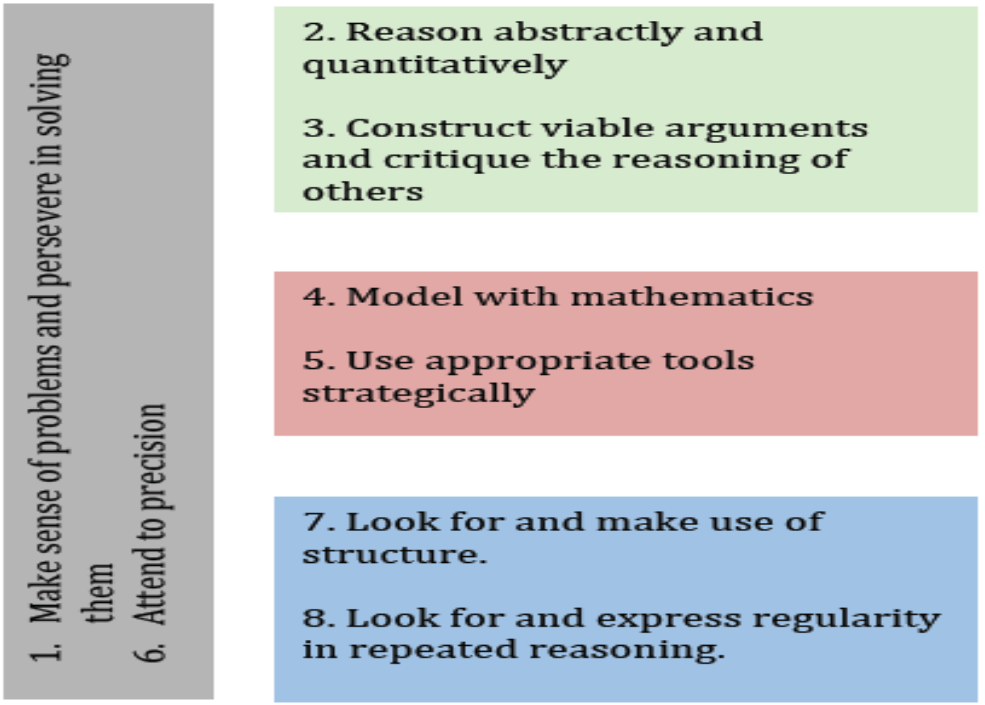
2.Teacher: Provides time for applying and discussing properties

Look for and express regularity in repeated reasoning (e.g.):

1.Students: Use repeated applications to generalize properties

2.Teacher: Models and encourages students to look for and discuss regularity in reasoning

Another Look



Bill McCallum's blog!

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Unpacking a Mathematical Practice

…applying the mathematics students know to solve problems arising in everyday life, society, and the workplace. Mathematics is "modeled" in solving problems – as solution strategies emerge and as the problem's solution is represented mathematically.

…writing an addition equation to describe a situation (primary grades). Mathematics is "modeled" when expressions (4x + 5), equations (4x + 5 = 17), and inequalities (4 < 7) are used to mathematically describe a problem or its solution.

…applying proportional reasoning to plan a school event or analyze a problem in the community (middle grades). A proportion may be used to solve and represent a problem's solution. The proportion is a mathematical model.

…making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. A problem's solution may come in stages, with the initial response being an approximation, which may be "fine tuned" as a closer estimate or as an exact response, each stage being a mathematical representation or model.

…identifying important quantities in a practical situation and mapping their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. Student solutions may be presented using a diagram or table or graph, such mappings are also models of mathematics.

Model with Mathematics & Other Practices

1. Make sense of problems and persevere in solving them.

As students are engaged in problem solving they are applying mathematics to a context or situation. Additionally, their solution will often be a number sentence, equation, or inequality – all mathematical models.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

Reasoning engages students in thinking mathematically and representing their thinking mathematically – through written or oral use of mathematical representations (e.g. 6x + 5 = 17).

6. Attend to precision.

Students attending to precision will examine whether a mathematical solution to a problems is reasonable, needs to be precise or is best as an estimate.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

The reasoning and structure practices both engage mathematical modeling as students consider patterns, the use of important properties (e.g. commutative, associative, distributive), and the composing and decomposing of a number (e.g. 52 = 50+2; 100-48; 13 x 2 x 2) as possible considerations.

Resources to Support the Mathematical Practices

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Inside Mathematics

- **Bringing the Mathematical Practice Standards Together: Establishing a Conversational Context for Mathematical Thinking** (Inside Mathematics) http://www.insidemathematics.org/index.php/math-standards-together

Hunt Institute and CCSSO

- **Common Core Implementation Videos** (CCSSO & The Hunt Institute, 2011) http://www.ccsso.org/Resources/Digital_Resources/Common_Core_Implementation_Video_Series.html

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CCL4s

- **Common Core Look-fors (CCL4s) - Mathematics** (Splaysoft, LLC)
  http://splaysoft.com/CCL4s/Welcome.html
  A peer-observation tool (iPad/iPhone App) for the Standards for Mathematical Practice and Content Standards.

The Practices and Planning

…and observations

…what are you looking for?

how do you see students doing math?

let's try this…

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In the Classroom

- *Model with Mathematics* and Planning
- *Model with Mathematics* and Instruction
- *Model with Mathematics* and Assessment

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Connecting the Practices to the Domains of the Common Core State Standards

Grade Level: 3

Domain: Operations and Algebraic Thinking **3.0A**

Standard: Solve problems involving the four operations, and identify and explain patterns in arithmetic.

8. Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

Model with Mathematics – this standard involves the problem solving practice as students solve problems using all four operations representing their solutions using equations with a letter (variable) representing the unknown quantity in a problem. It extends the standard from grade 2 to include all operations and involve two-step problems.

Activity:

Content Issues

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The Content

Grades K-2	*Grades 3-5*
• **Counting and Cardinality (K only)**	• Operations and Algebraic Thinking
• Operations and Algebraic Thinking	• Number and Operations in Base Ten
• Number and Operations in Base Ten	• **Number and Operations – Fractions**
• Measurement and Data	• Measurement and Data
• Geometry	• Geometry

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and…

Grades 6, 7	*Grades 8*
• **Ratios and Proportional Relationships** • The Number System • Expressions and Equations • Geometry • Statistics and Probability	• The Number System • Expressions and Equations • **Functions** • Geometry • Statistics and Probability

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A glimpse…probably not fair

	Cluster Expectations
K	24
1	23
2	27
3	30
4	34
5	34
6	43
7	44
8	33

- Don't let the number of understandings and skills be the whole story…

Less is more!?

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Domains/ Grades	K	1	2	3	4	5	Totals
Counting and Cardinality	9						5%
Operations and Algebraic Thinking	5	8	4	9	5	3	20%
Number and Operations in Base Ten	1	8	10	3	6	8	21% (K-5); 17% (3-5)
Number and Operations - Fractions				7	12	11	31% (3-5)
Measurement and Data	3	4	10	12	8	8	26%
Geometry	6	3	3	2	3	4	12%
Totals	24	23	27	30	34	34	172

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Grades K-5

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and…

High School Conceptual Categories

- Number and Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics and Probability
- **Note on courses and transitions**: course sequence, K-7 standards prepare students for Algebra I in grade 8, etc.

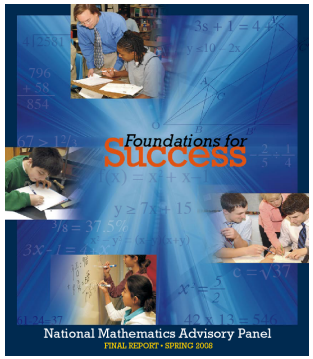
Deciding what's important?

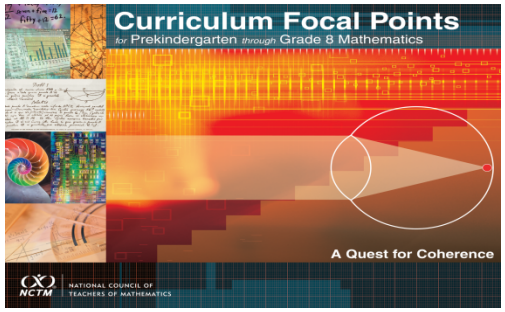
Four (or more) considerations…

Moving Beyond Transitioning

Critical and Foundational

- Place Value
- Operations
- Fractions





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Grade 7 Critical Areas

1. Developing understanding of and applying proportional relationships;

2. Developing understanding of operations with rational numbers and working with expressions and linear equations;

3. Solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume;

4. Drawing inferences about populations based on samples.

Curriculum Focal Points and Connections for Grade 7

The set of three curriculum focal points and related connections for mathematics in grade 7 follow. These topics are the recommended content emphases for this grade level. It is essential that these focal points be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations.

Grade 7 Curriculum Focal Points	Connections to the Focal Points
Number and Operations **and** ***Algebra*** **and** ***Geometry:*** **Developing an understanding of and applying proportionality, including similarity** Students extend their work with ratios to develop an understanding of proportionality that they apply to solve single and multistep problems in numerous contexts. They use ratio and proportionality to solve a wide variety of percent problems, including problems involving discounts, interest, taxes, tips, and percent increase or decrease. They also solve problems about similar objects (including figures) by using scale factors that relate corresponding lengths of the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and identify the unit rate as the slope of the related line. They distinguish proportional relationships ($y/x = k$, or $y = kx$) from other relationships, including inverse proportionality ($xy = k$, or $y = k/x$).	***Measurement*** and ***Geometry:*** Students connect their work on proportionality with their work on area and volume by investigating similar objects. They understand that if a scale factor describes how corresponding lengths in two similar objects are related, then the square of the scale
Measurement **and** ***Geometry*** **and** ***Algebra:*** **Developing an understanding of and using formulas to determine surface areas and volumes of three-dimensional shapes** By decomposing two- and three-dimensional shapes into smaller, component shapes, students find surface areas and develop and justify formulas for the surface areas and volumes of prisms and cylinders. As students decompose prisms and cylinders by slicing them, they develop and understand formulas for their volumes (*Volume = Area of base × Height*). They apply these formulas in problem solving to determine volumes of prisms and cylinders. Students see that the formula for the area of a circle is plausible by decomposing a circle into a number of wedges and rearranging them into a shape that approximates a parallelogram. They select appropriate two- and three-dimensional shapes to model real-world situations and solve a variety of problems (including multistep problems) involving surface areas, areas and circumferences of circles, and volumes of prisms and cylinders.	and b a… …dents continue to develop their unders… …ultiplication and division and the struc… …mbers by determining if a counting number grea… …1 is a prime, and if it is not, by factoring it into a p… …t of primes.
Number and Operations **and** ***Algebra:*** **Developing an understanding of operations on all rational numbers and solving linear equations** Students extend understandings of addition, subtraction, multiplication, and division, together with their properties, to all rational numbers, including negative integers. By applying properties of arithmetic and considering negative numbers in everyday contexts (e.g., situations of owing money or measuring elevations above and below sea level), students explain why the rules for adding, subtracting, multiplying, and dividing with negative numbers make sense. They use the arithmetic of rational numbers as they formulate and solve linear equations in one variable and use these equations to solve problems. Students make strategic choices of procedures to solve linear equations in one variable and implement them efficiently, understanding that when they use the properties of equality to express an equation in a new way, solutions that they obtain for the new equation also solve the original equation.	***Data Analysis:*** Students use proportions to make estimates relating to a population on the basis of a sample. They apply percentages to make and interpret histograms and circle graphs. ***Probability:*** Students understand that when all outcomes of an experiment are equally likely, the theoretical probability of an event is the fraction of outcomes in which the event occurs. Students use theoretical probability and proportions to make approximate predictions.

Data Analysis: Students use proportions to make estimates relating to a population on the basis of a sample. They apply percentages to make and interpret histograms and circle graphs.

Understanding

4.NBT

- Generalize place value ***understanding*** for multi-digit whole numbers.
- Use place value ***understanding*** and properties of operations to perform multi-digit arithmetic.

4.NF

- Extend ***understanding*** of fraction equivalence and ordering.
- Build fractions from unit fractions by applying and extending previous ***understandings*** of operations on whole numbers.
- ***Understand*** decimal notation for fractions and compare decimal fractions.

4.MD

- Geometric measurement: ***understand*** concepts of angle and measure angles.

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Try this…

- Pick a grade level you are familiar with (within K-8) – locate and highlight the following words within standards – ***understand, explain, interpret.***

- Pick a conceptual category you are familiar with (high school mathematics) – locate and highlight the following words within standards – ***understand, prove, rewrite, create, construct***

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Representation

- 3.NF.2 – Understand a fraction as a number on the number line; ***represent fractions on a number line diagram.***
- 4.NBT.5 – Multiply a whole number…Illustrate and explain…by ***using equations, rectangular arrays, and/or area models.***
- 5.MD.4 – Measure volumes by counting unit cubes, ***using cubic cm, cubic in, cubic ft, and improvised units.***
- 6.RP.3 – Use ratio and rate reasoning…by reasoning about ***tables of equivalent ratios, tape diagrams, double line diagrams or equations.***
- 8.FF.2 – Compare properties of two ***functions…represented in a different way (algebraically graphically, numerically in tables or by verbal descriptions).***

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Now, Try this…

- With the grade level (K-8) you have been working with highlight any reference to the use of **representations** (e.g. use area models to…)

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Here's the point…

- Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* (4.NF.4c)

- **Understanding + Representations = Time; Stuff; Depth**

Conceptual understanding is NOT an option,
it's an expectation!

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What's Important - Handout

- Consider (grade 4)
  - What's familiar?
  - What's new?
  - **What's challenging**
- Let's hear from you

Unpacking and Emphasis?

Operations and Algebraic Thinking

Grade 2	Grade 3	Grade 4	Grade 5
Represent and solve problems involving addition and subtraction (1).	Represent and solve problems involving multiplication and division (4).		
Add and subtract within 20 (1).	Multiply and divide within 100 (1).		
Work with equal groups of objects to gain foundations for multiplication (2).	Understand properties of multiplication and the relationship between multiplication and division (2).		
	Solve problems involving the four operations, and identify and explain patterns in arithmetic (2).	Use the four operations with whole numbers to solve problems (3).	
		Gain familiarity with factors and multiples (1).	Analyze patterns and relationships (1).
			Write and interpret numerical expressions (2).

Number and Operations in Base Ten

Grade 2	Grade 3	Grade 4	Grade 5
Understand place value (5).		Generalize place-value understanding for multidigit whole numbers (3).	Understand the place-value system (5).
Use place-value understanding and properties of operations to add and subtract (5).	Use place-value understanding and properties of operations to perform multidigit arithmetic (3).	Use place-value understanding and properties of operations to perform multidigit arithmetic (3).	Perform operations with multidigit whole numbers and with decimals to hundredths (3).

Number and Operations - Fractions

Grade 3	Grade 4	Grade 5
Develop understanding of fractions as numbers (7).	Extend understanding of fraction equivalence and ordering (2).	Use equivalent fractions as a strategy to add and subtract fractions (2).
	Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers (7).	Apply and extend previous understandings of multiplication and division to multiply and divide fractions (9).
	Understand decimal notation for fractions, and compare decimal fractions (3).	

A few examples…

- 4.NF.1 Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
- ***When?***
- ***How much time?***
- ***Assessment(s)?***

A few examples…

- 4.NF.3.d Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g. by using visual fraction models and equations to represent the problem.
- ***When?***
- ***How much time?***
- ***Assessment(s)?***

A few examples…

- 4.NBT.3 Use place value understanding to round multi-digit whole numbers to any place (builds off grade 3 to the nearest 10 or 100).
- ***When?***
- ***How much time?***
- ***Assessment(s)?***

Language…

Grade 1

- Students should apply the principle of ***transitivity of measurement*** to make indirect comparisons, but they need not use this technical term.

- ***Right rectangular prisms***
- ***Right circular cones***
- ***Right circular cylinders***

Language…

Grade 3

- Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into *b* equal parts; understand a fraction a/b as the quantity formed by *a* parts of size 1/b.

Language…

Grade 5

- Make a line plot to display…

Grade 6

- Display numerical data in plots on a number line, including dot plots, histograms, and box plots

Don't Forget

- **Pre-requisites**. What's the plan – for two years, forever?
- **RtI** – defining tier needs with a CCSS curriculum
- **Advanced students?** Acceleration – particularly between elementary and middle school.

Continuing teacher needs?

- Do they know this is going on? Awareness? Awareness+?
- Professional Development
  - Where will you start?
  - When?
  - Who will be involved? Stages?
- **Implementation Calendar – both directions**
- **Curriculum Materials**
- Assessments

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Back to the Mathematical Practices

Really important: "A lack of ***understanding*** effectively prevents a student from engaging in the mathematical practices." (p. 8)

ems&tl
Elementary Mathematics Specialists & Teacher Leaders Project

McDANIEL COLLEGE

Taking your CCSS Pulse

- District level awareness AND plan
- Building level awareness and PLAN
- Teachers
  - Standards
  - Content; related language
- Materials
- Professional Development
- PARCC - awareness of plan

Pulse rate?

Implementation Resources…

- Progressions
- Illustrative Mathematics Project
- *Institute for Mathematics and Education – University of Arizona; Bill McCallum*

- Math Common Core Coalition
- www.**math**ccc.org/

Down the road: the coming months, next year…

- Which grade levels will implement the CCSS next year?
- Do you have a plan for the amount of instructional time spent on each standard?
- Do you have the instructional tools (Practice 5) to accomplish your proposed plan? If not, what materials are needed?
- How will your students be engaged in the CCSS Mathematical Practices through their experiences with the content domains?

Thanks for asking…

- Mathematical Practices
- K-2
  - What about PreK – Wisconsin, Ohio, NY, Maryland
- Plan for beginning and end of levels work toward the middle (more emphasis at beginning)
- What's Important
  - Focal Points and Critical Areas
  - Fractions, Decimals – this afternoon…
- Beginning PD
  - Understanding and Representation
  - Scope and Unpacking
- Deciding Material (all of it) Needs

Reminder

- No set of standards has much meaning without equitable resources to ensure that teachers are trained well enough to reach kids who live in widely different circumstances.
- …it is important to remember that neither these standards nor any other single effort will be the silver bullet some mistakenly believe is out there…

Valerie Strauss, June 7, 2010

Your turn

Questions, Issues, Particular Challenges?