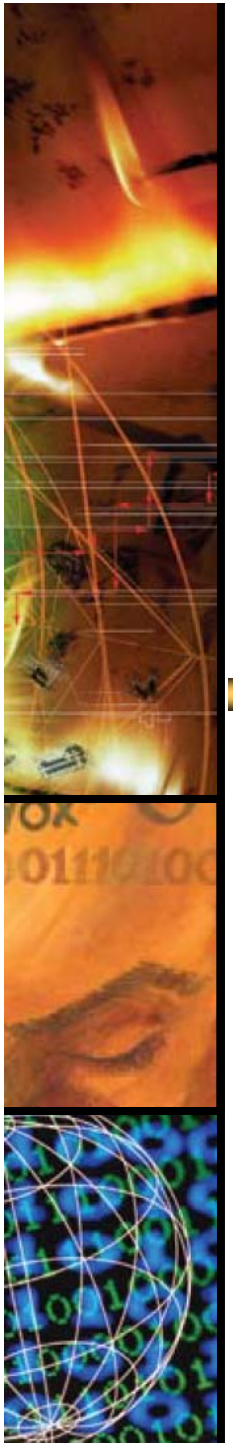


Implementing the More Challenging Aspects of Common Core State Standards

Diane J. Briars
NCSM President

43rd Annual NCSM Conference
April 11, 2011

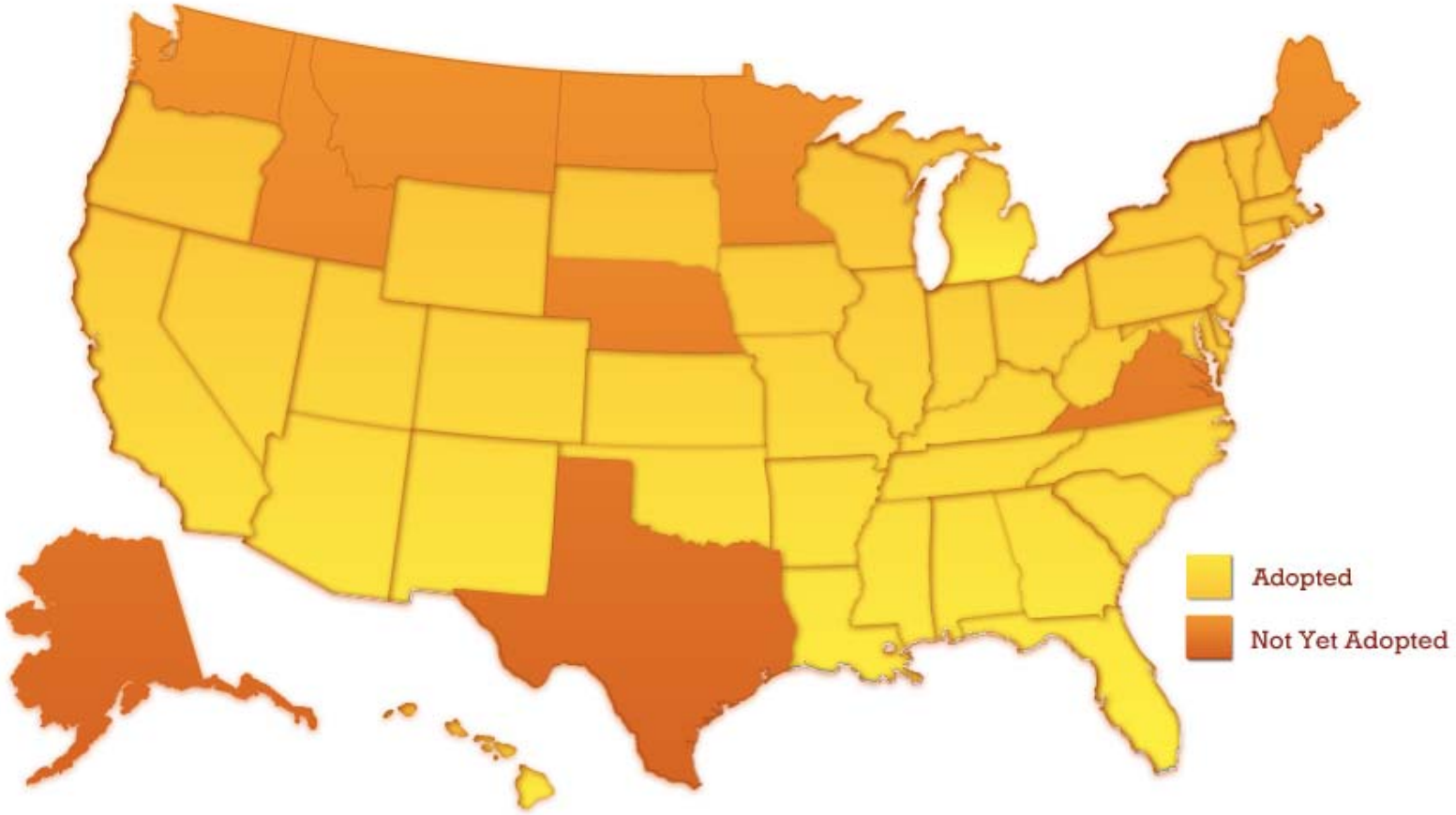
Today's Goals

- Examine some of the "Key Advances" in CCSS and their implications for practice.
- Explore productive starting points to help teachers and administrators understand these Key Advances and their implications.

That's Me

- Lives in Pittsburgh
- Elementary mathematics leader
- Middle school mathematics leader
- High school mathematics leader
- Administrator
- University mathematics leader
- Attended an NCSM webinar

" The Common Core State Standards represent an opportunity – once in a lifetime – to form effective coalitions for change." Jere Confrey, August 2010

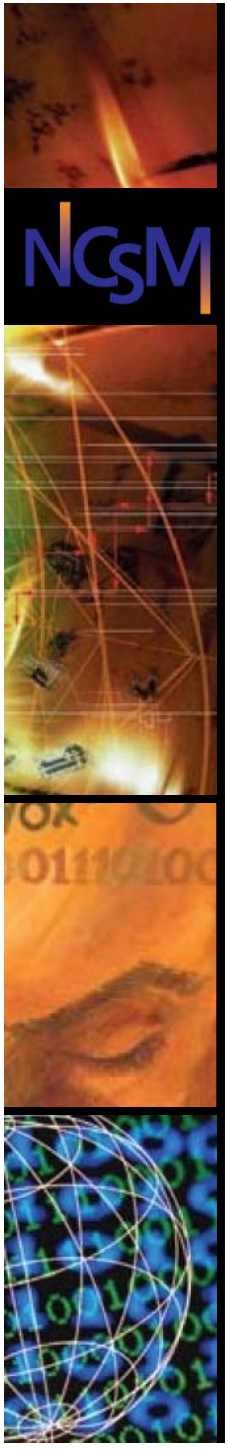


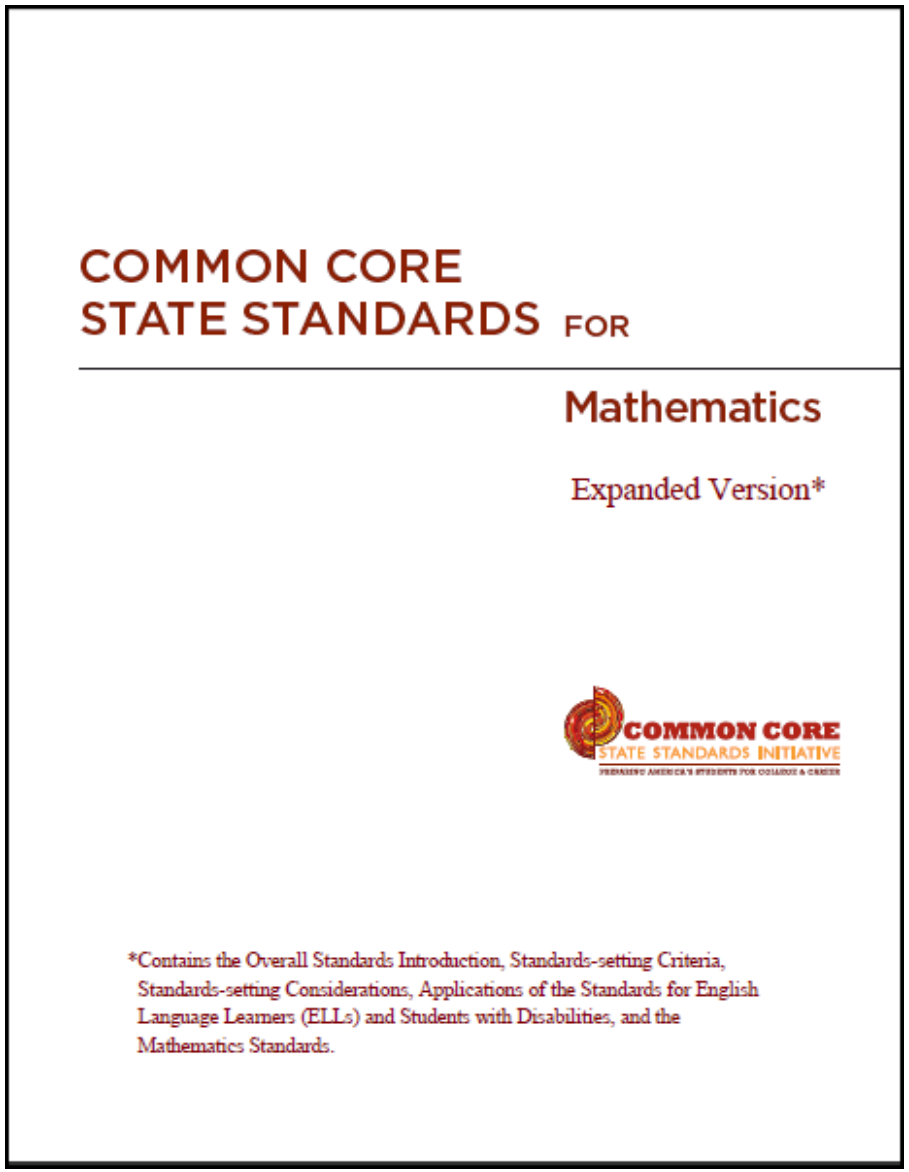
CCSS: A Major Challenge/Opportunity

- College and career readiness expectations
- Rigorous content and applications
- Stress conceptual understanding as well as procedural skills
- Organized around mathematical principles
- Focus and coherence
- Designed around research-based learning progressions whenever possible.

Common Core State Standards for Mathematics

- Introduction
  - Standards-Setting Criteria
  - Standards-Setting Considerations
- Application of CCSS for ELLs
- Application to Students with Disabilities
- Mathematics Standards
  - Standards for Mathematical Practice
  - Contents Standards: K-8; HS Domains
- Appendix A: Model Pathways for High School Courses





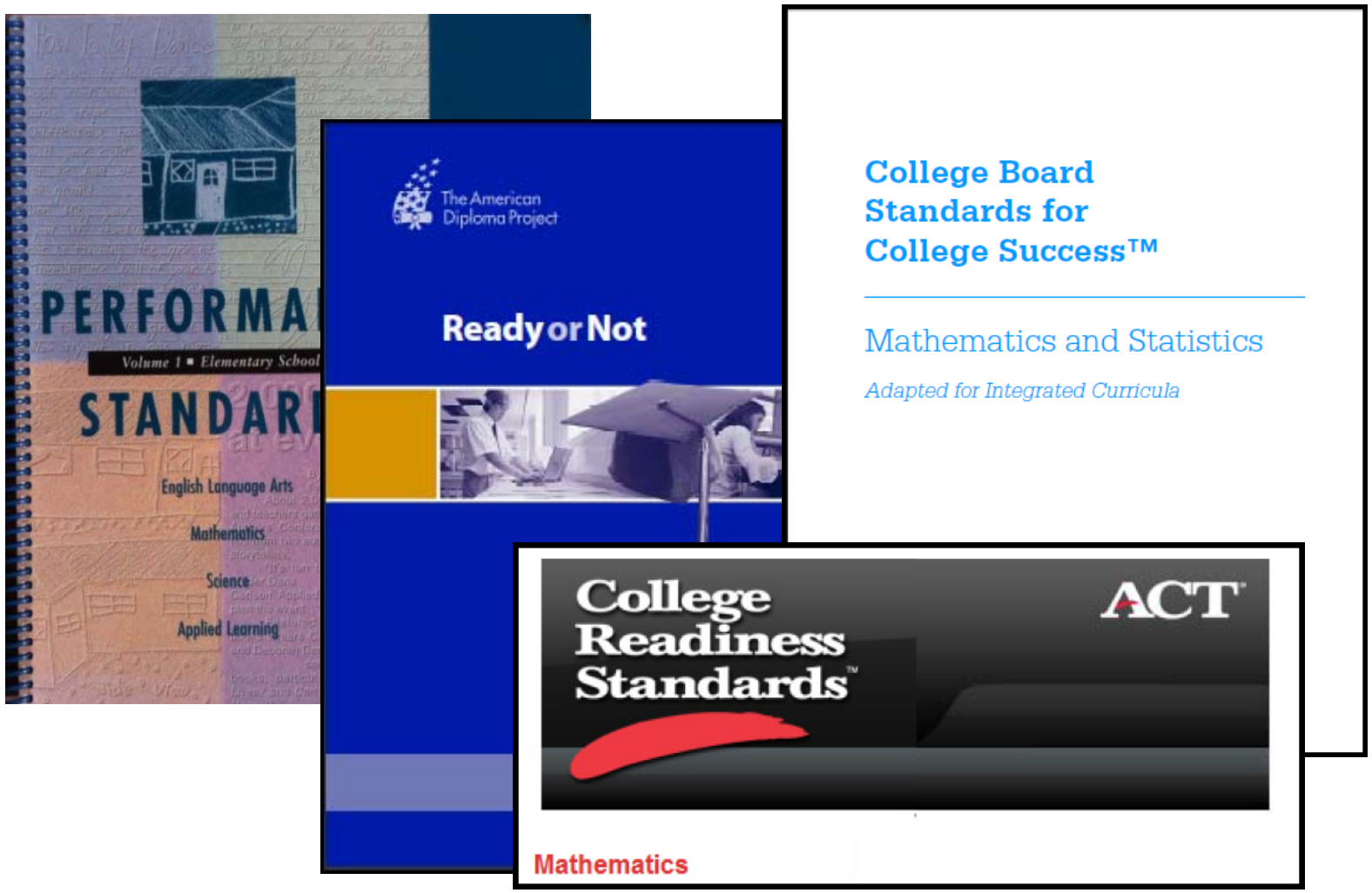
Expanded CCSS and Model Pathways available at www.mathedleadership.org/

History

NCTM

- *Curriculum and Evaluation Standards for School Mathematics* (1989)
- *Professional Standards for Teaching Mathematics* (1991)
- *Assessment Standards for School Mathematics* (1995)
- *Principles and Standards for School Mathematics* (2000)
- *Curriculum Focal Points* (2006)
- *High School Reasoning and Sense Making (2009)*

History

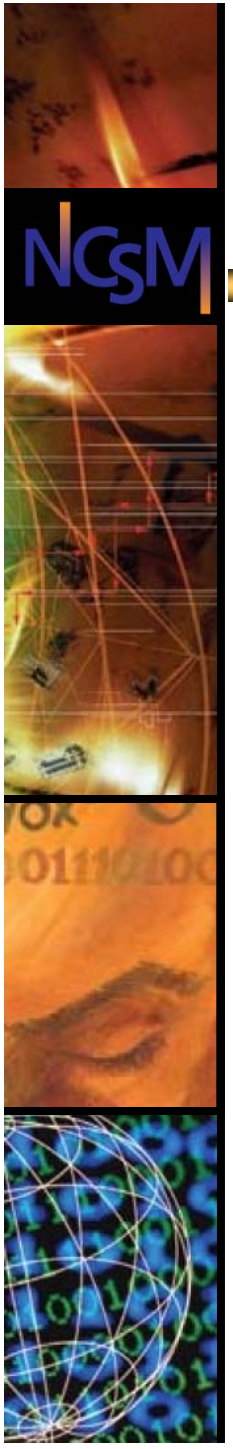

PERFORMA
Volume 1 • Elementary School
STANDARD
English Language Arts
Mathematics
Science
Applied Learning
The American Diploma Project
Ready or Not
College Board
Standards for
College Success™
Mathematics and Statistics
Adapted for Integrated Curricula
College Readiness Standards™
ACT
Mathematics

Common Core State Standards

- National Governors Association (NGA)
- Council of Chief State School Officers (CCSSO)
- Standards for College and Career Readiness for Mathematics and English/LA
  - Achieve
  - College Board
  - ACT

Common Core State Standards

- Mathematics Standards
  - Lead writers: Phil Daro, Bill McCallum, Jason Zimba,
  - Writing teams
  - Review teams
- Two rounds of public review and feedback
- States have option to adopt
  - Verbatim
  - 85% of State Standards must be CCSS



What's different about CCSS?

- Accountability
- Accountability
- Accountability

What's different about CCSS?

These Standards are not intended to be new names for old ways of doing business. They are a call to take the next step. It is time for states to work together to build on lessons learned from two decades of standards based reforms. It is time to recognize that standards are not just promises to our children, but promises we intend to keep.

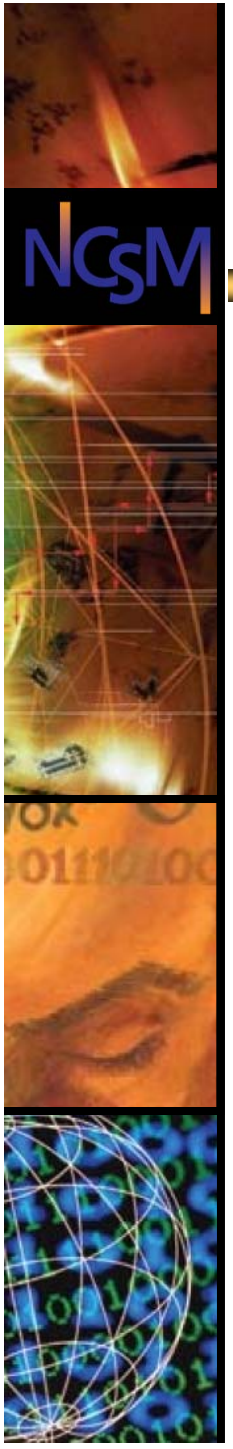
— CCSS (2010, p.5)

Assessment Consortia

- Partnership for the Assessment of Readiness for College and Careers (PARCC) http://www.fldoe.org/parcc/
- SMARTER Balanced Assessment Consortium http://www.k12.wa.us/SMARTER/

Implementing CCSS

- Challenge:
  - CCSS assessments not available for several years (2014-2015 deadline)
  - Recognizing that CCSS are not “business as usual”
- Where not to start--
  - Aligning CCSS standards grade-by-grade with existing mathematics standards



Key Advances

1. Standards for Mathematical Practice

Daro, 2010

Standards for Mathematical Practice

"The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education."

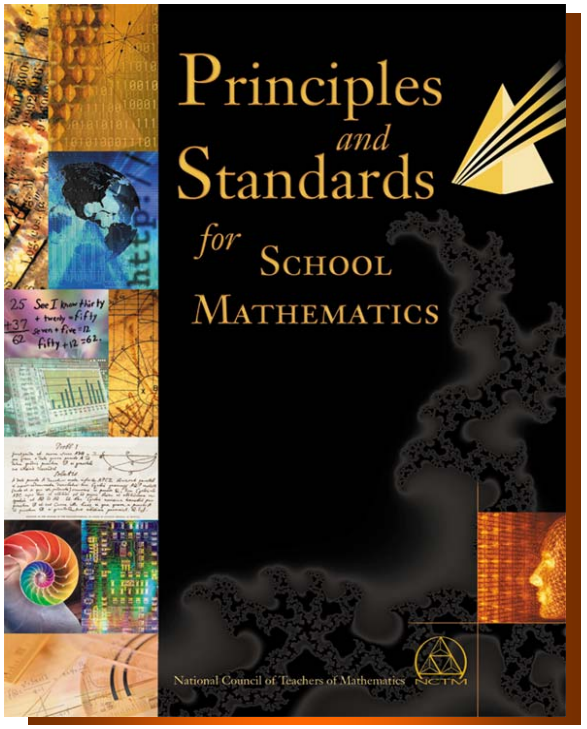
(CCSS, 2010)

Underlying Frameworks

National Council of Teachers of Mathematics

5 **Process** Standards

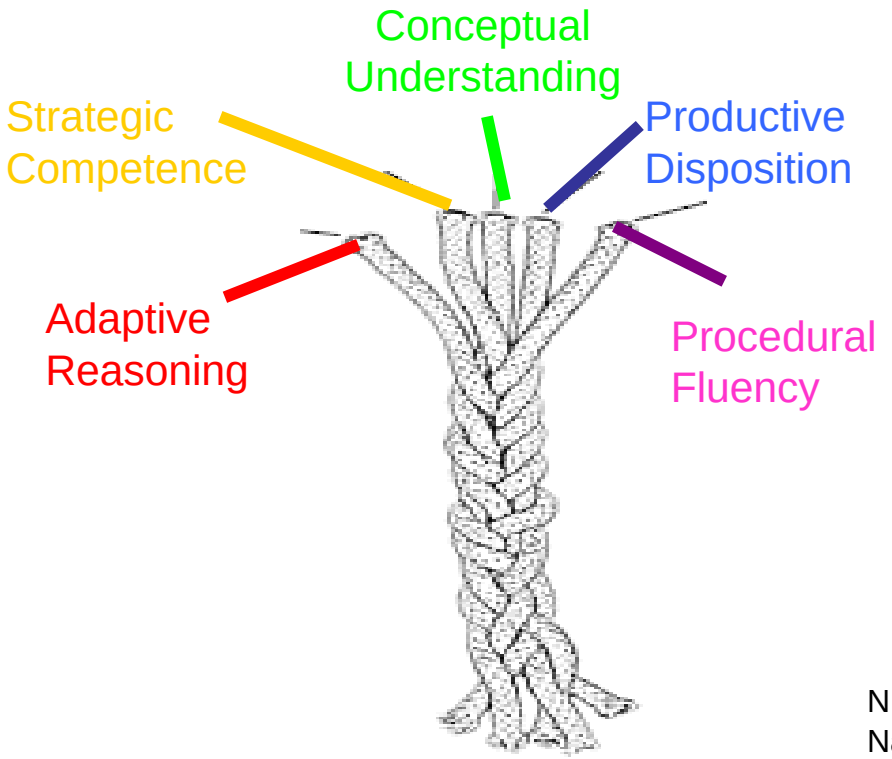
- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representations

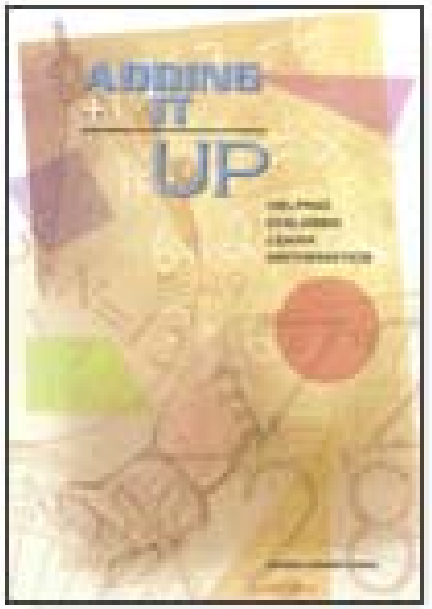


NCTM (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Underlying Frameworks

Strands of Mathematical Proficiency





NRC (2001). *Adding It Up*. Washington, D.C.: National Academies Press.

Strands of Mathematical Proficiency

- ***Conceptual Understanding*** – comprehension of mathematical concepts, operations, and relations
- ***Procedural Fluency*** – skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- ***Strategic Competence*** – ability to formulate, represent, and solve mathematical problems
- ***Adaptive Reasoning*** – capacity for logical thought, reflection, explanation, and justification
- ***Productive Disposition*** – habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Standards for Mathematical Practice

Take a moment to examine the first three words of each of the 8 mathematical practices… what do you notice?

Mathematically Proficient Students…

The Standards for [Student] Mathematical Practice

What are the *verbs* that illustrate the student actions for your assigned mathematical practice?

Circle, highlight or underline them for your assigned practice…

Discuss with a partner:

What jumps out at you?

The Standards for [Student] Mathematical Practice

SMP1: *Explain and make conjectures…*

SMP2: *Make sense of…*

SMP3: *Understand and use…*

SMP4: *Apply and interpret…*

SMP5: *Consider and detect…*

SMP6: *Communicate precisely to others…*

SMP7: *Discern and recognize…*

SMP8: *Notice and pay attention to…*

The Standards for [Student] Mathematical Practice

On a scale of 1 (low) to 6 (high),

to what extent is your school/district promoting students' proficiency in the practice you discussed?

Evidence for your rating?

Standards for Mathematical Practice

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Standards for Mathematical Practice in a Classroom

McDonald's Claim

Wikipedia reports that 8% of all Americans eat at McDonalds every day.

310 million Americans and 12,800 McDonalds…

Do you believe the Wikipedia report to be true? Create a mathematical argument to

justify your position.

McDonald's Claim Problem

- Which mathematical *practices* are needed to complete the task?
- What mathematics *content* is needed to complete the task?

Standards for Mathematical Practice in a Classroom

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

- Students make conjectures
- Students justify their conclusions and communicate them to others
- Students compare the effectiveness of two plausible arguments
- Students listen and respond to the arguments of others for sense making and clarity

HS N-Q: Reason quantitatively and use units to solve problems

- N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems;
- N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Standards for Mathematical Practice

- Describe the thinking processes, habits of mind and dispositions that students need to develop a deep, flexible, and enduring understanding of mathematics; in this sense they are also a means to an end.

SP1. Make sense of problems

"….they [students] analyze givens, constraints, relationships and goals. ….they monitor and evaluate their progress and change course if necessary. …. and they continually ask themselves "Does this make sense?"

Standards for Mathematical Practice

AND….

- Describe mathematical content students need to learn.

SP1. Make sense of problems

"……. students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends."

Standards for [*Student*] Mathematical Practice

"Not all tasks are created equal, and ***different tasks will provoke different levels and kinds of student thinking***."

Stein, Smith, Henningsen, & Silver, 2000

"***The level and kind of thinking in which students engage determines what they will learn***."

Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, Oliver, & Human, 1997

The Standards for [Student] Mathematical Practice

The 8 Standards for Mathematical Practice – place an emphasis on student demonstrations of learning…

Equity begins with an understanding of how the selection of tasks, the assessment of tasks, the student learning environment creates great inequity in our schools…

Implementation Issue

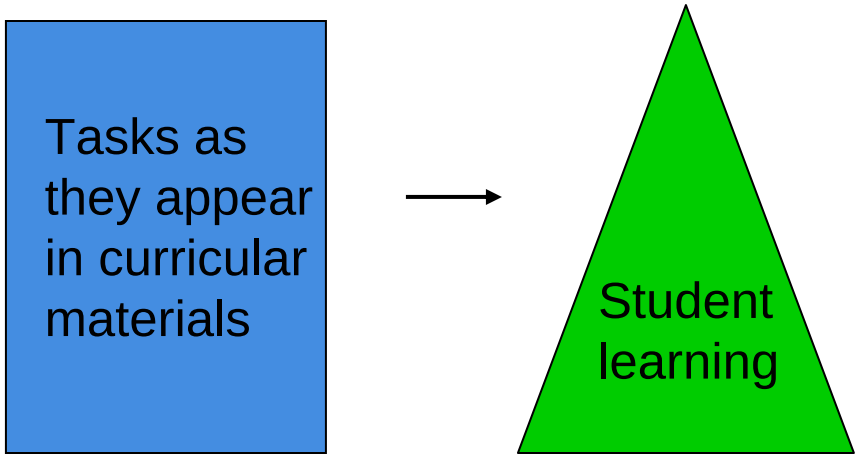
Do *all* students have the opportunity to engage in mathematical tasks that promote students' attainment of the mathematical practices on a regular basis?

Opportunities for *all* students to engage in challenging tasks?

- Examine tasks in your instructional materials:
  - Higher cognitive demand?
  - Lower cognitive demand?
- Where are the challenging tasks?
- Do *all* students have the opportunity to grapple with challenging tasks?
- Examine the tasks in your assessments:
  - Higher cognitive demand?
  - Lower cognitive demand?

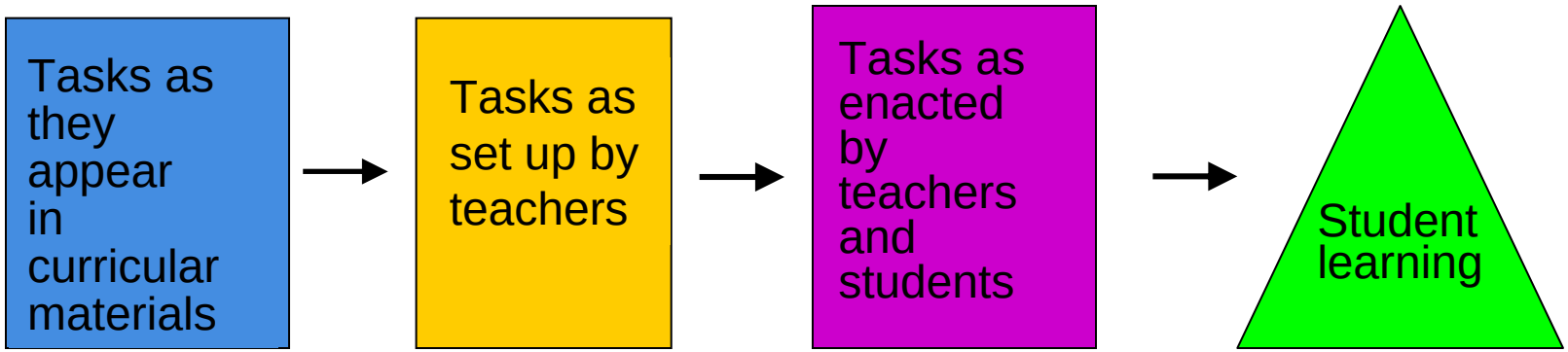
The Nature of Tasks Used in the Classroom …

Will Impact Student Learning!



But, WHAT TEACHERS DO with the tasks matters too!

The Mathematical Tasks Framework



Stein, Grover & Henningsen (1996)
Smith & Stein (1998)
Stein, Smith, Henningsen & Silver (2000)

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310 million Americans and 12,800 McDonalds…

Do you believe the Wikipedia report to be true? Create a mathematical argument to

justify your position.

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

Mathematically proficient students

- start by explaining to themselves the meaning of a problem and looking for entry points to its solution;
- analyze givens, constraints, relationships, and goals;
- make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt;
- consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution.

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

Mathematically proficient students

- monitor and evaluate their progress and change course if necessary;
- can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends;
- check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?”
- can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

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Students' Beliefs about Their Intelligence

- Fixed mindset:
  - Avoid learning situations if they might make mistakes
  - Try to hide, rather than fix, mistakes or deficiencies
  - Decrease effort when confronted with challenge
- Growth mindset:
  - Work to correct mistakes and deficiencies
  - View effort as positive; increase effort when challenged

Dweck, 2007

Students Can Develop Growth Mindsets

- Explicit instruction about the brain, its function, and that intellectual development is the result of effort and learning has increased students' achievement in middle school mathematics.
- Teacher praise influences mindsets
  - Fixed: Praise refers to intelligence
  - Growth: Praise refers to effort, engagement, perseverance

NCSM Position Paper #7

Promoting Positive Self-Beliefs

#6. Attend to precision

Mathematically proficient students

- try to communicate precisely to others;
- try to use clear definitions in discussion with others and in their own reasoning;
- state the meaning of the symbols they choose, including using the equal sign consistently and appropriately;
- are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem;
- calculate accurately and efficiently, and express numerical answers with a degree of precision appropriate for the problem context;
- examine claims and make explicit use of definitions.

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- examine claims and make explicit use of definitions.

Using the equal sign consistently and appropriately

- 6 + 9 = _____
- 6 + 9 = 15
- 15 = 6 + 9
- 6 + 9 = 8 + 7
- 15 = 15

Using the equal sign consistently and appropriately

8

8, 7, 3, 9, 2

Using the equal sign consistently and appropriately

8

8, 7, 3, 9, 2

8 + 9 = 17

Using the equal sign consistently and appropriately

8

8, 7, 3, 9, 2

$8 + 9 = 17 - 7 = 10$

Using the equal sign consistently and appropriately

8

8, 7, 3, 9, 2

$8 + 9 = 17 - 7 = 10 \div 2 = 5$

Using the equal sign consistently and appropriately

$$8$$

$$8,\ 7,\ 3,\ 9,\ 2$$

$$8 + 9 = 17 - 7 = 10 \div 2 = 5 + 3 = 8$$

$$8 + 9 = 8$$

Think about

- How do you use, model the use of “=“?
- How do the teachers you work with model the use of “=“?
- What opportunities are you providing for students to use “=“ to denote equality?

#6. Attend to precision

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Leading with the Mathematics Practices

- Build upon/extend work on NCTM Processes and NRC Proficiencies
- Phase in implementation
- Consider relationships among the practices
- Analyze instructional tasks in terms of opportunities for students to regularly engage in practices.

Cents and Non-Sense

http://www.youtube.com/watch?v=ANDk0SW_E


RANDALL PATRICK MUNROE
1053
Date 2004-12-09
Pay VERIZON COMMUNICATIONS
$ 0.002 + e^{i\pi} + \sum_{n=1}^{\infty} \frac{1}{2^n}
0.002 + e^{i\pi} + \sum_{n=1}^{\infty} \frac{1}{2^n}
Dollars
BB&T
BRANCH BANKING AND TRUST COMPANY
NEWPORT NEWS
Memo WHAT NOW,
?
Signature

Key Advances

1. Standards for Mathematical Practice
2. Units and unitizing
   a. Unit fractions
   b. Unit rates

Units are things you count

- Objects
- Groups of objects
- 1
- 10
- 100
- ¼ unit fractions
- Numbers represented as expressions

Daro, 2010

Units add up

- 3 pennies + 5 pennies = 8 pennies
- 3 ones + 5 ones = 8 ones
- 3 tens + 5 tens = 8 tens
- 3 inches + 5 inches = 8 inches
- 3 ¼ inches + 5 ¼ inches = 8 ¼ inches
- 3(1/4) + 5(1/4) = 8(1/4)
- 3(x + 1) + 5(x+1) = 8(x+1)

Daro, 2010

Key Advances

1. Standards for Mathematical Practice
2. Units and unitizing
   a. Unit fractions
   b. Unit rates
3. Operations and the problems they solve

Write a word problem that could be modeled by a + b = c.

- Result or total unknown; e.g. 5 + 3 = ?
  - Mike has 8 pennies. Sam gives him 3 more. How many does Mike have now?
- Change or part unknown; e.g., 5 + ? = 8
  - Mike has 5 pennies. Sam gives him some more. Now he has 8. How many did he get from Sam?
- Start unknown; e.g., ? + 3 = 8
  - Mike has some pennies. He gets 3 more. Now he has 11. How many did he have at the beginning?

Common Addition and Subtraction Situations

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3

	Total Unknown	Addend Unknown	Both Addends Unknown[1]
Put Together/ Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2

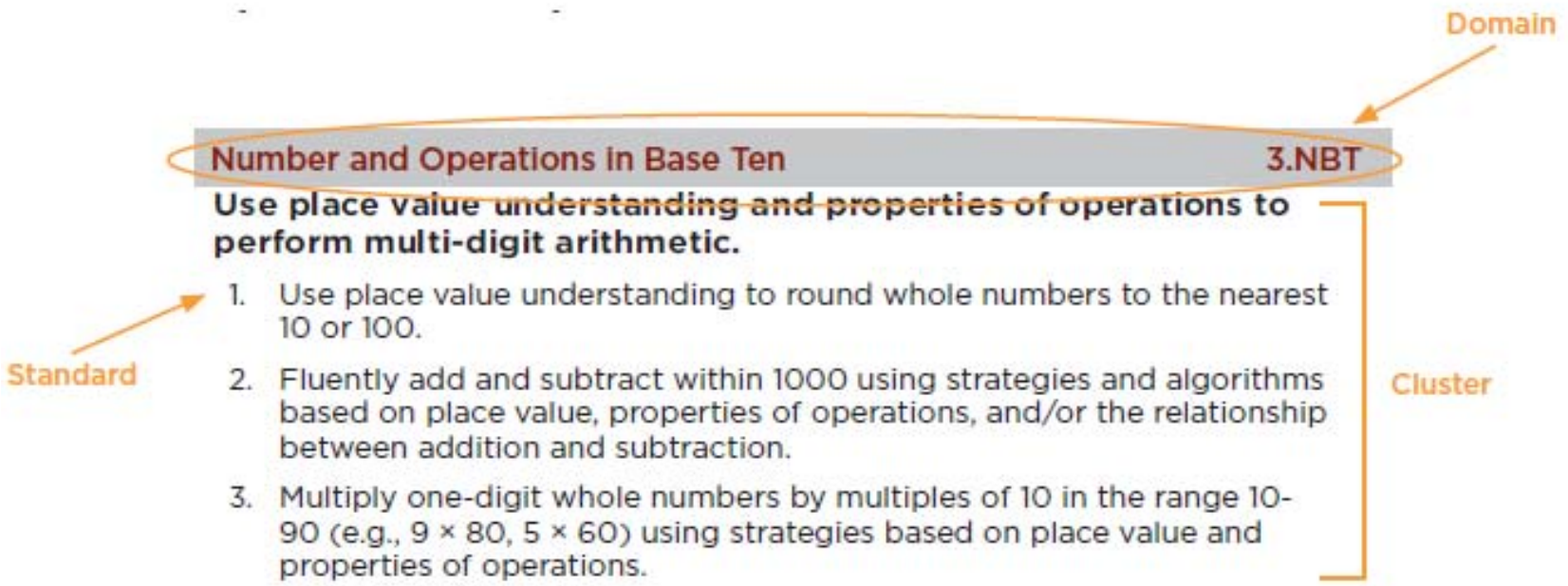
Common Addition and Subtraction Situations

	Difference Unknown	Bigger Unknown	Smaller Unknown
Compare[3]	(“How many more?” version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? (“How many fewer?” version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5

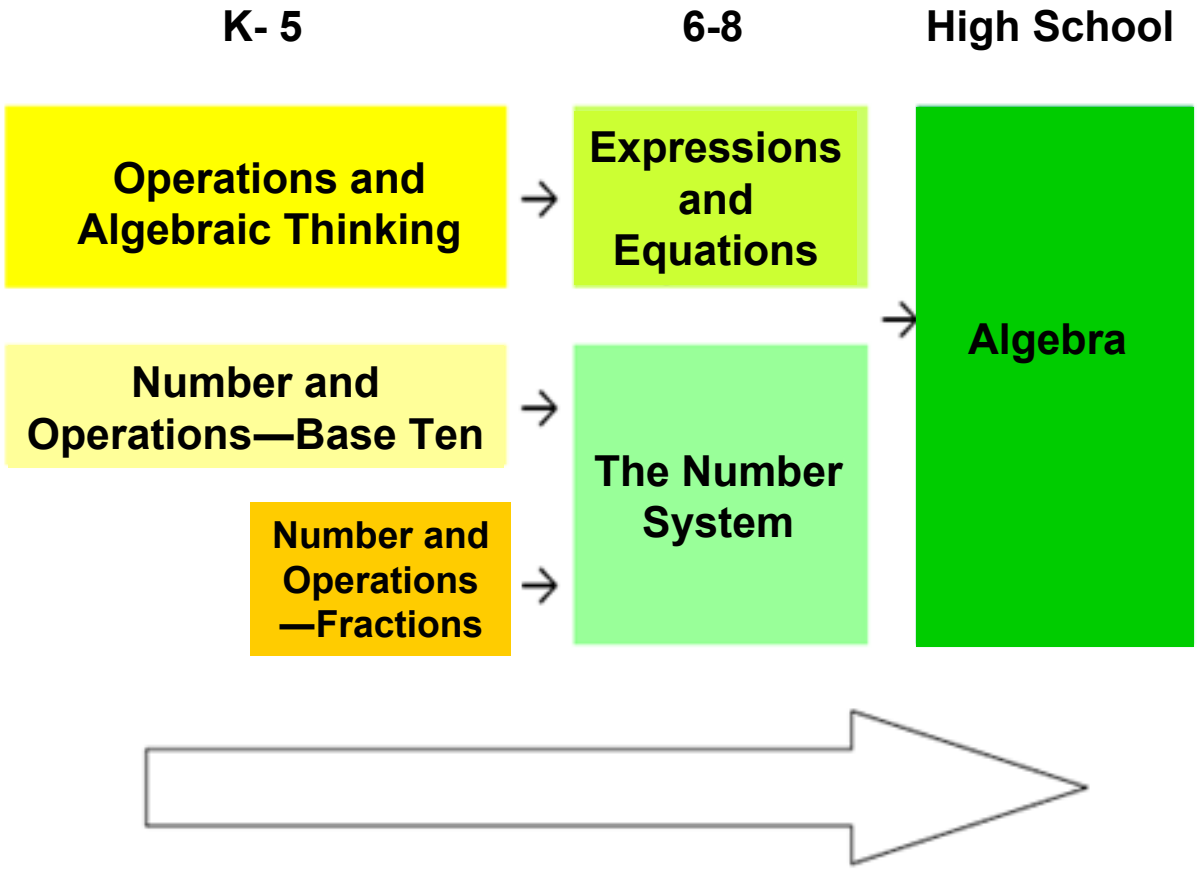
Standards for Mathematical Content

- Counting and Cardinality (K)
- Operations and Algebraic Thinking (K-5)
- Number and Operations in Base Ten (K-5)
- Measurement and Data (K-5)
- Geometry (K-HS)
- Number and Operations — Fractions (3-5)
- Ratios and Proportional Relationships (6-7)
- The Number System (6-8)
- Expressions and Equations (6-8)
- Statistics and Probability (6-HS)
- Functions (8-HS)
- Number and Quantity (HS)
- Algebra (HS)
- Modeling (HS)

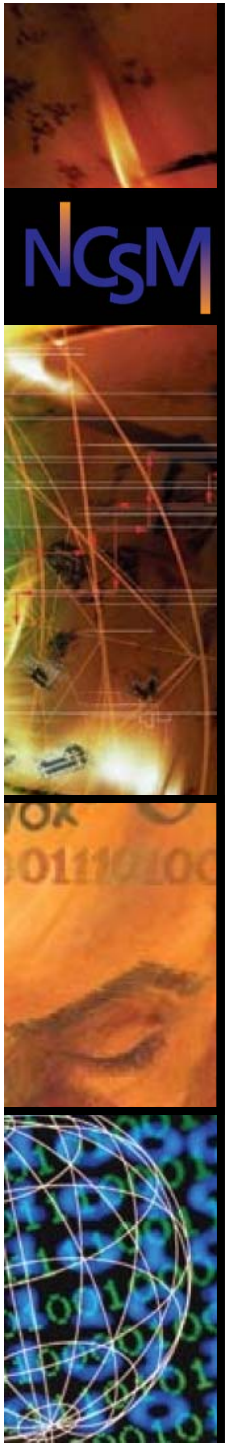
Grade Level Standards



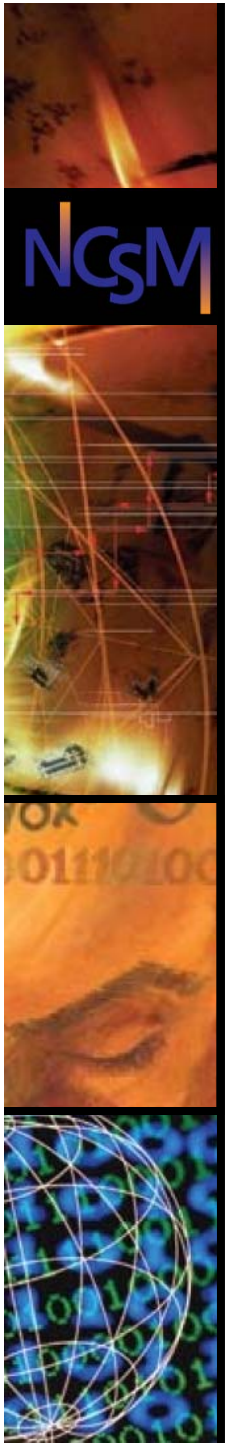
Progressions within and across Domains



Daro, 2010



	Operations and Algebraic Thinking	Numbers and Operations in Base Ten	Fractions
1	Understand and apply properties of operations and the relationship between addition and subtraction.	Use place value understanding and properties of operations to add and subtract.	
2		Use place value understanding and properties of operations to add and subtract.	
3	Understand properties of multiplication and the relationship between multiplication and division.	Use place value understanding and properties of operations to perform multi-digit arithmetic. *A range of algorithms may be used.*	
4		Use place value understanding and properties of operations to perform multi-digit arithmetic. *Fluently add and subtract multi-digit whole numbers using the standard algorithm.*	Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
5		Perform operations with multi-digit whole numbers and with decimals to hundredths. *Fluently multiply multi-digit whole numbers using the standard algorithm.*	Apply and extend previous understandings of multiplication and division to multiply and divide fractions.



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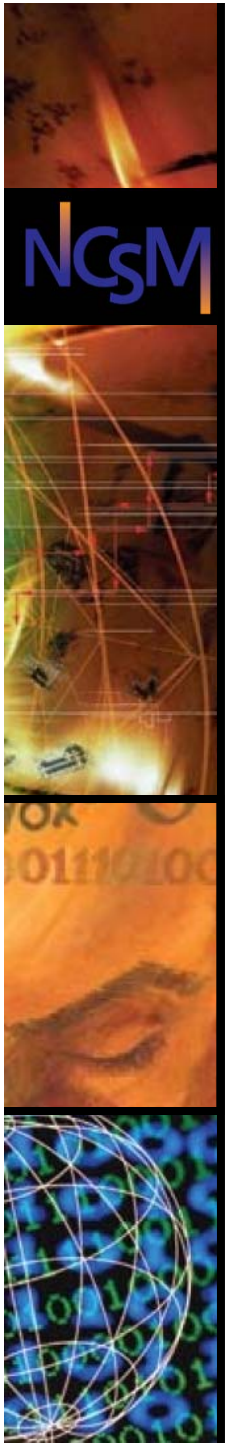
4		Use place value understanding and properties of operations to perform multi-digit arithmetic. *Fluently add and subtract multi-digit whole numbers using the standard algorithm.*	Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
5		Perform operations with multi-digit whole numbers and with decimals to hundredths. *Fluently multiply multi-digit whole numbers using the standard algorithm.*	Apply and extend previous understandings of multiplication and division to multiply and divide fractions.



	Operations and Algebraic Thinking	Numbers and Operations in Base Ten	Fractions
1	Understand and apply properties of operations and the relationship between addition and subtraction.	Use place value understanding and properties of operations to add and subtract.	
2		Use place value understanding and properties of operations to add and subtract.	
3	Understand properties of multiplication and the relationship between multiplication and division.	Use place value understanding and properties of operations to perform multi-digit arithmetic. ***A range of algorithms may be used.***	
4		Use place value understanding and properties of operations to perform multi-digit arithmetic. ***Fluently add and subtract multi-digit whole numbers using the standard algorithm.***	Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
5		Perform operations with multi-digit whole numbers and with decimals to hundredths. ***Fluently multiply multi-digit whole numbers using the standard algorithm.***	Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Key Advances

1. Standards for Mathematical Practice
2. Units and unitizing
   a. Unit fractions
   b. Unit rates
3. Operations and the problems they solve
4. Properties of operations: Their role in arithmetic and algebra
5. Mental math and “algebra” vs. algorithms

Daro, 2010

Key Advances

6. Defining similarity and congruence in terms of transformations
7. Quantities-variables-functions-modeling
8. Number-expression-equation-function
9. Modeling

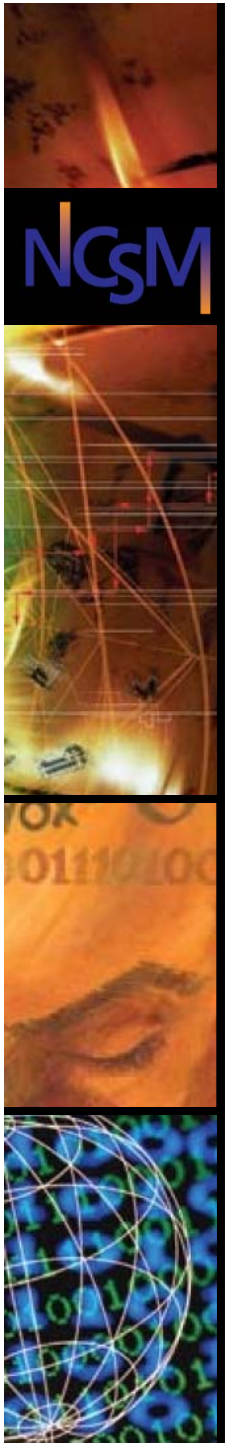
Daro, 2010

New Resources and Tools NCSM

- *Illustrating the Standards for Mathematical Practice* professional development materials.
- *Great Tasks for Mathematics*
- Tool for analyzing instructional materials in light of CCSS and related professional development activities.
  - Under development in collaboration with Bill Bush, University of Louisville, and CCSSO.
  - Target release date: Spring, 2011.

NCSM Professional Development Opportunities

- NCSM Summer Leadership Academy
  - June 21-23, 2011, Atlanta, GA
- Fall One-Day Seminars
  - October 19, 2011, Atlantic City
  - October 26, 2011, St. Louis
  - November 2, 2011, Albuquerque



Thank You!