



# Issues for Maryland Mathematics, Then and Now

*Next steps for all of us*

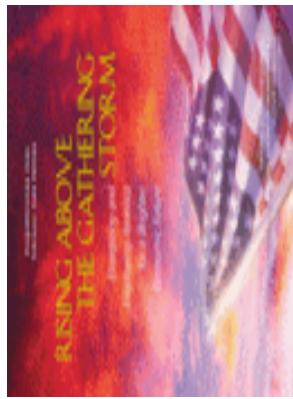
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Westminster, Maryland  
&

Past President  
National Council of Teachers of Mathematics  
October 17, 2008



# The Competition Thing

- 86% of U.S. voters believe that the U.S. must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.

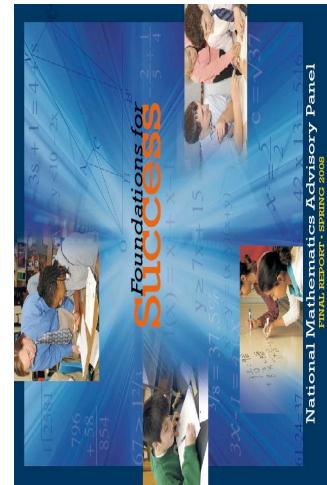


- Competitiveness – an advantage for new ideas

Rising Above the Gathering Storm, NAS, 2005

## • America Competes Act

### – Math Now



# Sound bites...

- "We cannot wait for a new **Sputnik** episode to energize our population to rise to this challenge – we must recognize the existing crisis and take the necessary actions." NSF, 2006
- If we don't step up to the challenge of finding and supporting the best teachers we'll undermine everything else we are trying to do to improve our schools. IBM, 2006



## And from the Secretary...

- "We must encourage students to take more advanced math and science classes. Employers today need workers with '**pocket protector**' skills – creative problem solvers with strong math and science backgrounds."

Margaret Spellings, June 21, 2007



Nerds Rock!!





- In academic 2005-2006, there were more students taking calculus at the high school level than taking calculus I in all 2- and 4-year colleges and universities in this country.

David Bressoud  
May, 2007



The downward push issue!



- ACT study notes gap between U.S. high school curriculum and college expectations.
  - Colleges generally want all incoming students to attain an in-depth understanding of a selected number of fundamental skills and concepts in their high school courses, while high schools tend to provide less in-depth instruction of a broader range of skills and topics.

April, 2007



# What Algebra? When?

- Grade level?
- Background?
- Who's teaching?
- The Misplaced Math Student – Lost in 8<sup>th</sup> Grade Algebra...



# More and better mathematics for all students



This is an imperative for  
America's competitiveness.



## All means...in the classroom

- Recognizing the importance of **formative assessment;**
- And the promise of **intervention.**



**Teachers assess all the time,  
every day!**

**Where does the decimal point go?**

$$306.15 \div 75.4 = 4.0603448$$

## Reminder

- All assessments are snapshots within a much larger album or record of learning.



## Assessment Distance

- **Immediate** – informal observation or artifacts from a lesson.
- **Close** – embedded assessments and semi-formal quizzes following several activities.
- **Proximal** – formal classroom exams following a particular curriculum.
- **Distal** – criterion-referenced achievement tests such as those required by NCLB.
- **Remote** – Broad outcomes measured over time – norm referenced tests.

Ruiz-Primo, Shavelson, Hamilton, and Klein (2002)

# Informal Assessments

- Observations
- Anecdotal Reports
- We know it is **more** informative to observe a student during a mathematical activity than to grade his papers. (Freudenthal, 1973)



## They're all yours...

- Start before they have the instructions.
- Seemingly get distracted by movement – of any type!
- Oh, yeah, I get it!
- I'm done!

Done 1<sup>st</sup> Generation!

**Write a word problem  
that can be solved by  
either addition or  
subtraction**



## Now what?

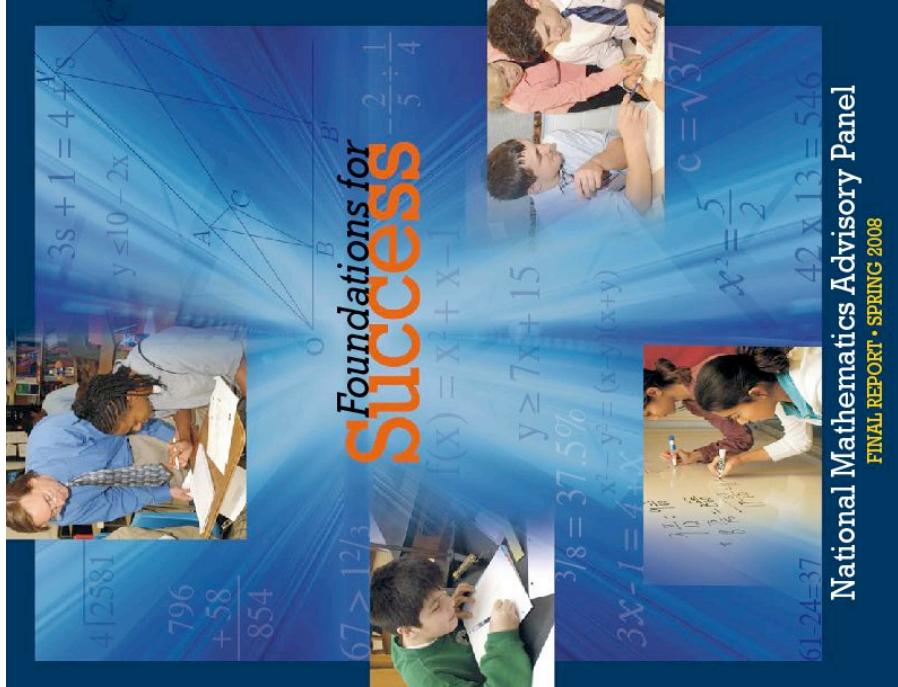
- There are 25 students in our class. Each student will get  $\frac{1}{4}$  of a pizza. Your job is to find out how many pizzas we should order. Be sure to show your work.
- How many pizzas should we order?

Fractions!

# Think about...

- Aside from teacher-made classroom tests, the integration of assessment and learning as an interacting system has been too little explored.

- NMAP and formative assessment.



Glaser and Silver, 1994

National Mathematics Advisory Panel  
FINAL REPORT • SPRING 2008

## The Challenge of Intervention

To provide guidance in the creation or selection of intervention programs that support - **high-quality, equitable instructional practices for all students.**



## Think about...

- The mathematics: Why are some mathematics topics more challenging than others, with regard to intervention?
- Why are some topics “quick fixes” and others long term?
- Differences among computational fluency, conceptual understanding and problem solving.



## An Intervention Program is:

- A structured plan ...
- Additional instruction on content that has already been introduced in the classroom
- Intended to **boost**—not supplant or copy—regular classroom instruction



## Be Vigilant

- Act Early – don't wait until students are falling behind or failing to intervene
- Continually assess students' strengths and weaknesses
- Provide or modify instruction that targets students' needs



## Many students benefit

- Struggling students (typically)
- Absentees
- Mathematically talented students, as a challenging supplement to a standard instructional program

# Curriculum – Importance of Focus and Coherence





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# Beyond the Focal Points

- Recognize the importance of focus and coherence;
- Identify such targets or benchmarks;
- Build the level of understanding and proficiency necessary to validate their “completion.”
- This discussion will continue:
  - National Curriculum and Local Control
    - Less is more
    - International comparisons...



# What does it mean to build “a deep understanding?”

- More pages?
- Variety of opportunities?
- More time?
- How?

## Curriculum Focal Points and Connections for Grade 4

The set of three curriculum focal points and related connections for mathematics in grade 4 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 4 Curriculum Focal Points

#### **Number and Operations and Algebra:** Developing quick recall of multiplication facts and related division facts and fluency with whole-number multiplication

Students use understandings of multiplication to develop quick recall of the basic multiplication facts and related division facts. They apply their understanding of models for multiplication (i.e., equal-sized groups, arrays, area models, area models, equal intervals on the number line), place value, and properties of operations (in particular, the distributive property) as they develop, discuss, and use efficient, accurate, and generalizable methods to multiply multidigit whole numbers. They select appropriate methods and apply them accurately to estimate products or calculate them mentally, depending on the context and numbers involved. They develop fluency with efficient procedures, including the standard algorithm, for multiplying whole numbers, understand why the procedures work (on the basis of place value and properties of operations), and use them to solve problems.

#### **Number and Operations.** Developing an understanding of decimals, including the connections between fractions and decimals

Students understand decimal notation as an extension of the base-ten system of writing whole numbers that is useful for representing more numbers, including numbers between 0 and 1, between 1 and 2, and so on. Students relate their understanding of fractions to reading and writing decimals that are greater than or less than 1, identifying equivalent decimals, comparing and ordering decimals, and estimating decimal or fractional amounts in problem solving. They connect equivalent fractions and decimals by comparing models to symbols and locating equivalent symbols on the number line.

#### **Measurement:** Developing an understanding of area and determining the areas of two-dimensional shapes

Students recognize area as an attribute of two-dimensional regions. They learn that they can quantify area by finding the total number of same-sized units of area that cover the shape without gaps or overlaps. They understand that a square that is 1 unit on a side is the standard unit for measuring area. They select appropriate units, strategies (e.g., decomposing shapes), and tools for solving problems that involve estimating or measuring area. Students connect area measure to the area model that they have used to represent multiplication, and they use this connection to justify the formula for the area of a rectangle.

### Connections to the Focal Points

**Algebra:** Students continue identifying, describing, and extending numeric patterns involving all operations and nonnumeric growing or repeating patterns. Through these experiences, they develop an understanding of the use of a rule to describe a sequence of numbers or objects.

**Geometry:** Students extend their understanding of properties of two-dimensional shapes as they find the areas of polygons. They build on their earlier work with symmetry and congruence in grade 3 to encompass transformations, including those that produce line and rotational symmetry. By using transformations to design and analyze simple tilings and tessellations, students deepen their understanding of two-dimensional space.

**Measurement:** As part of understanding two-dimensional shapes, students measure and classify angles.

**Data Analysis:** Students continue to use tools from grade 3, solving problems by making frequency tables, bar graphs, picture graphs, and line plots. They apply their understanding of place value to develop and use stem-and-leaf plots.

**Number and Operations:** Building on their work in grade 3, students extend their understanding of place value and ways of representing numbers to 100,000 in various contexts. They use estimation in determining the relative sizes of amounts or distances. Students develop understandings of strategies for multi-digit division by using models that represent division as the inverse of multiplication, as partitioning, or as successive subtraction. By working with decimals, students extend their ability to recognize equivalent fractions. Students' earlier work in grade 3 with models of fractions and multiplication and division facts supports their understanding of techniques for generating equivalent fractions and simplifying fractions.

## Critical Foundations for Algebra



- Whole Numbers

- Fractions (fractions, decimals, percent, leading to ratio and proportion)
- Particular aspects of geometry and measurement



- Fractions are a major area of study in upper elementary school mathematics. It is time to shift the emphasis and redefine the goal of fraction instruction from learning computation rules to developing fraction operation sense (Huinker, 2002).
- Do we do this?

# Rational Number Sense

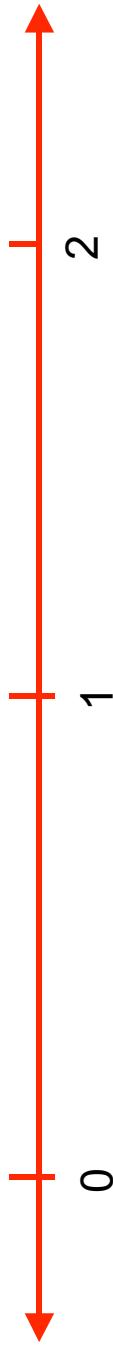
- Using representations of fractions, decimals, and percents interchangeably;
- Comparing and ordering fractions, decimals and percents;
- Using benchmarks to estimate when comparing and ordering and in determining sums, differences, products, and quotients.
- (Adapted from Moss, 2002)



**3/4**

- What happens to the value of the fraction if the numerator is increased by 1?
- What happens to the value of the fraction if the denominator is decreased by 1?
- What happens to the value of the fraction if the denominator is increased?

- Tell me about where  $2/3 + 1/6$  would be on this number line (Cramer, Henry, 2002).



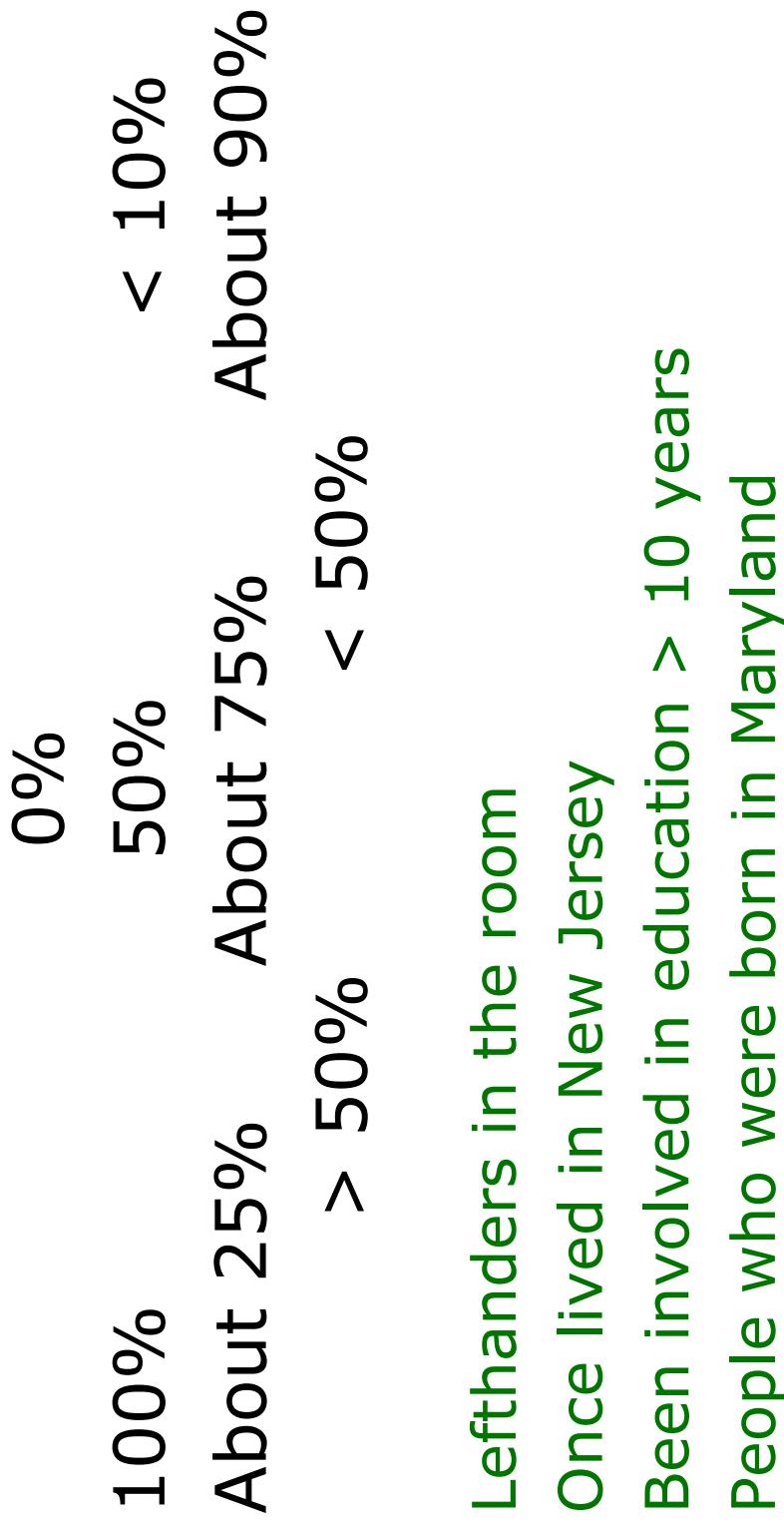
Sense Making:

“ $2/3$  is almost 1,  $1/6$  is a bit more, but the sum is  $< 1$ ”

- Put  $2/3$ ;  $0.5$  and  $3/4$  in order from smallest to largest.
- It's easy,  $0.5$  is  $50\%$  and  $2/3$  is  $66\%$ , and so it goes first  $0.5$ , then  $2/3$  and then  $3/4$  because that's  $75\%$ .\*

\*response by Andy in New Approaches to Teaching the Rational Number System by Joan Moss in How Students Learn: Mathematics in the Classroom, NRC, 2005.

# Percent Benchmarks



Reys, 1991

# **Foundational Topics are just that – Foundations**

Depth

Understanding – Proficiency – Problem Solving

# Disposition IS Important

aka – the Happiness Factor

## The Parent Conference from ...

- Well, I was never good in math either?
- Tell me, when will my child ever use this mathematics?
- Effort matters – NMP
- The cultural thing...



# Parting Shots

Actually, make that next steps...



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## No Child Left Behind Challenges

- Lots of requirements with very little resources
- Meeting AYP
- Overemphasis on high-stakes assessments.
- We must fix this...



These challenges are diverting teachers from teaching, and driving them from the profession!



## VSC and more

- It's time...
- Fewer topics – more time on the most important mathematics
- and
- Math specialist certification – Now

# For all of you

## Time

To teach  
For learning  
For assessing  
For planning  
For thinking...





# Teacher Education





## Teaching Mathematics No Wonder They Make Fun of Us

- Listening and watching others work.
- Being professional – what we say, how we act, how we dress...
- Probing ideas
  - Can we think of this differently?
  - Can you show me another way?
  - What have we learned here?
- Provoking disequilibrium and error
- Seeking to learn others' experiences and perspectives.
- Seeing and accepting people, responses, etc.

# Professional Development

What works?





# Re: Assessment

# High stakes are for tomatoes!

Susan Ohanian



# Our circle needs to widen

- Mathematicians
- Cognitive Scientists
- Policy Experts
- Community Members
- And the collective us:
  - Teachers
  - Teacher educators
  - Mathematics education researchers
  - Supervisors
  - Specialists



# Equity

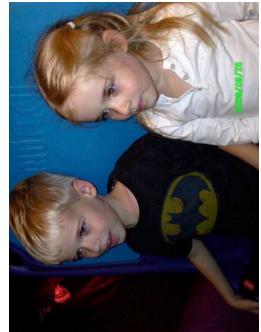
- We shortchange the challenge and limit the discussion when we think equity is all about achievement gaps.
- Equity is about:
  - How and when we assess
  - Intervention
  - Curriculum, and
  - Disposition



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- Reform vs Traditional
- Referencing Math Wars
- All references to the f \_ \_ \_ y word and mathematics





**It's all about the kids,  
making sense of the math  
they are learning, and good  
teaching**



It has been my pleasure to represent  
&  
serve all of you!

THANK YOU!!!

[www.ffennell.com](http://www.ffennell.com)