
NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

www.nctm.org

NCTM – some things you may not know!

# Every Student Loving Math – Really
# 4C's for Consideration

## Competitiveness, Coherence, Communication, & Choices

North Carolina ASCD
53rd Annual Conference
February 8, 2008

Francis (Skip) Fennell, President
National Council of Teachers of Mathematics
&
Professor of Education
McDaniel College
Westminster, MD

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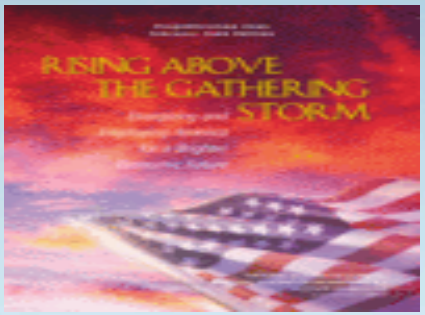
# Competitiveness

- 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.

- The Tom Friedman – effect!
- Competitiveness – an advantage for new ideas

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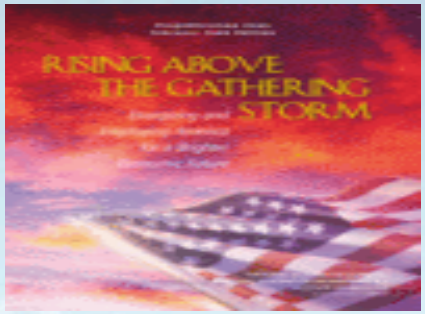
Rising Above the Gathering Storm, NAS, 2005

# 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

RAGS Effect II

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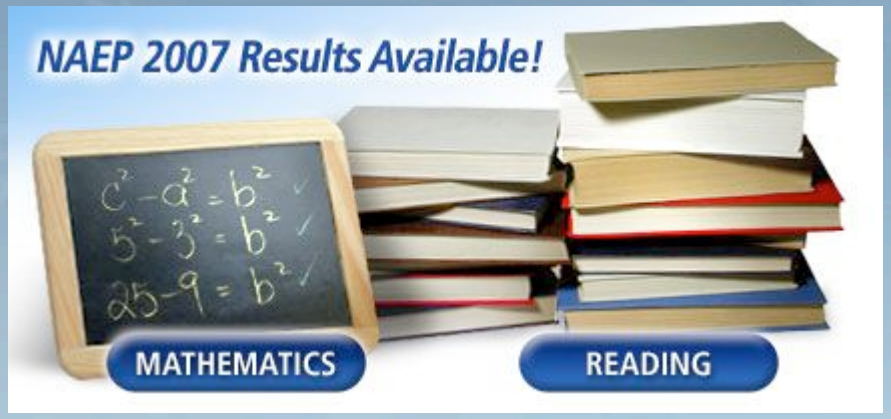
# America's Pressing Challenge: Building A Stronger Foundation

- Our nation must devote the necessary resources now to revitalize our precollege STEM education system. 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

# Recent Good news…




- Highest scores ever – grade 4 mathematics
- Highest scores ever – grade 8 mathematics
- Increasingly diverse student population
- NMP and NAEP

# No Child Left Behind Challenges

- Meeting AYP

- Highly Qualified Teachers
- Math for All
  - Special education challenges
  - Equity and “subgroups”
- Overemphasis on high stakes assessments.
  - Life does not come at you in multiple choice moments


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

# And, from my sister…*

Madaline Fennell, the Nebraska teacher of the year: Teachers are asking for,

- fully funding education and assessment programs that are federally mandated;
- language that addresses the special needs of students with disabilities, such as implementing state assessment systems that track the academic growth of individual students;
- replacing penalties against failing schools with methods to enhance achievement;
- multiple methods of assessment that evaluate a student's progress over the entire year, instead of just through standardized tests.

Ms. Fennell said that while there are positive aspects to the law, it is also "fraught with numerous deficiencies." The expertise of teachers who have been chosen as the best of the best in their states, she said, can help lawmakers craft a better version of the No Child Left Behind Act. "Teachers need to be included in this reauthorization," she said. "Please, leave no teacher behind."

* NOT

# Coherence

# Why Identify Focal Points?

- Address long lists of state learning expectations
- Address “mile wide, inch deep” math curriculum
- Identify the mathematics that should be the focus of instruction and student learning, preK-8
- Begin the discussion of appropriate curricular expectations
- Identify key mathematical ideas all others build on

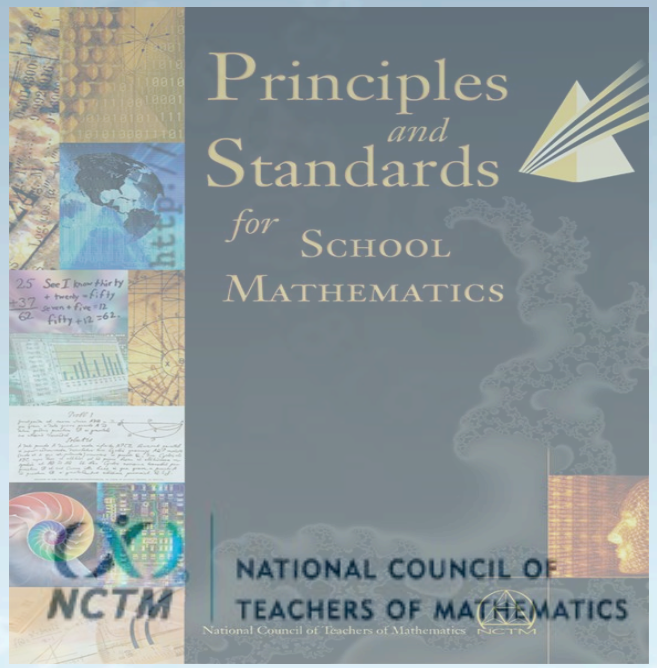
# Number of 4th-Grade Learning Expectations per State by Content Strand

| | Number & Operation | Geometry | Measurement | Algebra | Data Analysis, Probability & Statistics | Total Number of Learning Expectations |
|---|---|---|---|---|---|---|
| **California** | 16 | 11 | 4 | 7 | 5 | **43** |
| **Texas** | 15 | 7 | 3 | 4 | 3 | **32** |
| **New York** | 27 | 8 | 10 | 5 | 6 | **56** |
| **Florida** | 31 | 11 | 17 | 10 | 20 | **89** |
| **Ohio** | 15 | 8 | 6 | 6 | 13 | **48** |
| **Michigan** | 37 | 5 | 11 | 0 | 3 | **56** |
| **New Jersey** | 21 | 10 | 8 | 6 | 11 | **56** |
| **North Carolina** | 14 | 3 | 2 | 3 | 4 | **26** |
| **Georgia** | 23 | 10 | 5 | 3 | 4 | **45** |
| **Virginia** | 17 | 8 | 11 | 2 | 3 | **41** |

Reys, et al., 2006

## Principles

- Equity
- ***Curriculum***
- Teaching
- Learning
- Assessment
- Technology




## Content Standards

- Number/Operations
- Algebra
- Geometry
- Measurement
- Data/Probability

## Process Standards

- Problem Solving
- Reasoning
- Communication
- Connections
- Representation

This is NOT the next set of Standards!!!!!

# 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, 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.

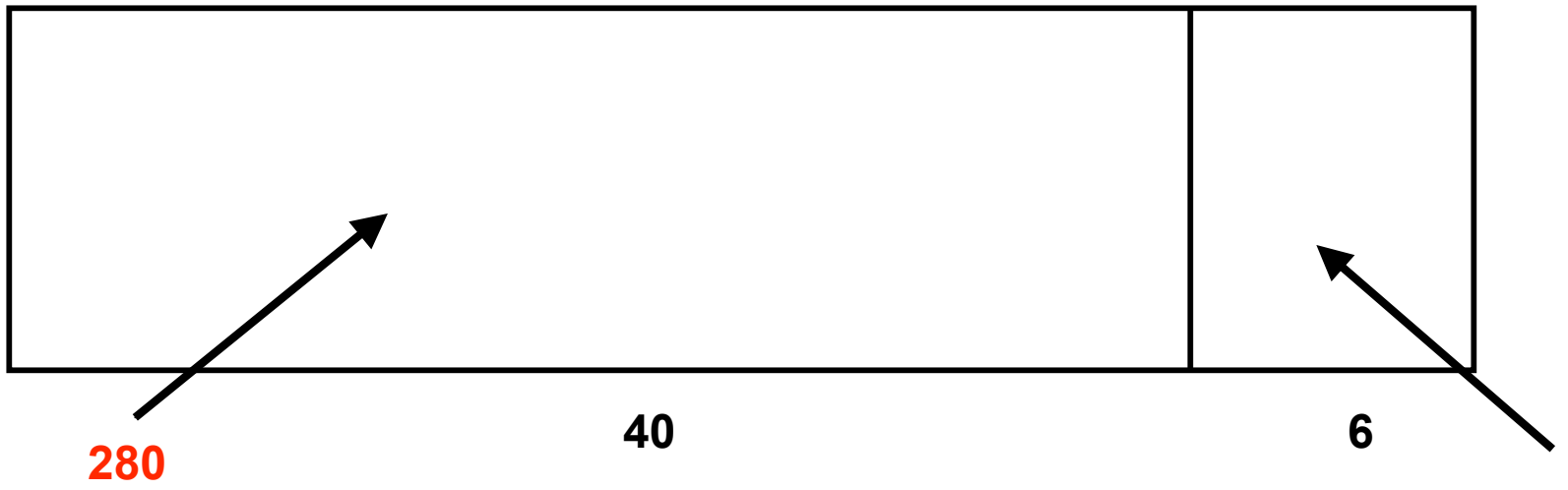
***Measurement:*** As part of understanding two-dimensional shapes, students measure and classify angles.

***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 multidigit 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.

# Boxes to multiply…

- Draw a rectangle to show 46 x 7 = 322




**46 x 7 = (40 x 7) + (6 x 7)**
**=**

**280 + 42 = 322**

# Curriculum Focal Points: What's New

- Priorities - focus
- Grade-by-grade descriptions
- Descriptive clusters of content
- More clarification
- Connections

# Opportunities

- The Immediate Horizon
  - National Mathematics Panel
  - America Competes and Math Now
  - NSB Initiative; Lessons Learned; NSF Science and Engineering Indicators
  - Election

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# Coherence - Who cares?

- Congress
- Publishers
- United States Department of Education
- NSB
- NSF
- Parents
- 37 of 42 state coordinators of mathematics…
- Others…

- And most importantly, TEACHERS care!

# Communication

## Three Views!

WSJ.com THE WALL STREET JOURNAL. ONLINE

September 12, 2006

Arithmetic Problem

**New Report Urges Return to Basics in Teaching Math**

By JOHN HECHINGER

Critics of 'Fuzzy' Methods Cheer Educators' Findings; Drills Without Calculators

The nation's math teachers, on the front lines of a 17-year Curriculum war, are getting some new marching orders: Make sure students learn the basics.

The New York Times
nytimes.com

April 13, 2000

**Math Teachers Back Return Of Education in Basic Skills**

By ANEMONA HARTOCOLLIS

In an important about-face, the nation's most influential group of mathematics teachers announced yesterday that it was recommending, in essence, that the arithmetic be put back into mathematics, urging teachers to emphasize the fundamentals of computation rather than focus on concepts and reasoning.

# It’s not about basics

What are the critical foundations ALL students need?

- Children should master the basic facts of arithmetic that are essential components of fluency with paper-pencil and mental computation and with estimation.

- It is important for children to learn the sequence of steps – and the reason for them – in the paper-and-pencil algorithms used widely in our culture.

PreK-4 – Curriculum and Evaluation Standards, NCTM, 1989, p.47

Importance of Computational Fluency, NCTM, 2000, 32

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# Parents and Others…

# More and better mathematics for all students

## This is an imperative for America's competitiveness.

Do the kids care that Singapore is #1?

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# And yet…

Ewing Marion KAUFFMAN Foundation

- ***Important, but NOT for me***
  - Parents are aware of the importance of math, but remain complacent
  - Students pay lip service to the importance of higher level math…

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- …math and science are the keys to innovation and power in today's world, and American parents had better understand that the people who are eating their kids' lunch in math are not resting on their laurels.

Tom Friedman, 2005

# A math teacher's recurring nightmare

- "Ya, know, I was never good in math either."

- What you might like to say?
  - Can ya read the newspaper?
  - Do you think parents from Singapore say that?
  - Wouldn't you want something better for YOUR child?

# Engaging/Involving Parents

- Parent Conferences – communication
- Before AND After School meetings
- Math Nights
- Math in the Mall
- Math Clubs and more
  - MATHCOUNTS
  - Math Kangaroo
  - Etc.

# “The Happiness Factor”

A good thing!

# My thinking…

- We want all students to be curious about the mathematics they are learning.
- We also want students to persevere.
- They should look for different ways to solve problems, find their own solutions, work to get the answer and also understand why things work.

- **If our students enjoy the subject and approach it with curiosity and confidence as well as the perseverance that embraces struggle within mathematics learning—what then? Well, just maybe our students will be more competitive and as they continue to mature value the importance of mathematics learning.**

# An observation

Soccer!

Three D Math!

# 3rd view!!!

# Communication is more than questioning!

# How do we do this?

- Conversations, discussions of thinking
- Explaining and justifying reasoning
- Use of models and pictures
- Writing – Prompts, Problem posing and Justifying Responses
- Using appropriate mathematics vocabulary

# Mathematical Discussions

- Procedural tasks for which students are expected to have well-developed algorithmic approaches are usually not good candidates for discussion. Interesting problems that "go somewhere" mathematically can often be catalysts for rich conversation.

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PSSM (NCTM, 2000, p. 60)

# How Many Marbles?

- Cameron counted the marbles he had collected. He counted more than 40 but less than 70. When he put the marbles in groups of 5, he had 1 left over. When he put them in groups of 4, he had 1 left over. When he put them in groups of 3, he had 1 left over. How many marbles did Cameron collect?
- Show your work. Explain how you got your answer.

# Messy Problems are Good!

Imagine you are at your favorite amusement park, ready to ride the roller coaster. The ride lasts 2 minutes 15 seconds. The wait for the coaster each weekend is about 45 minutes, which is double the weekday wait.

- Could you ride the coaster three times in an hour?

# The Writing Process & Problem Solving

- Prewriting
- Drafting
- Revising
- Editing
- Publishing

- Read and Understand
- Plan
- Solve
- Look Back and Check

# And So...

"Students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically."

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PSSM, 2000.

# Teacher's Role in Discourse

- Posing questions and tasks that elicit, engage, and challenge each student's thinking.
- Listening carefully to students' ideas.
- Asking students to clarify and justify their ideas orally and in writing.
- Deciding what to pursue in depth from among the ideas that students bring up during a discussion.
- Deciding when and how to attach mathematical notation and language to students' ideas.
- Deciding when to provide information, when to clarify an issue, when to model, when to lead, and when to let a student struggle with a difficulty.
- Monitoring students' participation in discussions and deciding when and how to encourage each student to participate.

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NCTM, 1991

# Students' Role in Discourse

- Listen to, respond to, and question the teacher and one another;
- Use a variety of tools to reason, make connections, solve problems, and communicate;
- Initiate problems and questions;
- Make conjectures and present solutions;
- Explore examples and counterexamples to investigate a conjecture;
- Try to convince themselves and one another of the validity of particular representations, solutions, conjectures, and answers.
- Rely on mathematical evidence and argument to determine validity.

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NCTM, 1991

# Choices

# Algebra Issues

- What is algebra?
- When?
- Who's the teacher?

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- And, then what?  What math?  When?

- Stay tuned for the NMP Report

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.


Louis Gerstner, former Chair, IBM

# Why did you become a mathematics teacher?

- Love of the subject
- “I knew I could get a job”
- Change the world syndrome
- Parental influence – “we, in my family, are all teachers.”

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# Teaching Mathematics – An Unnatural Act?

- Listening and watching others work.
- Being in your professional role!
- 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.

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Ball, 2007

# Immersion Issues

- Mentors – why?
- Things nobody told me about:
  - The principal
  - The secretary
  - The custodian
- The faculty lounge
- AYP and NCLB and other accountability isssues

# But, what about…

- Supervision issues!
- Getting along with others
- Finding stuff – copy machine wars!
  - Locating a printer
  - Cartridges!
- Day-to-day victories and losses

SCHOOL CULTURE ISSUES

# Do you remember?

- When I got everything done, I just sat down in the middle of my room and cried.

"*I didn't call myself anything. I was more than a teacher. And less. In the high school classroom you are a drill sergeant, a rabbi, a shoulder to cry on, a disciplinarian, a singer, a scholar, a clerk, a referee, a clown, a counselor, a dress-code enforcer, a conductor, an apologist, a philosopher, a collaborator, a tap dancer, a politician, a therapist, a fool, a traffic cop, a priest, a mother-father-sister-brother-aunt-uncle, a bookkeeper, a critic, a psychologist, the last straw.*"

"Teacher Man" Frank McCourt (p.19, 2005)

# Why do they leave?

- Too little planning time,
- Too much paperwork
- Unreliable assistance

- **A general lack of support, including limited pay!**
- **We must sustain and support teachers!**

- And then: "There is a trust there (at my school). They look at me as a professional, and it really makes or breaks whether you stay."

# Validation

# Mathematics is the gateway to good jobs!

But it's not just Algebra II

# We share a responsibility

This must be a concerted team effort, it's about every child every day.

# Challenges

- Competitiveness
- Coherence
- Communication
- Choices

Be Ready!

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# All Students Loving Math!

Effort matters

We can do this AND must