Get on Track with the Math Common Core

South Carolina Public Charter School Conference
Columbia, SC
April 24, 2013

Cynthia S. Millinger, M.Ed.
Charter School Essentials

Are Students Prepared for Math in College?

[Bar chart showing percentages of mathematics educators reporting student preparedness for college-level work in mathematics.]

Sources: ACT National Curriculum Survey 2009, Appendix B, Tables B.8 and B.9, page 43
In Mr. Stree’s class, this question was asked:

Rico is training for a multi-day, long-distance cycling race. The distance from Boston to Chicago is 990 miles. Rico bikes from Boston to Chicago at an average speed of 25 mph and returns at an average speed of 35 mph. For how many hours is Rico on the road?

In Ms. Taque’s class, this question was asked:

Rico is training for a multi-day, long-distance cycling race. He bikes from Boston to Chicago at an average rate of 25 mph and returns by the same route at an average speed of 35 mph. If he is on the road for 67 hours, how far is it from Boston to Chicago?


What Is Reasoning and Sense-Making?

• **Reasoning**: The process of drawing conclusions on the basis of evidence or stated assumptions.

• **Sense-making**: Developing understanding of a situation, context, or concept by connecting it with existing knowledge.
What Good Readers (and Mathematicians) Do

While you were reading that paragraph, you were…

- Monitoring for meaning
- Using and creating schema (visual images)
- Asking questions
- Determining importance
- Inferring
- Using sensory and emotional images
- Synthesizing

…using metacognitive strategies – listening to the voice in your mind that speaks while you read.’


Authentic Literacy (and Math)

- Close reading/underlining and annotation of text.
- Discussion of the text.
- Writing about the text informed by close reading, discussion or annotation.

“Literacy is still the unrivalled, but grossly under-implemented, key to learning both content and thinking skills.”

– Mike Schmoker, FOCUS: Elevating the Essentials to Radically Improve Student Learning
Teacher-Centered vs. Student-Centered Instruction

“Hub and Spoke” (teacher-centered)

“Constellation” (student-centered)

The Essential Math Charter School Curriculum

Standards
What students should know and be able to do

Assessments
The tools that directly measure student mastery of the standards

Instruction
The methods teachers use to enable students to master the standards

Resources
The materials that guide teachers in helping students master the standards

Reflection
The professional development opportunities provided to staff to enable them to evaluate student work and adjust the pacing, scope, and sequence as necessary to ensure students master the standards
Comprehending Math

KWI

K: What do I KNOW for sure?
W: What do I WANT to do, figure out, find out?
I: What IDEAS do I have for solving this problem?

The Six Shifts of the Math Common Core Standards

1. Focus:
   standards are an inch wide and a mile deep, prioritized

2. Coherence:
   learning is connected within and across grades

3. Fluency:
   students have speed and accuracy with foundational calculations

4. Deep Understanding:
   students reason & “make sense”, speak and write to express ideas

5. Applications:
   students make use of math in the “real world”, i.e. other classes

6. Dual Intensity:
   conceptual understanding and procedural fluency constantly coexist
Before Common Core: Math Content Standard Emphasis PK-12

The Content Standards should receive different emphases across the grade bands.


“Teach Less, Learn More”: Common Core Standards for Math Content

http://illustrativemathematics.org/standards/k8
Overview of K-8
Mathematics Standards

The K-8 standards:
- The K-5 standards provide students with a solid foundation in whole numbers, addition, subtraction, multiplication, division, fractions and decimals
- The 6-8 standards describe robust learning in geometry, algebra, and probability and statistics
- Modeled after the focus of standards from high-performing nations, the standards for grades 7 and 8 include significant algebra and geometry content
- Students who have completed 7th grade and mastered the content and skills will be prepared for algebra, in 8th grade or after

Overview of Common Core
High School Mathematics Standards

The High School Mathematics Standards:
- Call on students to practice applying mathematical ways of thinking to real world issues and challenges
- Require students to develop a depth of understanding and ability to apply mathematics to novel situations, as college students and employees regularly are called to do
- Emphasize mathematical modeling, the use of mathematics and statistics to analyze empirical situations, understand them better, and improve decisions
- Identify the mathematics that all students should study in order to be college and career ready.
Understanding the Math Common Core Standards

http://www.youtube.com/user/TheHuntInstitute

Common Core Math Standards: Grade 4 Math Excerpt

4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.

a. Understand a fraction $a/b$ as a multiple of $1/b$. For example, use a visual fraction model to represent $5/4$ as the product $5 \times (1/4)$, recording the conclusion by the equation $5/4 = 5 \times (1/4)$.

b. Understand a multiple of $a$ as a multiple of 1, and use this understanding to multiply a fraction by a whole number. For example, use a visual fraction model to express $3 \times (2/5)$ as $6 \times (1/5)$, recognizing this product as $6/5$. (In general, $n \times (a/b) = (n \times a)/b$.)

c. 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?

Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.
# Common Core Math Priorities

<table>
<thead>
<tr>
<th>Grade Band</th>
<th>70% Intensive Focus: Major Concepts</th>
<th>20% Rethink and Link: Supporting Concepts</th>
<th>10% Sample: Additional Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-2</td>
<td>•Addition and subtraction concepts, skills, and problem solving</td>
<td>•Geometry and measurement</td>
<td>•Patterns</td>
</tr>
<tr>
<td>3-5</td>
<td>•Multiplication and division of whole numbers and fractions – balance of concepts, skills, and problem solving</td>
<td>•Area, volume</td>
<td>•Patterns</td>
</tr>
<tr>
<td>6-8</td>
<td>•Proportional reasoning and linearity</td>
<td>•Quantitative relationships and functions</td>
<td>•Statistics</td>
</tr>
</tbody>
</table>

# Required Fluencies by Grade Level

<table>
<thead>
<tr>
<th>Grade</th>
<th>Required Fluency</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Add/Subtract within 5</td>
</tr>
<tr>
<td>1</td>
<td>Add/Subtract within 10</td>
</tr>
<tr>
<td>2</td>
<td>Add/Subtract within 20 (by end of year, know from memory all sums of two one-digit numbers) &lt;br&gt; Add/Subtract within 100 (paper and pencil)</td>
</tr>
<tr>
<td>3</td>
<td>Multiply/Divide within 100 (by end of year, know from memory all products of two one-digit numbers) &lt;br&gt; Add/Subtract within 1,000</td>
</tr>
<tr>
<td>4</td>
<td>Add/Subtract within 1,000,000</td>
</tr>
<tr>
<td>5</td>
<td>Multi-digit multiplication</td>
</tr>
<tr>
<td>6</td>
<td>Multi-digit division &lt;br&gt; Multi-digit decimal operations</td>
</tr>
<tr>
<td>7</td>
<td>Solve px + q = r, p(x+q) = r</td>
</tr>
<tr>
<td>8</td>
<td>Solve simple 2x2 systems by inspection</td>
</tr>
</tbody>
</table>
Courses in higher level mathematics: Precalculus, Calculus (upon completion of Precalculus), Advanced Statistics, Discrete Mathematics, Advanced Quantitative Reasoning, or other courses to be designed at a later date, such as additional career technical courses.

**Traditional Pathway**
Typical in U.S.

**Integrated Pathway**
Typical Outside of U.S.

Three Classrooms – #3

In Mr. Chen’s class, this question was asked:

A cyclist competed in a race. How long did it take him to finish?

*Is this even a viable question?*

### Common Core Standards for Mathematical Practice

**Mathematically proficient students...**

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.

---

### (Young) Student-Friendly Explanations of the Mathematical Practices

<table>
<thead>
<tr>
<th>Mathematical Practices</th>
<th>Student-Friendly Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Make sense of problems and persevere in solving them.</td>
<td>1. I can try many times to understand and solve a math problem.</td>
</tr>
<tr>
<td>2. Reason abstractly and quantitatively.</td>
<td>2. I can think about the math problem in my head, first.</td>
</tr>
<tr>
<td>3. Construct viable arguments and critique the reasoning of others.</td>
<td>3. I can make a plan, called a strategy, to solve the problem and discuss other students’ strategies, too.</td>
</tr>
<tr>
<td>4. Model with mathematics.</td>
<td>4. I can use math symbols and numbers to solve the problem.</td>
</tr>
<tr>
<td>5. Use appropriate tools strategically.</td>
<td>5. I can use math tools, pictures, drawings, and objects to solve the problem.</td>
</tr>
<tr>
<td>6. Attend to precision.</td>
<td>6. I can check to see if my strategy and calculations are correct.</td>
</tr>
<tr>
<td>7. Look for and make use of structure.</td>
<td>7. I can use what I already know about math to solve the problem.</td>
</tr>
<tr>
<td>8. Look for and express regularity in repeated reasoning.</td>
<td>8. I can use a strategy that I used to solve another problem.</td>
</tr>
</tbody>
</table>

What is “Dual Intensity”? 

**Dual Intensity**: an instructional approach in which conceptual understanding and procedural fluency are equally important.

**Conceptual Understanding**: the ability to make sense of a problem, generate possible strategies for solving it, and determine if a solution is reasonable.

**Procedural Fluency**: the ability to quickly and accurately compute numbers.

---

Why instruct with “Dual Intensity”? 

Continuum of Understanding

Conceptual Understanding
(Relational Understanding)

Procedural Fluency
(Instrumental Understanding)

### How to Implement “Dual Intensity”

**Dual Intensity is best implemented through High-Level, Task-Based Instruction**

**Tasks are high-level when:**

- Predictable solution pathways are not explicitly suggested or implied
- Students must access relevant knowledge and experiences and use them appropriately to work through the task
- Students must explain why they used a given strategy and how they derived their solution

---

### What is Depth of Knowledge (DOK)?

How deeply do you have to know the CONTENT in order to answer the question/perform the task?

- **Level 1:** Recall (Factual)
- **Level 2:** Skills and/or Concepts (Procedural)
- **Level 3:** Strategic Thinking (Conceptual)
- **Level 4:** Extended Thinking (Metacognitive)

Depth of Knowledge developed by Norman Webb,
Knowledge Dimension developed by Anderson and Krathwohl, reordered here
DOK and “Difficulty”

DOK is a reference to the complexity of mental processing that must occur to answer a question, perform a task, or generate a product.

- Adding is a mental process.
- Knowing the rule for adding is the intended outcome that influences the DOK.
- Once someone learns the “rule” of how to add, 4 + 4 is DOK 1 and is also easy.
- Adding 4,678,895 + 9,578,885 is still a DOK 1 but may be more “difficult.”

Bloom’s Revised Questioning: “Critical Thinking Ladder”

Creating: Formulating new products or ideas by synthesizing different elements

Evaluating: Assessing the reasonableness and quality of products or ideas

Analyzing: Determining relationships, patterns, or characteristics of entities

Applying: Using information for practical purposes and solving problems

Understanding: Constructing meaning from different sources

Remembering: Retrieving, recalling, or recognizing knowledge from memory
“Never Say Anything a Kid Can Say!”

“When I was in front of the class demonstrating and explaining, I was learning a great deal, but many of my students were not! Eventually I concluded that if my students were to ever really learn mathematics, they would have to do the explaining, and I, the listening.

My definition of a good teacher has since changed from ‘one who explains things so well that students understand’ to ‘one who gets students to explain things so well that they can be understood.’”

-- Steven C. Reinhart, “Never Say Anything a Kid Can Say!”, Mathematics Teaching in the Middle School
# Math Monitoring and Observation Guide

## Students

<table>
<thead>
<tr>
<th>Focus Questions</th>
<th>Notes</th>
<th>Focus Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Content</td>
<td>- What mathematical ideas and standards are students working on during the lesson?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- What makes the lesson tasks worthwhile mathematics?</td>
<td>- Knowledge of Mathematics Content</td>
</tr>
<tr>
<td></td>
<td>- Is the task appropriate for the mathematical goals of the lesson?</td>
<td>- What does the teacher seem to understand about the mathematics?</td>
</tr>
<tr>
<td></td>
<td>- Appropriate level of cognitive demand</td>
<td>- What is the teacher's understanding of tasks and how do they represent the mathematical ideas and standards?</td>
</tr>
<tr>
<td></td>
<td>- Appropriate for students</td>
<td>- What does the teacher seem to understand about the development of children's ideas in these standards?</td>
</tr>
<tr>
<td></td>
<td>- Requires use of CCSS Mathematical Practices</td>
<td>- What does the teacher seem to understand about children's development in the CCSS Mathematical Practices?</td>
</tr>
</tbody>
</table>

## Teachers

- Teach Less, Learn More
- Assessments Performance-Based
- Instruction Dual Intensity
- Resources Focused & Coherent

- Reflection
  - Student work, not “data”

---

**Chart School Essentials**
keeping you ahead of the curve
Are You Ready for the Math Common Core?

1. Our math program follows the “teach less, learn more” philosophy, so we focus on mastery and not “coverage.”
2. Our students have speed and accuracy with the basic math skills required at each grade level.
3. Our students solve math problems that require them to use reasoning and sense-making, not just “plug and chug.”
4. Our students can articulate why they selected a given strategy for solving a math problem and can explain their mathematical thinking through speaking and writing.
5. Our students see how math is used in the real world and have opportunities to apply math in other subjects such as science and social studies.

Get the Support You Need

1. Download today’s resources at:
   - Bloom’s Questioning Stems
   - Math Monitoring and Observation Rubric

2. Common Core sessions from the SC Alliance!
Thank You!

- Q & A
- Evaluations

Cynthia S. Millinger, M.Ed.
c.millinger@charterschoolessentials.com

www.charterschoolessentials.com