

Shrewsbury Math Initiative

Presentation to School Committee
April 9, 2014

Intended and Implemented Curriculum

All districts in Massachusetts work under same standards but have different results.

Our implementation of the 2011 math standards is designed to continue Shrewsbury's history of implementing state level standards at a high level of rigor.

Impact of Delay in Aligning with 2011 Standards

- Students are being assessed on math standards they are not being taught
- Teachers don't have the resources to provide students the experiences they'll need to compete globally (Analyze, Critique, Model, Persevere)

2011 Massachusetts State Frameworks

What's stayed the same?

- Fluency with math facts is essential
- Knowing how to solve algorithms
- Attending to precision

What's Changed?

- Grade level content
- Emphasis on Mastery
- **Increased emphasis on application and real world problem solving**

New Standards Address Changing Global Environment

"The world economy no longer pays you for what you know. Google knows everything. The world economy pays you for what you can do with what you know, and that makes a very big difference."

- Andreas Schleicher, Organization for Economic Cooperation and Development

PISA's Definition of Advanced Problem-Solver

- Develops complete, coherent mental models of diverse problem scenarios
- Explores scenarios in a highly strategic manner to understand all information pertaining to the problem. The information may be presented in different formats, requiring interpretation and integration of related parts.

Advanced Problem Solver, cont.

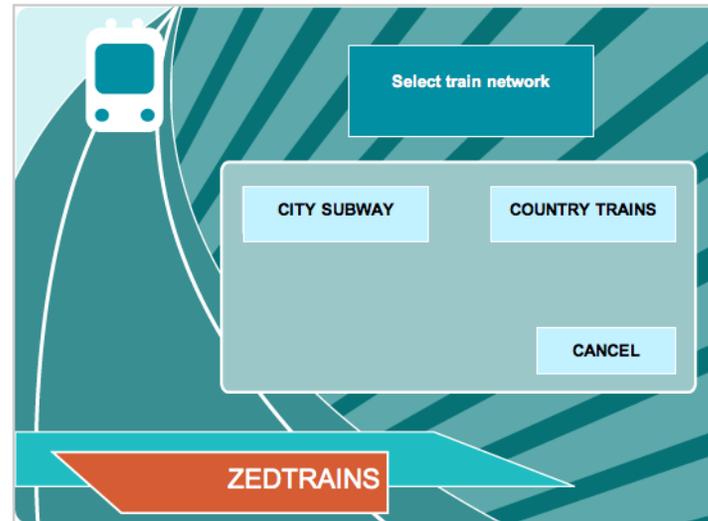
- Sets up general hypotheses about a system and thoroughly test them.
- Follows a premise through to a logical conclusion or recognise when there is not enough available information to reach one.
- Creates complex, flexible, multi-step plans that they continually monitor during execution.
- Modifies his/her strategies

TICKETS

A train station has an automated ticketing machine. You use the touch screen on the right to buy a ticket. You must make three choices.

- Choose the train network you want (subway or country).
- Choose the type of fare (full or concession).
- Choose a daily ticket or a ticket for a specified number of trips. Daily tickets give you unlimited travel on the day of purchase. If you buy a ticket with a specified number of trips, you can use the trips on different days.

The BUY button appears when you have made these three choices. There is a CANCEL button that can be used at any time BEFORE you press the BUY button.



Question 3: TICKETS CP038Q03

You want to buy a ticket with two individual trips for the city subway. You are a student, so you can use concession fares. Use the ticketing machine to purchase the best ticket available.

Task 1 of 7

You and Abby have 3 minutes to decide how you will find the best conditions for the fish to live in the aquarium. Start with chatting to Abby.

CHAT



You

I'll try to work with my control panel



Abby

Wait – let me share my control panel with you first. Can you see it? Click on 'Share it' so I'll see yours



You

Cool! Now it'll be easier.



Abby

What should we do now?



You

- Are you ready to start?
- Let's play with the control panel
- Let's change the scenery

Control panel

- Water type: Fresh Sea
Scenery: Rocky Plants
Lightning: Low High

Abby's control panel

- Food type: Dry Food blocks
Fish: Few Many
Temperature: Low High

Tryout conditions



Results



K-5 Math in Focus

Singapore Math

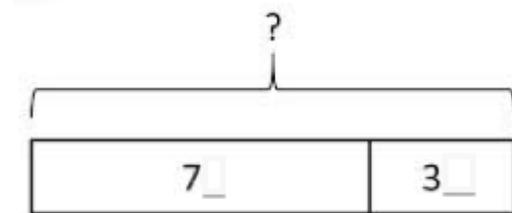
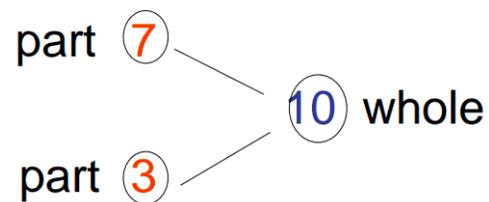
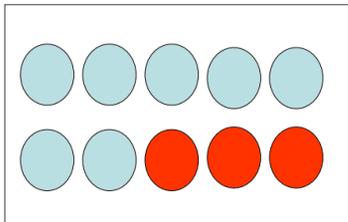
Singapore then and now

1952



The Big Ideas

- **Math is thinking, not just “answer getting”.**
- **The goal is deep understanding.**
- **Every student should experience rigor.**



What's the difference?

2012: Subtract. Show your work.

$$\begin{array}{r} 4\overset{1}{5}3 \\ -38 \\ \hline 15 \end{array}$$

You can't take 8 from 3, so you get a ten from the tens place. The five becomes a 4, so you have 4 tens and 13 in the ones place. Now you can subtract: 8 from 13 is 5, and 30 from 40 is ten. **$10 + 5 = 15$.**

What does rigor look like in action?

2014: Why do these two different methods result in the same answer? Explain.

Method 1

Method 2

$$\begin{array}{r} 4\cancel{5}3 \\ -38 \\ \hline 15 \end{array}$$

You can't take 8 from 3, so you get a ten from the tens place. The five becomes a 4, so you have 4 tens and 13 in the ones place. Now you can subtract: 8 from 13 is 5, and 30 from 40 is ten.
 $10 + 5 = 15.$

$$\begin{array}{r} 53 \\ -38 \\ \hline 20 \end{array} \textcircled{-5}$$

3 minus 8 is negative 5. I'm going to hold that in my head while I think about the tens. 50 minus 30 is 20.
Combine -5 and the 20 and my answer is 15.

BONUS: Will both methods *always* work?

National Math Panel

“In elementary school textbooks in the United States, easier arithmetic problems are presented far more frequently than harder problems. The opposite is the case in countries with higher mathematics achievement, such as Singapore.” (p. 26)

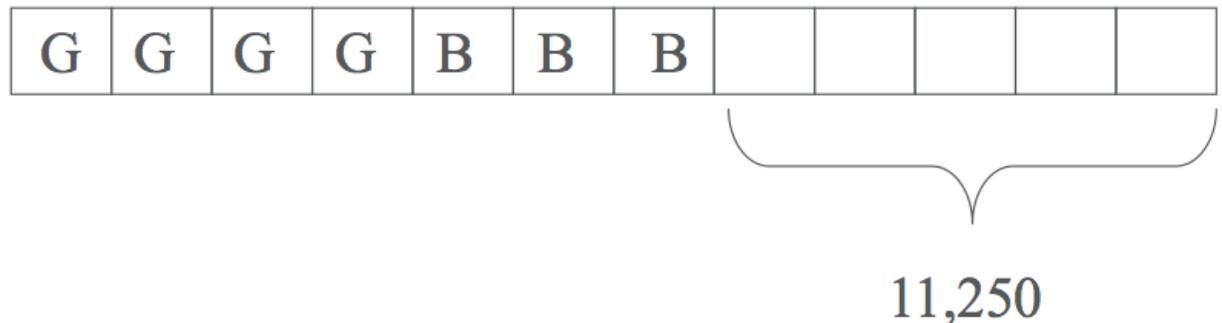
Math in Focus - Foundational Understanding

Let's consider this MCAS example:

"Of the people in attendance at a recent baseball game, one-third had grandstand tickets, one-fourth had bleacher tickets, and the remaining 11,250 people in attendance had other tickets. What was the total number of people in attendance at the game?"

- A. 20,250
- B. 27,000
- C. 12,000
- D. 21,000

Seats



Suppose x people attended the game.

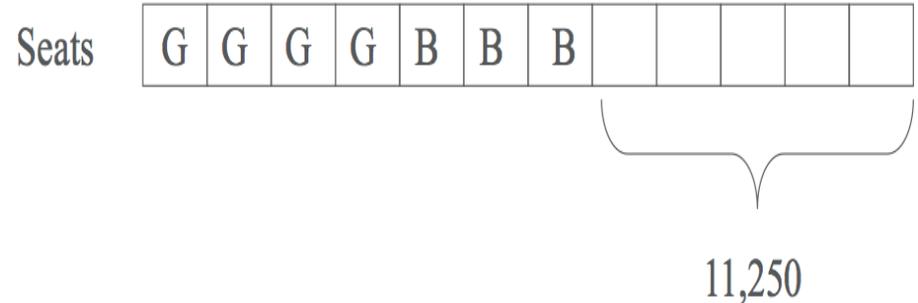
Then
$$x = \frac{1}{3}x + \frac{1}{4}x + 12,500$$

$$x = \frac{7}{12}x + 12,500$$

$$\frac{5}{12}x = 12,500$$

$$\frac{1}{12}x = 2,250$$

$$x = 27,000$$



$$5 \text{ units} = 11,250$$

$$1 \text{ unit} = 2,250$$

$$12 \text{ units} = 27,000$$

The total attendance was 27,000.

Sherwood - Grade 5 - Increased Rigor

2004 MA Standard	2011 MA Standard
5.N.9 Solve problems involving multiplication of whole numbers and multiplication of positive fractions with whole numbers.	5.NF.6 Solve real world problems involving multiplication of fractions and mixed numbers by using visual fraction models or equations to represent the problem.

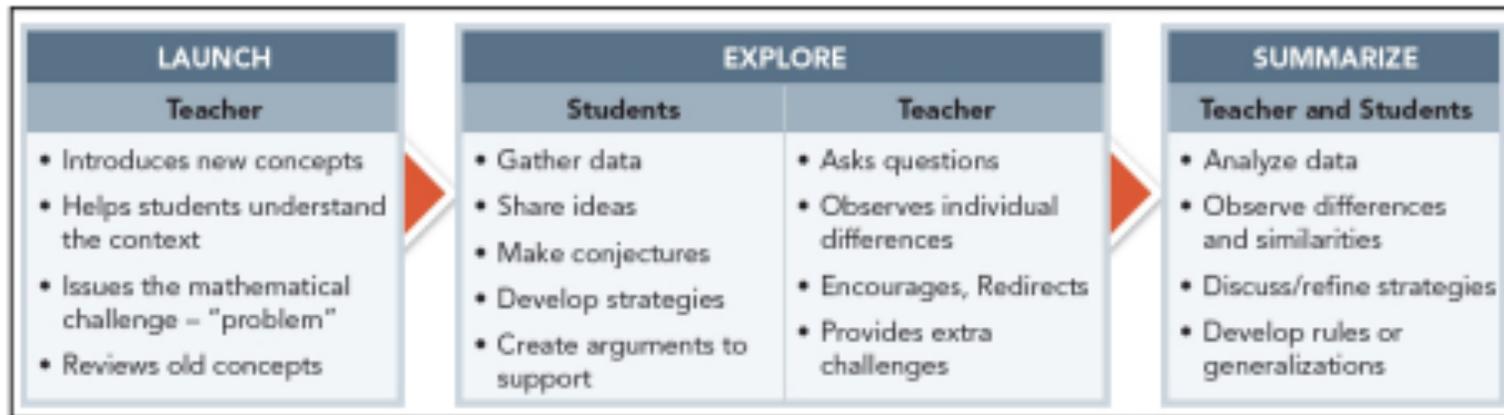
Everyday Math Assessment Example	Math in Focus Assessment Example
If you draw a line segment twice as long as a $2\frac{1}{4}$ inch line segment, how long would the new line segment be?	Jody has a rectangular piece of fabric $\frac{7}{8}$ yard long and $\frac{5}{8}$ yard wide. a) What is the area of the piece of fabric? b) Jody decides to share the piece of fabric equally with her friend. What is the area of the piece of fabric each person gets?
Student Work Sample: https://www.dropbox.com/s/xrty709rcj8di0p/MiF-3.pdf	
PARCC Example: http://www.parcconline.org/sites/parcc/files/PARCC_SampleItems_Mathematics_G5AreaofBoard_081913_Final.pdf	

6-8 Connected Math Program

CMP3

Connected Math Program (CMP)

Creating problem solvers and critical thinkers



Sherwood - Grade 6 - Increased Rigor

2000 MA Standards	2011 MA Standards
<p><i>Exploratory Concepts and Skills</i></p> <p>6.N Investigate the concepts of ratio and proportion.</p> <p>6.P Model situations with proportional relationships and solve problems.</p>	<p>6.RP Understand ratio concepts and use ratio reasoning to solve problems.</p> <p>6.RP.3b Solve unit rate problems including those involving unit pricing and constant speed.</p>

Everyday Math Assessment Example	CMP3 Assessment Example
<p>Jenny bought 6 boxes of pencils for \$4. How many boxes of pencils can she buy for \$6?</p>	<p>The grocery store is running a sale on two different brands of juice. DGS brand is 4 cans for \$5. LIIT brand is 3 cans for \$4.</p> <p>a) Which brand is the better deal? Explain.</p> <p>b) What is the unit rate (price per can) for each brand?</p> <p>c) For each brand, what is the cost for 18 cans of juice?</p>
<p>Student Work Sample: https://www.dropbox.com/s/b4oiojln7e63dpk/CMP3-1.pdf</p>	
<p>PARCC Example: http://www.parcconline.org/sites/parcc/files/Grade6-ProportionsofInstruments.pdf</p>	

Oak

CMP2 to CMP3 Shift in Content

2011 MA Framework changes addressed in CMP3

Grade 7	Grade 8
<ul style="list-style-type: none">• Linear Functions• Equivalent Expressions• Statistics and Probability <p>Units previously taught in 8th Grade</p>	<ul style="list-style-type: none">• Systems of Equations• Formalizing Functions• Quadratic Functions <p>Units previously taught in 9th grade</p>

Shift in Complexity- Geometry

2000 MA Standards	2011 MA Standards
8.G.4 Demonstrate an understanding of the Pythagorean Theorem. Apply the theorem to the solution of problems.	8.G.6 Explain a proof of the Pythagorean Theorem and its converse. 8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real world and mathematical problems in two and three dimensions

“Plug and chug”

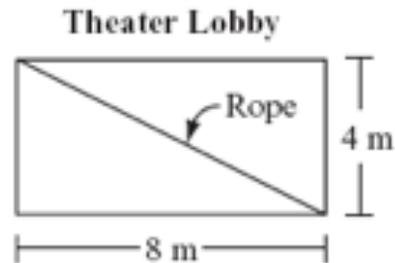


Use prior knowledge



2010 MCAS

The floor of the lobby of a theater is shaped like a rectangle, as shown below.



Before a performance starts, a velvet rope is stretched diagonally across the lobby. Which of the following best describes the diagonal length of the lobby?

- A. between 8 and 9 meters
- B. between 9 and 10 meters
- C. between 10 and 11 meters
- D. between 11 and 12 meters

Plug in values
for a and b



$$a^2 + b^2 = c^2$$

PARCC

A right circular cone is shown in the figure. Point A is the vertex of the cone and point B lies on the circumference of the base of the cone.

What's a , b and c ?



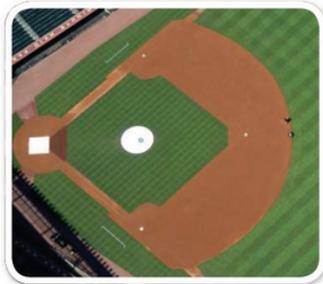
The cone has a height of 24 units and a diameter of 20 units. What is the distance from point A to point B ?

units

5.1 Stopping Sneaky Sally

Finding Unknown Side Lengths

A baseball diamond is actually a square. If you can find right triangles in this shape, you can use the Pythagorean Theorem to solve problems about distances.



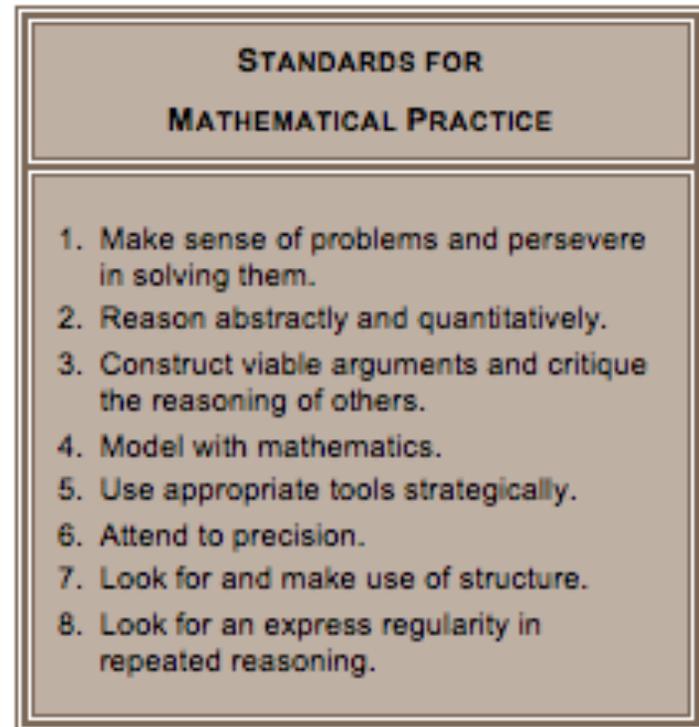
Is the pitcher's mound in line with 1st and 2nd base? Is it half way between home and 2nd?

Does the ball travel on a straight line?

- A** 1. How far must Horace throw the baseball to get Sally out at second base? Explain.
2. Jen says the distance that Horace throws the baseball is a rational number. Funda says that it is an irrational number. Explain each student's reasoning.
- B** The shortstop is standing on the baseline, halfway between second base and third base. How far is the shortstop from Horace?
- C** The pitcher's mound is 60 feet 6 inches from home plate. Use this information and your answer to Question A to find the distance from the pitcher's mound to each base.

K-8 to 9-12 Transition

- Standards for Mathematical Practice were a core feature of the SHS math program prior to the adoption of the 2011 standards
- Students will be better prepared to transition into the SHS program if the foundations of these standards begin in the earlier grades



Typical Pathway at SHS Increases in Level of Rigor

Approximately 80% of students will follow this pathway...

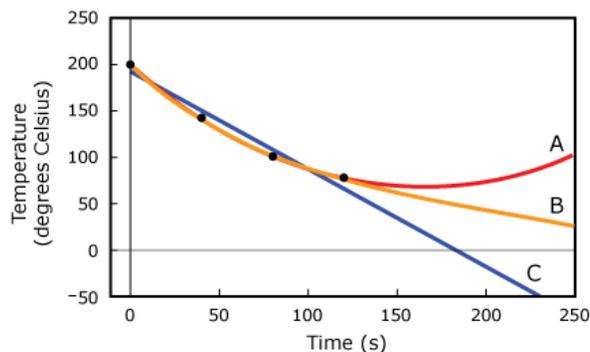
- Model Mathematics I, II, and III (Grades 8-10)
- Pre-Calculus or Functions & Trigonometry (Grade 11)
- Advanced Quantitative Reasoning, AP Statistics or a Calculus course (Grade 12)

Assessment reflects

A scientist is studying the cooling patterns of a particular material over time. Her research requires heating a sample of the material to 200°C . She records the temperature of the sample as it is cooled to 0°C . The table shows the data collected during the first 2 minutes of the cooling process.

Time material is cooling (seconds)	0	40	80	120
Temperature (0°C)	200	141	101	74

The figure shows the scientist's data (data points are plotted as large dots). Three possible models for the data are also shown: a linear model, a quadratic model, and an exponential model.



Sample PARCC assessment question

Part A

- Which model is linear? Which model is quadratic? Which model is exponential?
- Which model is best for the range of times $0 \leq t \leq 250$?
- Explain why the other models do not fit the data very well for the range of times $0 \leq t \leq 250$.

Part B

Construct a function using the type of model you decided is best (linear, quadratic, or exponential). Show your work and use function notation when entering your answer.

SHS

Sample Common Writing Assignment for Algebra & Geometry II o Functions & Trigonometry at SHS

PROMPT:

The math teachers at SHS are interested in setting up a coffee station in the department office. They have approached two businesses about supplying this coffee station for the school year. (Notes: There are 180 days in the school year. There are 15 math teachers, only some of whom drink coffee.)

Dunkin Donuts® has offered to deliver boxes of hot coffee every morning. Each box contains 100 fluid ounces of coffee (the equivalent of 10 small coffees) and costs \$9.90. Dunkin Donuts® will not charge a delivery fee but they will only deliver full boxes of coffee.

The Keurig® company has offered to rent an industrial brewer at a cost of \$249.95 for the school year. The K-Cups® themselves are usually sold in bulk packs of 80 cups for \$62.00, where each cup can brew up to 10 fluid ounces of coffee (the equivalent of one small coffee).

Write a detailed letter to the math teachers advising them on which company they should choose.

“Modeling in mathematics is an important avenue for motivating students to study mathematics, for building their understanding of mathematics and for preparing them for future success.”

*Massachusetts Curriculum Frameworks,
March 2011*

New Standards Address Changing Global Environment

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Questions?