# The Common Core State Standards for Math (CCSSM): Great Hopes and Deep Fears

**Lesson Study Conference**
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## What a week!

- **84 left**
- **66 arrived**
- **52 spoke**
- **40 left**
- **20 arrived**



## Some data

| | | |
|---|---|---|
| | | |
| | | |
| | | |
| | 40 | 4 |
| | 10 | 2 |
| | 30 | 4 |
| | | |



## Predict some additional data

| | | |
|---|---|---|
| | | |
| | | |
| | | |
| | 40 | 4 |
| | 10 | 2 |
| | 30 | 4 |
| | | |

## All the numbers – so?

| | | |
|---|---|---|
| | 45 | 4 |
| | 25 | 3 |
| | 15 | 2 |
| | 40 | 4 |
| | 10 | 2 |
| | 30 | 4 |
| | 20 | 3 |



## A lot more information (where are you?)

| | | |
|---|---|---|
| Roller Coaster | 45 | 4 |
| Ferris Wheel | 25 | 3 |
| Bumper Cars | 15 | 2 |
| Rocket Ride | 40 | 4 |
| Merry-go-Round | 10 | 2 |
| Water Slide | 30 | 4 |
| Fun House | 20 | 3 |



## Fill in the blanks

| Ride | ??? | ??? |
|---|---|---|
| Roller Coaster | 45 | 4 |
| Ferris Wheel | 25 | 3 |
| Bumper Cars | 15 | 2 |
| Rocket Ride | 40 | 4 |
| Merry-go-Round | 10 | 2 |
| Water Slide | 30 | 4 |
| Fun House | 20 | 3 |



## At this point,

## it's almost anticlimactic!

## The amusement park

| Ride | Time | Tickets |
|---|---|---|
| Roller Coaster | 45 | 4 |
| Ferris Wheel | 25 | 3 |
| Bumper Cars | 15 | 2 |
| Rocket Ride | 40 | 4 |
| Merry-go-Round | 10 | 2 |
| Water Slide | 30 | 4 |
| Fun House | 20 | 3 |



## The Amusement Park

The 4th and 2nd graders in your school are going on a trip to the Amusement Park. Each 4th grader is going to be a buddy to a 2nd grader.

Your buddy for the trip has never been to an amusement park before. Your buddy want to go on as many different rides as possible. However, there may not be enough time to go on every ride and you may not have enough tickets to go on every ride.



The bus will drop you off at 10:00 a.m. and pick you up at 1:00 p.m. Each student will get 20 tickets for rides.

Use the information in the chart to write a letter to your buddy and create a plan for a fun day at the amusement park for you and your buddy.



## Why do you think I started with this task?

- **Standards don't teach, teachers teach**
- **It's the translation of the words into tasks and instruction and assessments that really matter**
- **We need to give kids (and ourselves) a reason to care**
- **Difficult, unlikely, to do alone!!!**

## So the key things we know

**People won't do what they can't envision,**

**People can't do what they don't understand,**

**People can't do well what isn't practiced,**

**But practice without feedback results in little change, and**

**Work without collaboration is not sustaining.**

**Ergo: Our job, as professionals, at its core, is to help people envision, understand, practice, receive feedback and collaborate.**



# Today's Goal

**To provoke and inform your thinking about the need to shift our curriculum, instructional practices, and mindsets in ways that are aligned with the vision of the new Common Core State Standards and that truly meet the needs of all students.**



## Today's Agenda

- **Gauntlet-setting premises**
- **Some perspectives on our reality**
- **Some glimpses of the CCSSM**
- **Some glimpses of a CCSSM future**
- **Outstanding Issues – fears and hopes**

**(That is, a bombardment in 5 parts with time for push-back and questions)**



## Opening Premise

**Mediocre mathematics achievement and unacceptably stark achievement gaps are the symptom – not the problem. If we conceive of it as an "achievement" gap, then it's THEIR problem or fault.**

**Alternatively, it is a system failure, the heart of which is modal instruction that fails to provide adequate opportunity to learn, that is the problem. If we conceive of it as an "instruction" gap, then it's OUR problem or fault.**

**Fascinating, isn't it?**

## The System Problem

**A depressingly comprehensive, yet honest, appraisal must conclude that our typical math curriculum is generally incoherent, skill-oriented, and accurately characterized as "a mile wide and an inch deep." It is dispensed via ruthless tracking practices and focused mainly on the "one right way to get the one right answer" approach to solving problems that few normal human beings have any real need to consider. Moreover, it is assessed by 51 high-stakes tests of marginal quality, and overwhelmingly implemented by under-supported and professionally isolated teachers who too often rely on "show-tell-practice" modes of instruction that ignore powerful research findings about better ways to convey mathematical knowledge**.



## Non-negotiable take-away:

## Make no mistake,
## for K-12 math in the U.S., this
## (the advent of Common Standards)
## IS brave new world.



# Let's be clear:

**We're being asked to do what has never been done before:**

**Make math work for nearly ALL kids and get nearly ALL kids ready for college.**

**There is no existence proof, no road map, and it's not widely believed to be possible.**



# ERGO

**Ergo, because there is no other way to serve a much broader proportion of students:**

**We're therefore being asked to teach in distinctly different ways.**

**Again, there is no existence proof, we don't agree on what "different" mean, nor how we bring it to scale.**

**That's the hope of the CCSS for Math**

# Full disclosure

**For better or worse, I've been drinking the CCSSM Kool-aid.**

**Leinwand on the CCSSM in the 2011 Heinemann catalog.**



## A Long Overdue Shifting of the Foundation

**For as long as most of us can remember, the K-12 mathematics program in the U.S. has been aptly characterized in many rather uncomplimentary ways: underperforming, incoherent, fragmented, poorly aligned, unteachable, unfair, narrow in focus, skill-based, and, of course, "a mile wide and an inch deep." Most teachers are well aware that there have been far too many objectives for each grade or course, few of them rigorous or conceptually oriented, and too many of them misplaced as we ram far too much computation down too many throats with far too little success. It's not a pretty picture and helps to explain why so many teachers and students have been set up to fail and why we've created the need for so much of the intervention that test results seem to require.**

**But hope and change have arrived! Like the long awaited cavalry, the new *Common Core State Standards (CCSS) for Mathematics* presents us – at least those of us in the 44 states that have now adopted them (representing over 80% of the nation's students) – a once in a lifetime opportunity to rescue ourselves and our students from the myriad curriculum problems we've faced for years.**

**COHERENT FAIR TEACHABLE**



# Enter the new Common Core State Standards for Mathematics

## (www.corestandards.org)

## Not perfect, but clearer, fairer, and more coherent



## The Math Field of Activity

The heart of ensuring instructional quality and producing high levels of student achievement includes four key elements:

- A coherent and aligned **curriculum** that includes a set of grade level content expectations, appropriate print and electronic instructional materials, with a pacing guide that links the content standards, the materials and the calendar;
- High levels of **instructional effectiveness**, guided by a common vision of effective teaching of mathematics and supported by deliberate planning, reflection and attention to the details of effective practice;
- A set of aligned benchmark and summative **assessments** that allow for monitoring of student, teacher and school accomplishment at the unit/ chapter and grade/course levels; and
- **Professional growth** within a **professional culture** of dignity, transparency, collaboration and support.

**(What, how, how well and with what support to do it better)**

## But….as we need to acknowledge

- **Our curriculum is stale,**
- **Our instruction is underperforming,**
- **Our assessments are mediocre, and**
- **Our professional development is essentially useless!**



# BUT…Great News

- **Our curriculum is stale – enter CCSSM**
- **Our instruction is underperforming,**
- **Our assessments are mediocre – enter SBAC/PARCC**
- **Our professional development is essentially useless!**

**Welcome to a far more simplified world.**



## The Reduced Field of Activity (in the CCSS Era)

The heart of ensuring instructional quality and producing high levels of student achievement includes four key elements:

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- **Professional growth** within a **professional culture** of dignity, transparency, collaboration and support.

**(What, how, how well and with what support to do it better)**



## So finally, let's take a look at the game changer:

## The Common Core State Standards for Mathematics

## Promises

**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)*



## Characteristics of the CCSS

- **Fewer, therefore teachable**
- **Fair, therefore expectable**
- **Aligned with college and career expectations**
- **Internationally benchmarked**
- **Rigorous content *and* application of higher-order skills – rigor as depth, not complexity**
- **Learning progressions that build coherence and mastery expectations**
- **Research-based**
- **Common – finally!**



## CCSSM Mathematical Practices

**The Common Core proposes a set of Mathematical Practices that all teachers should develop in their students. These practices are similar to NCTM's Mathematical Processes from the *Principles and Standards for School Mathematics*.**



## 8 CCSSM Mathematical Practices

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.**

# 8 CCSSM Mathematical Practices

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.



# CCSSM Grade 2 (pp. 17-20)

**Operations and Algebraic Thinking**
- **Represent and solve problems involving addition and subtraction.**
- **Add and subtract within 20.**
- **Work with equal groups of objects to gain foundations for multiplication.**

**Number and Operations in Base Ten**
- **Understand place value.**
- **Use place value understanding and properties of operations to add and subtract.**

**Measurement and Data**
- **Measure and estimate lengths in standard units.**
- **Relate addition and subtraction to length.**
- **Work with time and money.**
- **Represent and interpret data.**

**Geometry**
- **Reason with shapes and their attributes.**



**GRADE 2: Use place value understanding and properties of operations to add and subtract.**

**5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.**

**6. Add up to four two-digit numbers using strategies based on place value and properties of operations.**

**7. Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds.**

**8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.**

**9. Explain why addition and subtraction strategies work, using place value and the properties of operations**



# CCSSM Grade 6 (pp. 41-45)

**Ratios and Proportional Relationships**
- **Understand ratio concepts and use ratio reasoning to solve problems.**

**The Number System**
- **Apply and extend previous understandings of multiplication and division to divide fractions by fractions.**
- **Compute fluently with multi-digit numbers and find common factors and multiples.**
- **Apply and extend previous understandings of numbers to the system of rational numbers.**

**Expressions and Equations**
- **Apply and extend previous understandings of arithmetic to algebraic expressions.**
- **Reason about and solve one-variable equations and inequalities.**
- **Represent and analyze quantitative relationships between dependent and independent variables.**

**Geometry**
- **Solve real-world and mathematical problems involving area, surface area, and volume.**

**Statistics and Probability**
- **Develop understanding of statistical variability.**
- **Summarize and describe distributions.**

**Grade 6: Understand ratio concepts and use ratio reasoning to solve problems.**

**1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."***

**2. Understand the concept of a unit rate *a/b associated with a ratio a:b* with *b ≠ 0, and use rate language in the context of a ratio relationship. For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."1***

**3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.**

**a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.**

**b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?***

**c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.**

**d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.**



# CCSS 9-12 Functions (68-71)

**Interpreting Functions**

- Understand the concept of a function and use function notation
- Interpret functions that arise in applications in terms of the context
- Analyze functions using different representations

**Building Functions**

- Build a function that models a relationship between two quantities
- Build new functions from existing functions

**Linear, Quadratic, and Exponential Models**

- Construct and compare linear, quadratic, and exponential models and solve problems
- Interpret expressions for functions in terms of the situation they model

**Trigonometric Functions**

- Extend the domain of trigonometric functions using the unit circle
- Model periodic phenomena with trigonometric functions
- Prove and apply trigonometric identities



# A closer glimpse at functions

**Understand the concept of a function and use function notation**

1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f is a function and x is an element* of its domain, then *f(x) denotes the output of f corresponding to the* input *x. The graph of f is the graph of the equation y = f(x).*
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*



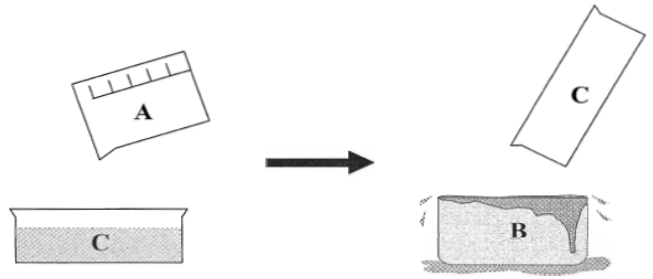
# Any question as to why we're going to need structures like lesson study?

# Some glimpses of the future

# (the real hope and implications)



# Hong Kong – Grade 3 - 2007




Container A is filled completely with water and all the water is poured into Container C. Then all the water in Container C is poured into Container B (the results are shown in the diagram above). Arrange Containers A, B and C in order, from the largest capacity to the smallest. Write the letters for the answer.

Answer: _____ , _____ , _____
(Largest) (Smallest)



# PISA Released Item
# (google "PISA released items)

**Internet Relay Chat**

**Mark (from Sydney, Australia) and Hans (from Berlin, Germany) often communicate with each other using 'chat" on the Internet. They have to log on to the Internet at the same time to be able to chat. To find a suitable time to chat, Mark looked up a chart of world times and found the following:**

**Greenwich 12 midnight**
**Berlin 1:00 a.m.**
**Sydney 10:00 a.m.**

**Question 1: At 7:00 p.m. in Sydney, what time is it in Berlin?**

**Question 2: Mark and Hans are not able to chat between 9:00 a.m. and 4:30 p.m. their local time, as they have to go to school. Also, from 11:00 p.m. till 7:00 a.m. their local time, they won't be able to chat because they will be sleeping. When would be a good time for Mark and Hans to chat? Write the local times in the chart.**

| Place | Time |
|---|---|
| Sydney | _____ |
| Berlin | _____ |



# China 9-12 Standards E.g.
# (http://hrd.apec.org)

**Example 4** According to weather forecast, the probability that there will be a small flood in some place next month is 0.25, and that the probability for a big flood is 0.01. Suppose that there is a piece of large-scale equipment in a construction site and there are three plans to protect it from the floods.

Plan 1: Remove the equipment. This costs 3800 dollars.

Plan 2: Construct a wall for protection. This costs 2000 dollars. But this wall cannot stop the big flood. When the big flood comes and the equipments are destroyed, the loss is 60000 dollars.

Plan 3: No plan at all. Hope that no flood will come. When there is a big flood the loss is 60000 dollars. When there is a small flood the loss is 10000 dollars.

Try to compare and decide which plan is better.

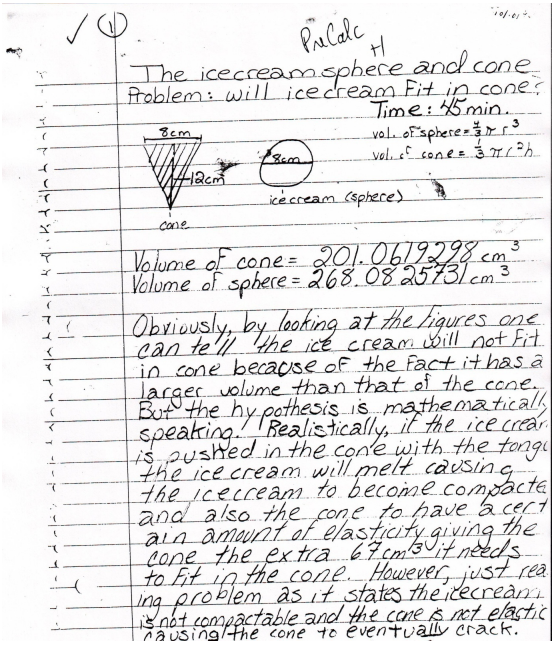
# Ice Cream Cones

**You may or may not remember that the formula for the volume of a sphere is $4/3\pi r^3$ and that the volume of a cone is $1/3\ \pi r^2 h$.**

**Consider the Ben and Jerry's ice cream sugar cone, 8 cm in diameter and 12 cm high, capped with an 8 cm in diameter sphere of deep, luscious, decadent, rich triple chocolate ice cream.**

**If the ice cream melts completely, will the cone overflow or not? How do you know?**




PreCalc H

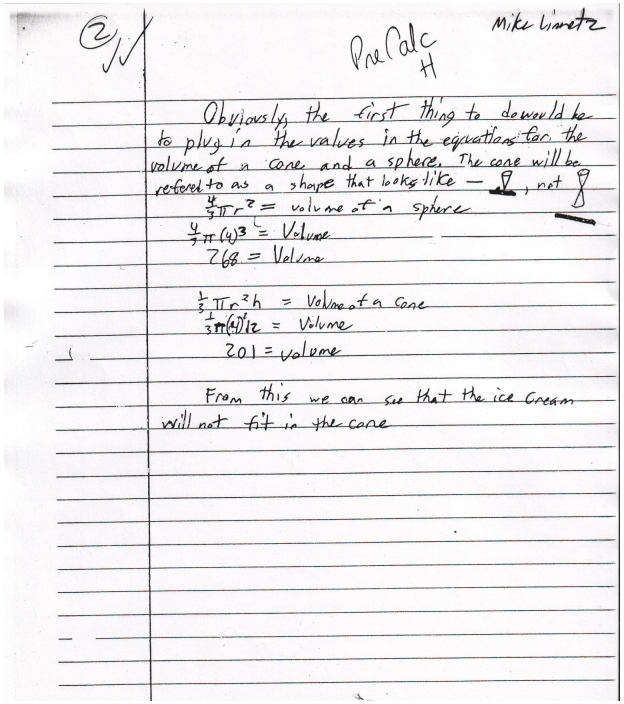
The icecream sphere and cone
Problem: will icecream fit in cone?
Time: 45 min.
vol. of sphere = $\frac{4}{3}\pi r^3$
vol. of cone = $\frac{1}{3}\pi r^2 h$

8cm
12cm
8cm
icecream (sphere)
cone

Volume of cone = 201.0619298 $cm^3$
Volume of sphere = 268.0825731 $cm^3$

Obviously, by looking at the figures one can tell the ice cream will not fit in cone because of the fact it has a larger volume than that of the cone. But the hypothesis is mathematically speaking. Realistically, if the ice cream is pushed in the cone with the tongue the ice cream will melt causing the icecream to become compacted and also the cone to have a certain amount of elasticity giving the cone the extra 67 $cm^3$ it needs to fit in the cone. However, just reading problem as it states the icecream is not compactable and the cone is not elastic causing the cone to eventually crack.




Mike Lisnetz
PreCalc H

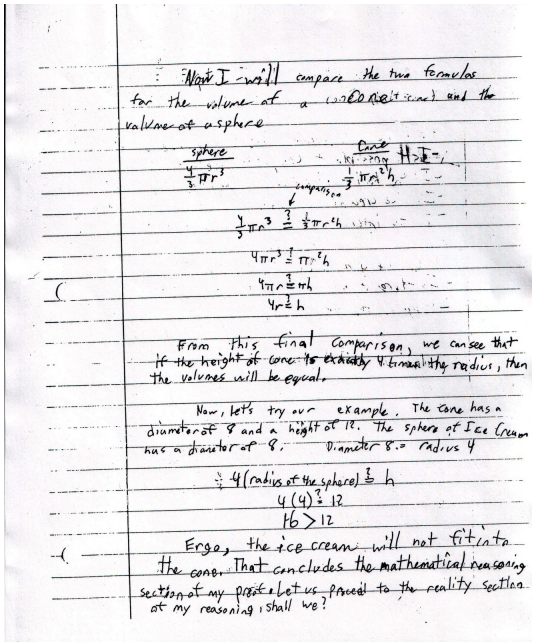
Obviously the first thing to do would be to plug in the values in the equations for the volume of a cone and a sphere. The cone will be referred to as a shape that looks like — , not

$\frac{4}{3}\pi r^3$ = volume of a sphere
$\frac{4}{3}\pi(4)^3$ = Volume
268 = Volume

$\frac{1}{3}\pi r^2 h$ = Volume of a cone
$\frac{1}{3}\pi(4)^2 12$ = Volume
201 = volume

From this we can see that the ice cream will not fit in the cone




Now I will compare the two formulas for the volume of a cone (not ice cream) and the volume of a sphere

sphere: $\frac{4}{3}\pi r^3$ ; cone: $\frac{1}{3}\pi r^2 h$

comparison: $\frac{1}{3}\pi r^3 \stackrel{?}{=} \frac{1}{3}\pi r^2 h$

$4\pi r^3 \stackrel{?}{=} \pi r^2 h$

$\frac{4\pi r^3}{\pi r^2} \stackrel{?}{=} h$

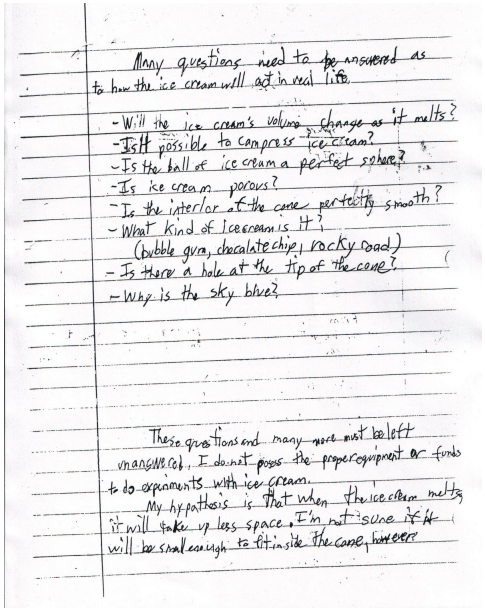
$4r \stackrel{?}{=} h$

From this final comparison, we can see that ~~If the height of cone is exactly 4 times~~ the radius, then the volumes will be equal.

Now, let's try our example. The cone has a ~~diameter of 8~~ and a height of 12. The sphere of ice cream has a diameter of 8. Diameter 8 = radius 4

$\div$ 4(radius of the sphere) $\stackrel{?}{=}$ h
$4(4) \stackrel{?}{=} 12$
$16 > 12$

Ergo, the ice cream will not fit into the cone. That concludes the mathematical reasoning section of my proof. Let us proceed to the reality section of my reasoning, shall we?



Many questions need to be answered as to how the ice cream will act in real life.

- Will the ice cream's volume change as it melts?
- Is it possible to compress ice cream?
- Is the ball of ice cream a perfect sphere?
- Is ice cream porous?
- Is the interior of the cone perfectly smooth?
- What kind of ice cream is it? (bubble gum, chocolate chip, rocky road)
- Is there a hole at the tip of the cone?
- Why is the sky blue?

These questions and many more must be left unanswered, I do not poses the proper equipment or funds to do experiments with ice cream.

My hypothesis is that when the ice cream melts it will take up less space. I'm not sure if it will be small enough to fit inside the cone, however



# Implementation Issues



# Long Reach HS

**Howard County (MD) recognized that there were a significant number of 9th graders who were not being successful in Algebra 1. To address this problem, the county designed Algebra Seminar for approximately 20% of the 9th grade class in each high school. These are students who are deemed unlikely to be able to pass the state test if they are enrolled in a typical one-period Algebra I class. Algebra Seminar classes are:**



- **Team-taught with a math and a special education teacher;**
- **Systematically planned as a back-to-back double period;**
- **Capped at 18 students;**
- **Supported with a common planning period made possible by Algebra Seminar teachers limited to four teaching periods;**
- **Supported with focused professional development;**
- **Using Holt Algebra I, Carnegie Algebra Tutor, and a broad array of other print and non-print resources;**
- **Notable for the variety of materials and resources used (including Smart Board, graphing calculators, laptop computers, response clickers, Versatiles, etc.);**
- **Enriched by a wide variety of highly effectively instructional practices (including effective questioning, asking for explanations, focusing of different representations and multiple approaches); and**
- **Supported by county-wide on-line lesson plans that teachers use to initiate their planning.**

# Dream with me about Tests

- Computer adaptive assessments with routers and appropriate items for stage 2
- 4 week testing windows
- Computer-scoreable constructed response items
- Item banks for formative, benchmark AND summative assessments
- Student, class, school, district, state and nation results three days after the window closes



# Outstanding HS Issues

- Some vs. All
  - 113 for all + 43 (*) for STEM nerds
- Traditional vs. Integrated
  - "Pathways"
- Grade 8 Algebra
  - When can we skip? Or should we double up?
- Catching up
  - Boost-up



# Math for Normals and Nerds

| Grade | Traditional Normal | Integrated Normal | Accelerated Nerd | Double-up Nerd |
|---|---|---|---|---|
| 6 | 6 | 6 | 6/7 | 6 |
| 7 | 7 | 7 | 7/8 | 7 |
| 8 | 8 | 8 | Alg 1/Math 9 | 8 |
| 9 | Alg 1 | Math 9 | Geom/Math 10 | Alg 1/Math9 |
| 10 | Geom | Math 10 | Alg 2/Math 11 | Geom/Alg 2 or Math 10/11 |
| 11 | Alg 2 | Math 11 | Pre-calc | Pre-calc |
| 12 | (Pre-college) | (Math 12) | Calc/Stat | Calc/Stat |
| | 85% → | | 10% | 5% |



# Rollout Timeline, hopefully

- 2010-11: A year of comprehensive planning (clarifying what needs to be done when)
- 2011-12: A year of study (analyzing crosswalks, curricular implications, policy shifts)
- 2012-13: A year of piloting and collaborative discussions
- 2013-14: A year of curriculum and policy implementation and an assessment moratorium
- 2014-15: A year of accountable implementation

# Next steps

- Build familiarity
- Grade by grade and course by course discussions
- Professional collaboration
- Crosswalks
- The mathematical practices
- Think 15% per year
- Focus on instructional quality/opportunity to learn



# What's to be afraid of?

- Ok – we've got the standards, go do 'em
- Another fad with political intrusion
- Doomed by the same lack of capacity that got us into this mess in the first place
- Assessment compromises
- Not enough time gel
- We forget that it's instruction stupid
- We ignore the essential roles of school and department culture



# But what's to be so hopeful about?

- Systemic alignment of standards, materials, assessments and pd
- Less attention to WHAT math and more attention to HOW to best teach it
- Greater collaboration around clearer and common goals and better data
- Market incentives for technology and video
- A chance to finally focus primarily in instruction and learning



# So….

While we acknowledge the range and depth of the problems we face,

It should be comforting to see the availability and potential of solutions to these problems….

Now go forth and start shifting YOUR school's mathematics program to better serve our students, our society and our future.

# Thank you!

**SLeinwand@air.org**