High School Real World Problem-Based Lessons

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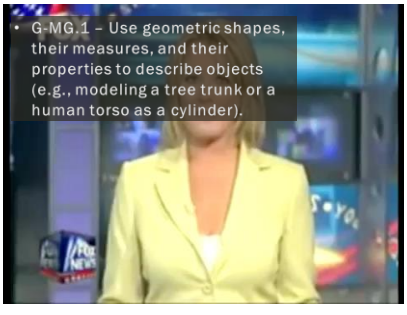
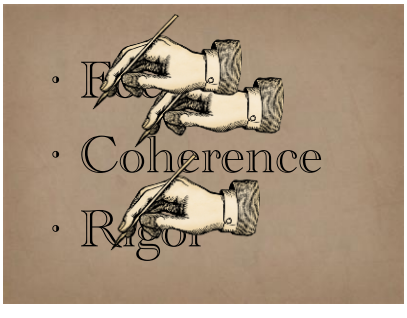
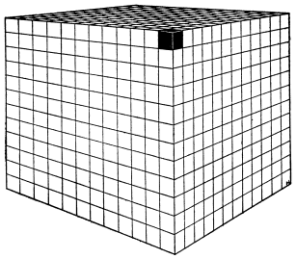






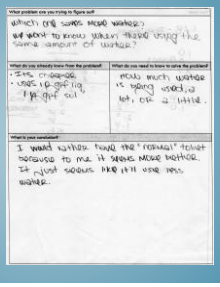
Standards for Mathematical Practice

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.

Solving Real-World Geometry Problems

High School	Middle School	Elementary School
• G-MG.1 – Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). • G-GMD.3 – Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	• 8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. • 7.G.6 – Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects. • 6.G.2 –Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.	• 5.MD.5 – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. • 4.MD.3 – Apply the area and perimeter formulas for rectangles in real world and mathematical problems • 3.MD.7d – Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. • 2.MD.1 – Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes. • 1.MD.2 – Express the length of an object as a whole number of length units. • K.MD.1 – Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

STUDENT WORK SAMPLES



The Reality

- Systems of equations versus tables
  - While I intended on this being a systems of equations problem, most students did not choose to use it.
  - Most students chose to approach the problem as a series ratios they verified by guess and check.
  - Students that chose to use an algebraic approach were competent at solving equations but had significant trouble setting it up.
- The context was surprisingly not a big deal
- Students had trouble articulating themselves in writing
  - Many students struggled with their explanations and will need extensive practice to improve.

Sinkhole Dimensions

- National Geographic: "60 feet (18 meters) wide and about 30 stories deep"
- Time Magazine: "runs some 200 ft. deep"
- CNN: "The 20-meter (about 66 feet) diameter sinkhole is about 30 meters (about 100 feet) deep."
- Slate: "A sinkhole, 65 feet across and 100 feet deep"

- G-GMD.3 – Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- G-MG.1 – Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Slate

whether
best
er. A
foot wad
serve
nitrate water
runoff in other areas,
leading to more
sinkholes."

WHAT ISN'T MATHEMATICAL MODELING?

- *It is not modeling in the sense of, "I do; now you do."*
- *It is not modeling in the sense of using manipulatives to represent mathematical concepts.*
- *It is not modeling in the sense of a "model" being just a graph, equation, or function.*
- *It is not just starting with a real world situation and solving a math problem.*
- *It is not beginning with the mathematics and then moving to the real world.*

Source: http://www.cde.ca.gov/be/cc/cd/documents/modelingaprilreview.pdf

- 8.F.4 - Construct a function to model a linear relationship between two quantities.

Connection to Learning Focused

- Essential question
  - Every lesson comes with questions listed.
  - Most lessons have learning goals (objectives) and CCSS content standards listed.
- Activating strategies
  - Most lessons include highly engaging multimedia that build background knowledge and establish the context.
- Teaching strategies
  - Most lessons come with strategies and questions you can use to guide students without telling them.
- Summarizing
  - Built into the lesson through open ended questions.

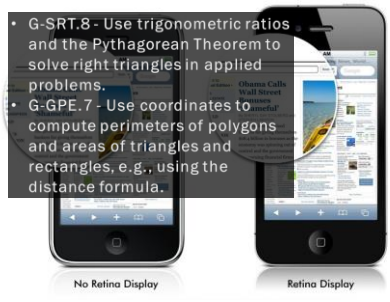
PROBLEM-BASED LEARNING FAQ

- *How often do teachers do problem-based learning?*
- *How long do problem based lessons take?*
- *Do teachers use problem-based lessons to introduce a topic or after you've already taught it?*
- *How is problem-based learning assessed?*
- *How much time does it take to create a problem-based lesson?*

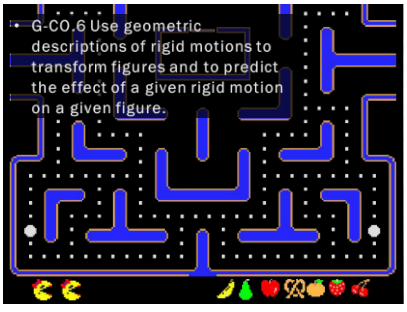
The Four C's

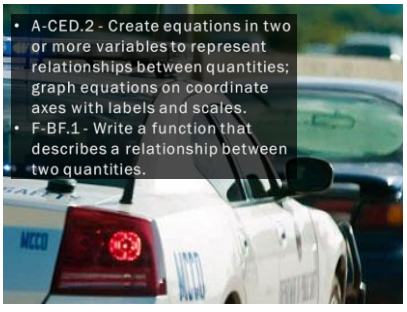
- Communication
- Curiosity

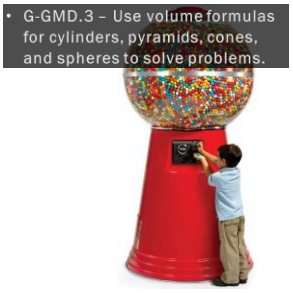
- G-SRT.8 - Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- G-GPE.7 - Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.



- A-CED.1 - Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- F-IF.7a - Graph linear and quadratic functions and show intercepts, maxima, and minima.







The Four C's

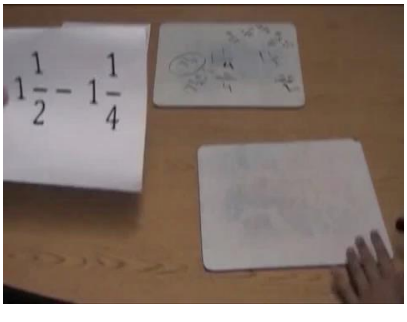
- Communication
- Curiosity
- Critical Thinking
- Content Knowledge

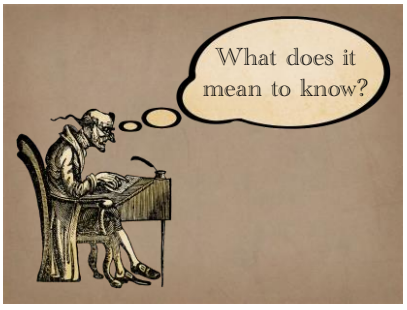
WHAT DOES IT LOOK LIKE...

- when students **can** work with numbers but **cannot**:
  - critically think
  - applying knowledge and skills to real-world settings
  - analyze and solve complex problems
- when students have procedural skill but not conceptual understanding or the ability to apply mathematics?
- when students struggle to process mathematics at a higher depth of knowledge?

How far apart are the exits on this freeway: Jct 90 and Jefferson Blvd?

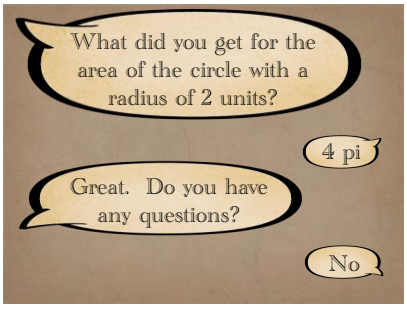
$$1\frac{1}{2} - 1\frac{1}{4}$$

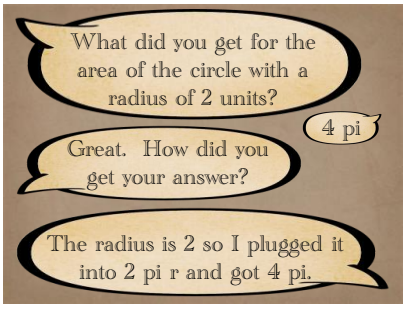




Questioning Scenarios

- The activity begins with teachers in groups of three taking the roles of teacher, student, or observer.
- The individuals playing the role of teacher and student each receive a slip of paper describing their scenario.
- The individual playing the role of observer waits to record all of the teacher's questions to the student.
- Once the activity begins, the teacher will talk to the student in the context of the scenario they read about on the slips of paper.





Problem-Based Lesson Resources

- My lessons: http://www.robertkaplinsky.com/lessons
- Dan Meyer: http://threeacts.mrmeyer.com
- Andrew Stadel: http://tinyurl.com/mrstadel
- Geoff Krall: http://tinyurl.com/PrBLmaps
- Nathan Kraft: http://tinyurl.com/mrkraft
- Sam J Shah: http://samjshah.com/worksheets-projects
- Dan Meyer's TED talk: http://tinyurl.com/meyer-TED

Planning Time

- Create a list of lessons for your grade level(s).
- Figure out which lessons you would like to incorporate first.
- Go through those lessons and figure out details such as:
  - When would I do this lesson?
  - What resources would I need?
  - What other teachers could I collaborate with?

NEXT STEPS

- *Start with realistic goals:*
  - *At least one per semester*
  - *Perhaps one per unit*
- *Collaboration is key*
- *Standards for Mathematical Practice*
  - *Talking and writing about mathematics*

Contact

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