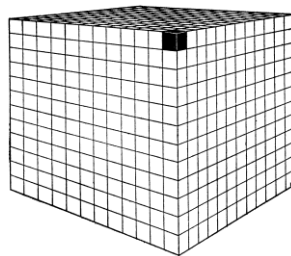
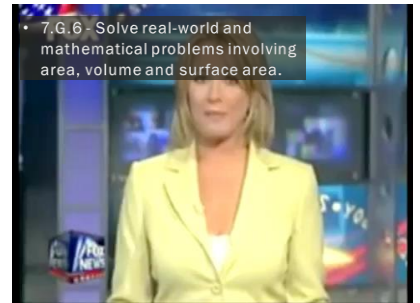


Middle School Real World  
 Problem-Based Lessons  
 Robert Kaplinsky  
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- Standards for Mathematical Practice**
1. Make sense of problems and persevere in solving them.
  2. Reason abstractly and quantitatively.
  3. Construct viable arguments and 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   |
|--|---|---|
| <ul style="list-style-type: none"> <li>G-MG.1 – Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk as a cylinder).</li> <li>G-GMD.3 – Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.</li> </ul> | <ul style="list-style-type: none"> <li>8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.</li> <li>7.G.6 – Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects.</li> <li>6.G.2 Apply the formulas <math>V = lwh</math> and <math>V = bh</math> to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.</li> </ul> | <ul style="list-style-type: none"> <li>5.MD.5 – Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.</li> <li>4.MD.3 – Apply the area and perimeter formulas for rectangles in real-world and mathematical problems.</li> <li>3.MD.7 – Find area 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.</li> <li>2.MD.1 – Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.</li> <li>1.MD.2 – Express the length of an object as a whole number of length units.</li> <li>1.MD.1 – Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.</li> </ul> |

- 6.RP.2 – Understand the concept of a unit
- 6.RP.3 – Use ratio and rate reasoning to solve real-world and mathematical problems.

### The Reality

- What does "best" mean?
  - 120 tickets for \$50 is "best" because you get the most tickets
  - 1 ticket for \$0.50 is "best" because you spend the least amount of money
- "What do you need to know to solve the problem?"
  - How many tickets will we use?
  - How long will we be staying there?
  - How many people are we going with?
  - How many tickets do the rides cost?
- Once they started working, they had no idea what to do.
  - They didn't realize that they could buy multiple sets of tickets.

### STUDENT WORK SAMPLES

### 7.RP.3 Use proportional relationships to solve multistep ratio and percent problems.

### 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/modelingapnreview.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

- o Communication
- o Curiosity

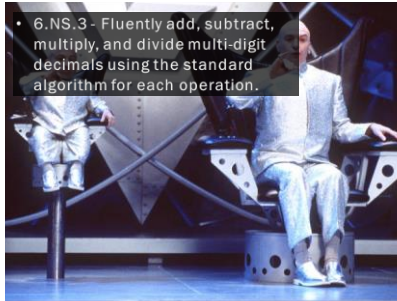
- 6.G.4 - Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.
- 7.G.6 - Solve real-world and mathematical problems involving area, volume and surface area.

- 8.EE.3 - Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
- 8.EE.4 - Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.

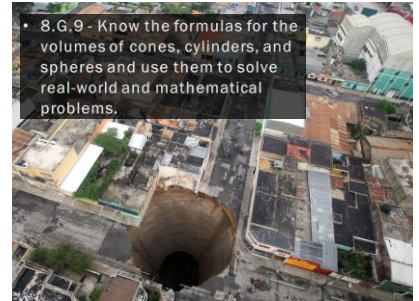
- 7.RP.2 - Recognize and represent proportional relationships between quantities.



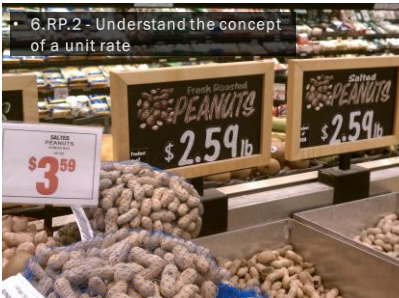
- 6.NS.3 - Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.



- 8.G.9 - Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.



- 6.RP.2 - Understand the concept of a unit rate



## The Four C's

- o Communication
- o Curiosity
- o Critical Thinking
- o Content Knowledge

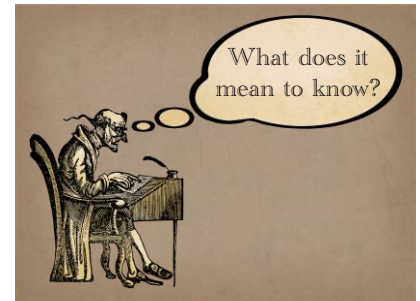
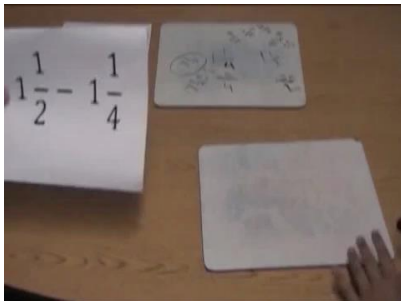
### WHAT DOES IT LOOK LIKE...

- 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.

What did you get for the area of the circle with a radius of 2 units?

4 pi

Great. Do you have any questions?

No

What did you get for the area of the circle with a radius of 2 units?

4 pi

Great. How did you get your answer?

The radius is 2 so I plugged it into  $2\pi r$  and got  $4\pi$ .

### 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>
- 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

