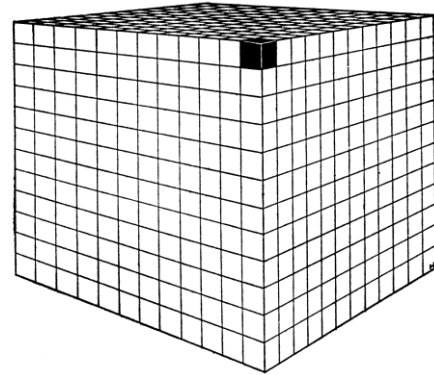
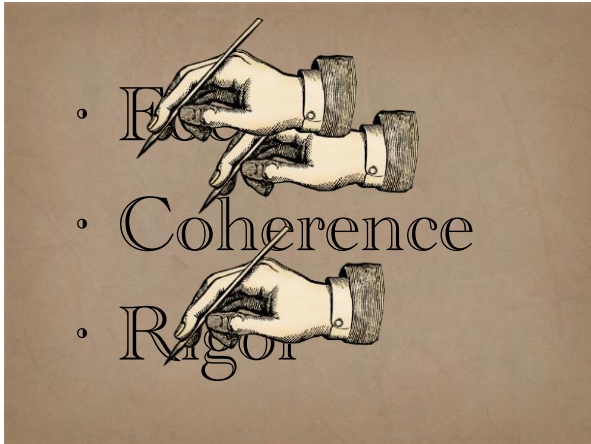


Real World Problem-Based Lessons Using Perplexing Tasks

Robert Kaplinsky
August 24, 2013



- 5.MD.5 – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
- 7.G.6 – Solve real-world and mathematical problems involving area, volume and surface area.
- 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).



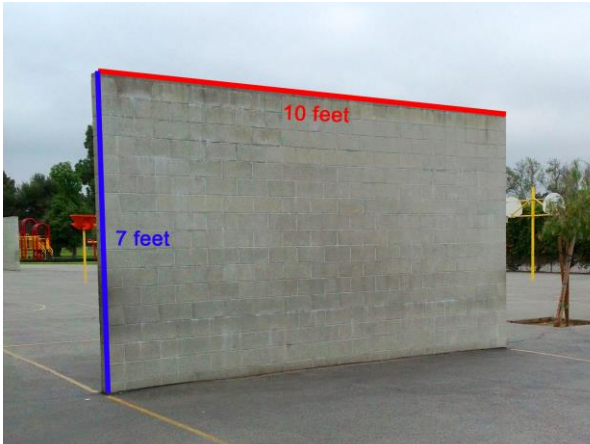
Standards for Mathematical Practice

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.



The Challenge

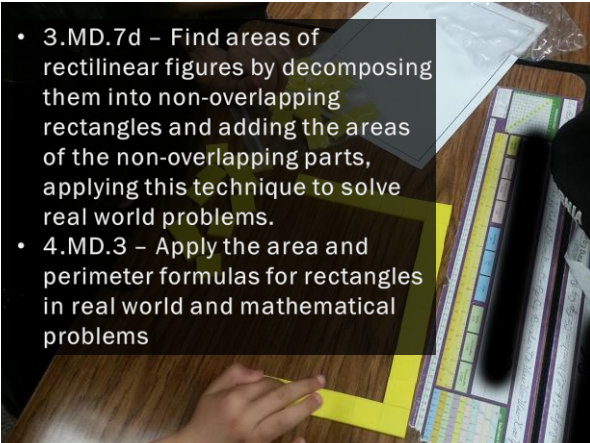
How can we figure out if we have enough paint to cover the handball wall?



SPECIFICATIONS

Color	Tintable	Color Family	Whites
Container Size	1 QT-Quart	Coverage Area (sq. ft.)	100 ft ²
Exterior Paint & Stains Product Type	Sliding & Trim	Low Temperature	No
Manufacturer Warranty	Limited Lifetime Guarantee	Minimum Temperature for Use (F)	50.0

- 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.
- 4.MD.3 – Apply the area and perimeter formulas for rectangles in real world and mathematical problems



STUDENT WORK SAMPLES

Do I have enough paint to cover the front of the handball wall? **Explain** how you know.

Yes because $100 - 70 = 30$ and $100 - 30 = 70$. We had 30 left over. We have 70 square feet on the handball court and 30 square feet left over.

Do I have enough paint to cover the front of the handball wall? **Explain** how you know.

Yes! Because we counted 7 times ten and we got 70.

The Reality

- The question matters
 - Initially we asked students, "Do we have enough paint to cover the handball wall?"
- A few students immediately shouted out "Yes!"
 - I asked them to prove to me that they were correct using a drawing or tiles and many were initially unable to do so.
- Students had trouble articulating themselves in writing
 - Many students struggled with their explanations and will need extensive practice to improve.

PROBLEM-BASED LEARNING FAQ

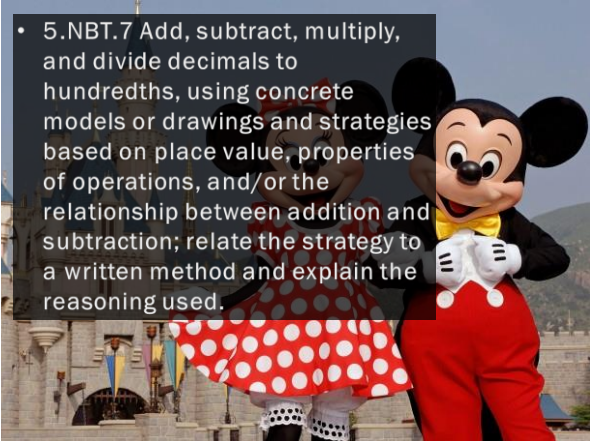
- How often do teachers do problem-based learning?
- How long do problem based lessons take?
- Do teachers use problem-based lessons to introduce a topic or after you've already taught it?
- How is problem-based learning assessed?
- How much time does it take to create a problem-based lesson?

The Four C's

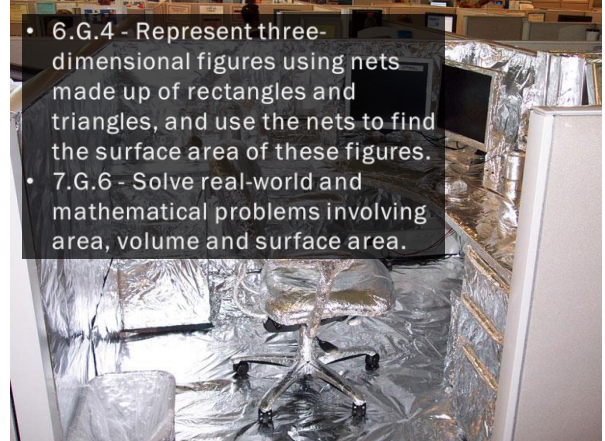
- o Communication
- o Curiosity

- 3.MD.1 - Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes.
- 4.MD.2 - Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money.

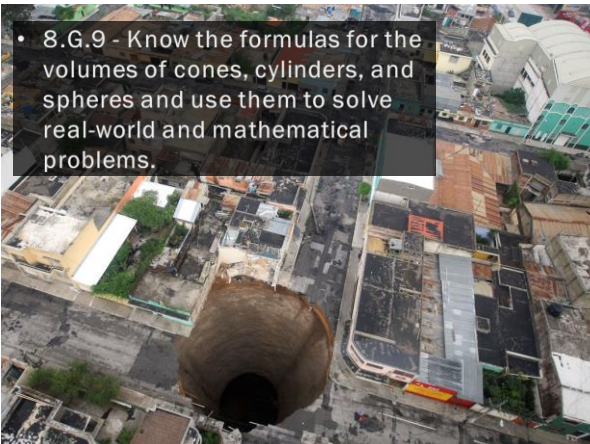
- 5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.



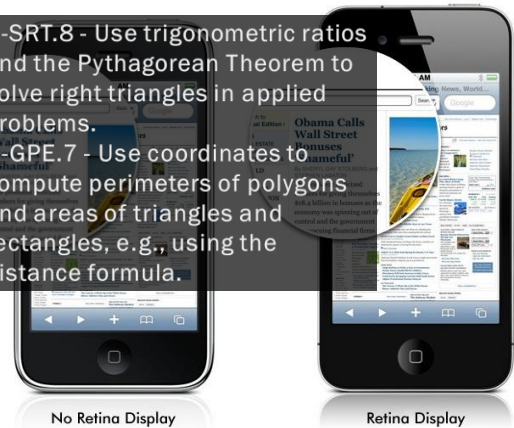
- 6.G.4 - Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.
- 7.G.6 - Solve real-world and mathematical problems involving area, volume and surface area.



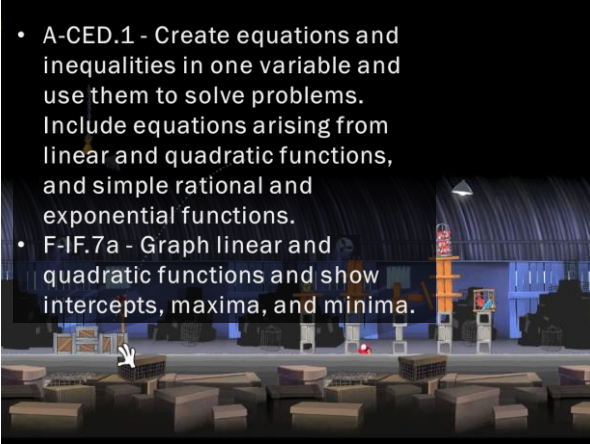
- 8.G.9 - Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.



- 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.

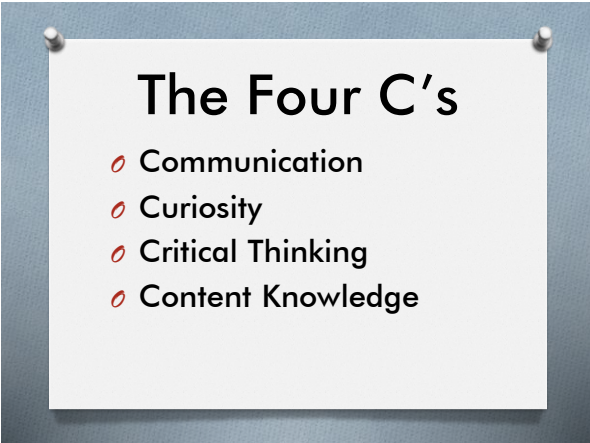


- 6.RP.2 - Understand the concept of a unit rate



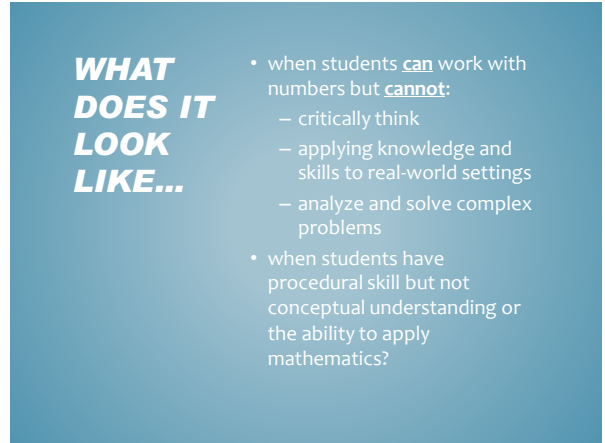
The Four C's

- Communication
- Curiosity
- Critical Thinking
- Content Knowledge



WHAT DOES IT LOOK LIKE...

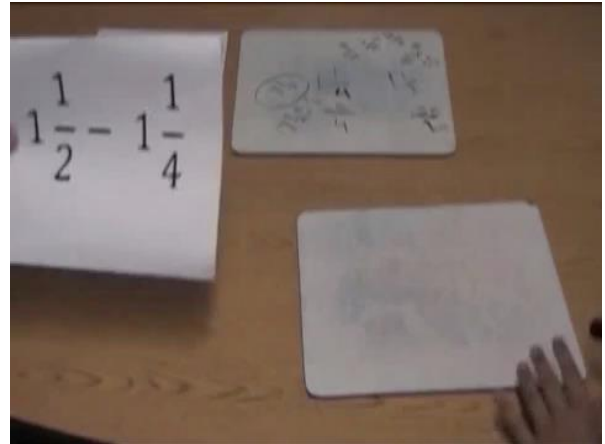
- when students can work with numbers but cannot:
 - critically think
 - applying knowledge and skills to real-world settings
 - analyze and solve complex problems
- when students have procedural skill but not conceptual understanding or the ability to apply mathematics?



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



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



Robert Kaplinsky's Problem-Based Lessons

Task Name	Concept / Skill	Standard 1	Standard 2	Standard 3	Standard 4	SS
1. How Can We Water All Of The Grass?	Circle, Pythagorean Theorem, Ingonometric ratios	7.G.4	8.G.7	G-RT.8	G-MG.1	G-4
2. How Much Money Should I Get Paid?	Volume of rectangular prism	5.MD.3	5.MD.4	5.MD.5	5.MD.5	5-M
3. How Tall Is My Uncle?	Exponential Growth	N-RI.2	A-SE.1	A-SE.3c	A-SE.4	A-R
4. How Can We Measure The Earth's Circumference?	Scale and Similar Figures	5.NF.1	5.NF.5	5.NF.5b	5.NF.5c	5-N
5. How Can We Measure The Earth's Circumference?	Transformations: Rotations, Reflections, and Translations	5.G.1	5.G.2	5.G.3	5.G.4	G-1
6. Which Toilet Paper Is The Best Deal?	Unit Rates and Ratios	6.RP.2	6.RP.3	6.RP.3a	6.RP.3b	6-R
7. How Can We Measure The Earth's Circumference?	Fractions on a Number Line and Subtracting Fractions	5.NF.2	5.NF.2b	4.NF.2	4.NF.3a	4-N
8. Do You Have Enough Paper?	Area	3.MD.5	3.MD.6	3.MD.7		
9. How Many Sheets Do You Need To Break Out Of Prison?	Scientific Notation	5.EE.1	5.EE.4			
10. What Does Can You Do On?	Inequalities and Measurement	2.MD.1	6.NS.7a	6.NS.7b		
11. Do You Speak Enough Money?	Money	2.MD.3				
12. Which Bed Bath & Beyond Coupon Should You Use?	Percent Discount	7.RP.3				
13. Is Gas Cheaper With Cash Or Credit Card?	Percent Discount	7.RP.3				
14. Which A The Largest Gas Is Unit?	Pythagorean Theorem (Distance in coordinate system)	6.G.8	G-RT.8	G-GPE.7		
15. How Should We Measure The Length of a Side?	Pythagorean Theorem (Length of a side)	6.G.7	G-SRT.8	G-GPE.7		
16. When Should We Use The Median?	Operations with Time Intervals	4.MD.2				
17. How Big Are Superballs?	Converting Units, Proportions, and Scientific Notation	5.MD.1	7.RP.2	7.G.4	8.EE.4	G-4
18. What Michael's Coupon Should I Use?	Percent Discount	7.RP.3	A-CED.3			
19. Is A Change In Two Months or Annually?	Decimal Operations and/or Systems of Equations	5.NBT.7	8.EE.8c	A-CED.3	A-REI.11	F-8
20. How Many Sheets Do You Need To Break Out Of Prison?	Volume of Cylinder	5.MD.3	5.MD.4	5.MD.5	8.G.9	G-4
21. How Can We Measure The Earth's Circumference?	Decomposing Numbers and/or Systems of Equations	2.NBT.7	3.NBT.2	3.NBT.3	8.EE.8c	A-C
22. How Many Sheets Do You Need To Break Out Of Prison?	Probability	2.SP.5	7.SP.6	7.SP.7	5.MD.5	5-A
23. How Can We Measure The Earth's Circumference?	Surface Area	6.G.4	7.G.6	8.G.7	G-MG.1	G-4
24. How Can We Measure The Earth's Circumference?	Percent Increase and Compound Interest	7.RP.3	A-SE.1b	F-8.F.1	F-8.F.2	F-4
25. How Much Does The Maximum Fuel Project Cost?	Surface Area and Unit Rates	6.G.4	6.RP.2	6.RP.3	7.G.8	
26. How Many Sheets Do You Need To Break Out Of Prison?	Perimeter	4.MD.3				
27. Which Toilet Paper Is The Best Deal?	Systems of Equations/Inequalities	8.EE.8c	A-CED.3	A-REI.11	F-8.F.1	
28. How Can We Measure The Earth's Circumference?	Linear Equations	A-CED.2	F-8.F.1	F-8.F.4	F-8.F.6	
29. How Big Is The World's Largest Delishious Pizza?	Area of Circle, Square, and Unit Rates	3.MD.5	3.MD.6	3.MD.7	4.MD.3	3-M
30. How Many Sheets Do You Need To Break Out Of Prison?	Area of Square	3.MD.5	3.MD.6	3.MD.7	4.MD.3	3-M
31. How Many Sheets Do You Need To Break Out Of Prison?	Area of Square	3.MD.5	3.MD.6	3.MD.7	4.MD.3	3-M
32. Do You Have Enough Paper?	Area of Square	3.MD.5	3.MD.6	3.MD.7	4.MD.3	3-M
33. How Many Sheets Do You Need To Break Out Of Prison?	Systems of Equations or Rates	6.RP.2	6.RP.3	8.EE.8c	A-CED.3	F-8
34. How Many Sheets Do You Need To Break Out Of Prison?	Linear and Quadratic Functions	8.F.1	8.F.4	F-8.F.1	F-8.F.2	F-4
35. How Much Paper Ribbon Will You Need?	Perimeter & Circumference	3.MD.9	4.MD.3	7.G.4		
36. How Many Sheets Do You Need To Break Out Of Prison?	Adding Times	3.MD.11	4.MD.2			
37. Which Chinese Food Coupon Should I Use?	Percent Discount	7.RP.3				
38. How Many Sheets Do You Need To Break Out Of Prison?	Ratios and Proportions	7.RP.3				
39. Which Paper Towel Coupon Should I Use?	Create Equation From Quadratic Graph	A-CED.1	F-8.F.1	F-8.F.4	F-8.F.7a	F-4
40. How Many Sheets Do You Need To Break Out Of Prison?	Adding Times	3.MD.11	4.MD.2			
41. Which Car Wash Should You Use?	Unit Rates	6.RP.1	6.RP.2	6.RP.3		
42. How Fast Can You Throw A Baseball?	Converting Units and Unit Rates	5.MD.1	6.RP.2			

Contact

Robert Kaplinsky

✉ robert@robertkaplinsky.com

🌐 robertkaplinsky.com/launch-la/

🐦 [@robertkaplinsky](https://twitter.com/robertkaplinsky)

