## Tustin USD

AUGUST 21, 2014



DOUBLE-DOUBLE

## 2004-10-31

YOUR GUEST NUMBER IS
98

$$
\begin{aligned}
& \text { IN-N=OUT BURGER LAS VEGAS EASTERN } \\
& 2004=10-31 \\
& 1651598 \\
& 8: 21 \text { PM }
\end{aligned}
$$

Cashier: SAM

## GLEST <br> \#: 98

## Counter-Eat In

 DblDbl98 Meat Pty KChz
2.65
88.20

Counter-Eat In
TAX 7.50 x
90.85

Amount Due
6.81

CASH TENDEA
Change
$\$ 97.66$
$\$ .00$
$2004-10-31$

## Cashier: SAM

## GLEST <br> H: 98

## Counter-Eat In

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98 Meat Pty XChz

2.65
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Counter-Eat In TAX 7,50x 90.85

Amount Due
6.81
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CASH TENOER Change
$\$ 97.66$ $\$ .00$

2008-10-31

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| Hamburger w/Onion | 243 | 390 |
| Cheeseburger w/Onion | 268 | 480 |
| Double-Double w/Onion | 330 | 670 |

## The Reality

- Students needed guidance to figure out a layer's cost
- Not every class is ready to go straight to $100 \times 100$
- Common wrong answers included:
- $\$ 175.00$ ( $\$ 1.75 \times 100$ cheeseburgers)
- \$132.50 (\$2.65 x 50 Double-Doubles)
- Students had equations that had more than X patties
- Students were surprised to see three different equations:
- Starting with a Double-Double
- Starting with a cheeseburger
- Starting with produce and bun only



|  |  |
| :--- | :--- |
| Layers | Cost |
| 1 | $\$ 1.75$ |
| 2 | $\$ 2.65$ |
| 3 | $\$ 3.55$ |
| 4 | $\$ 4.45$ |
| $\cdot$ | $\cdot$ |
| $\cdot$ | $\cdot$ |
| 20 | $\$ 18.85$ |
| $\cdot$ | $\cdot$ |
| $\cdot$ | $\cdot$ |
| 100 | $\$ 90.85$ |
| $\cdot$ | $\cdot$ |
| $\cdot$ | $\$ 1.75+(\mathrm{N}-1)^{*} \$ 0.90$ |
| N |  |

bun + produce + meat + cheese + meat + cheese $=\$ 2.65$
bun + produce + meat + cheese
= \$1.75
meat + cheese $=\$ 0.90$

# WHAT ISN'T MATHEMATICAL MODEHNG? 

- 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.


# PROBLEM- • How often do teachers do 

 problem-based learning? 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?


## Why 2 > 4

A proof by induction by Max Ray



# How much 

shorter are 20
layers of
staggered
pipe stacks?






## Layers: 0



# The Four C's 

- Communication - Curiosity
- 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).
- 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.
- G-GMD. 3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

:. G-co. 4 - Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

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


## The Four C's

- Communication
- Curiosity
- Critical Thinking


## Problem Solving Framework

- Inspired by Geoff Krall's resources at emergentmath.com


## The Four C's

- Communication
- Curiosity
- Critical Thinking
- Content Knowledge NHA


## Math Question

- Solve the problem on your own. Do not work or share your answer with anyone else.
- You will have 30 seconds to complete it.
- Write your answer down on a paper.

$$
\begin{gathered}
\text { There are } 125 \\
\text { sheep and } 5 \text { dogs } \\
\text { in a flock. How old } \\
\text { is the shepherd? }
\end{gathered}
$$

## Of the 32 students I interviewed...

- $75 \%$ of them gave me numerical responses
- 2 students calculated the answer to be $130(125+5)$
- 2 students calculated the answer to be 120 (125-5)
- 12 students calculated the answer to be $25(125 \div 5)$
- 0 students calculated the answer to be 625 ( $125 \times 5$ )
- 4 students stated that they guessed their answer (90, 5,42 , and 50)
- 4 students tried to divide 125 by 5 but could not correctly implement the procedure


## Takeaways

- Making sense of mathematics
- Intellectual autonomy
- Intellectual autonomy is about being able to think for yourself and not being dependent on others for the direction and control of one's thinking.


## What Does the NHTSA Say?

## Kev Statistics and Consumer Insights:

- Motor vehicle crashes are the leading cause of death for children age 1 through 12 years old. ${ }^{1}$


## According to a NHTSA study, 3 out of 4 kids are not as secure in the car as they should be because their car seats are not being used correctly.

${ }^{1}$ Source: Based on the latest mortality data currently available from the CDC's National Center for Health Statistics.


- "because they have their child in the right seat"
- "because their car seats are not being used correctly"

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.
Ad
council
VISIT SAFERCAR.GOV/THERIGHTSEAT


## KNOW FOR SURE

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.

## VISIT SAFERCAR.GOV/THERIGHTSEAT

 NHTSA
## 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?

Great. Do you have any questions?

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

Great. How did you get your answer?

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


## How long is Can't Buy Me Love?

Can't Buy Me Love
The Beatles - A Hard Day's Night

## THE BERTLES

pariophons


| Day <br> \# | Description | Too <br> Low | Too <br> High <br> t | My <br> Estimate | My Reasoning |
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## How long is Can't Buy Me Love?

Can't Buy Me Love
The Beatles - A Hard Day's Night

## THE BERTLES

pariophons


## (8. THE BEDTLES


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ESTIMATION 1 80.COM

| £. THE BERTLEES |
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| ARIOHON A HARD DAYY'S NIGHTT |



## How long is We Will Rock You?

| We Will Rock You |
| :--- | :--- |
| Queen - Greatest Hits I |$\quad \$ 8 \%$

## QUEEN GREATESTHIITS

## OUEEN <br> GREATMSTHIM

ESTIMATION 1 80.COM

estimation180.com

## How long is I Got You (I Feel Good)?

I Got You (I Feel Good)
James Brown - 40th Anniversary Collection (Disc 1)

JAMESBROWN
40th ANNIVERSARY COLLECTION

I Got You (I Feel Good)


ESTIMATION $180 . C O M$

JAMES BROWN
4OTH ANNIVERSARY COLLECTION
estimation180.com

## Word Count Estimates!!!

(days 187-190)







## DEGREES: $0^{\circ}$

PERCENT:

- \%



## Dr. Clayton Edwards

Amazing to see 6th graders w/ no \% background learn so much in 20 min w/ pie pics @mr_stadel bit.ly/1ilros1 \#mathchat \#iaedchat

* Reply 47 Retweeted * Favorited ** More

| RETWEETS | FAVORITES | 里 |
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| 3 | 2 | , |

2:03 PM - 1 May 2014



The height of the board is $12^{\prime} 2^{\prime \prime}$ and $I$ am $5^{\prime} 6^{\prime \prime}$.


S brought in necklace she made for us to estimate! She also came with the answer!Now we have 181 days! \#estimation180 pic.twitter.com/TgchZtZ1AT


## Would You Rather?

ASKING STUDENTS TO CHOOSE THEIR OWN PATH AND JUSTIFY IT

By: John Stevens wyrmath.wordpress.com

## Would You Rather?

## A stack of quarters from the floor to the top of your head or $\$ 250$ ?



Name:
Situation:

## My argument

I believe...

The evidence I have to support this belief is...

Someone might disagree with me because...

| ClaSSMate |
| :--- |
|  |
| believes... |
| The evidence they have to support their belief is... |
|  |

## Would You Rather?

## A stack of quarters from the floor to the top of your head or $\$ 250$ ?



## Which student would you choose to pack your parachute?



Adapted from How to Grade for Learning (O'Connor, 2002)

## Which student would you choose to pack your parachute?



Adapted from How to Grade for Learning (O'Connor, 2002)

## dy/dan


[Confab] Money Duck
April 30th, 2014 by Dan Meyer

Confab time! Let's make some magic here. This is a Money Duck. It's soap.


My name is
Dan Meyer
and I like to teach.

## marinneremere 083838

 REALSS in wery bar of saep
## 

each bar contains real MONE: \$1,\$5, \$10, \$20,0R EVEN A $\$ 50$ BIL

Money Duck

## Buyer

Seller

## Teacher Work time

## Goal: Explore \& plan to use today's resources.

## Teacher Woxk time

## Goal: Explore \& plan to use today's resources.

O Find a task to use this year. Solve it.

## Teacher Work time

## Goal: Explore \& plan to use today's resources.

O Find a task to use this year. Solve it.

O Practice some open-ended happenings.

## Teacher Work time

## Goal: Explore \& plan to use today's resources.

O Find a task to use this year. Solve it.

O Practice some open-ended happenings.

O Makeover a boring textbook problem.

## Teacher Work time

## Goal: Explore \& plan to use today's resources.

$\bigcirc$ Find a task to use this year. Solve it.

O Practice some open-ended happenings.

O Makeover a boring textbook problem.

O Choose a curious classroom activity.

## Problem-Based Lesson Resources

- Problem-based lesson search engine:


## http://robertkaplinsky.com/prbl-search-engine/

- 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
- Dan Meyer's TED talk: http://tinyurl.com/meyer-TED


How Many Sheets Do You Need To Break Out Of Prison?
Goperations with rationalinumiberso ENTE


Robert graduated from University of


Math content expert

California, Los Angeles (UCLA) with a Bachelors of Science in Mathematics. He has taught mathematics to students at the

Lessons elementary, middle, and high school levels. As



How Much Is One Third Of A Cup Of Butter?



How Do Skytypers Write Messages?


Robert Kaplinsky's Problem-Based Lessons
File Edit View Insert Format Data Tools Help All changes saved in Drive
두
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$\mathrm{B} \quad I \quad \mathrm{~A}$

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 $\Sigma$


## Task Name

How Can We Water All Of The Grass?
How Much Money IS That?!
How Much Money Should Dr. Evil Demand?
How Tall Is Mini-Me?
How Did They Make Ms. Pac-Man?
Which Ticket Option Is The Best Deal?
How Far Apart Are The Freeway Exits?
Do We Have Enough Paint?
How Many Stars Are There In The Universe?
What Rides Can You Go On?
Do You Have Enough Money?
Which Bed Bath \& Beyond Coupon Should You Use?
Is Gas Cheaper With Cash Or Credit Card?
Where's The Nearest Toys R Us?
How Sharp Is The iPhone 5's Retina Display?
When Should She Take Her Medicine?
How Biq Are Sunspots?
What Michael's Coupon Should I Use?
Is It Cheaper To Pay Monthly or Annually?
How Biq Is The 2010 Guatemalan Sinkhole?
How Can You Win Every Prize At Chuck E. Cheese's?
How Many Royal Flushes Will You Get?
How Much Does The Paint On A Space Shuttle Weigh?
How Did Motel 6 Go From $\$ 6$ to $\$ 66$ ?
How Much Does The Aluminum Foil Prank Cost?
How Many Laps Is A 5k Race?
Which Toilet Uses Less Water?
How Did Someone Get A \$103,000 Speeding Ticket In Finland? Which Pizza Is A Better Deal?
How Biq Is The World's Largest Deliverable Pizza?
How Many Sheets Do You Need To Break Out Of Prison?
Do Hybrid Cars Pay For Themselves?
How Many Hot Dogs Did They Eat?!
How Much Purple Ribbon Will You Need? Are We There Yet?
Which Chinese Food Coupon Should I Use?
How Biq Is The Vehicle That Uses Those Tires?
Where Would The Angry Birds Have Landed?
How Many Movies Can You See In One Day?
Which Carrots Should You Buy?
How Fast Can You Throw A Baseball?

| B | c | D | E | F |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Concept / Skill | Standard 1 | Standard 2 | Standard 3 | Standard 4 | St |
| Circles, Pythagorean Theorem, trigonometric ratios | 7.G. 4 | 8.G. 7 | G-SRT. 8 | G-MG. 1 | G |
| Volume of rectangular prism | 5.MD. 3 | 5.MD. 4 | 5.MD. 5 | 5.MD.5b | 5. |
| Exponential Growth | N-RN. 2 | A-SSE. 1 | A-SSE.3c | A-SSE. 4 | A- |
| Scale and Dividing Decimals | 5.NF. 5 | 5.NF.5a | 5.NF.5b | 6.NS. 3 |  |
| Transformations (Rotations, Reflections, and Translations) | 8.G. 1 | 8.G. 2 | 8.G. 3 | 8.G. 4 | G |
| Unit Rates and Ratios | 6.RP. 2 | $6 . \mathrm{RP} .3$ | 6.RP.3a | 6.RP.3b |  |
| Fractions on a Number Line and Subtracting Fractions | 3.NF. 2 | 3.NF.2b | 4.NF. 2 | 4.NF.3a | 4. |
| Area | 3.MD. 5 | 3.MD. 6 | 3.MD. 7 |  |  |
| Scientific Notation | 8.EE. 3 | 8.EE. 4 |  |  |  |
| Inequalities and Measurement | 2.MD. 1 | 6.NS.7a | 6.NS.7b |  |  |
| Money | 2.MD. 8 |  |  |  |  |
| Percent Discount | 7.RP. 3 |  |  |  |  |
| Percent Discount | 7.RP. 3 |  |  |  |  |
| Pythagorean Theorem (Distance in coordinate system) | 8.G. 8 | G-SRT. 8 | G-GPE. 7 |  |  |
| Pythagorean Theorem (Length of a side) | 8.G. 7 | G-SRT. 8 | G-GPE. 7 |  |  |
| Operations with Time Intervals | 4.MD. 2 |  |  |  |  |
| Converting Units, Proportions, and Scientific Notation | 5.MD. 1 | 7.RP. 2 | 7.G. 4 | 8.EE. 4 | G |
| Percent Discount | 7.RP. 3 | A-CED. 3 |  |  |  |
| Decimal Operations and/or Systems of Equations | 5.NBT. 7 | 8.EE.8c | A-CED. 3 | A-REI. 11 | F- |
| Volume of Cylinder | 5.MD. 3 | 5.MD. 4 | 5.MD. 5 | 8.G.9 | G |
| Decomposing Numbers and/or Systems of Equations | 2.NBT. 7 | 3.NBT. 2 | 3.NBT. 3 | 8.EE.8c | A- |
| Probability | 7.SP. 5 | 7.SP. 6 | 7.SP. 7 | S-MD. 5 | S- |
| Surface Area | 6.G.4 | 7.G. 6 | 8.G. 7 | G-MG. 1 | G |
| Percent Increase and Compound Interest | 7.RP. 3 | A-SSE. 1b | F-BF. 1 | F-IF.8b | F- |
| Surface Area and Unit Rates | 6.G.4 | 6.RP. 2 | 6.RP. 3 | 7.G.6 |  |
| Perimeter | 4.MD. 3 |  |  |  |  |
| Systems of Equations/Inequalities | 8.EE.8c | A-CED. 3 | A-REI. 11 | F-BF. 1 |  |
| Linear Equations | A-CED. 2 | F-BF. 1 | F-IF. 4 | F-IF. 6 |  |
| Area or Circle, Square, and Unit Rates | 3.MD. 5 | 3.MD. 6 | 3.MD. 7 | 4.MD. 3 | 6. |
| Area of Square | 3.MD. 5 | 3.MD. 6 | 3.MD. 7 | 4.NBT. 3 | 4.1 |
| Integer Operations | 5.NBT. 6 |  |  |  |  |
| Systems of Equations or Rates | 6.RP. 2 | 6.RP. 3 | 8.EE.8c | A-CED. 3 | F- |
| Linear and Quadratic Functions | 8.F. 3 | 8.F. 4 | F-BF. 1 | F-BF. 2 | F- |
| Perimeter \& Circumference | 3.MD. 8 | 4.MD. 3 | 7.G. 4 |  |  |
| Adding Times | 3.MD. 1 | 4.MD. 2 |  |  |  |
| Percent Discount | 7.RP. 3 |  |  |  |  |
| Ratio and Proportions | 7.RP. 2 |  |  |  |  |
| Create Equation From Quadratic Graph | A-CED. 1 | F-BF. 1 | F-IF. 4 | F-IF.7a | F-L |
| Adding Times | 3.MD. 1 | 4.MD. 2 |  |  |  |
| Unit Rates | 6.RP. 1 | 6.RP. 2 | 6.RP. 3 |  |  |
| Converting Units and Unit Rates | 5.MD. 1 | 6.RP. 2 |  |  |  |

## Google <br> gl

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The links below are the pages that are being searched by the search engine:

- 101 Questions
- Andrew Stadel
- Dan Meyer
- Dane Ehlert
- Emergent Math's Problem Based Curriculum Maps
- Estimation180
- Geoff Krall
m Feeling Lucky


## Problem-Based Lesson Search Engine

This search engine searches all of the sites below to quickly help you find a problem-based lesson (also called 3-Act Task, mathematical modeling, or application problem):

The link belo

## Problem-Based Fessons

## 101qs.com

Andrew Stadel

## Dan Meyer

Mathalicious

Problem Based Curriculum Maps


