

GETTING STRUGGLING MATH LEARNERS TO MATHEMATIZE THEIR WORLD AND ENGAGE THEM IN MEANINGFUL PROCEDURES

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 <http://msmaths.weebly.com>

Understanding Math Matters

The image shows a television screen with a dark background. At the top left, there is a logo for '4GIFs.com' and the text '지면 다음주 자유기 법학의상!!'. At the top right, the 'SBS' logo is visible. In the center, the question 'Q' is followed by the mathematical expression $2+2 \times 2$. Below this, the answer 'A' is followed by three options: '6', '8', and '8'. The background of the screen is divided into horizontal bands of yellow, red, and yellow. At the bottom, there are three white, dome-shaped objects on a yellow surface, with a red and white striped line running across them.

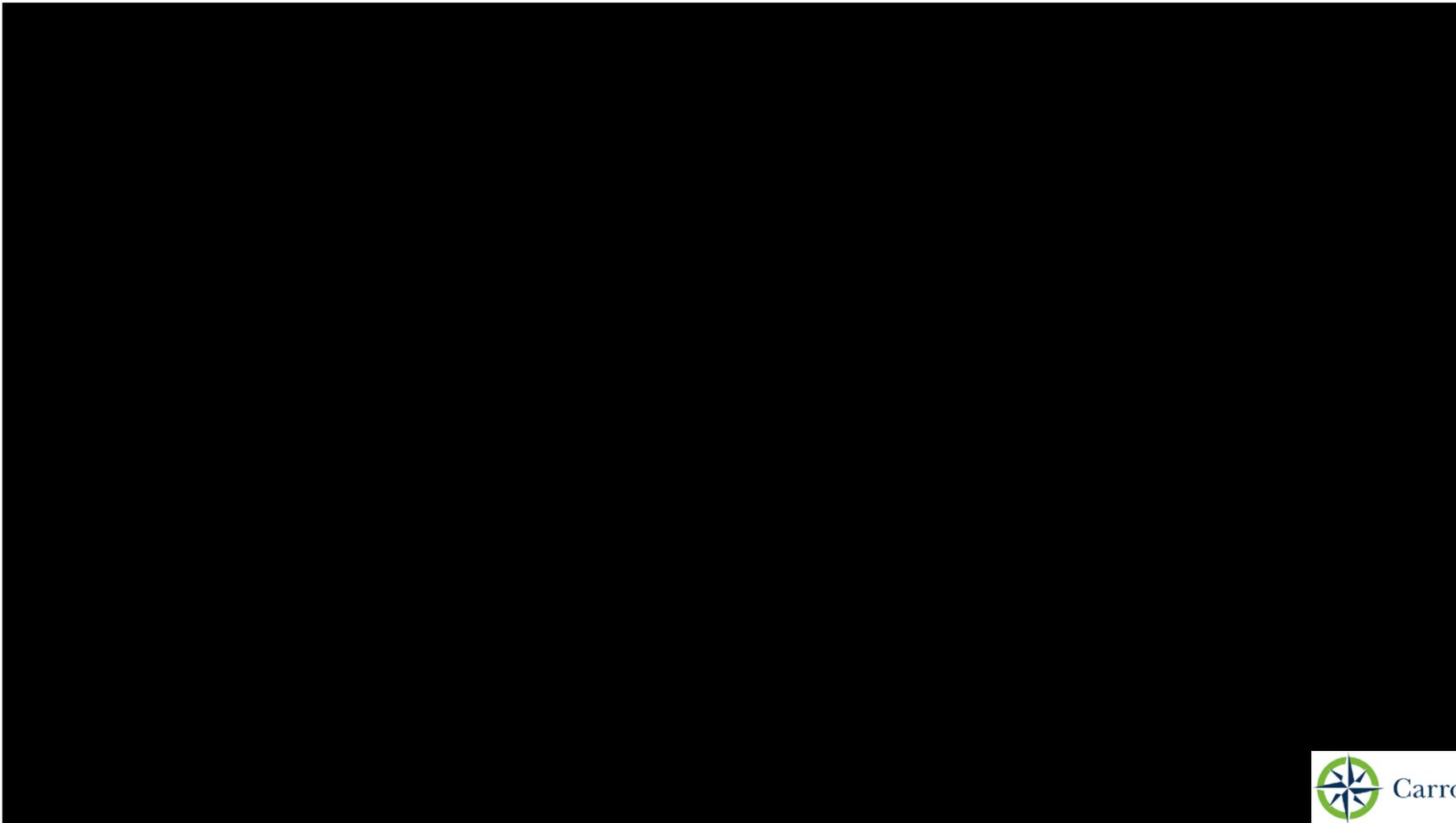
지면 다음주
자유기 법학의상!!
4GIFs.com

SBS

Q $2+2 \times 2$

A 6 8 8

What do kids think math is?



The eight Standards for Mathematical Practice are:

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.

Ways MD/RD can affect students

Processing quantity issues and number sense

- Inability to make decisions about quantity
- Estimation difficulties
- Difficulties with magnitude

Weaknesses in mapping symbols to magnitude

- Does not affect nonsymbolic processing
- Comparing quantities symbolically but can compare lengths

Working Memory deficits

- Automaticity with arithmetic procedures
- Not attributed to a weakness in NS

Hybrid of representing and manipulating numerical magnitude (internal number line and WM) - RD + MD comorbidity

- NS difficulties as well as impaired abilities to solve word problems

**“When you have mastered numbers,
you will in fact no longer be reading
numbers, any more than you read
words when reading books.
You will be reading meanings.”**

-W.E.B. Du Bois



Deficits in phonological processing are linked to memorization and retrieval of basic arithmetic facts from long-term memory

(De Smedt, Taylor, Archibald, & Ansari, 2010; Geary, 2004)

...especially when verbal retrieval is the optimal strategy

(Boets & De Smedt, 2010)

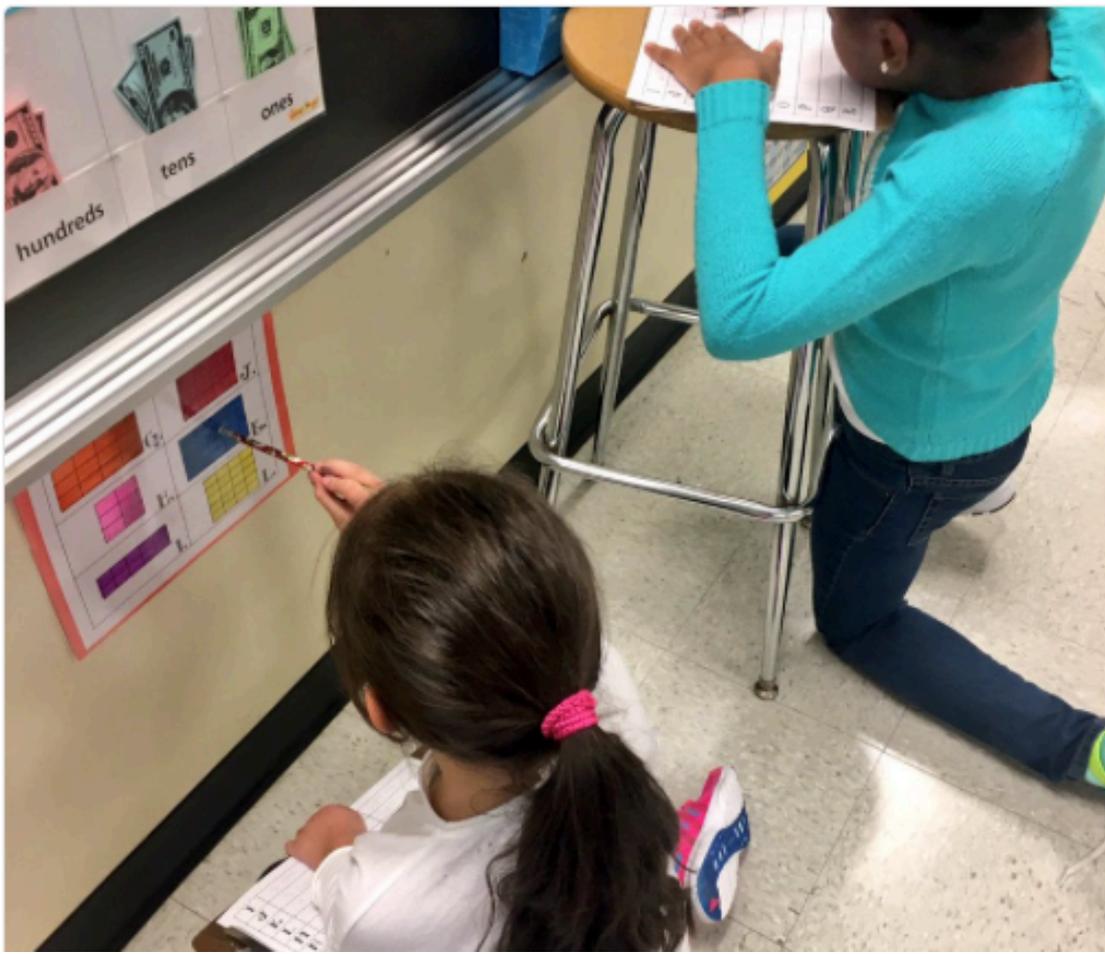
Phonological deficits play a major role in impairments in problem-solving situations

Math facts on ball worksheets! #iChar



Alalen Sadri @asadri24 · Sep 27

"I Spy Arrays" around the room during Math with Someone...working hard on multiplication fact fluency!



facts!



Two types of learners - inchworms and grasshoppers

TASK	INCHWORM	GRASSHOPPER
Analyzing and identifying problems		Source: Chinn, 1997

The GPS Study



Source: Youtube user kimbloop



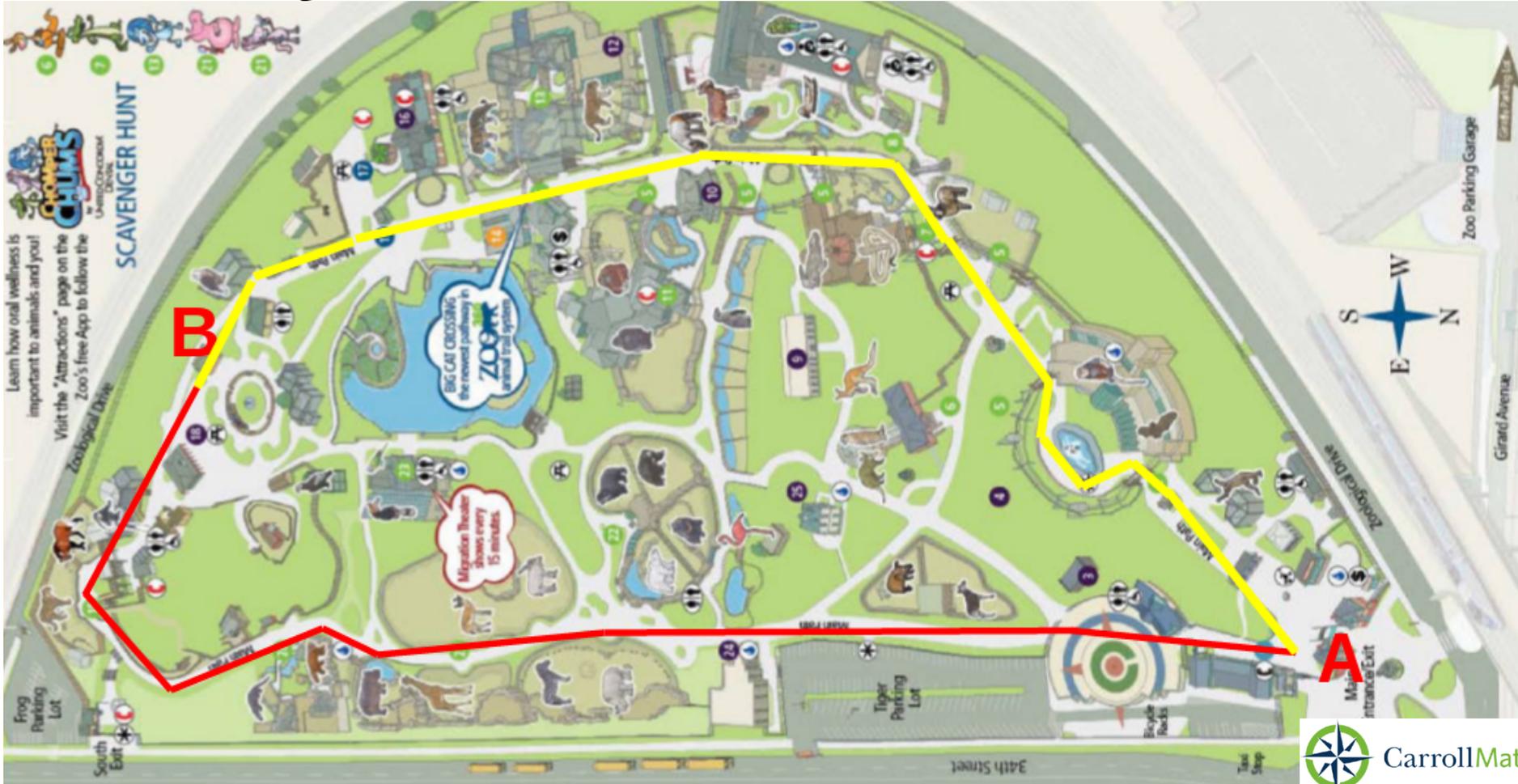
CarrollMath

2006 Study

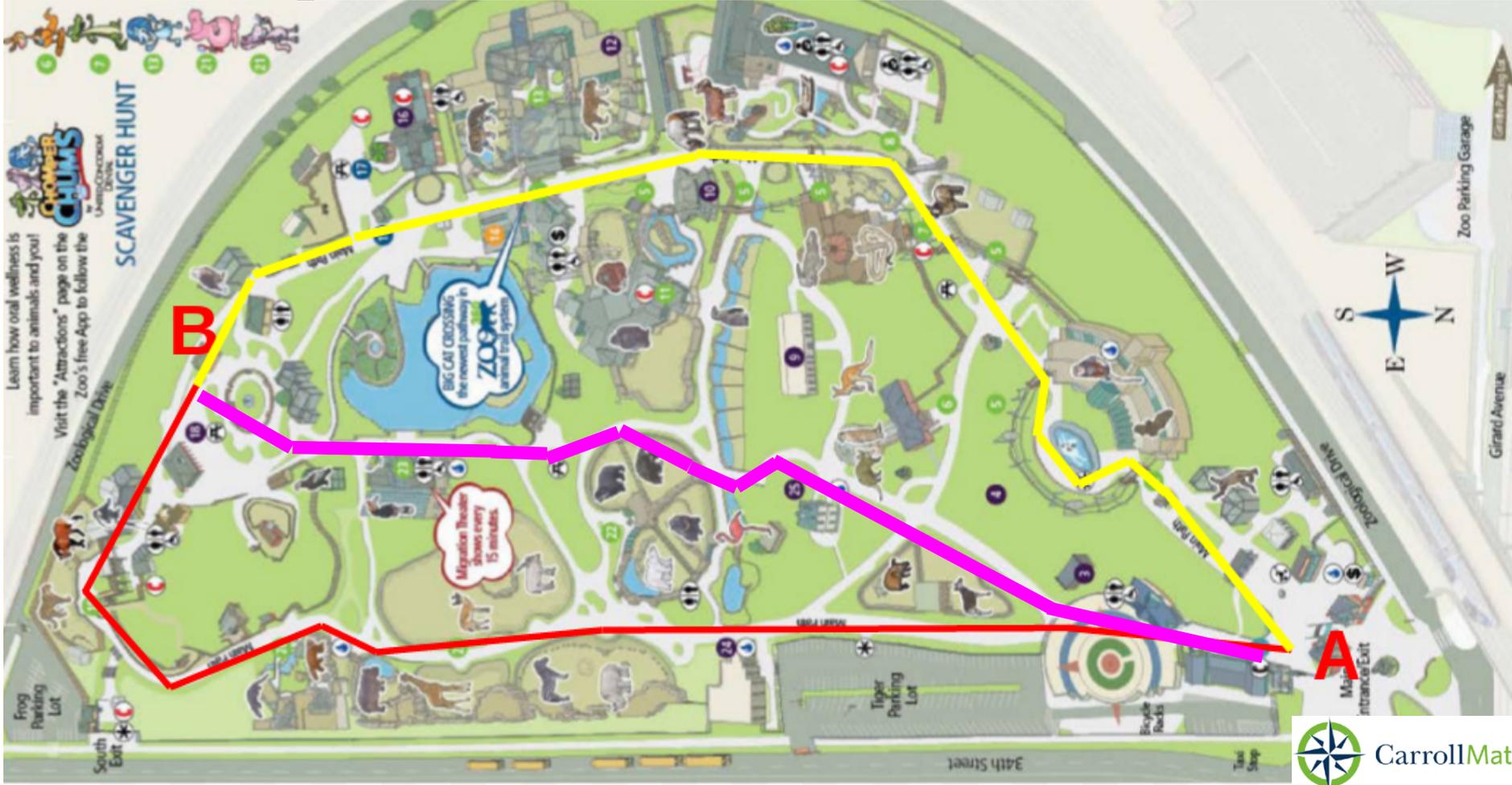
Stefan Munzer Journal of Environmental Psychology Volume 26, Issue 4, December 2006, Pages 300–308
<http://www.sciencedirect.com/science/article/pii/S0272494406000594>



2006 Study



2006 Study





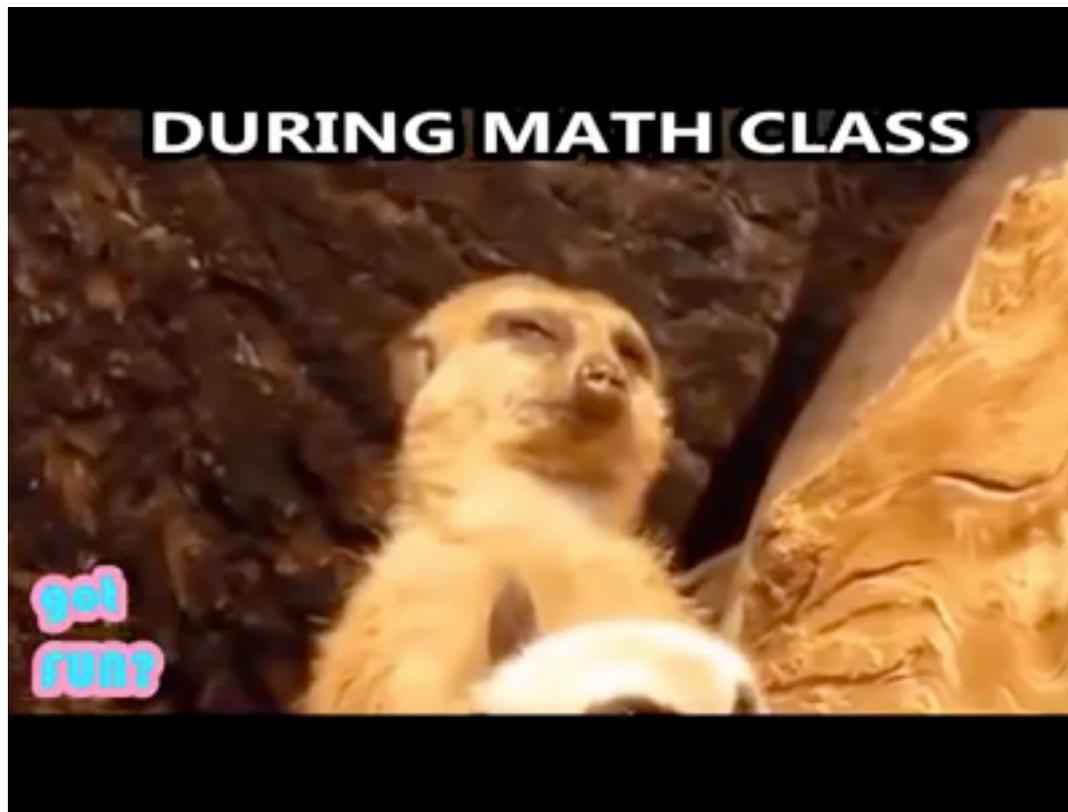
“The researchers explain their results from the perspective of active learning, arguing that travelers need to do something effortful and difficult while they learn in order to remember both route and survey knowledge.”

- Dan Meyer

Source: 2014©Ann Shannon & Associates and Dan Meyer's blog (<http://blog.mrmeyer.com>) 2016



What does memorization without meaning or value often look like in math class?



Source: Youtube user AcemanMCT

COMMON CHORUS

"I ju
k

"I wa



remember
Teacher
me"

understand
s"

Teaching Mathematics through Problem Solving - Robert Kaplinsky

The result of
non-contextualized
learning of math?

Math in Context

Math that is relevant to kids

"Real world" \neq Context



Nathan Kraft @nathankraft1 · 46s

Dumbest textbook question of the day: 50 of the 1,500 possibly active volcanoes on Earth erupt every year. What is the GCF of 50 and 1,500?

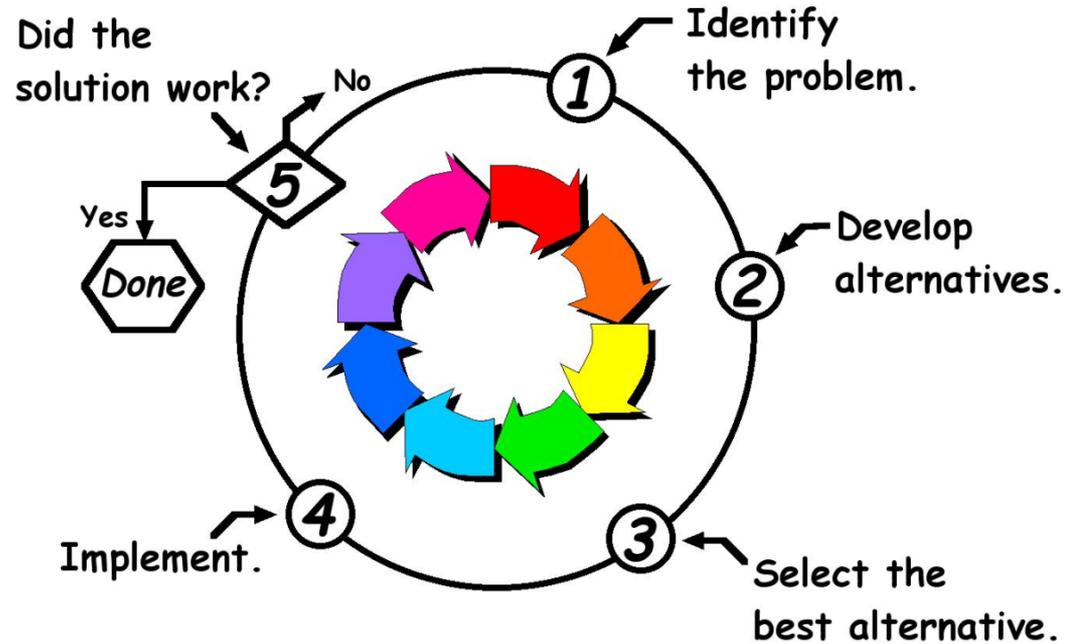
PROBLEM SOLVING

What is it?

Why do we need it?

How do we teach it?

Steps to solve a problem...

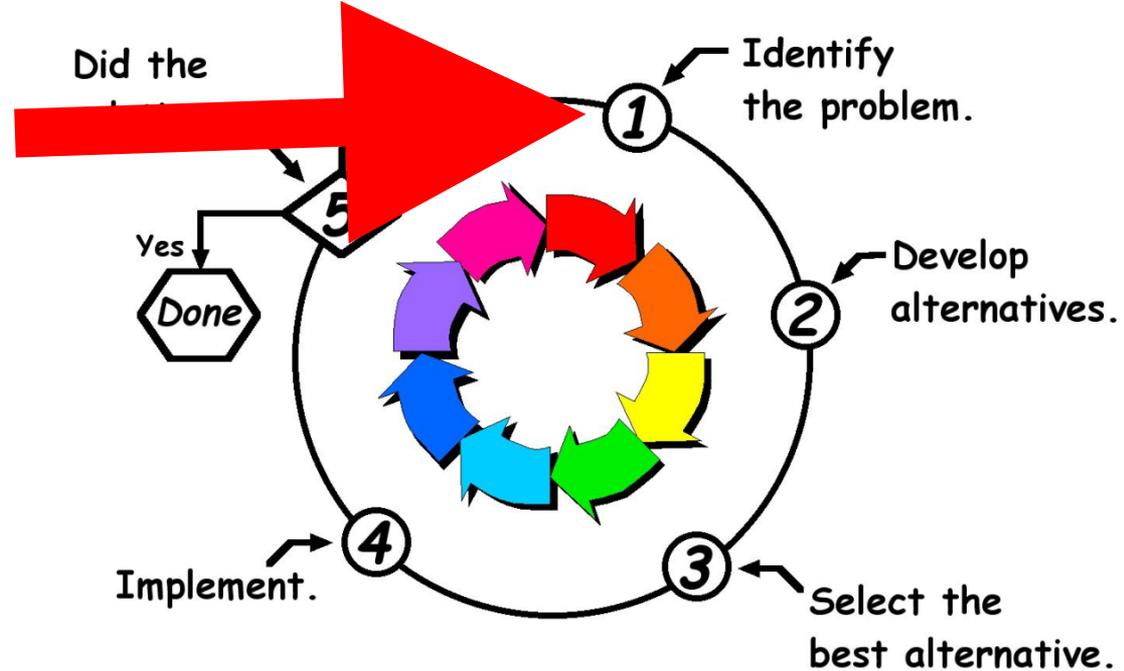


<http://www.3vadmin.com/>

PROBLEM SOLVING

Steps to solve a problem...

How many students never make it past Step 1?



<http://www.3vadmin.com/>

TEXTBOOK

Two pitchers of milk, Pitcher A and Pitcher B, are placed on a dining table. Describe a sequence of a reflection followed by a translation that maps Pitcher A onto Pitcher B.

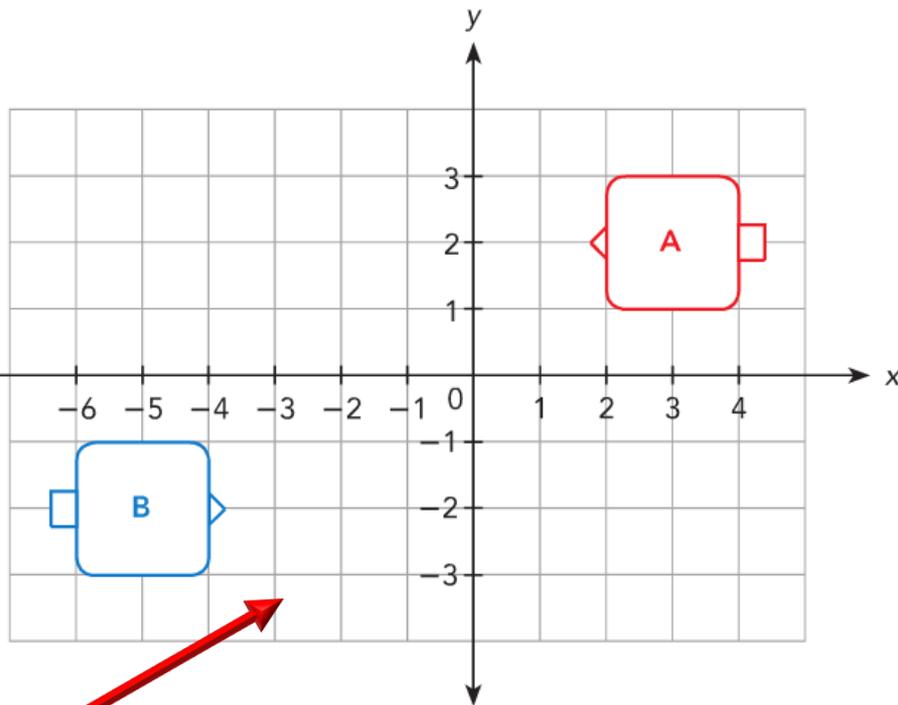
Student reaction is missing

No buy-in

Cheap "real-world" problem by adding in "real-world" objects

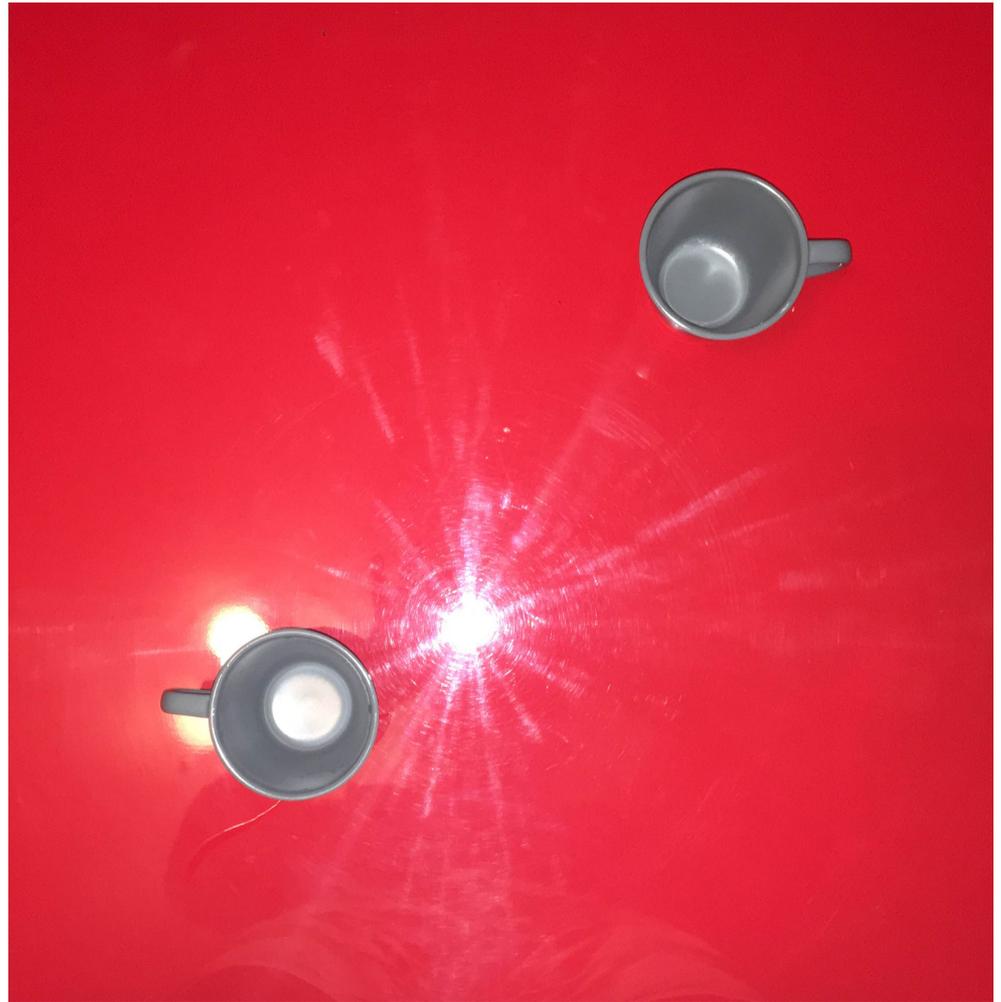
This is not real world and does not teach our students meaningful procedures.

Structure for solving the problem already set -- no curiosity



Grid lines provided, labeled, and shoved in students' faces. It has lost its "real-world" feel

Same question,
different
presentation



How could the slope $(-5/9)$ be changed to make the above zipline safer?

(4 responses)

$(-5/25)$

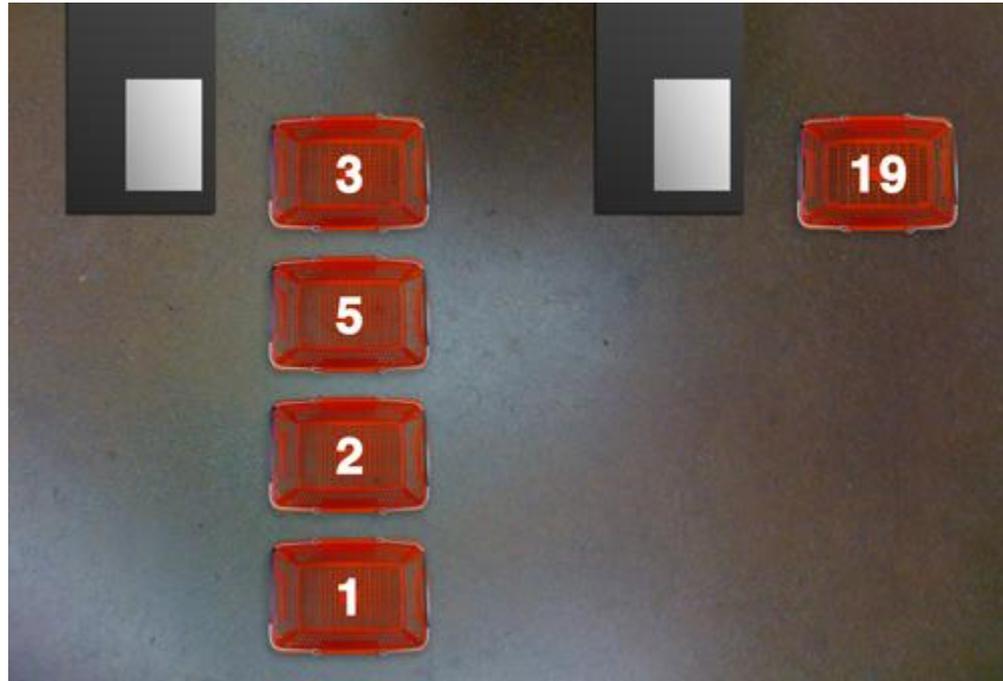
It should be $-9/36$

I think we can make it safer by pushing the zipline out to 19 feet so that it is much safer.

making it less steep

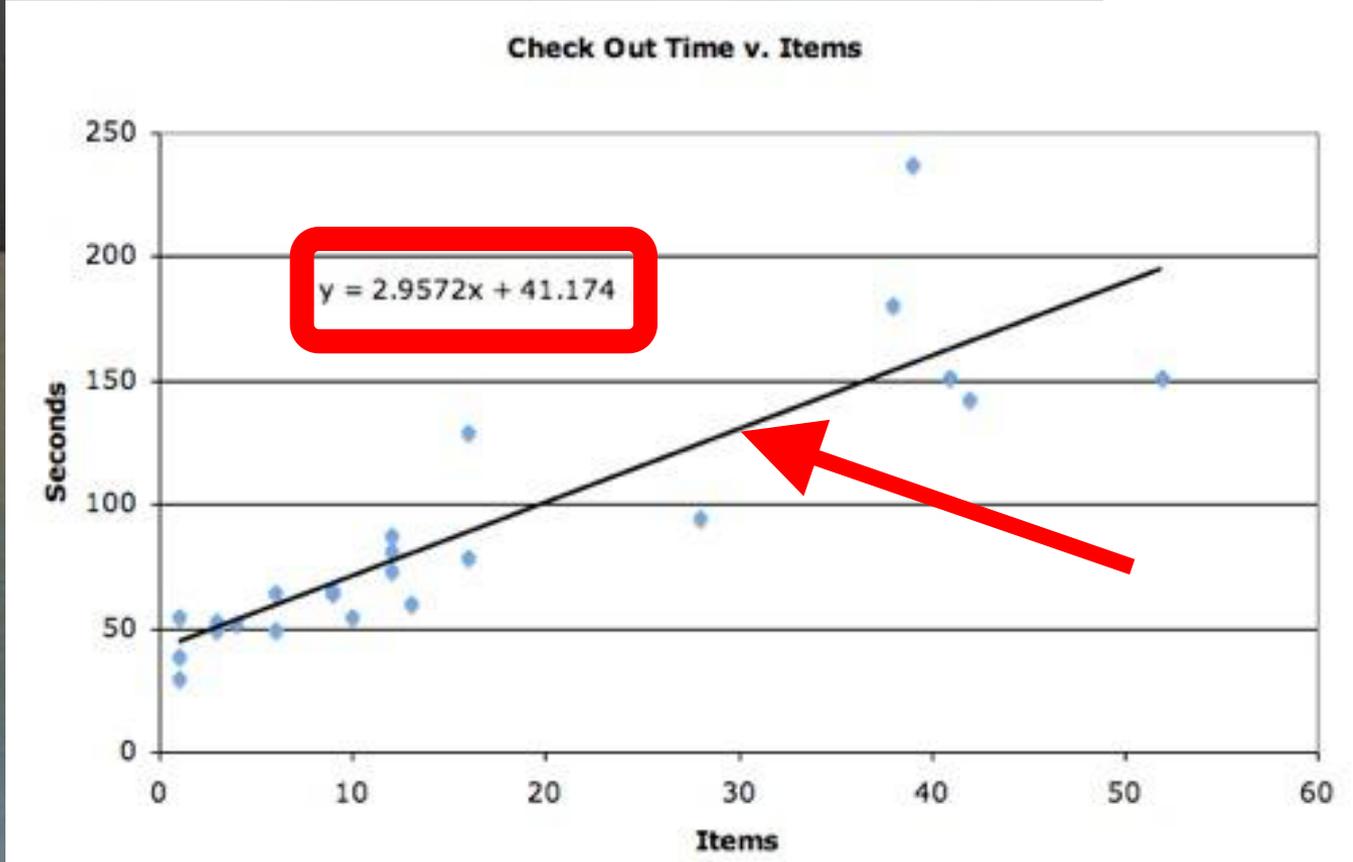
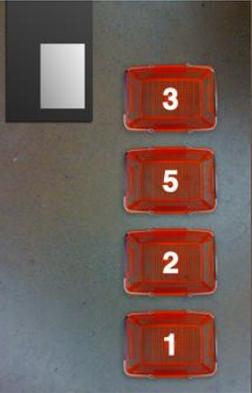


THREE ACT MATH EXAMPLE



All other things equal, which line is the fastest?

WE NEED MORE INFORMATION!



10 T

TV
14

CC

This program contains intense footage of
sharks and shark attacks.
Some of these images are graphic.
Viewer discretion is advised.

Formula D

Deadly Fac

(deadly at

ion Factor

ACT ONE

Introduce the central conflict of your story/task clearly, visually, viscerally, using as few words as possible.

With *Jaws* your first act looks something like this:



With a math problem it might look like this:



No words are necessary. You are immediately curious

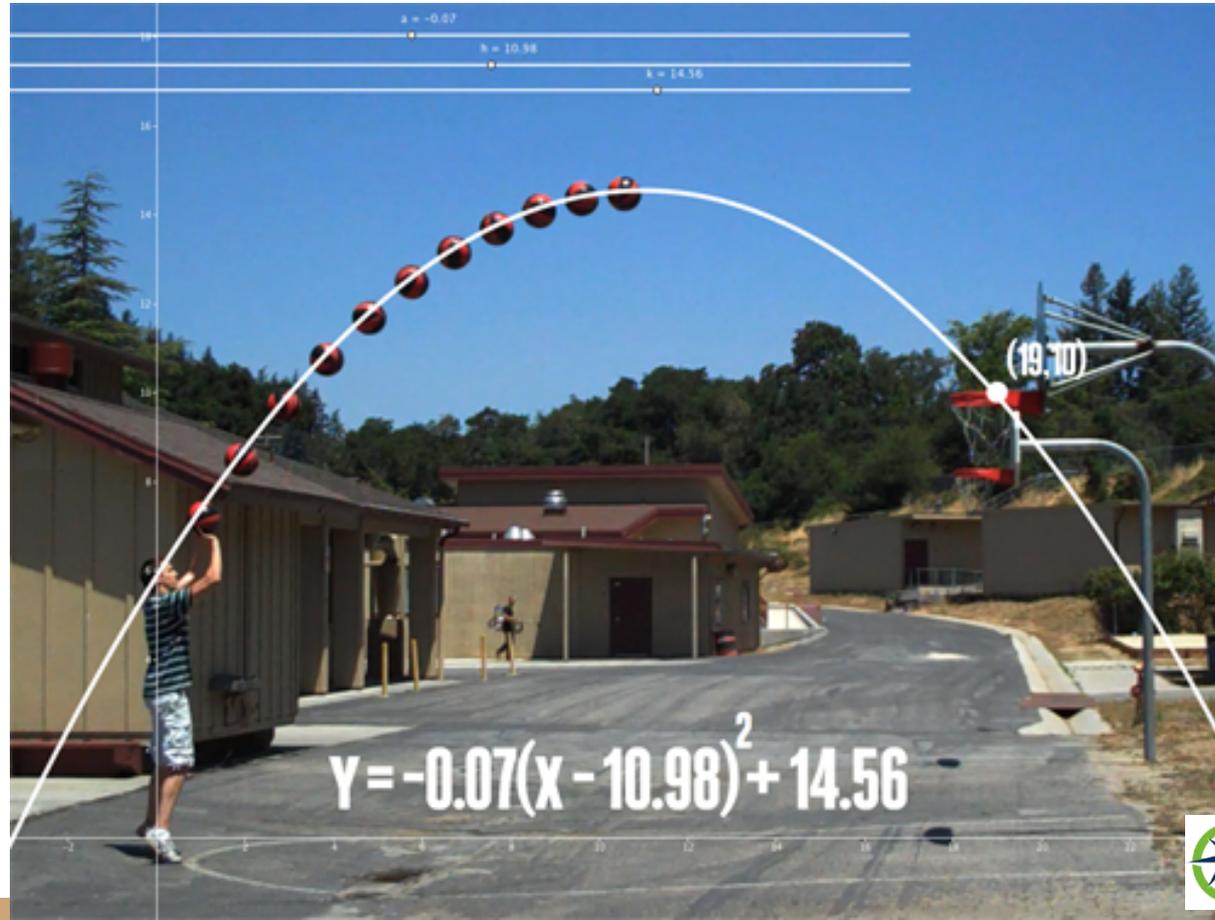
THE BEAUTY OF GUESSING

Guessing, estimating, or attempting to solve a problem has many benefits:

- “You don't know until you try before!”*
- 1) You start off right away -- you are involved in the problem with little to no repercussion
 - 2) Builds grit
 - 3) The more you do it, the more efficient you are

ACT TWO

The protagonist/student overcomes obstacles, looks for resources, and develops new tools.



ACT 3

Resolve the conflict and set up a sequel/extension.

meters per second.

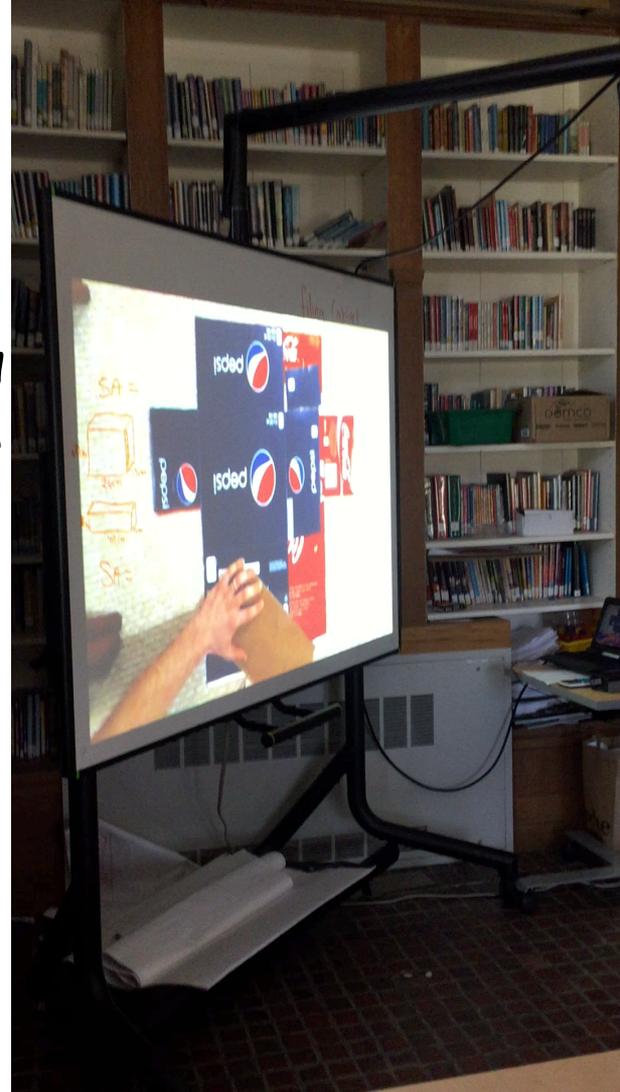
42. The ball goes in.

43. 12 meters



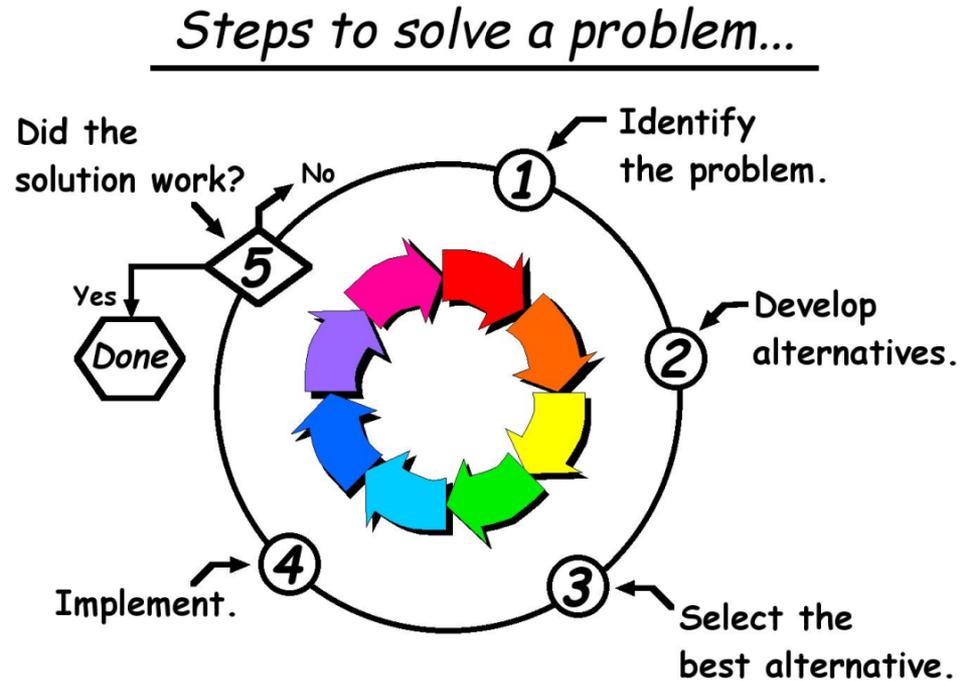


What can
invested,
contextualized
learning look
like when
finding an
answer?



Breakdown of tasks

- 1) Identify the question
- 2) Come up with a hypothesis and backed it with evidence
- 3) Everyone has or can have an opinion
- 4) Receive/find more information
- 5) Reevaluate the approach
- 6) Reach a solution



One HUGE benefit of Three Act problems

ESTIMATION

High/Low Estimates

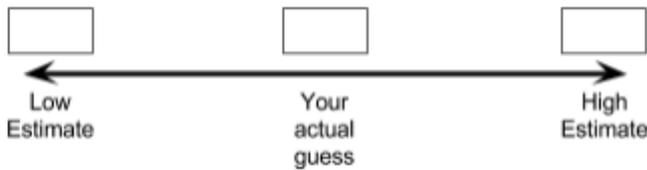
What is a reasonable answer?

Without this we have no basis to “check” our answer

How many mini starburst are in the cup?



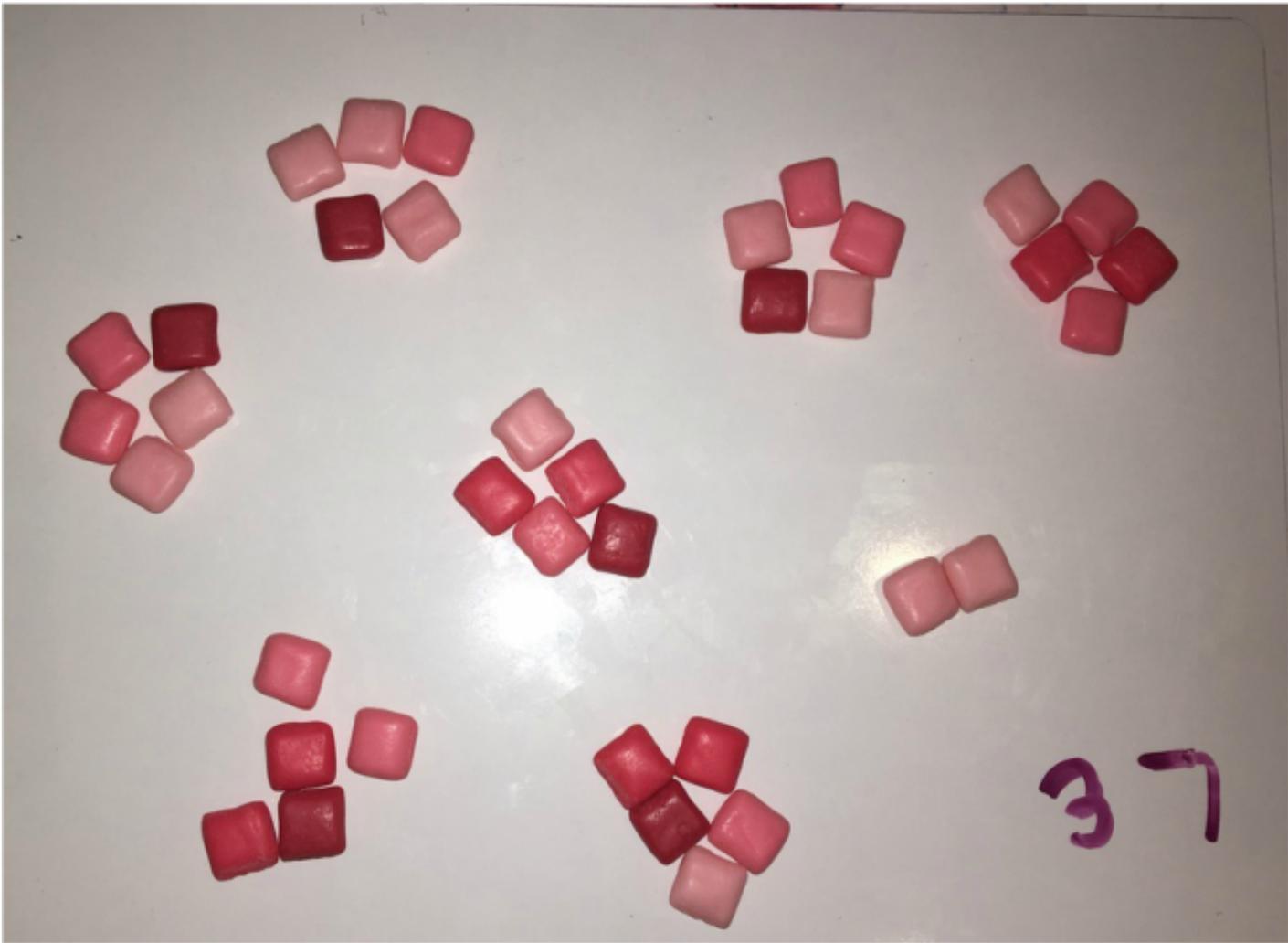
How did you figure
it out?

Description	Too Low ↓	My Estimate	Too High ↑	Reasoning	Actual	+/- Error
						

Never let students estimate without a reason

Give students a low entry point with high/low estimates

Make ALL students commit



Five misconceptions about the ways people learn

Dr. Sue Berryman names 5 common misconceptions about the ways people learn:

1. People ~~predictably transfer~~ learning ~~from~~ ~~one~~ ~~situation~~ ~~to~~ ~~situation~~. if they understand how and why to use procedures
2. Learners are ~~passive receivers~~ of information and ~~must be~~ ~~integrated~~ ~~in~~ ~~material~~ ~~knowledge~~ ~~is~~ ~~put~~ ~~to~~ ~~them~~, that they see a purpose in
3. Learning is ~~a process in which we become flexible in our approach in order to~~ the strengthening of bonds between stimuli and correct responses. solve problems or obstacles we encounter
4. ~~What matters is~~ ~~getting~~ ~~the~~ ~~right~~ ~~answers~~.
5. Skills and knowledge, to be transferable to new situations, should be acquired ~~independent of~~ ~~the~~ ~~table~~ ~~texts~~ of uses.

VISUAL PATTERNS

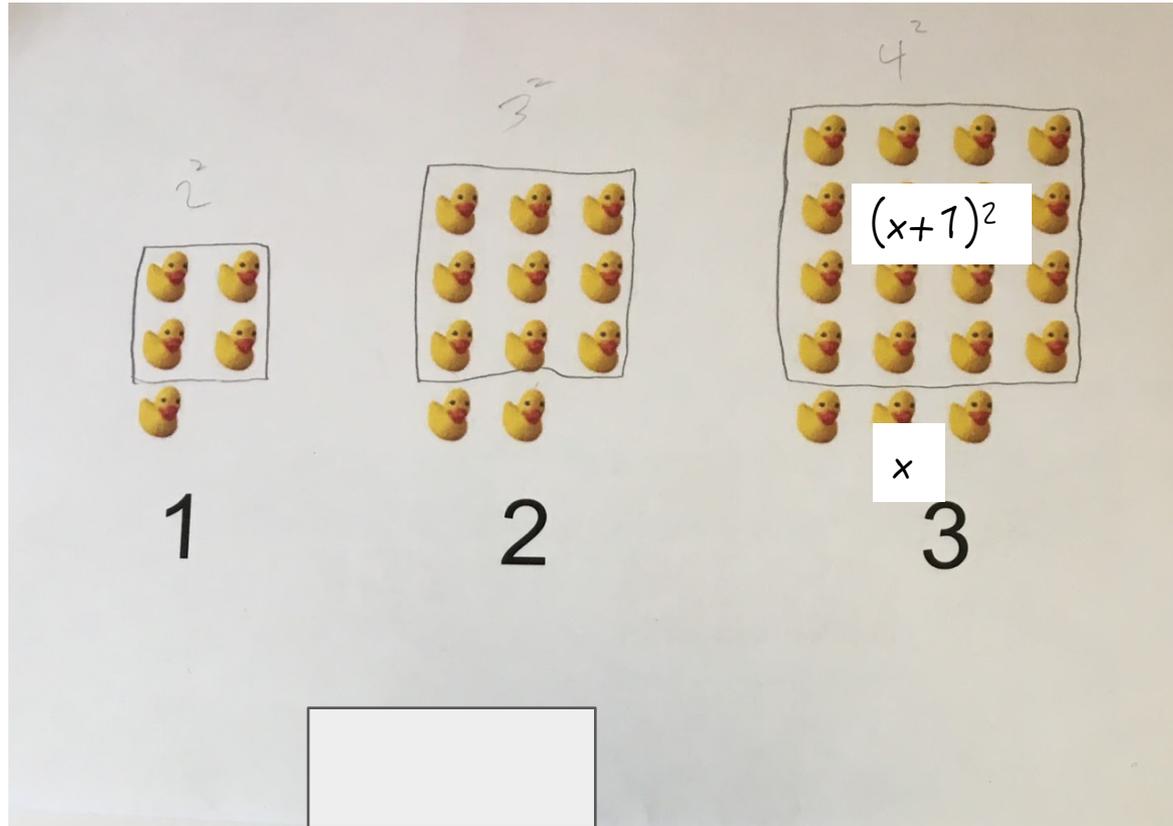
<http://www.visualpatterns.org/>



Pattern #147

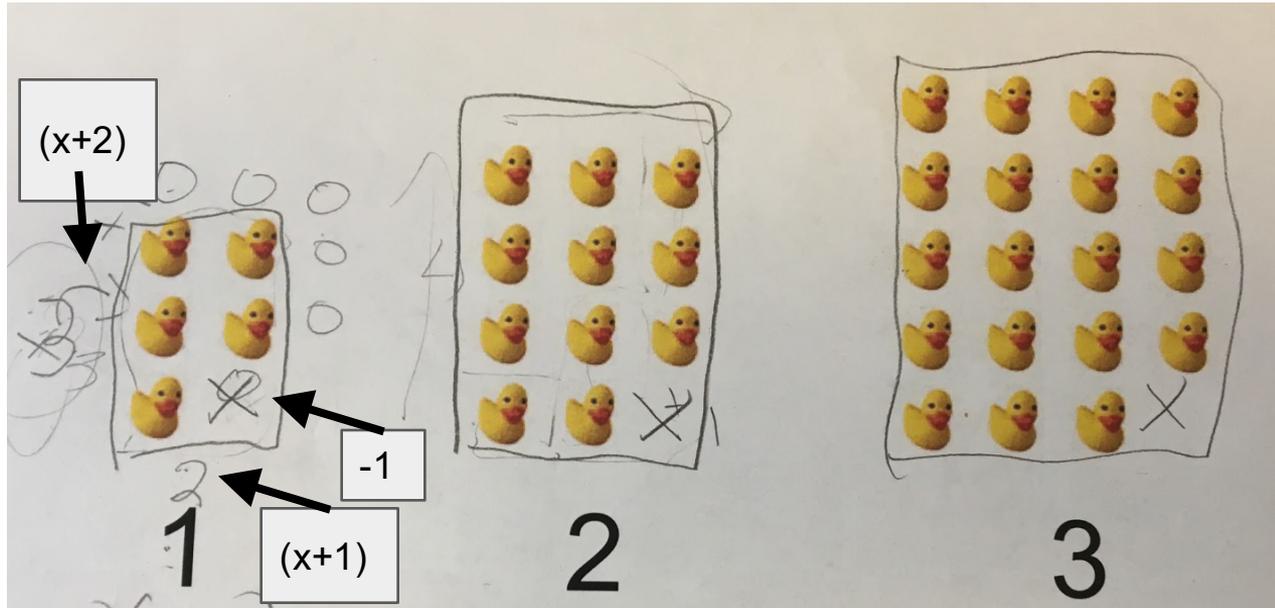
How my students saw it

<http://www.visualpatterns.org/>



How my students saw it

<http://www.visualpatterns.org/>



$$\text{Total} = (x+2)(x+1) - 1$$

How my students saw it

<http://www.visualpatterns.org/>

$(x+2)^2$

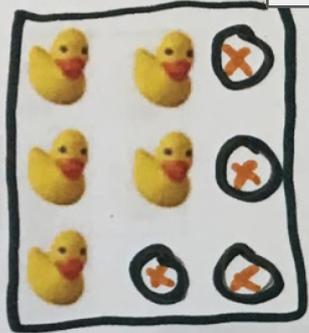
$3^2 - 4$

$x+3$

$2^2 - 3$

$4^2 - 5$

$5^2 - 6$



0

1

2

3

Total = $(x+2)(x+2) - (x+3)$

All the equations:

$$(x+1)^2 + x = x^2 + 2x + 1 + x = x^2 + 3x + 1$$

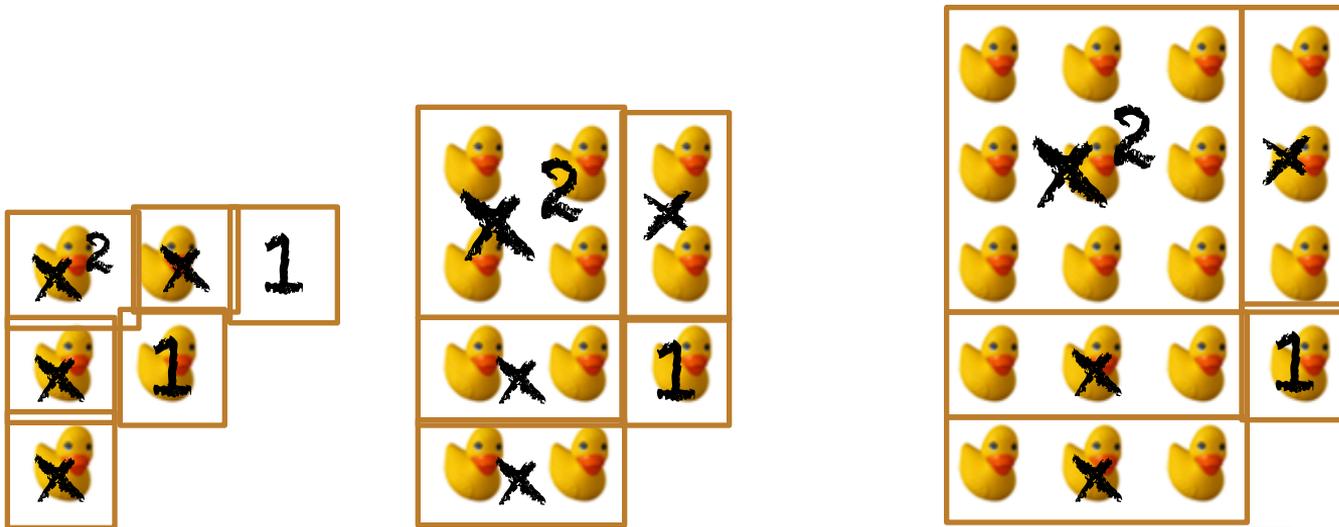
$$2(x+1) + x(x+1) - 1 = 2x + 2 + x^2 + x - 1 = x^2 + 3x + 1$$

$$(x+2)(x+1) - 1 = x^2 + 2x + 1x + 2 - 1 = x^2 + 3x + 1$$

$$(x+2)(x+2) - (x+3) = x^2 + 2x + 2x + 3 - x - 3 = x^2 + 3x + 1$$

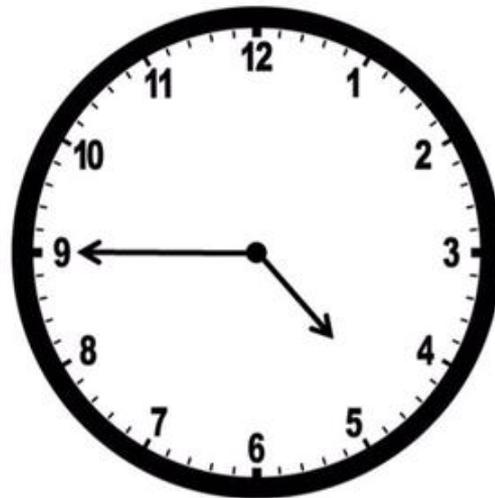
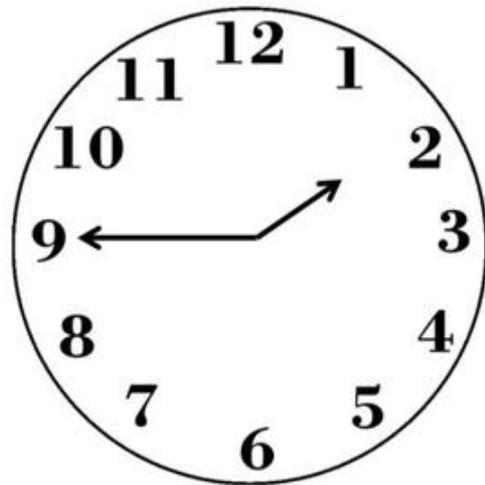
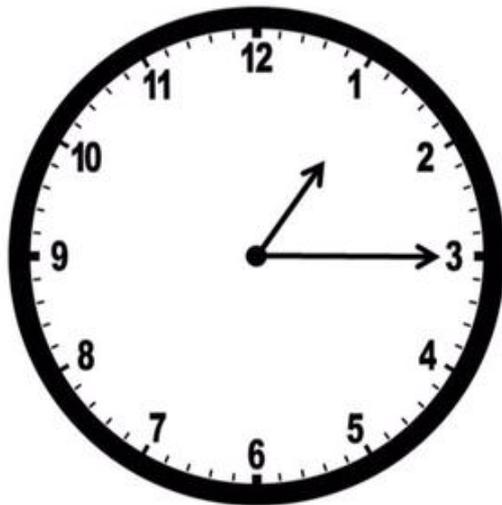
VISUAL PATTERNS

<http://www.visualpatterns.org/>



Pattern #147

$$x^2 + 3x + 1$$



WODB.ca

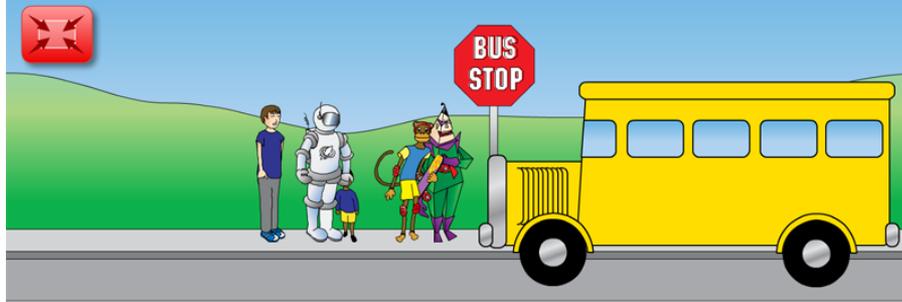
HORSE PROBLEM

$$\text{Horse} + \text{Horse} + \text{Horse} = 30$$

$$\text{Horse} + \text{Horseshoe} + \text{Horseshoe} = 18$$

$$\text{Horseshoe} - \text{Boots} = 2$$

$$\text{Boots} + \text{Horse} \times \text{Horseshoe} = ??$$



www.learningclip.co.uk

At the first bus stop 9 people got on the empty bus.

At the second bus stop 1 more person got on the bus.

At the third bus stop 5 people got off the bus.

How many people are on the bus now ?

“ In doing so the elegance of school-taught algorithms may come to be appreciated as well as their underlying structure-why they work and how they may work... [we] must encourage connections between the mathematics of the classroom and the mathematics of the real world, and in forging these connections make the usefulness of both transferable” - Jo Boaler

The eight Standards for Mathematical Practice are:

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.

 Kyle Pearce Retweeted



Suzanne Lustenhouwer @MsLuss · 4h

"Fail faster. If everything goes perfectly you learn nothing" #ade2016



Benefit of Struggling with Contextualized Problems

Pre-Intervention Annual National Test Time

During and Post Annual National Test Time

30 minutes	→	80.75 minutes
8.5 minutes	→	26 minutes
14.8 minutes	→	24.5 minutes
15.125 minutes	→	29 minutes
13.6 minutes	→	26.88 minutes
19.4 minutes	→	25.25 minutes
15.8 minutes	→	24.64 minutes
29 minutes	→	53.25 minutes
11.8 minutes	→	20.75 minutes

**“IF A CHILD CAN'T LEARN THE WAY
WE TEACH, MAYBE WE SHOULD
TEACH THE WAY THEY LEARN.”**

- IGNACIO ESTRADA

"Children with dyslexia tend to look at the world differently. Isn't the world lucky they do?"

Word of advice



Resources and ways to reach me

LINK TO PRESENTATION SLIDES and RESOURCES shown:

<http://msmaths.weebly.com/PBIDA2016.html>

<http://www.wodb.ca>

<http://www.wouldyourathermath.com>

<http://www.estimation180.com>

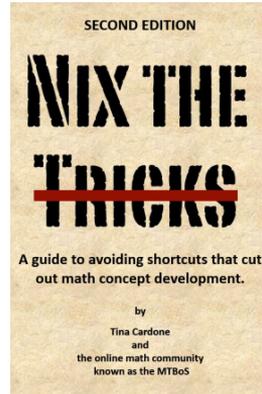
<http://robertkaplinsky.com/why-depth-of-knowledge-is-critical-to-implement/>

<http://www.101qs.com>

<http://www.nixthetricks.com>

<http://www.youcubed.org>

<http://www.twitter.com> - get on twitter, find your math PD!



jmcaleer@carrollschool.org



[jennifuhs4](#)



<http://msmaths.weebly.com>

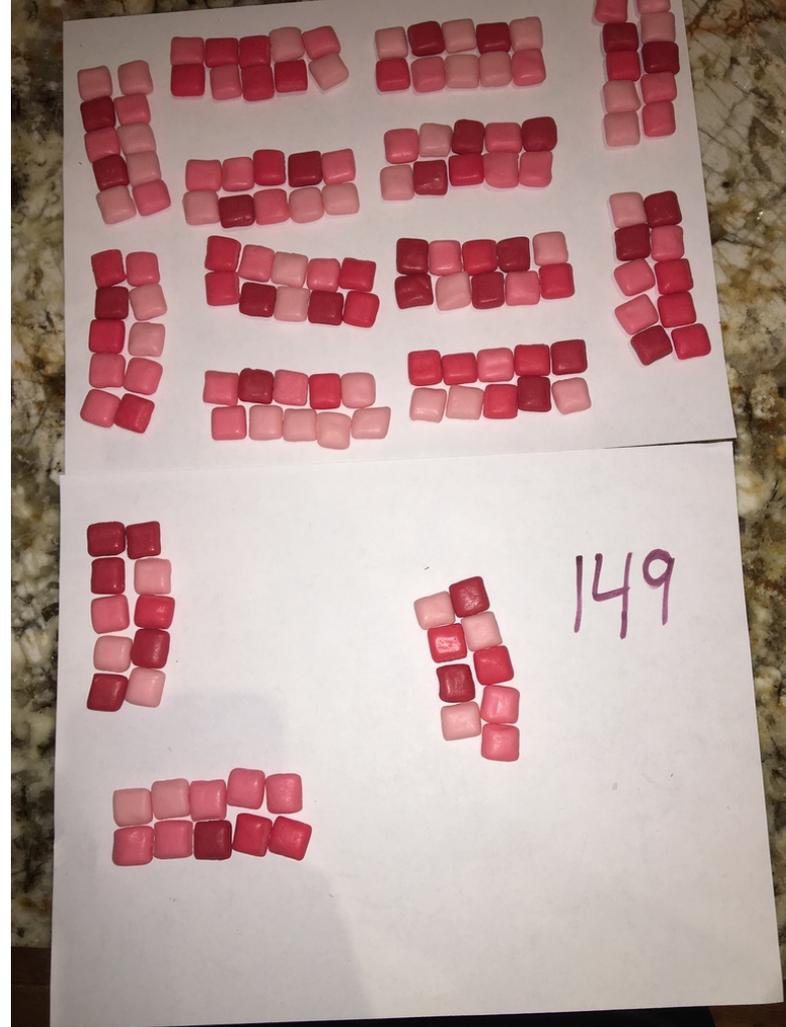
Extensions of estimating

Remember there were
30-37 starburst minis
in the $\frac{1}{4}$ cup. How
many are in the bag?



Extensions of estimating

Are you surprised?



Extensions of estimating

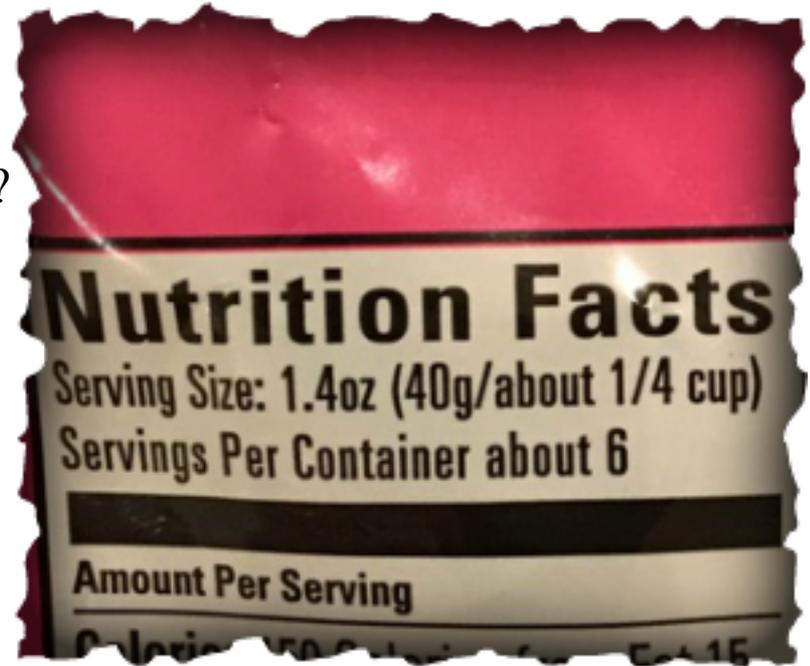
Ok... now the nutrition label... Are you surprised now?

What do you notice? What do you wonder?

Is the difference a lot or a little? What is the percentage of error?

How many would be per serving if there truly are 6 servings???

If you paid \$3.09... were you ripped off? By how much?



R u mad, bro? (math)

MENU ☰



ALWAYS QUESTION THE MAN

...even though he's not always out to get you

This site is dedicated to creating problems that require students to estimate, calculate, and finally interpret the results of REAL life products and company promotions with the overarching question, "r u mad, bro?" These problems are aimed to get kids to question the information they are given and see if it matches up to reality. Ever have a bag of chips that didn't seem like there were as many chip pieces as advertised on the nutrition label? How far off is it from what you expected? Is it enough to incite rage inside you because you were ripped off? That's what we are doing here... GET MAD!

DISCLAIMER: This site is in no way suggesting that companies are *cheating* customers out of deals and products. It is intended as a joyful math activity to encourage students to question deals, sales, and "approximations" that companies give. We are not responsible for any angry students whom may or may not feel compelled to write said companies a letter to express their concern.

