EMPOWERED PROBLEM SOLVING

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GOALS

- ❑ ENGAGING PROBLEM SOLVING
- ❑ REAL WORLD PROBLEM-BASED LEARNING
- ❑ HIGHER DEPTH OF KNOWLEDGE PROBLEMS
- ❑ BETTER IMPLEMENTATION
- ❑ IMPROVE QUESTION ASKING
- ❑ PRACTICE PREPARING FOR A LESSON
- ❑ DEAL WITH UNCOMFORTABLE SITUATIONS

DOUBLE-DOUBLE® *Double Meat & Double Cheese* 2.65

CHEESEBURGER 1.75

HAMBURGER 1.50

FRENCH FRIES 1.05

SHAKES *Chocolate Strawberry Vanilla* 1.55

SM	MED	LG	X-LG
99	1.10	1.29	1.49

COKE *Classic or Diet*
SEVEN-UP
ROOT BEER
DR PEPPER
LEMONADE
ICED TEA

MILK 70
COFFEE 70

IN-N-OUT BURGER

OPEN 10:30 a.m. to 1:00 a.m.
.....Fri. and Sat. until 1:30 a.m.

2004-10-31

8:21 PM

YOUR GUEST NUMBER IS
98

IN-N-OUT BURGER LAS VEGAS EASTERN
2004-10-31 8:21 PM

165 1 5 98

Cashier: SAM
GUEST #: 98

Counter-Eat In

Dbl Dbl	
98 Meat Pty XChz	2.65
	88.20
Counter-Eat In	90.85
TAX 7.50%	6.81
Amount Due	97.66
CASH TENDER	$97.66
Change	$.00

2004-10-31

Cashier: SAM
GUEST #: 98

Counter-Eat In

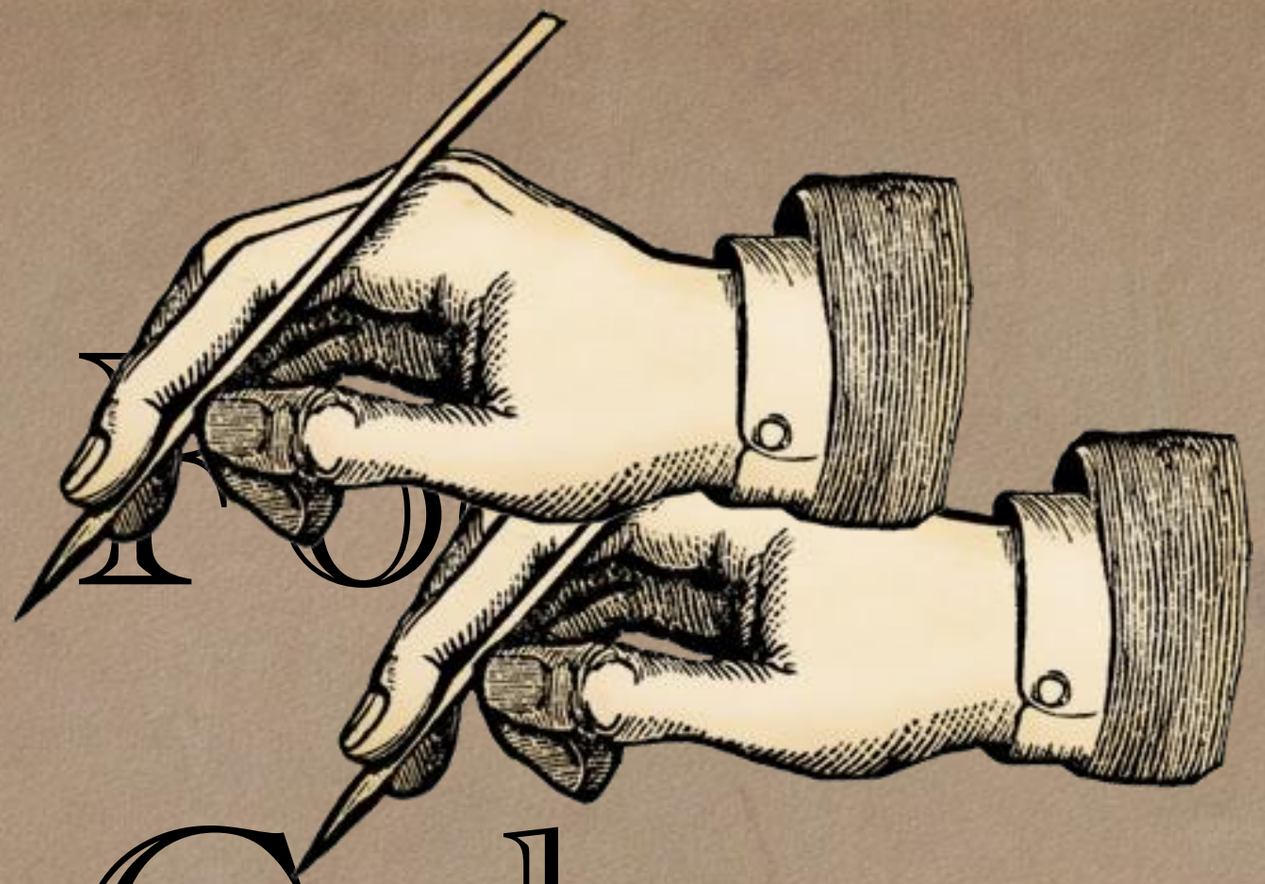
Db1Db1	
98 Meat Pty XChz	2.65
	88.20
Counter-Eat In	
TAX 7.50%	90.85
Amount Due	6.81
	97.66
CASH TENDER	
Change	$97.66
	$.00

2004-10-31

6:21 PM

	Serving Size (g)	Calories
Hamburger w/Onion	243	390
Cheeseburger w/Onion	268	480
Double-Double w/Onion	330	670

- Focus
- Coherence
- Rigor

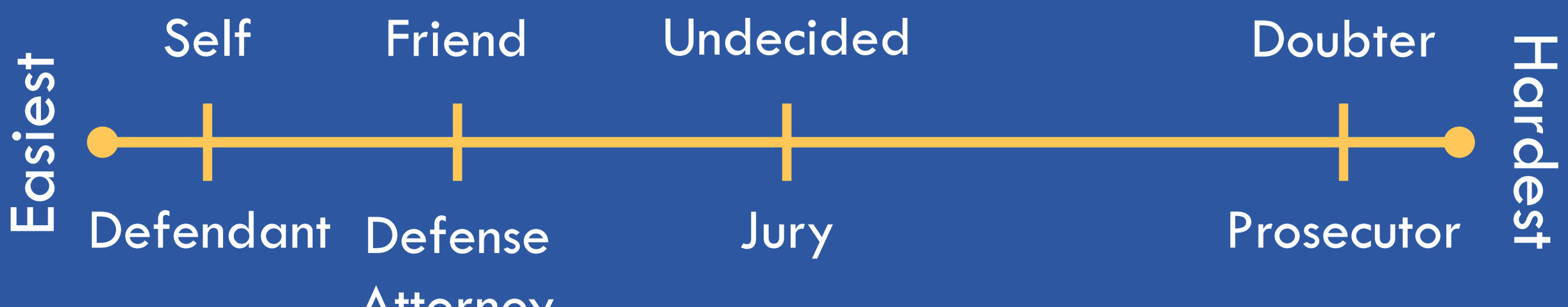


Layers	Cost
1	$1.75
2	$2.65
3	$3.55
4	$4.45
.	.
.	.
20	$18.85
.	.
.	.
100	$90.85
.	.
.	.
N	$1.75 + (N-1)*$0.90

MATH PRACTICES

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.

LEVELS OF CONVINCING



Construct a viable argument

Critique the reasoning of others

Inspired by *Thinking Mathematically* by J. Mason, L. Burton, and K. Stacey

MATH PRACTICES

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.

bun + produce + meat + cheese + meat + cheese = $2.65

bun + produce + meat + cheese = $1.75

meat + cheese = $0.90

MATH PRACTICES

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 REALITY

- Students struggled to find a layer's cost.
- Common wrong answers included:
  - $175.00 ($1.75 x 100 cheeseburgers)
  - $132.50 ($2.65 x 50 Double-Doubles)
- Some classes were not ready for a 100x100.
- There were equations with more than N patties.
- Students were surprised to see many correct equations.

STUDENT WORK

What problem are you trying to figure out?

How much does a 100x100 burger cost?

What do you already know from the problem?	What do you need to know to solve the problem?
• theres 100 beef patties	• How much does a regular cheeseburger cost.

What is your conclusion?

To get the answer, I first figured out what the price of a regular & double-double cheeseburgers are. From there I subtracted the price of the produce & buns, then multiplyed by 100. That gave me the answer, which I once again had to add the price of the buns & produce.

What is your conclusion?

The only difference between a double double and a cheeseburger is one patty and one slice of cheese. So you subtract the prices of the two to find the price of only one patty & cheese. You then use that number (.90) & subtract it from the cost of one whole cheeseburger to find the price of all the extra stuff. Multiply by 100

What is your conclusion?

A 100×100 at In-n-Out cost $90.85. To solve that, you start by subtracting the price of a cheeseburger from a double double. The answer (.90) is the price of a patty and cheese slice. You multiply (.90) by one less patty than what you want. (x-1), and you add the price of a cheeseburger (1.75). You end up with the eq. [$y = .90(x-1)+1.75$.]. For the 100×100, you plug in 100 to the (x) and you end up with $90.85.

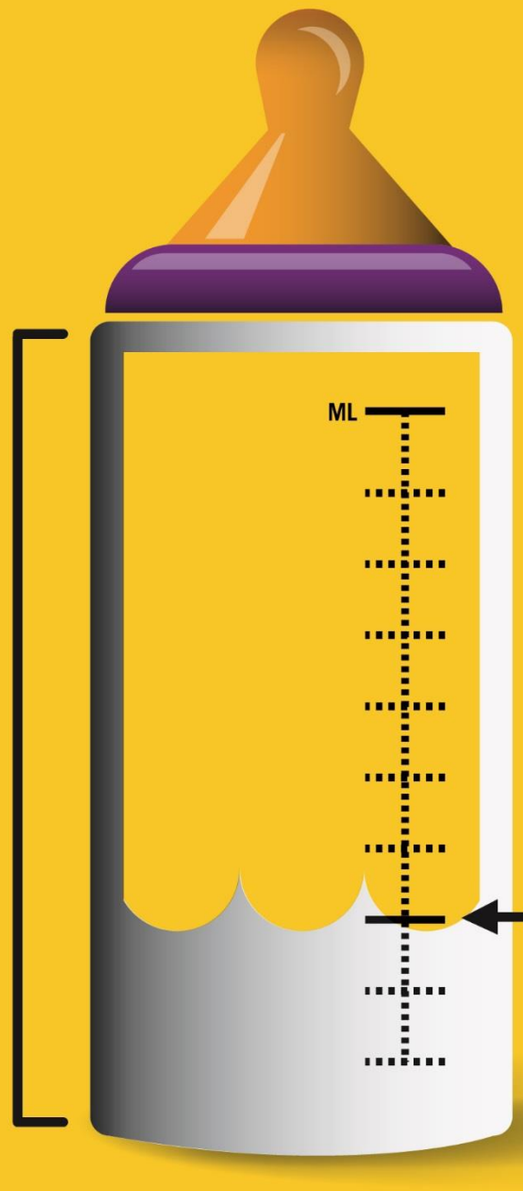
$$\left[\begin{array}{l} y = .90(100-1)+1.75 \\ y = 89.10+1.75 \\ y = 90.85 \end{array}\right]$$

What is your conclusion?

Figure the price difference from the Double-Double with a cheeseburger. Then find out the prize for the produce and cheese-beef. get total into $90.85

CHOOSE CAR SEAT:
BY AGE & SIZE

THE NUMBER OF PEOPLE **WHO THINK** THEY HAVE THEIR CHILD IN THE RIGHT SEAT.



THE ONES **WHO ACTUALLY DO.**

KNOW FOR SURE

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.

VISIT SAFERCAR.GOV/THERIGHTSEAT

Ad Council

NHTSA www.nhtsa.gov

Child Car Safety

CHOOSE CAR SEAT:
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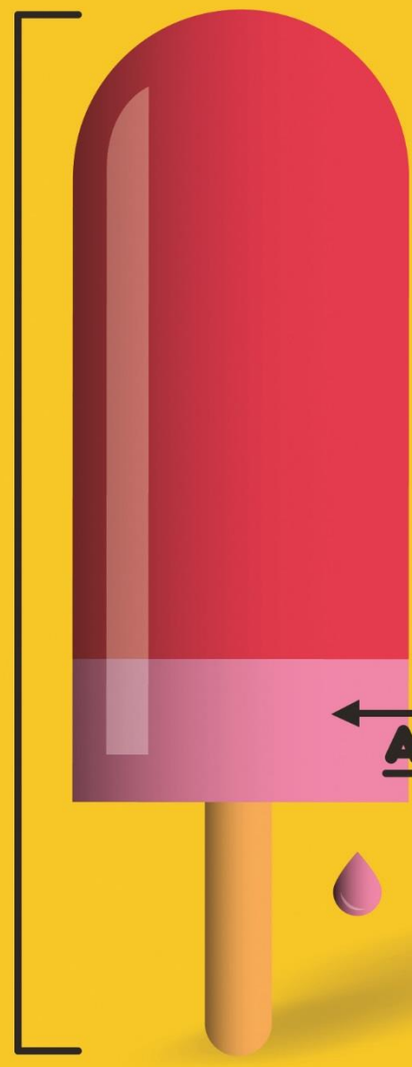

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Child Car Safety

There are 125 sheep and 5 dogs in a flock. How old is the shepherd?

32 STUDENTS

- 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 ÷ 5)
- 0 students calculated the answer to be 625 (125 x 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?

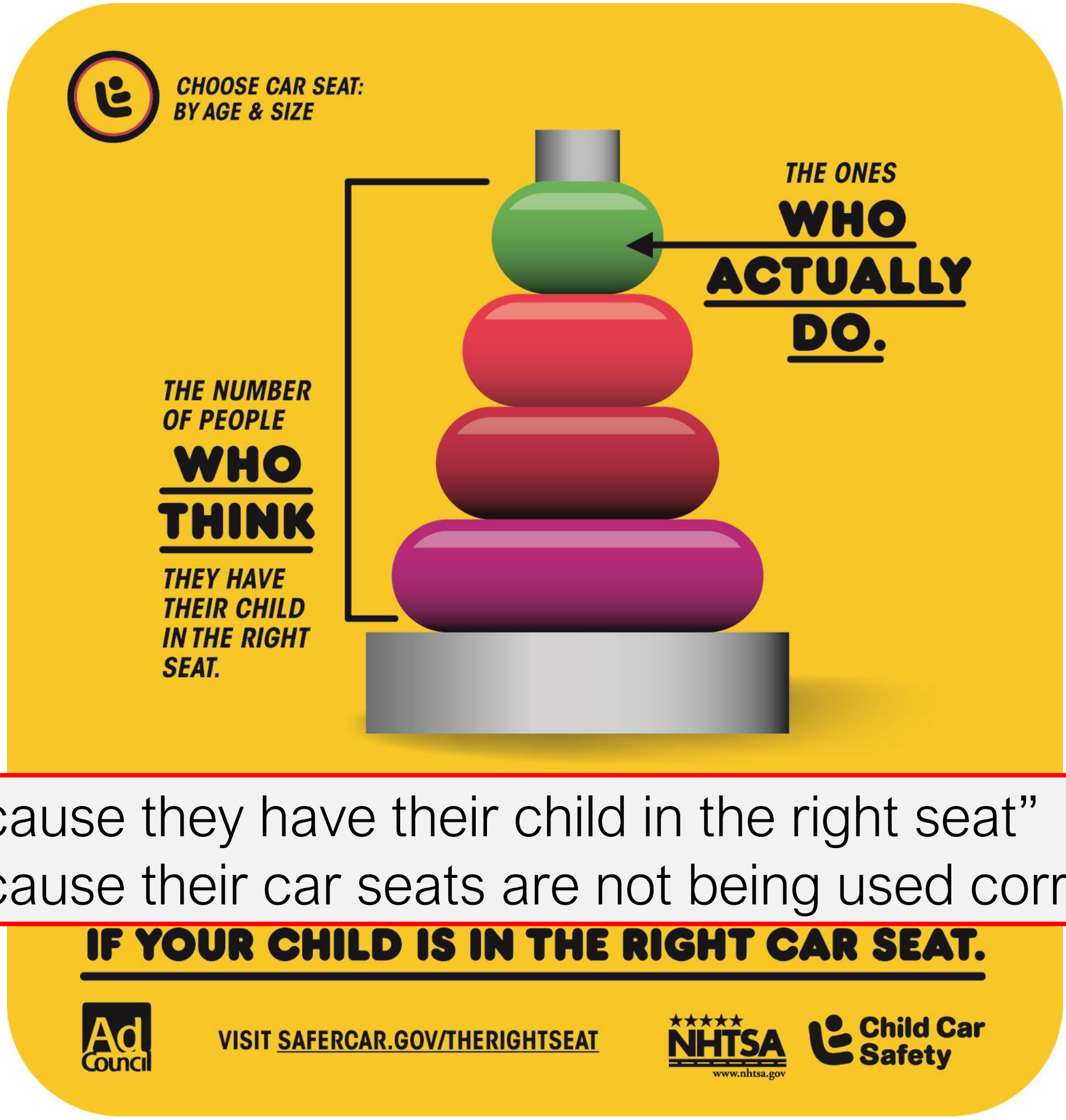
Key Statistics and Consumer Insights:

- 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.

be reduced by about half if the correct child safety seats were always used.

[1] Source: Based on the latest mortality data currently available from the CDC's National Center for Health Statistics.

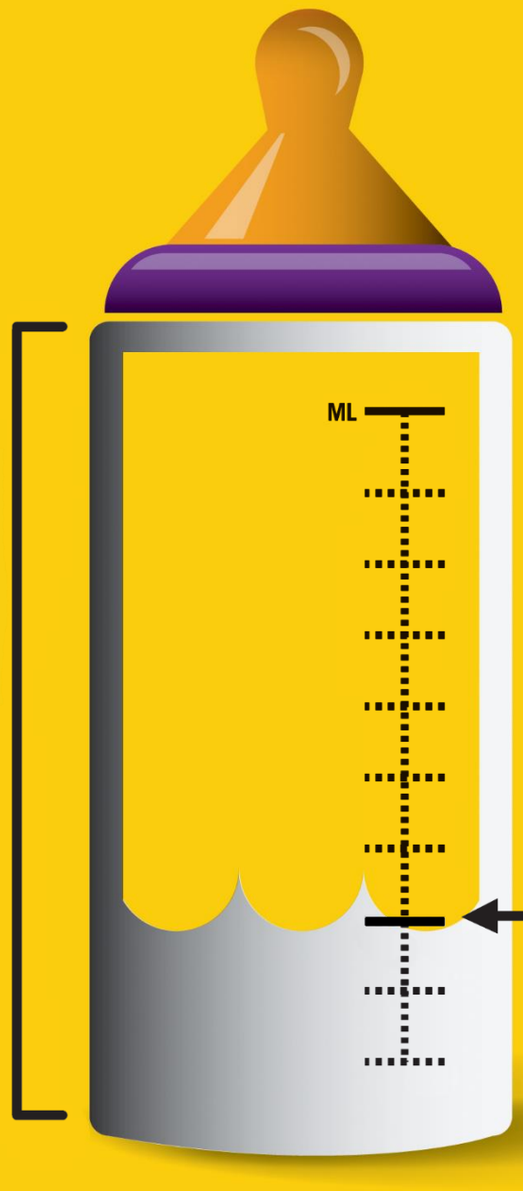


- “because they have their child in the right seat”
- “because their car seats are not being used correctly”

CHOOSE CAR SEAT:
BY AGE & SIZE

THE NUMBER OF PEOPLE **WHO THINK**

THEIR CAR SEATS ARE BEING USED CORRECTLY.



THE ONES **WHO ACTUALLY DO.**

KNOW FOR SURE

IF YOUR CHILD IS IN THE RIGHT CAR SEAT.

VISIT SAFERCAR.GOV/THERIGHTSEAT

Ad Council

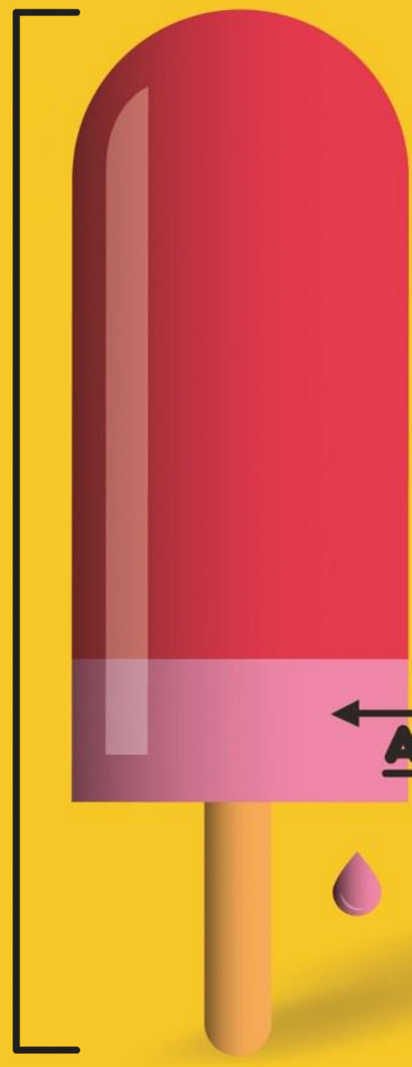
NHTSA www.nhtsa.gov

Child Car Safety

CHOOSE CAR SEAT:
BY AGE & SIZE

THE NUMBER OF PEOPLE **WHO THINK**

THEY HAVE THEIR CHILD IN THE RIGHT SEAT.



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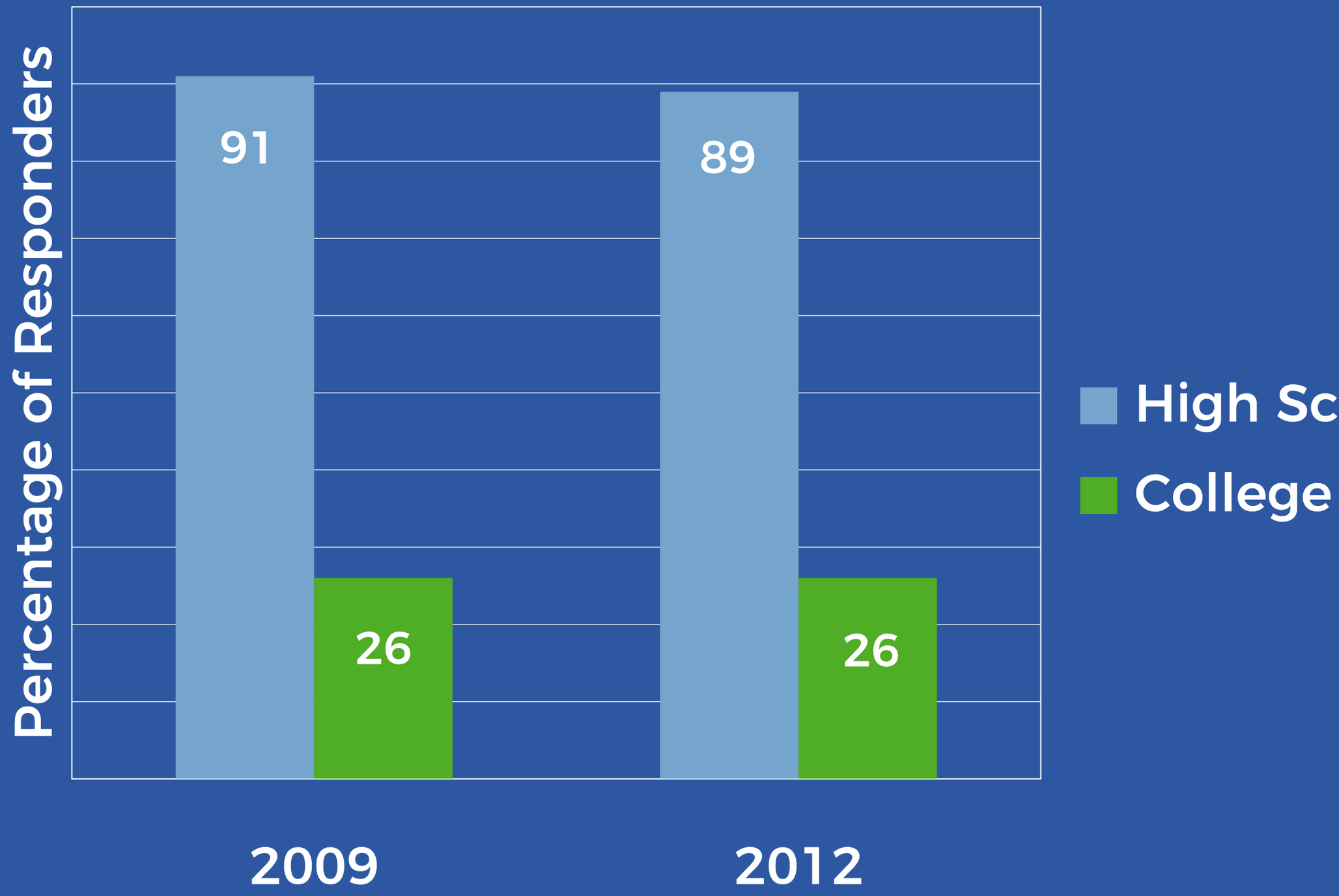
Ad Council

NHTSA www.nhtsa.gov

Child Car Safety

PURPOSE OF K-12 ED?

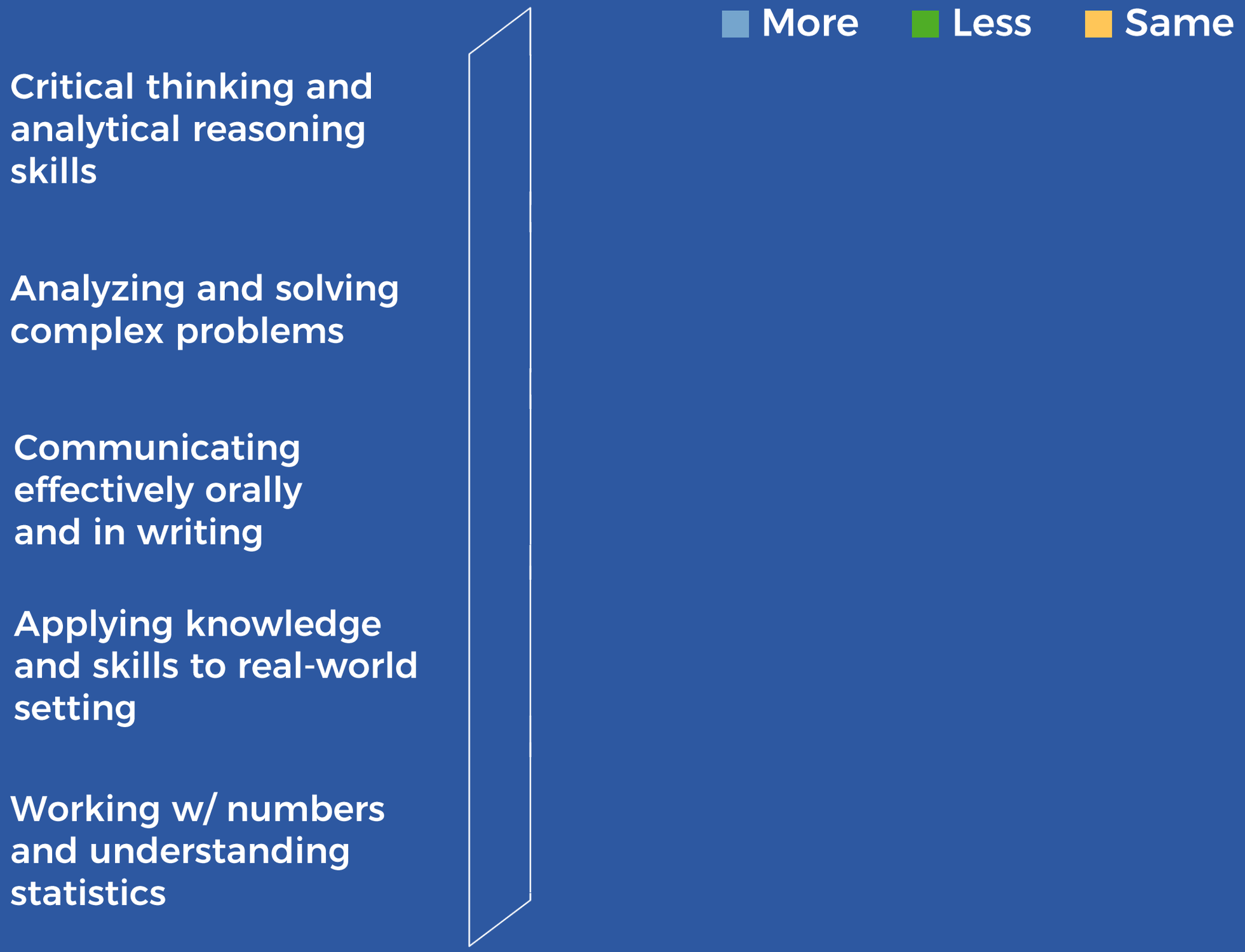
- College readiness
  - ACT National Curriculum Survey
  - Surveyed 9,937 educators
    - What percent of students are “very well” or “well” prepared for college?



Source: act.org/research/policymakers/pdf/NCS-PolicySummary2012.pdf

PURPOSE OF K-12 ED?

- College readiness
- Career readiness
  - Association of American Colleges and Universities survey
  - Surveyed over 300 employers with at least 25 employees and many new hires



Source: aacu.org/leap/documents/2013_EmployerSurvey.pdf


ALTO

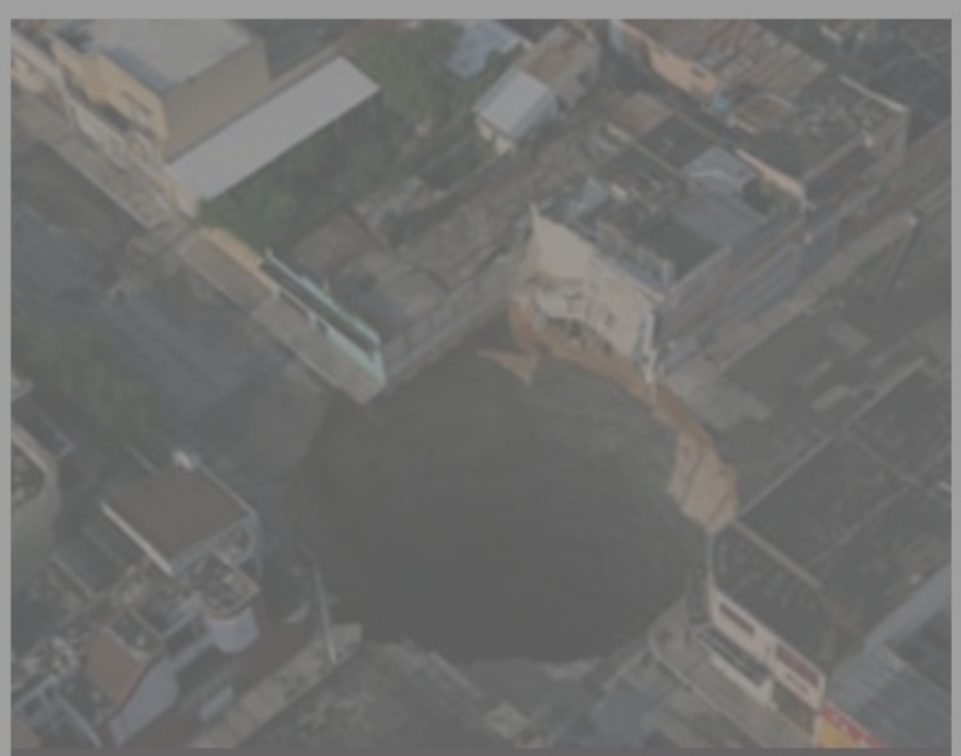
SINKHOLE DIMENSIONS

- Slate Magazine
  - “A sinkhole, 65 feet across and 100 feet deep”

How To Fix a Giant Sinkhole

The cement method vs. the graded-filter technique.

By Brian Palmer



A sinkhole in Guatamala

It's not clear whether cement is the best option, however. A 6,500-cubic-foot wad of concrete may serve to concentrate water runoff in other areas, leading to more sinkholes. Many engineers prefer the **graded-filter technique**, in which the hole is filled with a layer of boulders, then a layer of smaller rocks, and, finally, a layer of gravel. This fills the hole, more or less, while permitting water to drain through the area.

2010 Guatemalan Sinkhole - Google Chrome

Reply Reply All Forward

2010 Guatemalan Sinkhole

Kaplinsky, Robert

To: [redacted]

Wednesday, February 06, 2013 1:39 PM

Hi Brian,

I am using your "How to Fix a Giant Sinkhole" article for a math lesson on volume of a cylinder. I have one question for you. You mentioned.

> "It's not clear whether cement is the best option, however. A 6,500-cubic-foot wad of concrete may serve to concentrate water runoff in other areas, leading to more sinkholes."

Can you please tell me where you got 6500 cubic feet from? Did you do 65 x 100? We get something closer to 342,000 cubic feet.

Thanks,
Robert

Re: 2010 Guatemalan Sinkhole - Google Chrome

Reply Reply All Forward

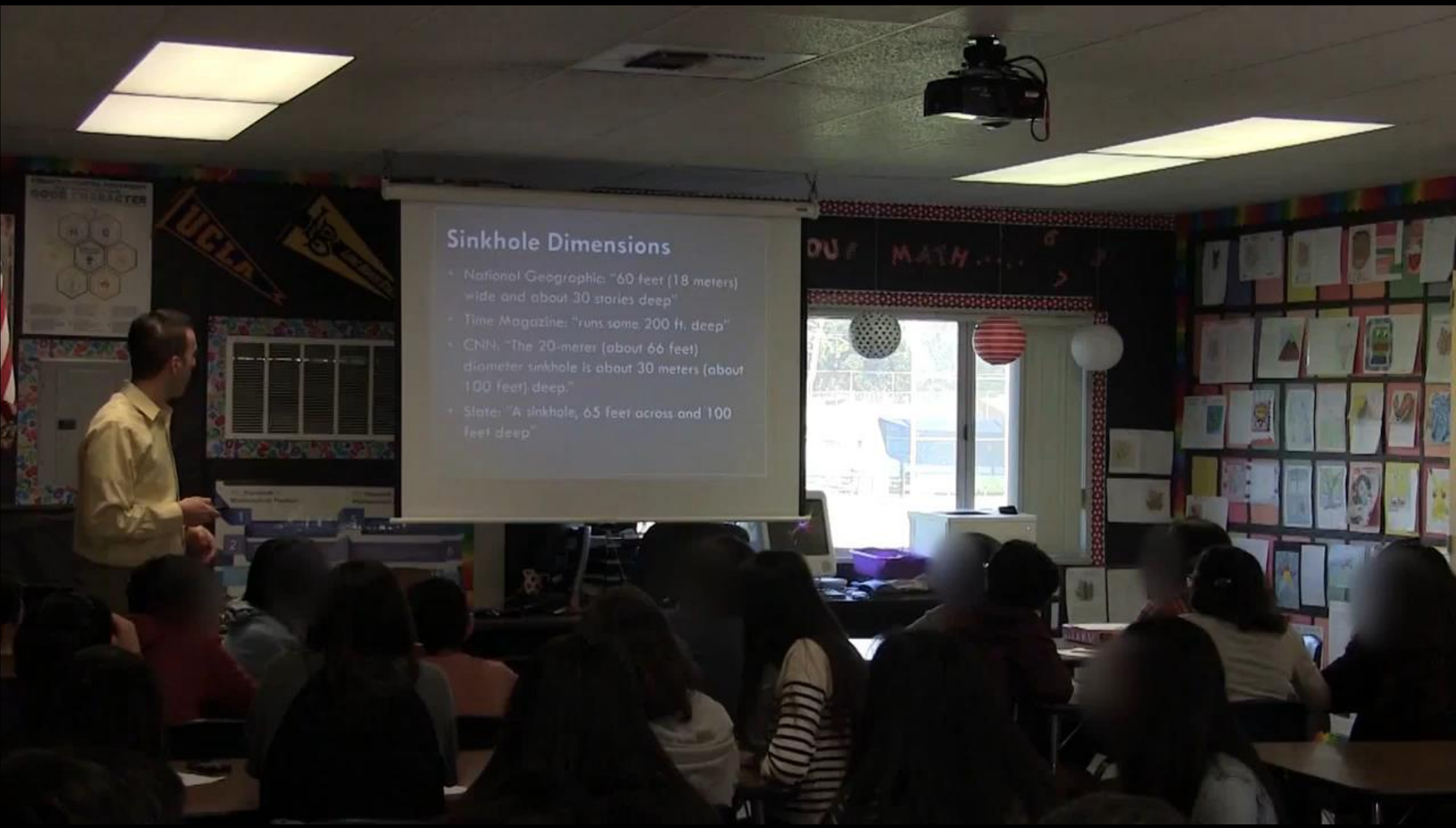
Re: 2010 Guatemalan Sinkhole

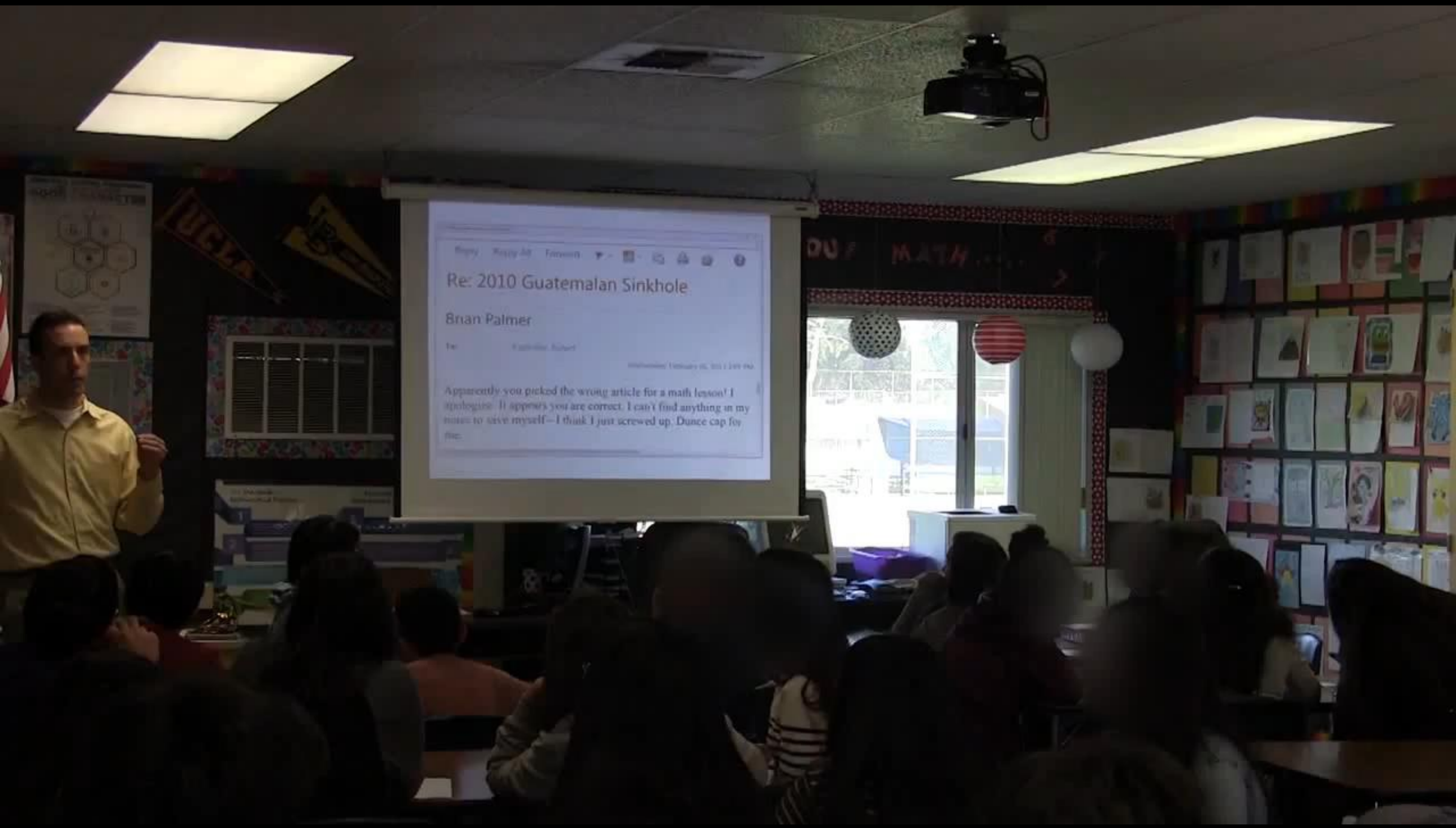
Brian Palmer

To: Kaplinsky, Robert

Wednesday, February 06, 2013 2:01 PM

Apparently you picked the wrong article for a math lesson! I apologize. It appears you are correct. I can't find anything in my notes to save myself-- I think I just screwed up. Dunce cap for me.


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"


Re: 2010 Guatemalan Sinkhole
Brian Palmer
Apparently you picked the wrong article for a math lesson! I apologize. It appears you are correct. I can't find anything in my notes to save myself—I think I just screwed up. Dunce cap for me.

STUDENT REFLECTIONS

- “I didn’t say his answer was wrong since he is supposed to know more than an average 8th grader.”
- “Even though Brian was wrong, no one corrected him, because of fear of being wrong and lack of confidence in ourselves.”

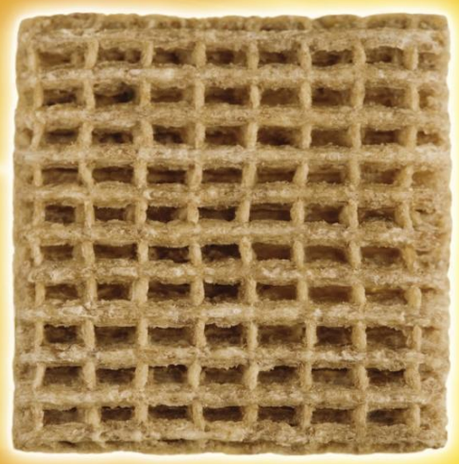
STUDENT REFLECTIONS

- “I didn’t say anything when we were shown the ‘right’ answer because I thought that it must be right because he’s the author, but I knew in my mind he was actually wrong.”
- “I think that I should be the one who argues for my opinion, not just listening to others and accepting that my answer is wrong all the time.”

NEW

Diamond Shreddies

Cereal



OLD
(Boring)

NEW
(Exciting!)


Shreddies
SQUARE OR DIAMOND?
Vote for your Favourite at DiamondShreddies.com
Post
Diamond
Shreddies
Combo Pack
ENLARGED TO SHOW TEXTURE
Square
Diamond
Made with 100% Whole Grain Wheat
620 g Cereal
SERVING SUGGESTION
COR 114
Limited Edition
Sensible Solution
• Very High Source of Fibre
• Good Source of 8 Essential Nutrients
• Low in Fat

“Kraft Foods saw an immediate 18% increase in baseline sales of Shreddies within the first month alone, and for months thereafter.”

Source: http://www.visualtargeting.com/diamondshreddies.html

Complicated or Complex?


Cookie Monster Cupcakes


Nailed it

method

1. Using an electric mixer, whip the butter until it is pale. This will take at least 5 minutes on high.
2. Gradually add in the icing mixture and vanilla until well combined.
3. With the mixer running, add in food colouring until you get to the Cookie Monster colour. This may be a lot if you are using liquid food colouring or a little if using gel food colouring.
4. Add in the milk and mix until the frosting puffs up.
5. Fill a piping bag with a fluted nozzle and pipe on icing.
6. With the writing icing, place black spots on the marshmallows for pupils.
7. Place on each cupcake.
8. Cut cookies in half and place in 'mouth'.

CUBES

A problem solving strategy

C - circle the #s

U - underline the ques.

B - box the words

http://www.teachingwithsimplicity.com/math-anchor-charts

Content Objective Example

- SWBAT apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. (MP4)

Language Objective Example

- SWBAT explain correspondences between equations, verbal descriptions, tables, and graphs. (MP1)

WHAT'S IT LOOK LIKE...

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

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

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

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

THE FOUR C's

- Communication
- 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.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
- G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure.

- 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

PROBLEM SOLVING FRAMEWORK

Inspired by Geoff Krall's resources at emergentmath.com

What problem are you trying to figure out?	What estimates do you have?
	 Place your estimate on the number line.
What info do you already know about the problem?	What info do you need about the problem?
What is your conclusion? How did you reach that conclusion?	

RobertKaplinsky.com

THE FOUR C's

- Communication
- Curiosity
- Critical Thinking
- Content Knowledge

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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 a square with a side length of 4 units?

16

Great. Do you have any questions?

No

What did you get for the area of a square with a side length of 4 units?

16

Great. How did you get your answer?

Each side is 4 so I added 4 together 4 times and got 16.

WHY?

How do you know?

Convince me.

Explain that please.

Draw a picture.

$y = 20 + 4x$

EXPONENTIAL

Source: Steve Leinwand

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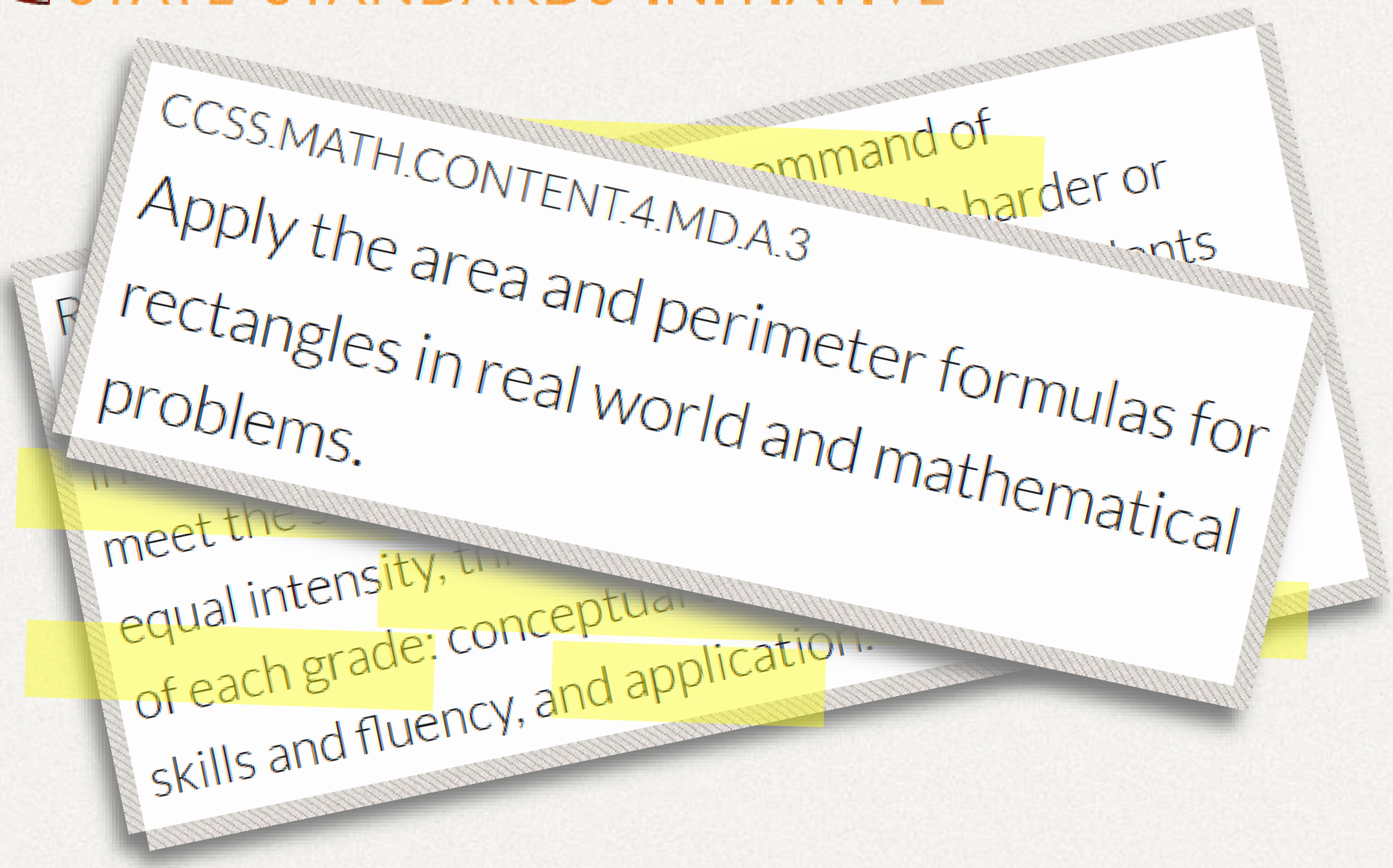
COMMON CORE
STATE STANDARDS INITIATIVE



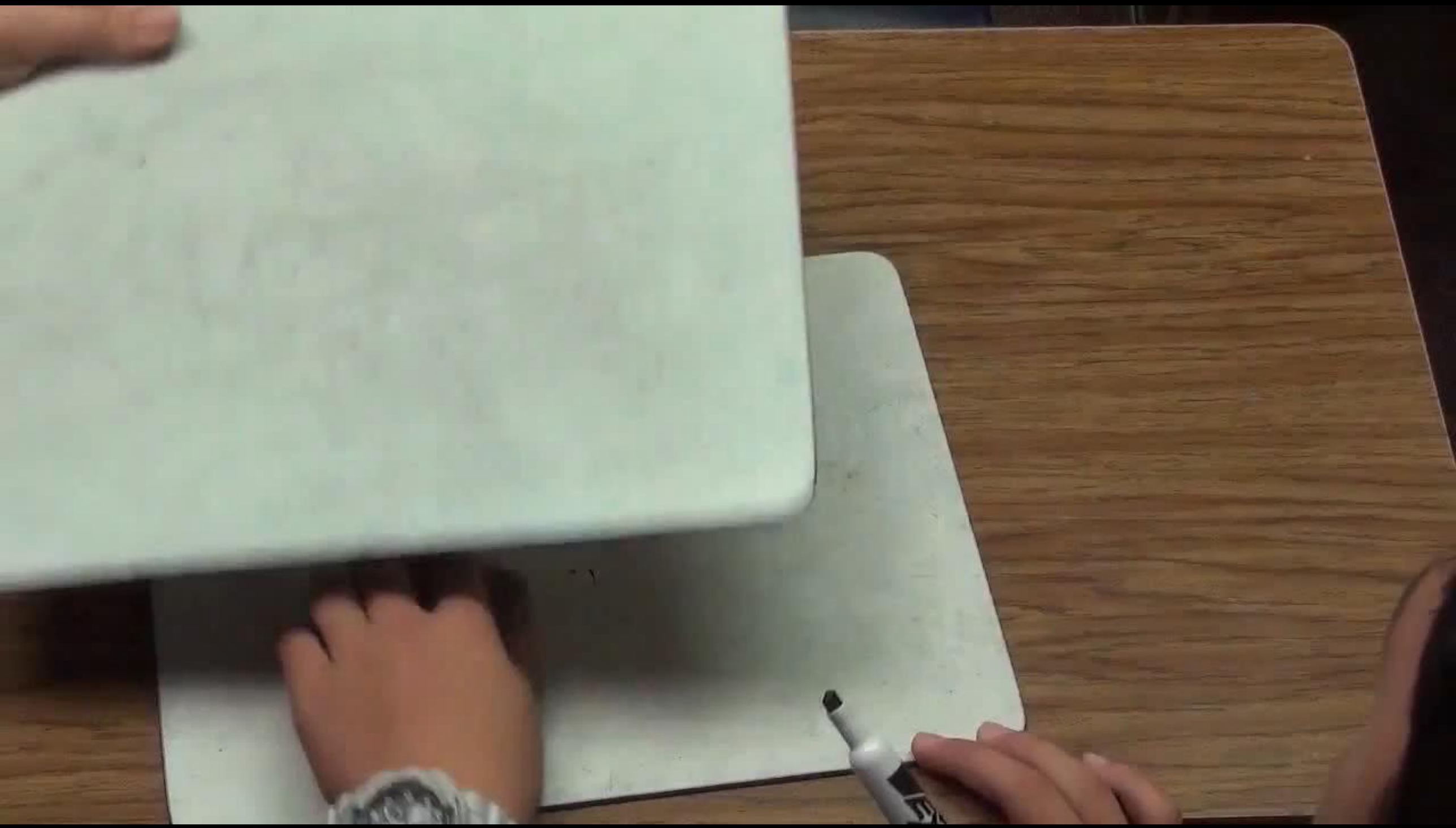
Source: http://www.corestandards.org/other-resources/key-shifts-in-mathematics/

What is the perimeter of a rectangle that measures 8 units by 4 units?

COMPONENTS OF RIGOR

- ☑ Procedural Skill and Fluency
- ☑ Conceptual Understanding

List the dimensions of a rectangle with a perimeter of 24 units.



COMPONENTS OF RIGOR

- [x] Procedural Skill and Fluency
- [x] Conceptual Understanding

Why?

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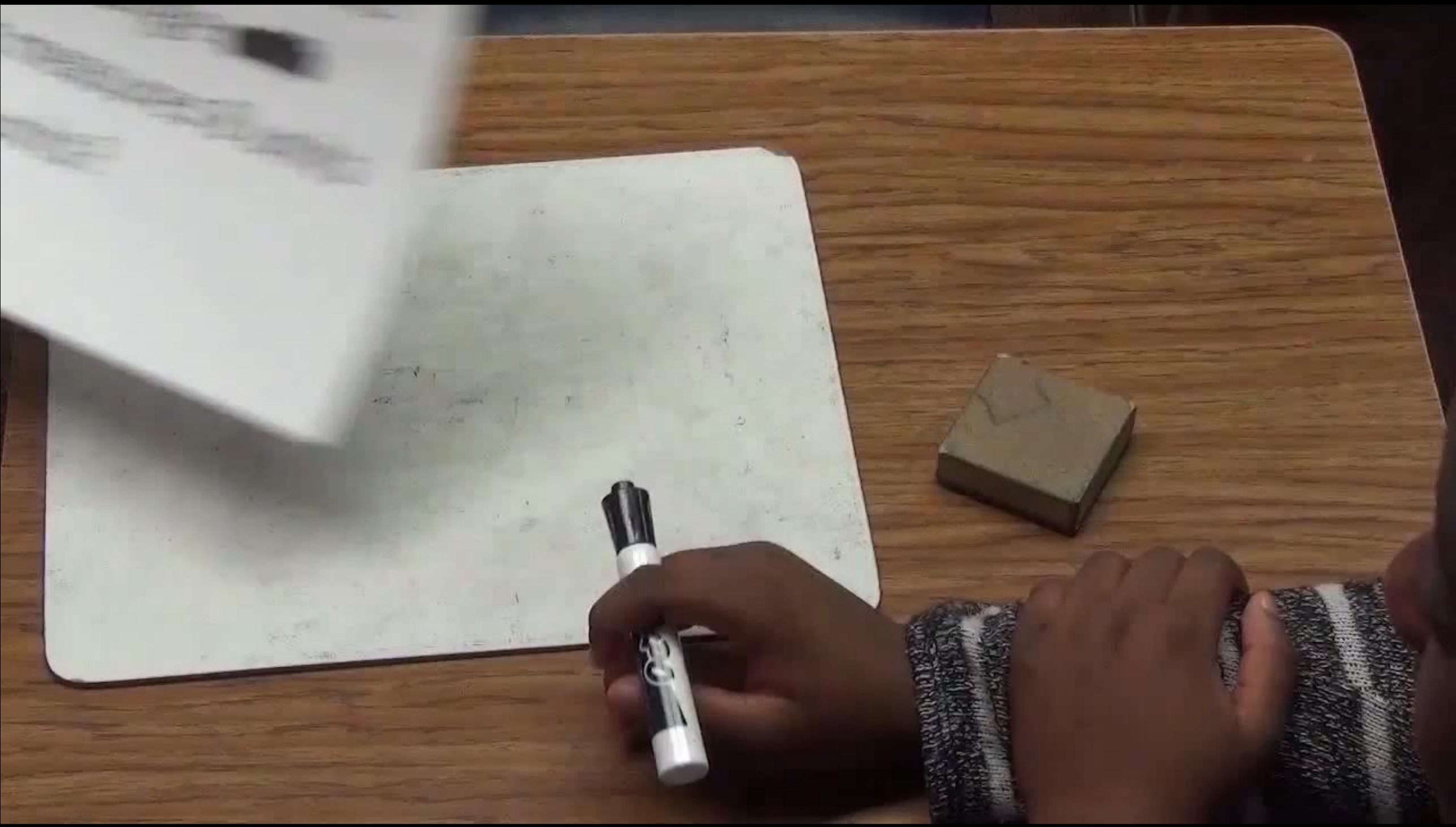


COMPONENTS OF RIGOR

- ☑ Procedural Skill and Fluency
- ☑ Conceptual Understanding

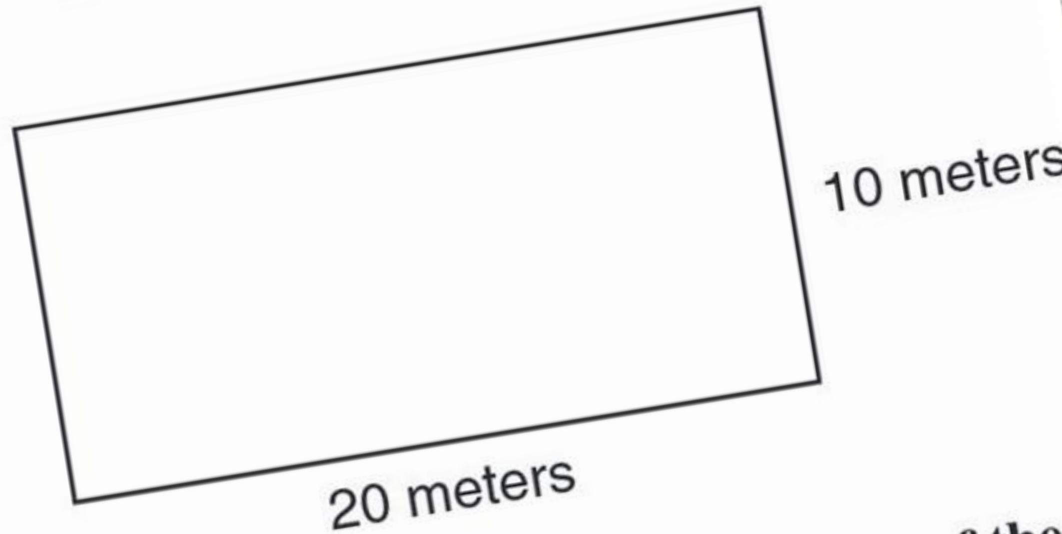
List the

of a rectangle with a perimeter of 24 units.

COMPONENTS OF RIGOR

- [x] Procedural Skill and Fluency
- [x] Conceptual Understanding

71 A basketball court is shaped like a rectangle 20 meters long and 10 meters wide.



What is the perimeter in meters of the court?

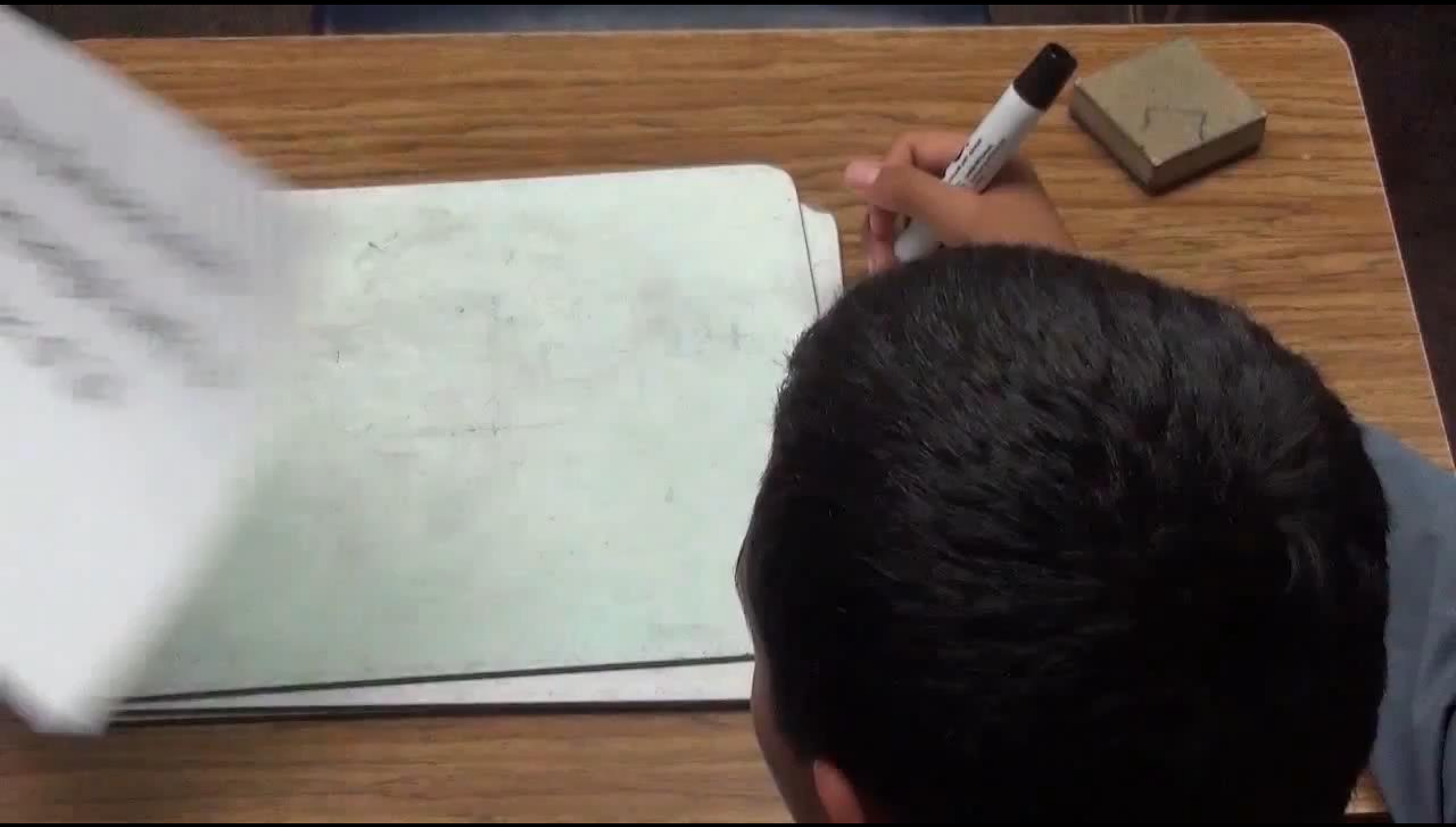
- **A** 30 meters
- **B** 50 meters
- **C** 60 meters
- **D** 200 meters

Source: http://www.cde.ca.gov/ta/tg/sr/documents/cstrtqmath3.pdf

What is the perimeter of a rectangle [redacted] that measures 8 units by 4 units?

COMPONENTS OF RIGOR

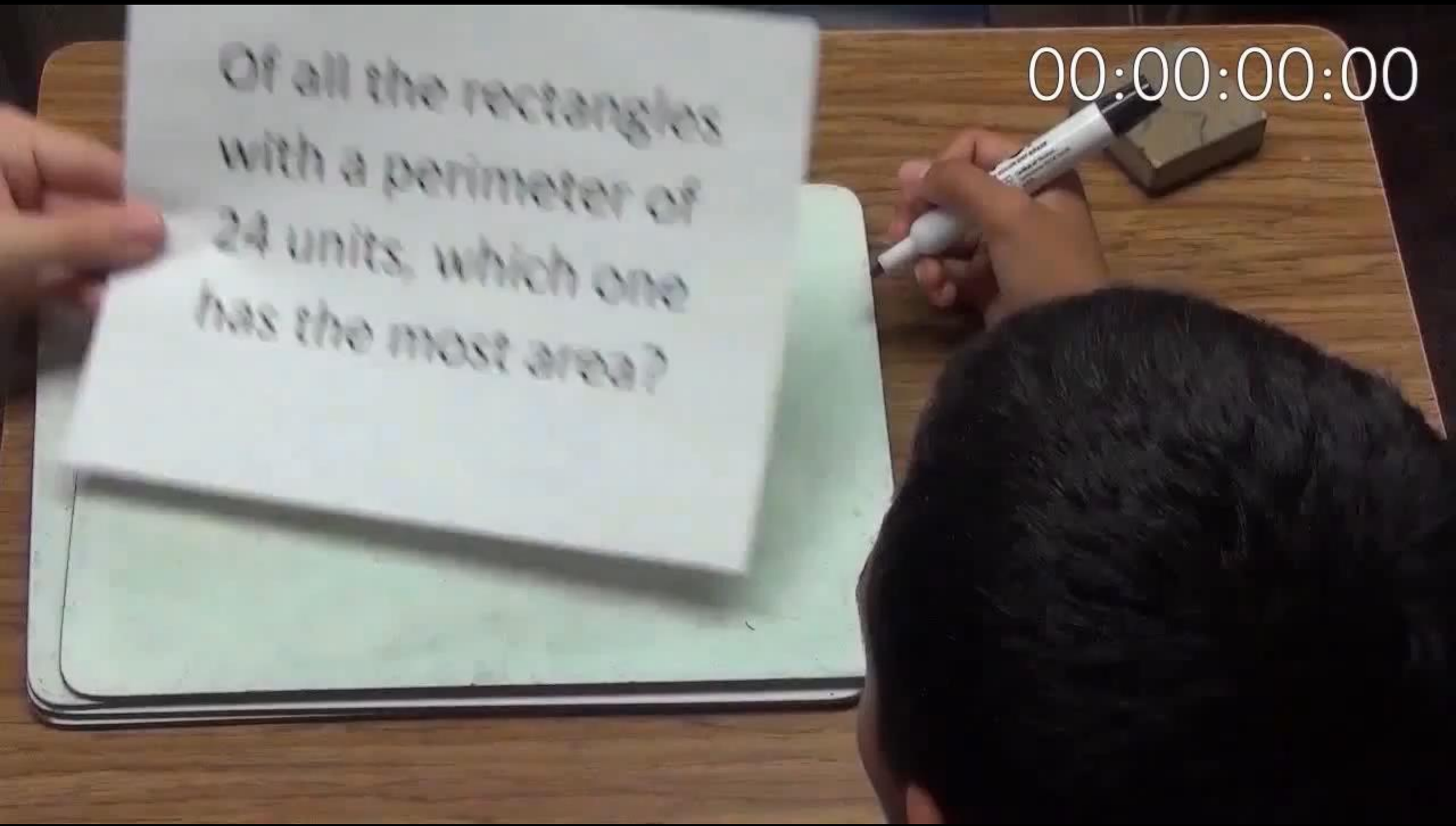
- ☑ Procedural Skill and Fluency
- ☑ Conceptual Understanding



COMPONENTS OF RIGOR

- ☑ Procedural Skill and Fluency
- ☑ Conceptual Understanding

Of all the rectangles with a perimeter of 24 units, which one has the most area?


Of all the rectangles with a perimeter of 24 units, which one has the most area?
00:00:00:00

COMPONENTS OF RIGOR

- [x] Procedural Skill and Fluency
- [x] Conceptual Understanding

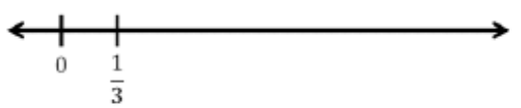
DEFINING THE PROBLEM

- Students appear to demonstrate "deep, authentic command of mathematical concepts" when given commonly used problems.
- However with more challenging problems, the same students seem to no longer demonstrate that command.

ADDRESSING THE PROBLEM

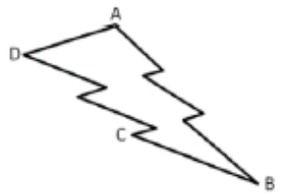
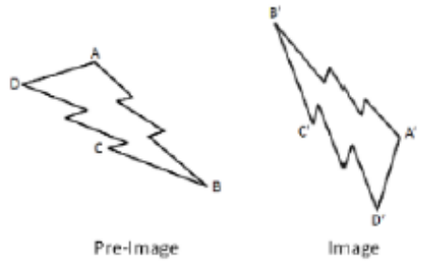
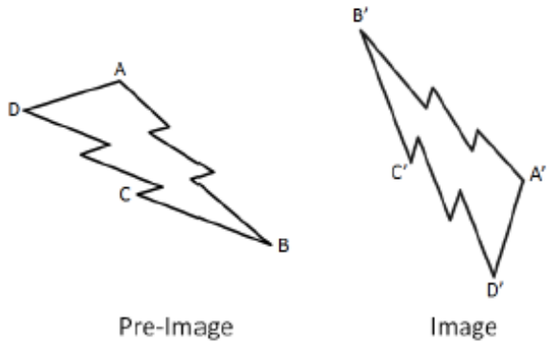
- First, we must have a clear understanding about why these problems are different from one another.
- Next, we need to practice using these problems so that we understand how students may react to them.
- Last, we need a source that can provide us with a variety of free problems.

Depth of Knowledge Matrix - Elementary & Secondary Math

Topic	Adding Whole Numbers	Money	Fractions on a Number Line	Area and Perimeter	Subtracting Mixed Numbers
CCSS Standard(s)	• 1.NBT.4 • 2.NBT.5	• 2.MD.8	• 3.NF.2	• 3.MD.8 • 4.MD.3	• 5.NF.1
DOK 1 Example	Find the sum. $44 + 27 =$	If you have 2 dimes and 3 pennies, how many cents do you have?	Which point is located at $\frac{7}{12}$ below? 	Find the perimeter of a rectangle that measures 4 units by 8 units.	Find the difference. $5\frac{1}{2} - 4\frac{2}{3} =$
DOK 2 Example	Fill in the boxes below using the whole numbers 1 through 9, no more than one time each, so that you make a true equation. $\square\square + 53 = \square\square$	Make 47¢ in three different ways with either quarters, dimes, nickels, or pennies.	Label the point where $\frac{3}{4}$ belongs on the number line below. Be as precise as possible. 	List the measurements of three different rectangles that each has a perimeter of 20 units.	Create three different mixed numbers that will make the equation true by using the whole numbers 1 through 9, no more than one time each. You may reuse the same whole numbers for each of the three mixed numbers. $5\frac{4}{5} - \square\frac{\square}{\square} = 3\frac{1}{20}$
DOK 3 Example	Make the largest sum by filling in the boxes below using the whole numbers 1 through 9, no more than one time each. $\square\square + \square\square =$	Make 47¢ using exactly 6 coins with either quarters, dimes, nickels, or pennies.	Create 5 fractions using the whole numbers 0 through 9, exactly one time each as numerators and denominators, and place them all on a number line.	What is the greatest area you can make with a rectangle that has a perimeter of 24 units?	Make the smallest difference by filling in the boxes below using the whole numbers 1 through 9, no more than one time each. 

Version 1.17

Depth of Knowledge Matrix - Elementary & Secondary Math

Topic	Surface Area and Volume	Probability	Transformations	Factoring Quadratics	Quadratics in Vertex Form
CCSS Standard(s)	• 6.G.4 • 7.G.6	• 7.SP.5 • 7.SP.7	• 8.G.1 • G-CO.5	• A-SSE.3a	• F-IF.7a
DOK 1 Example	Find the surface area of a rectangular prism that measures 3 units by 4 units by 5 units.	What is the probability of rolling a sum of 5 using two 6-sided dice?	Rotate the image below 90° counterclockwise about point D and reflect it across a horizontal line. 	Find the factors: $2x^2 + 7x + 3$	Find the roots and maximum of the quadratic equation below. $y = -3(x-4)^2 - 3$
DOK 2 Example	List the measurements of three different rectangular prisms that each have a surface area of 20 square units.	What value(s) have a 1/12 probability of being rolled as the sum of two 6-sided dice?	List three sequences of transformations that take pre-image ABCD to image A′B′C′D′. 	Find three different integers to put in the blank that will make the quadratic expression factorable. $x^2 + \_\_x + 4$	Create three equations for quadratics in vertex form that have roots at 3 and 5 but have different maximum and/or minimum values.
DOK 3 Example	What is the greatest volume you can make with a rectangular prism that has a surface area of 20 square units?	Fill in the blanks to complete this sentence using the whole numbers 1 through 9, no more than one time each. Rolling a sum of ___ on two ___-sided dice is the same probability as rolling a sum of ___ on two ___-sided dice.	What is the fewest number of transformations needed to take pre-image ABCD to image A′B′C′D′? 	Fill the blank by finding the largest and smallest integers that will make the quadratic expression factorable. $2x^2 + 3x + \_\_$	Create a quadratic equation with the largest maximum value using the whole numbers 1 through 9, no more than one time each. $y = -\square(x-\square)^2 + \square$

Complex or Complicated?

DOK VERB WHEEL

Source: Unknown

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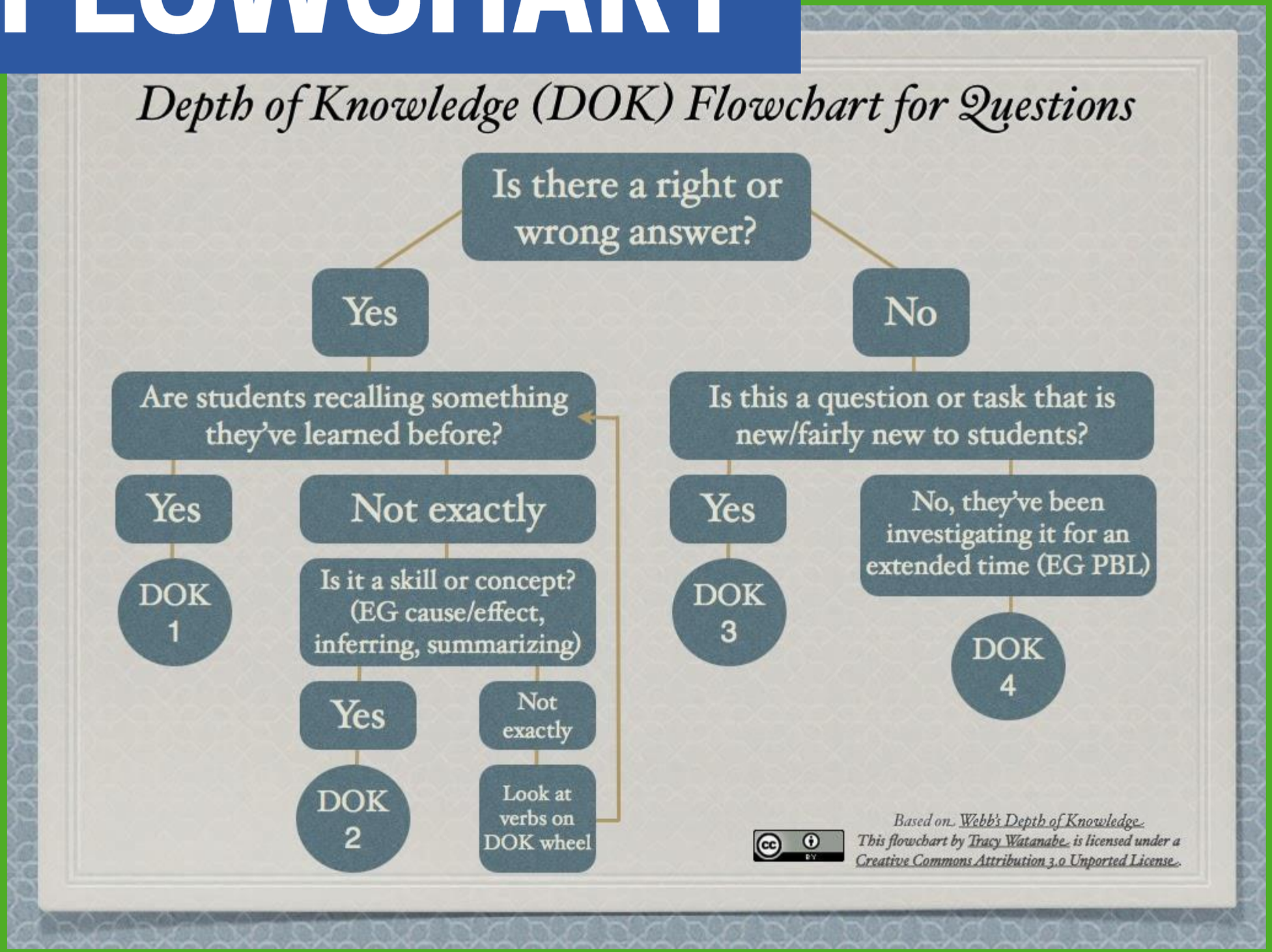
DOK FLOWCHART



Source:

Tracy Watanabe

@tracywatanabe

RobertKaplinsky.com

DOK POSTERS

Source: Penny Lund

isntitelementary.blogspot.com/

DOK LEVEL DIFFERENCES

Level 1: Recall & Reproduction

- Often a trivial application of facts.
- Generally requires little effort beyond remembering a formula.
- Usually only one answer.

Level 2: Skills & Concepts

- Usually requires more than one step to solve.
- Often multiple answers.

Level 3: Strategic Thinking

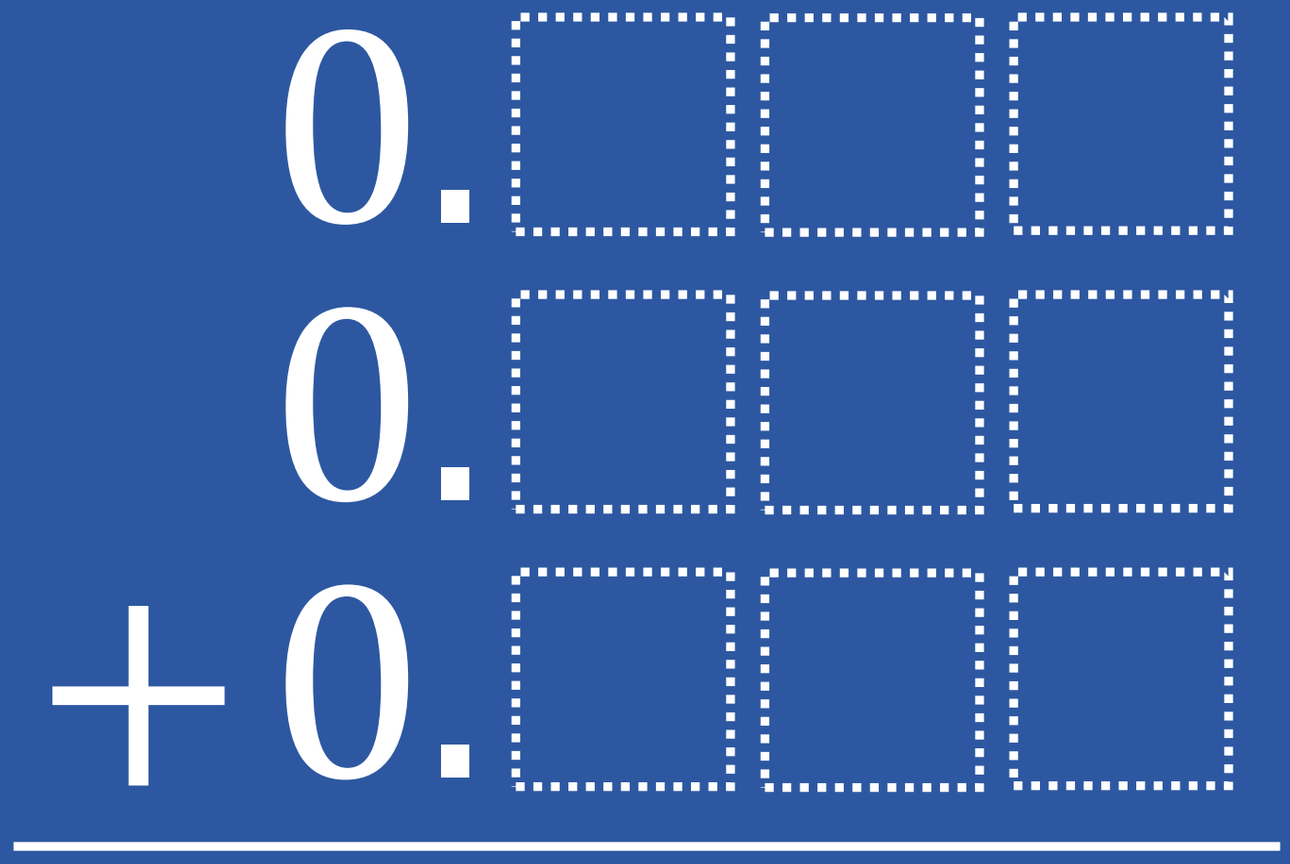
- Usually requires critical thinking about how to approach a problem.
- May be multiple answers or a single optimal answer.
- Often challenging enough to make your head hurt.

Level 4: Extended Thinking

- These are generally represented by performance tasks or problem-based lessons.

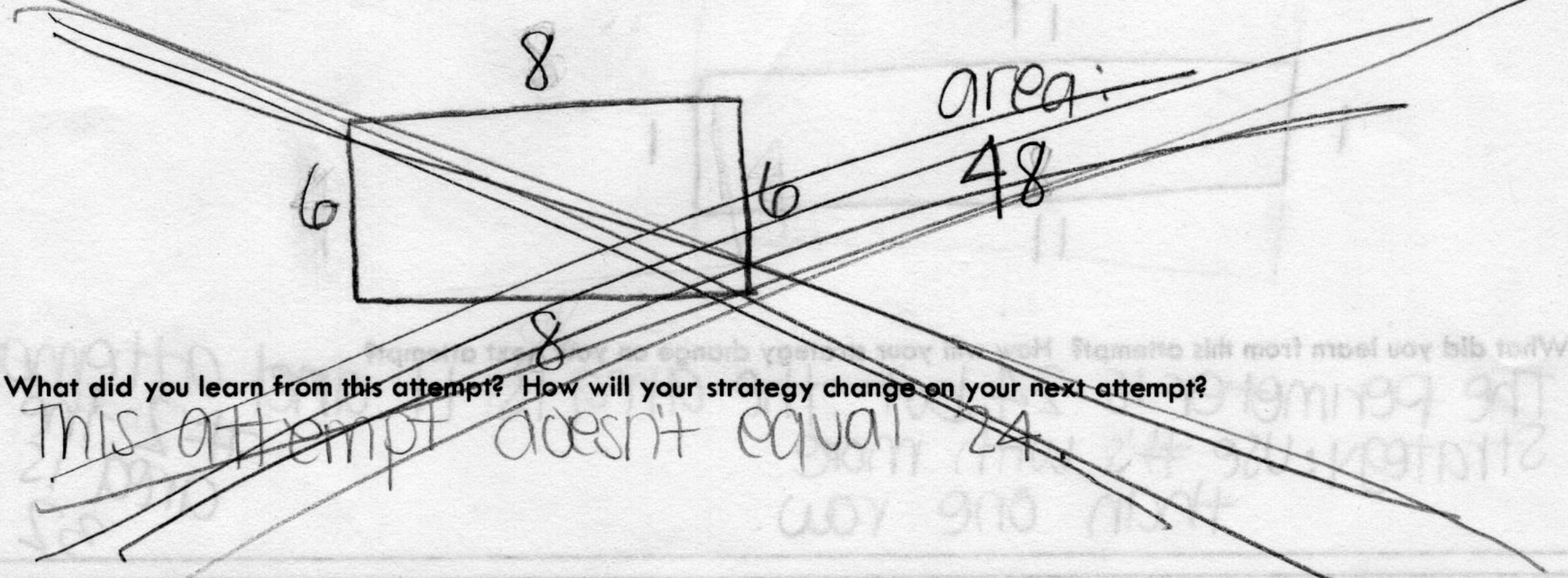
ADDING DECIMALS

Use the numbers 1 through 9, exactly one time each, to fill in the boxes and make three decimals whose sum is as close to 1 as possible.



First attempt:

Points: ____/2 attempt ____/2 explanation

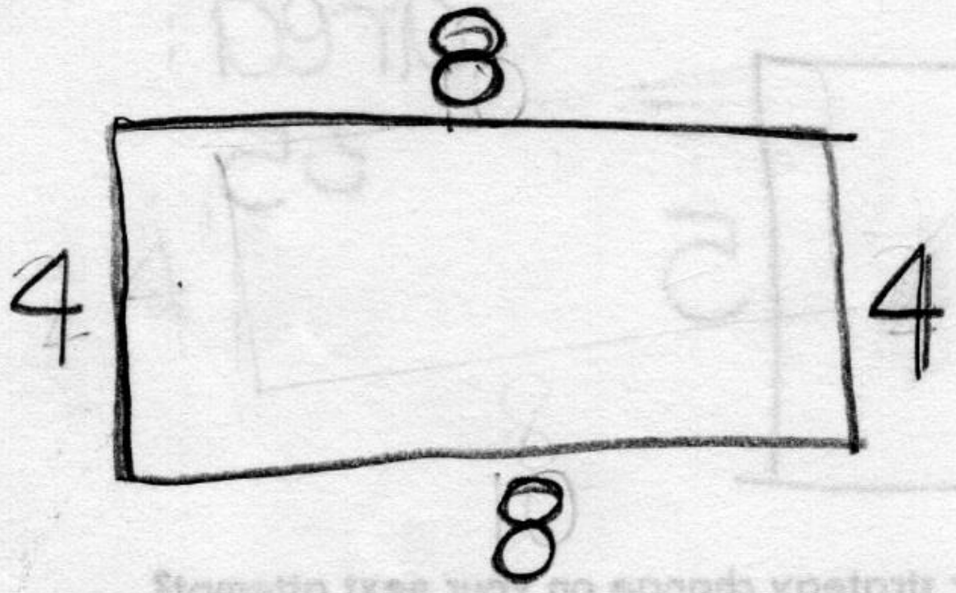


What did you learn from this attempt? How will your strategy change on your next attempt?

This attempt doesn't equal 24.

Second attempt:

Points: ____/2 attempt ____/2 explanation



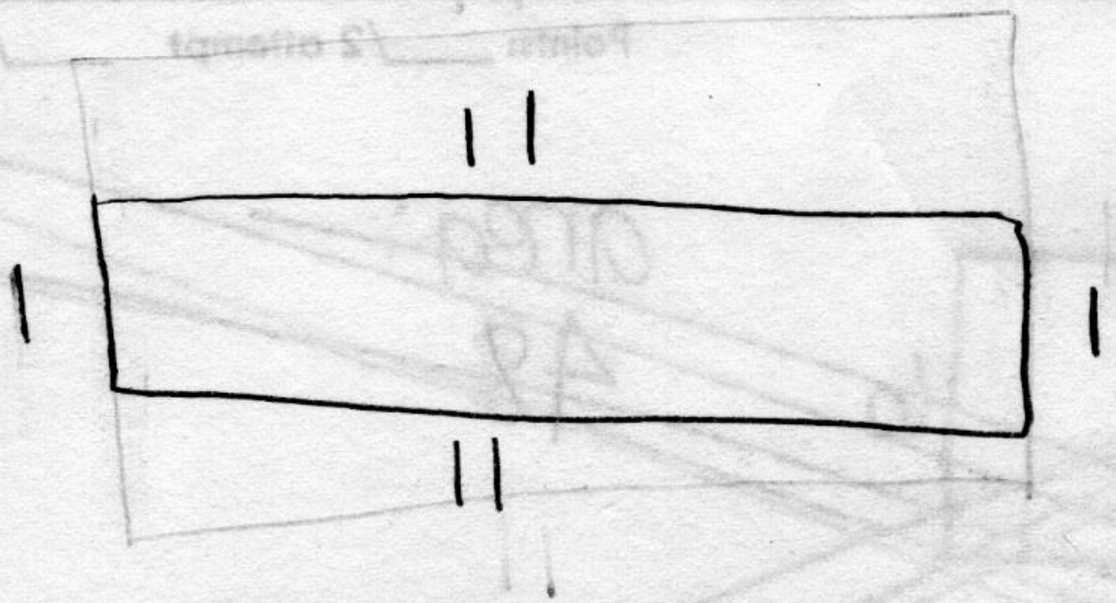
area:
32

What did you learn from this attempt? How will your strategy change on your next attempt?

The perimeter was 24, and the area was 32 but I think there's a bigger #

Fourth attempt:

Points: ____/2 attempt ____/2 explanation



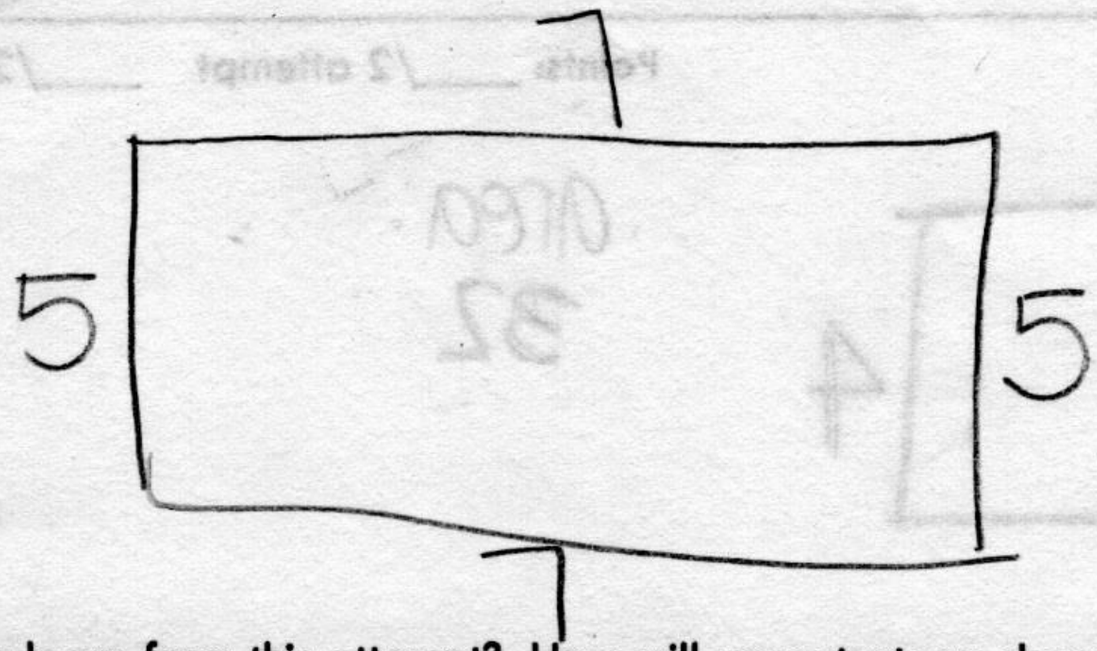
What did you learn from this attempt? How will your strategy change on your next attempt?

The perimeter is 24, but the area is 11 and attempt #2 the area is 32

Strategy: Use #'s with more than one raw.

Fifth attempt:

Points: ____/2 attempt ____/2 explanation



area:
35

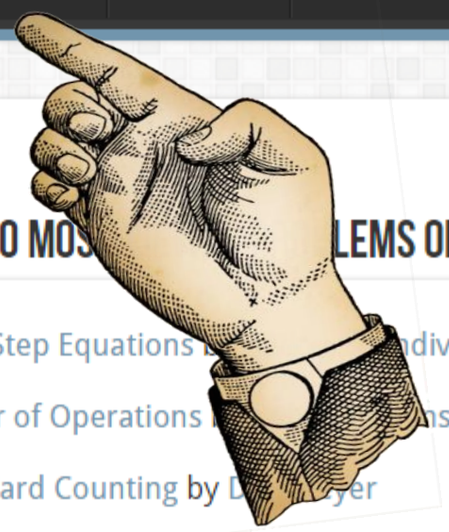
What did you learn from this attempt? How will your strategy change on your next attempt?

DOK FAQ

- When will students ever use this?
- What DOK level should I start students with?
- How do teachers fit these problems in?
- How do I help prevent students from giving up after trying the problem once or twice?
- Where can I find other DOK 2 and DOK 3 problems or submit ones I've made?

Open Middle

Challenging math problems worth solving



THE TOP 10 MOS[illegible]LEMS OF 2016

1. Two-Step Equations [illegible]ndivil, Daniel Luevanos, and Robert Kaplinsky
2. Order of Operations [illegible]nsky with answer from Michael Fenton and his students
3. Dot Card Counting by D[illegible]yer
4. Rational and Irrational Numbers by Bryan Anderson
5. One Solution, No Solutions, Infinite Solutions by Bryan Anderson
6. Multiplying a Two-Digit Number by a Single-Digit Number by Robert Kaplinsky
7. Exponents and Order of Operations by Zack Miller
8. Converting Between Fractions and Decimals by Robert Kaplinsky
9. Interpretting Percentages by Robert Kaplinsky
10. Two-Step Equations 3 by Erick Lee

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Brian Marks
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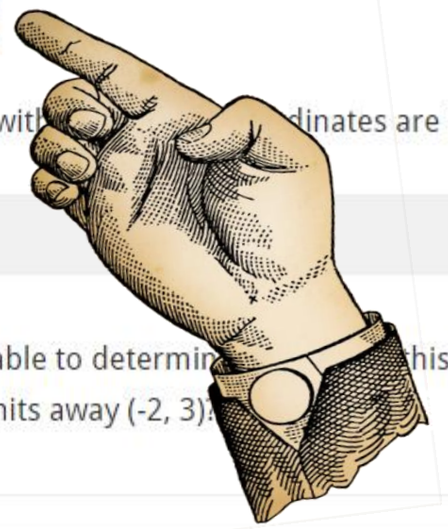
BROWSE BY COMMON CORE STATE STANDARDS

- Kindergarten (6)
  - Counting & Cardinality (2)
  - Number & Operations in Base Ten (1)
  - Operations & Algebraic Thinking (3)

EQUIDISTANT POINTS



Directions: How many points with ...dinates are 5 units away from (-2, 3)?

Hint

Which methods are available to determin... this problem? What shape is defined by *all* of the points that are 5 units away (-2, 3)?

Answer

12 points: (-5, 7), (-7, 3), (-5, -1), (-2, -2), (3, 3), (1, -1), (-2, 8), (1, 7), (2,6), (-6, -6), (-6, 0), and (2, 0)

Source: Dylan Kane

Tags 8.G.8 • DOK 2: SKILL / CONCEPT • DYLAN KANE • G-GPE.1

BROWSE BY COMMON CORE STATE STANDARDS

GOALS

- [x] ENGAGING PROBLEM SOLVING
- [x] REAL WORLD PROBLEM-BASED LEARNING
- [x] HIGHER DEPTH OF KNOWLEDGE PROBLEMS
- [ ] BETTER IMPLEMENTATION
- [x] IMPROVE QUESTION ASKING
- [ ] PRACTICE PREPARING FOR A LESSON
- [ ] DEAL WITH UNCOMFORTABLE SITUATIONS

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PBL RESOURCES

- Problem-based lesson search engine:
  robertkaplinsky.com/prbl-search-engine
- My lessons (Elementary, Middle, and High School)
  robertkaplinsky.com/lessons
- Dan Meyer (Middle and High School)
  threeacts.mrmeyer.com
- Andrew Stadel (Elementary and Middle School)
  www.estimation180.com/lessons.html
- Graham Fletcher (Elementary and Middle School)
  gfletchy.com/3-act-lessons

Home

How I Can Help You

Real World Problems

My workshops help teachers implement problem-based lessons by helping them experience them from both student and teacher perspective, leading to increase students' success with performance tasks and the Common Core State Standards.

Depth of Knowledge

Problems at higher depth of knowledge levels have the potential to challenge your most talented student yet remain accessible to everyone. I can help teachers develop best practices for implementing them so that students persevere longer towards finding the solution.

Lessons

View all | Kinder | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | Alg 1 | Geo | Alg 2

How Much Money Were Those Pennies?

How Can We #SaveNelly?

How Many Chip Bags Will There Be?

How Can We Make Stronger Passwords?

Search

Type and hit enter ...

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Do you like the ideas you're reading? If so, you'll love having the best ones sent to you via email!

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If you live in the United States, enter your zip code and I'll use it to let you know about events near you.

First Name

Last Name

Robert Kaplinsky's Problem-Based Lessons

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D
1	Lesson	Concept / Skill	Standard 1	Standard 2
2	How Much Money Were Those Pennies?	Money, Multiplying Decimals, Proportions	4.MD.2	5.NBT.5
3	How Can We #SaveNelly?	Dividing Decimals	6.NS.3	
4	How Many Chip Bags Will There Be?	Ratio and Proportions, Population Sampling	6.RP.3	6.RP.3c
5	How Can We Make Stronger Passwords?	Permutations, Combinations, Probability, Exponents, Exponential Growth	7.SP.8	8.EE.1
6	How Many Hot Dogs And Buns Should He Buy?	Least Common Multiple (LCM)	6.NS.4	
7	What Does 2000 Calories Look Like?	Unit Rates, Ratios, Solving Equations, and Solving Inequalities	6.EE.3	6.EE.4
8	How Much Money Are The Coins Worth?	Decimal Operations and Coin Counting	2.MD.8	5.NBT.7
9	How Many Times Will A Case of Paper Jam?	Interpreting Percentages	6.RP.3c	7.RP.3
10	How Many Soda Combinations Are There On A Coke Freestyle?	Counting, Composing, and Decomposing Numbers	K.CC.5	K.CC.6
11	What Should The Freeway Sign Show?	Fractions on Number Lines, Converting Units, Decimal and Fraction Operations	3.NF.1	3.NF.2
12	How Fast Was The Fastest Motorcycle Speeding Ticket Ever?	Converting Units and Unit Rates	5.MD.1	6.RP.3d
13	How Much Did Patrick Peterson Lose By Not Cashing His Check?	Compound and/or Simple Interest	7.RP.3	N-RN.2
14	How Many Biscuits Can You Make?	Dividing Fractions and Mixed Numbers	5.NF.7	5.NF.7a
15	How Much Bigger Should They Make Zoolander's School?	Scale and Proportions	5.NF.5A	7.RP.2
16	Where Is The Freeway Sign Located?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2
17	How Far Apart Are Exits On A Ring Road?	Arc length measures	G-C.5	
18	How Much Is One Third Of A Cup Of Butter?	Identifying Fractions on a Number Line	3.NF.1	3.NF.2
19	How Do Skytypers Write Messages?	Transformations (Rotations, Reflections, Dilations, and Translations)	8.G.1	8.G.2
20	How Big Is The Bermuda Triangle?	Coordinate Geometry: Area of Triangle	G-GPE.7	
21	What Fraction Of Children Are In The Right Car Seat?	Representing and Comparing Fractions	3.NF.1	3.NF.2
22	How Much Did The Temperature Drop?	Absolute Value	6.NS.7c	7.NS.1c
23	How Much Shorter Are Staggered Pipe Stacks?	Circles, Pythagorean Theorem, trigonometric ratios, and linear functions	8.G.7	A-CED.1
24	How Do You Write A Check To Pay For Something?	Expanded Form	2.NBT.3	4.NBT.2
25	How Can We Correct The Scarecrow?	Pythagorean Theorem	8.G.6	G-SRT.4
26	How Much Does A 100×100 In-N-Out Cheeseburger Cost?	Building and Interpretting Linear Functions	8.F.1	8.F.3
27	How Can We Water All Of The Grass?	Circles, Pythagorean Theorem, trigonometric ratios	7.G.4	8.G.7
28	How Much Money IS That?!	Volume of rectangular prism	5.MD.3	5.MD.4
29	How Much Money Should Dr. Evil Demand?	Exponential Growth	N-RN.2	A-SSE.1
30	How Tall Is Mini-Me?	Scale and Dividing Decimals	5.NF.5	5.NF.5a
31	How Did They Make Ms. Pac-Man?	Transformations (Rotations, Reflections, and Translations)	8.G.1	8.G.2
32	Which Ticket Option Is The Best Deal?	Unit Rates and Ratios	6.RP.2	6.RP.3
33	How Far Apart Are The Freeway Exits?	Fractions on a Number Line and Subtracting Fractions	3.NF.2	3.NF.2b
34	Do We Have Enough Paint?	Area	3.MD.5	3.MD.6

Sheet1

EMPOWERED PROBLEM SOLVING

ROBERT KAPLINSKY

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@robertkaplinsky

GOALS

- [x] ENGAGING PROBLEM SOLVING
- [x] REAL WORLD PROBLEM-BASED LEARNING
- [x] HIGHER DEPTH OF KNOWLEDGE PROBLEMS
- [ ] BETTER IMPLEMENTATION
- [x] IMPROVE QUESTION ASKING
- [ ] PRACTICE PREPARING FOR A LESSON
- [ ] DEAL WITH UNCOMFORTABLE SITUATIONS

Source: Andrew Stadel via www.estimation180.com

Height:
72 inches

Source: Andrew Stadel via www.estimation180.com

Height:
72 inches

Width:
36 inches

Source: Andrew Stadel via www.estimation180.com

Height:
72 inches

Width:
36 inches

Depth:
18 inches

Source: Andrew Stadel via www.estimation180.com

Sticky note

Dimensions:
3” x 3”

Source: Andrew Stadel via www.estimation180.com

Source: Andrew Stadel via www.estimation180.com

PERFORMANCE TASK

CEREAL BOXES

A cereal company uses cereal boxes that are rectangular prisms The boxes have the dimensions shown.

- 12 inches high
- 8 inches wide
- 2 inches deep

The managers of the company want a new size for their cereal boxes. The new boxes have to be rectangular prisms. You will evaluate one box design the company proposed. Then you will create and propose your own design for the company.

Requirements for the new boxes:

- The new boxes have to use less cardboard than the

1

Determine the volume of the current cereal box with the dimensions 12 inches high, 8 inches wide, and 2 inches deep.

Find the volume, V, in cubic inches, of each box.

Volume of Original Box: $V =$ __ in^3

1 2 3
4 5 6
7 8 9
0 . -

2

Label the dimensions of the net for the current cereal box with dimensions 12 inches high, 8 inches wide, and 2 inches deep.

12 in Delete

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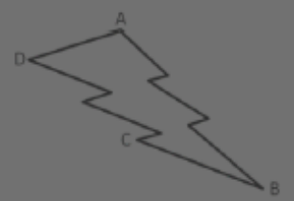
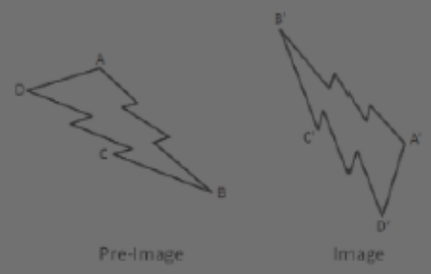
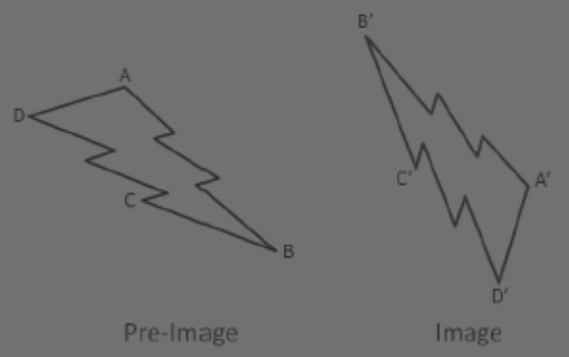
Depth of Knowledge Matrix - Elementary & Secondary Math

Topic	Surface Area and Volume	Probability	Transformations	Factoring Quadratics	Quadratics in Vertex Form
CCSS Standard(s)	• 6.G.4 • 7.G.6	• 7.SP.5 • 7.SP.7	• 8.G.1 • G-CO.5	• A-SSE.3a	• F-IF.7a
DOK 1 Example	Find the surface area of a rectangular prism that measures 3 units by 4 units by 5 units.	What is the probability of rolling a sum of 5 using two 6-sided dice?	Rotate the image below 90° counterclockwise about point D and reflect it across a horizontal line. 	Find the factors: $2x^2 + 7x + 3$	Find the roots and maximum of the quadratic equation below. $y = -3(x-4)^2 - 3$
DOK 2 Example	List the measurements of three different rectangular prisms that each have a surface area of 20 square units.	What value(s) have a 1/12 probability of being rolled as the sum of two 6-sided dice?	List three sequences of transformations that take pre-image ABCD to image A′B′C′D′. 	Find three different integers to put in the blank that will make the quadratic expression factorable. $x^2 + \_\_x + 4$	Create three equations for quadratics in vertex form that have roots at 3 and 5 but have different maximum and/or minimum values.
DOK 3 Example	What is the greatest volume you can make with a rectangular prism that has a surface area of 20 square units?	Fill in the blanks to complete this sentence using the whole numbers 1 through 9, no more than one time each. Rolling a sum of ___ on two ___-sided dice is the same probability as rolling a sum of ___ on two ___-sided dice.	What is the fewest number of transformations needed to take pre-image ABCD to image A′B′C′D′? 	Fill the blank by finding the largest and smallest integers that will make the quadratic expression factorable. $2x^2 + 3x + \_\_$	Create a quadratic equation with the largest maximum value using the whole numbers 1 through 9, no more than one time each. $y = -\square(x-\square)^2 + \square$

FIVE PRACTICES

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DISCUSSION QUESTIONS

- "Giving students too much or too little support, or too much direction, can result in a decline in the cognitive demands of the task." (p. 550) Why?
- "By making purposeful choices about the order in which students' work is shared, teachers can maximize the chances that their mathematical goals for the discussion will be achieved." (p. 554) What ways do teachers currently select students? How would you suggest they change their selection process after reading this?
- What challenges might teachers have when trying to "connect" student solutions? (p. 554)

IMPLEMENT 5 PRACTICES

1. Pick a mathematical goal that you anticipate using before looking at the student work.
2. Next, review the student work to simulate the reality that you won't know what students will actually do.
3. Figure out which students you would have share their mathematical work.
4. Determine the order you would have those students present their work.
5. Decide on which connections you would emphasize between the students' work and mathematical ideas.

POSTERS

- At the top of the poster, list the mathematical goal picked by your group. For example:
  - Starting with the most commonly used strategy and moving to one that few students used.
  - Starting with a strategy that is more concrete and moving to strategies that are more abstract.
  - Incorporating wrong answers to address common misconceptions (“Who made the best mistake?”)
- Attach those students’ work to the poster in the order that you would present it.
- Next to the student work list the questions you would ask the student(s) or ideas that you would want to come out as a result of showing that student’s work.

- Change
- Transition
- Ending

- Change
- Transition
- Ending
- Neutral Zone

- Change
- Transition
- Ending
- Neutral Zone
- New Beginning

What does this mean for math education?

- Change
- Transition
- Ending

- People may not stop doing anything. They may try to do all the old things and the new things. Soon they burn out with the overload.
- People make their own decisions about what to discard and what to keep, and the result is inconsistency and chaos.
- People toss out everything that was done in the past.

- Change
- Transition
- Ending
- Neutral Zone

- Change
- Transition
- Ending
- Neutral Zone
- New Beginning

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- [x] PRACTICE PREPARING FOR A LESSON
- [ ] DEAL WITH UNCOMFORTABLE SITUATIONS

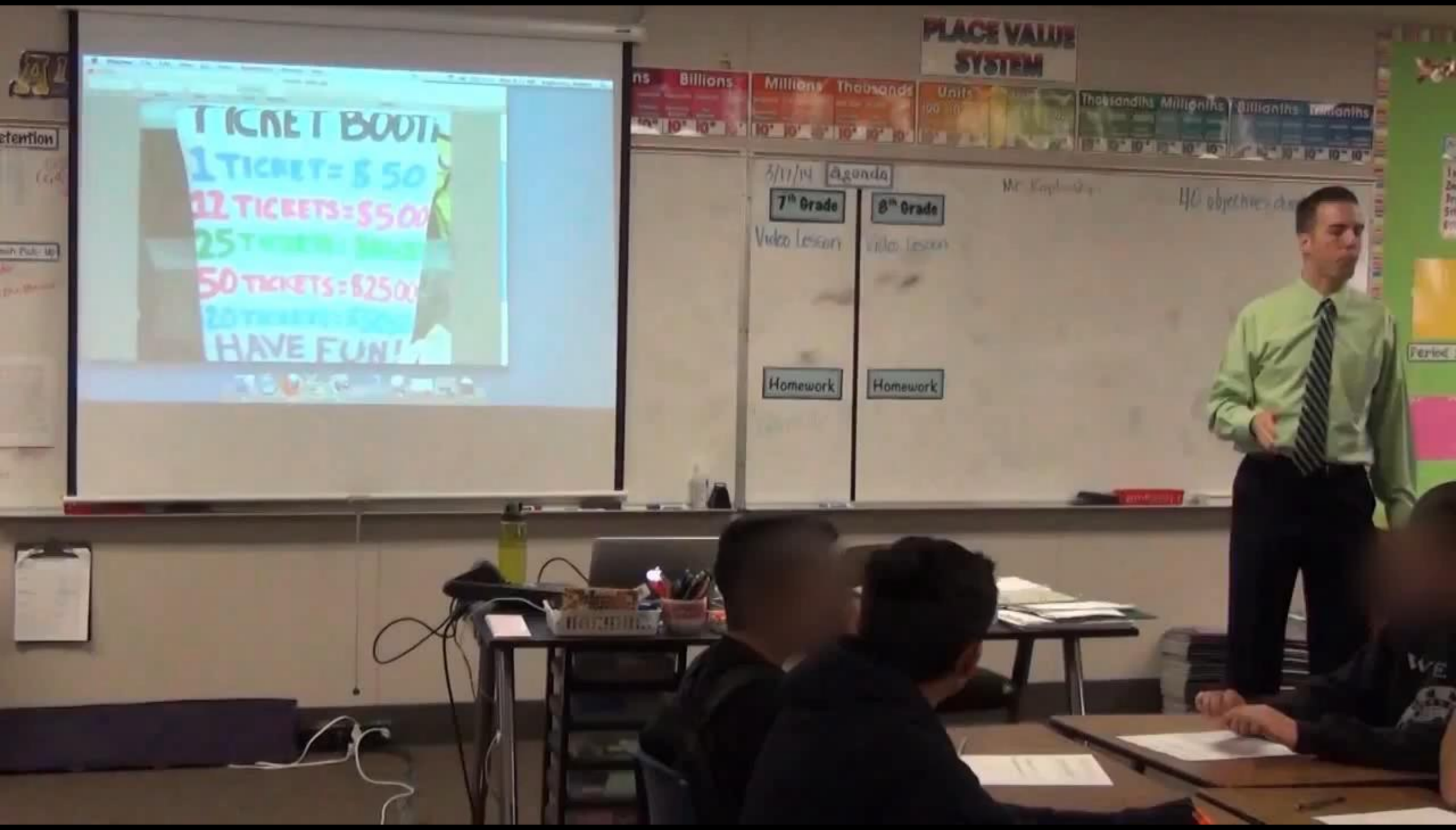
PRE-MORTEM

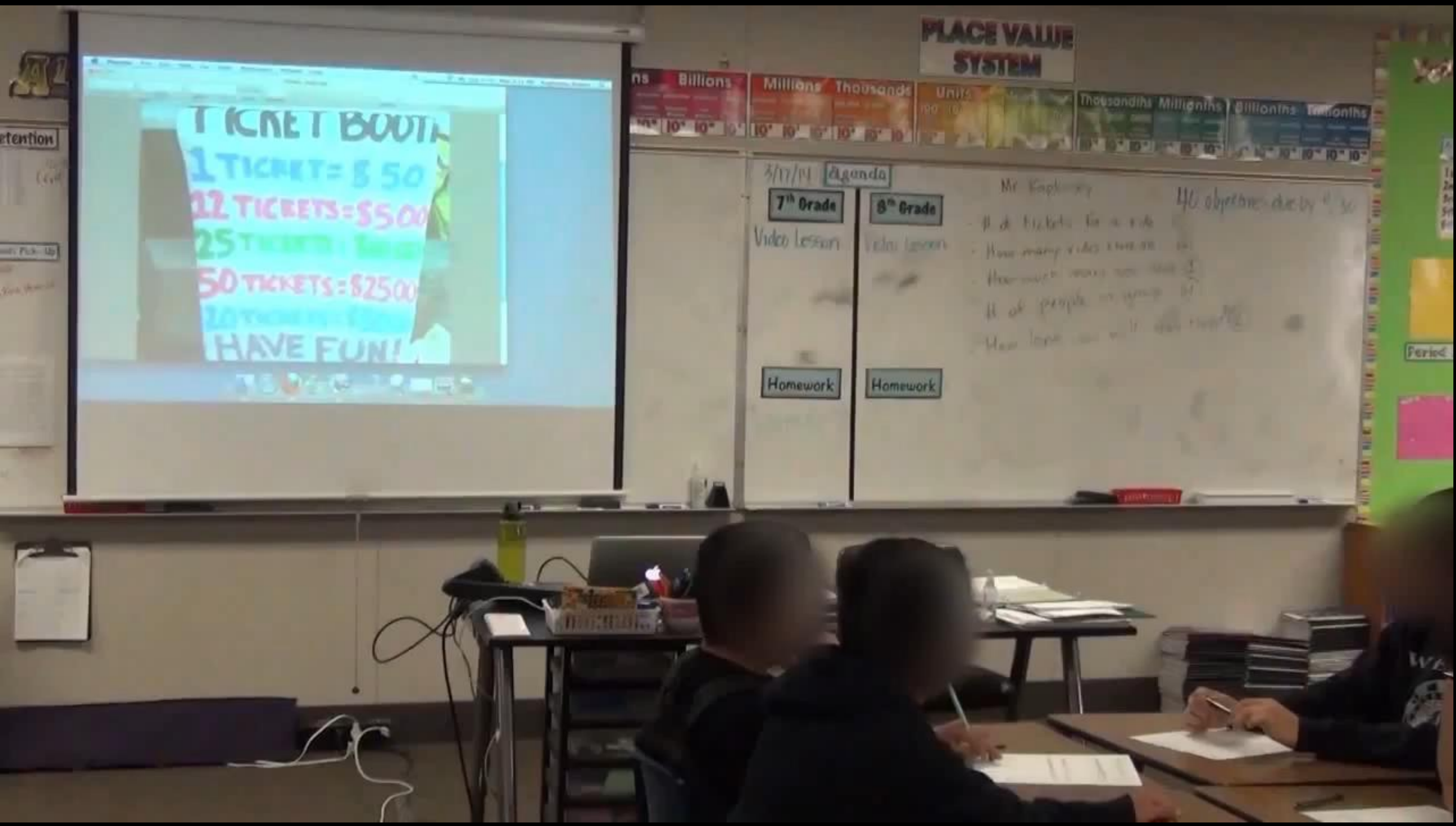
- The lesson flopped. What went wrong?
- You have sixty seconds to write down all the reasons the lesson did not go well.
- Create a combined list with your neighbors.
- Then discuss “less helpful” and “more helpful” ways you could address them if they do happen.

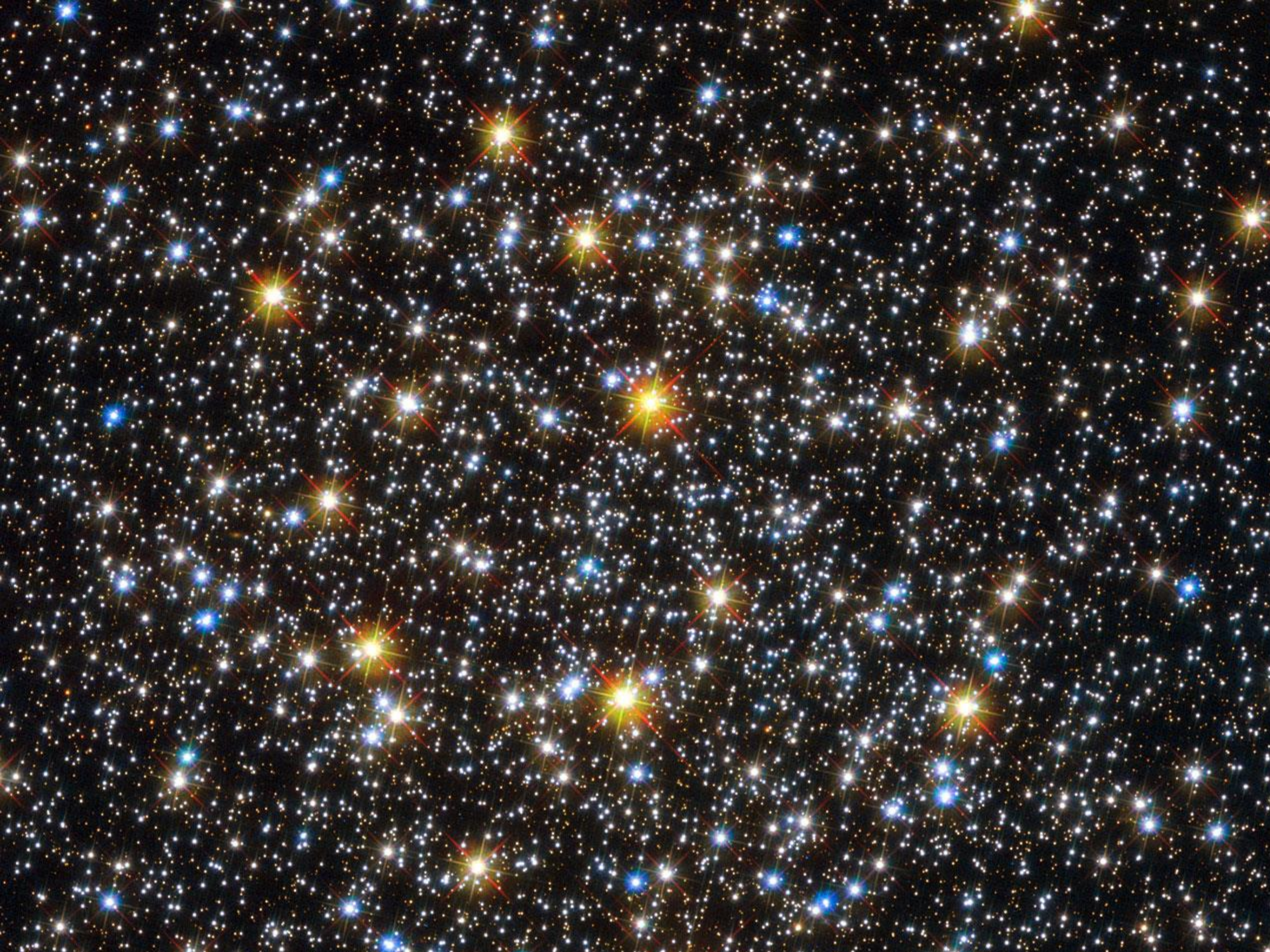
SETTING UP THE PROBLEM

- What do you do when students ask for data/information you don't have, hadn't considered, or forgot to get?
- What do you do when students ask for information that is probably not important or that they don't actually need?


TICKET BOOTH
1 TICKET = $.50
12 TICKETS = $5.00
25 TICKETS = $10.00
50 TICKETS = $25.00
120 TICKETS = $50.00
HAVE FUN!

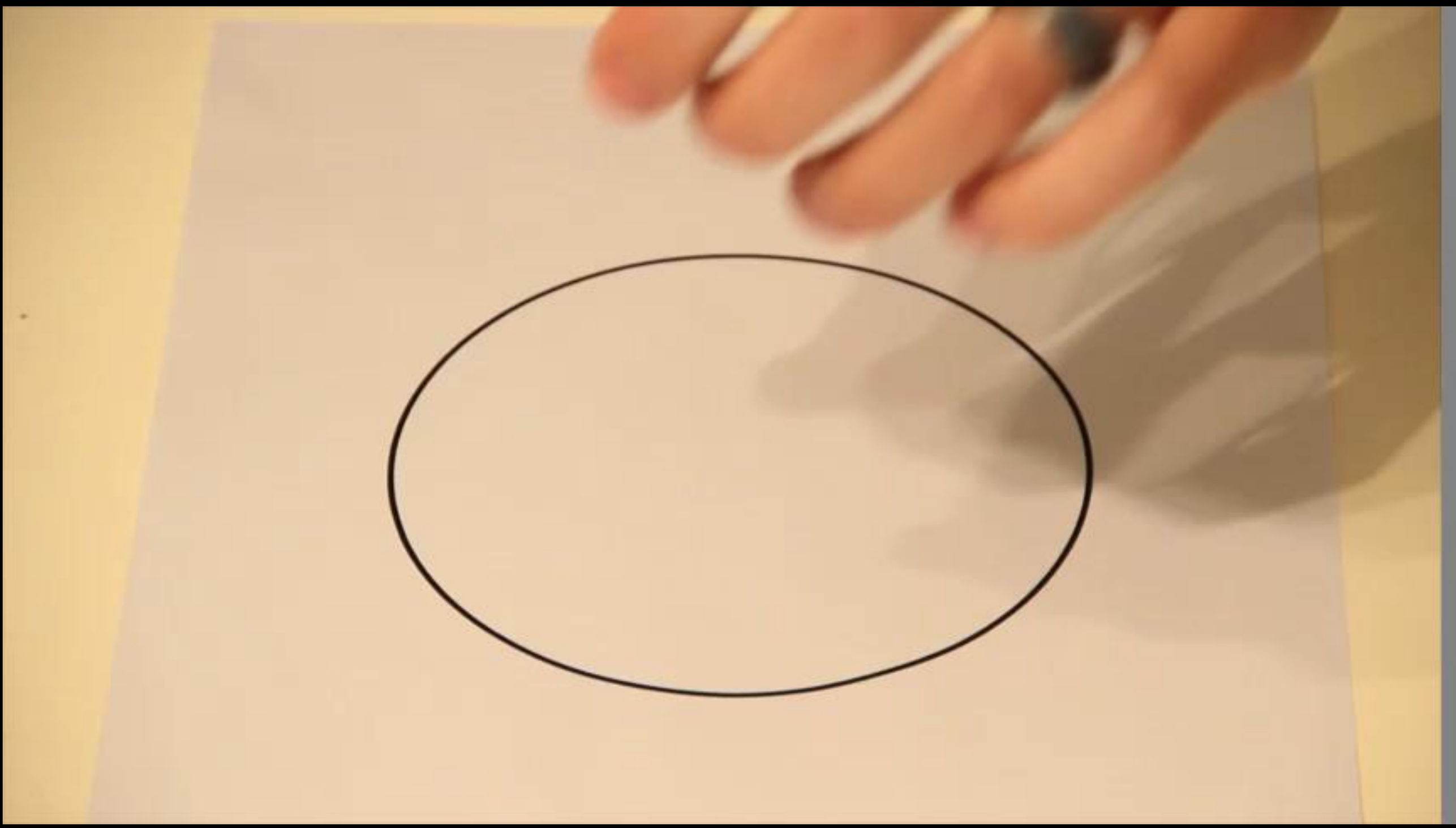

TICKET BOOTH
1 TICKET = $ 50
HAVE FUN!
PLACE VALUE SYSTEM
Billions
Millions
Thousands
Units
Thousandths
Millionths
Billionths
Trillionths
3/11/14
Agenda
7th Grade
8th Grade
Video Lesson
Homework
Homework
Period


PLACE VALUE SYSTEM
Billions
Millions
Thousands
Units
Thousandths
Millionths
Billionths
Trillionths
3/17/14
Agenda
7th Grade
8th Grade
Video Lesson
Homework
Homework
HAVE FUN!



SETTING UP THE PROBLEM

- What do you do when students ask for data/information you don't have, hadn't considered, or forgot to get?
- What do you do when students ask for information that is probably not important or that they don't actually need?
- What do you do when students don't know what to write for what they know and don't know?
- What do you do when you ask for an estimate and they don’t know?
- What do you do when they don't ask you for information that they need to solve the problem?



Source: Dan Meyer via mrmeyer.com

PROBLEM SOLVING

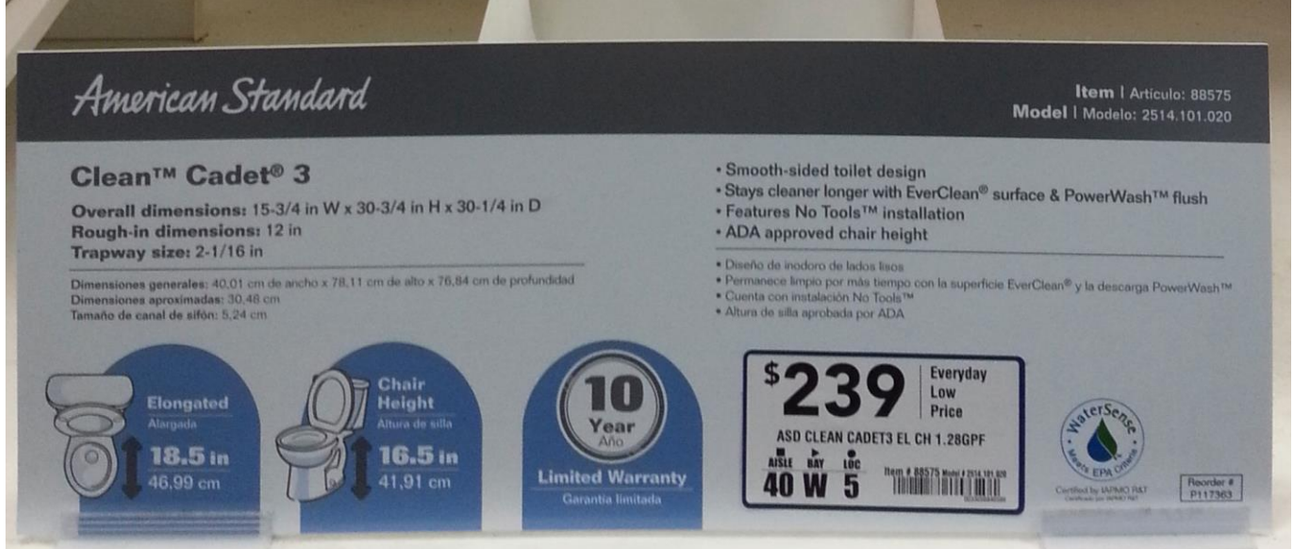
- What do you do when students don't use the strategy you anticipated they would use?


TICKET BOOTH
1 TICKET = $.50
12 TICKETS = $5.00
25 TICKETS = $10.00
50 TICKETS = $25.00
120 TICKETS = $50.00
HAVE FUN!


Dual Flush
Descarga Doble
1.0
gallon flush
for liquids
1.6
gallon flush
for solids
Dual Flush
1.0 gallon flush for liquids
1.6 gallon flush for solids
American Standard
Style That Works Better
LOWE'S
Display


American Standard
Item | Artículo: 84065
Model | Modelo: 3381.216.020
Clean™ Cadet® 3
Overall dimensions: 15 in W x 31 in H x 29-3/4 in D
Rough-in dimensions: 12 in
Trapway size: 2 in
Dimensiones generales: 38,10 cm de ancho x 78,74 cm de alto x 75,57 cm de profundidad
Dimensiones aproximadas: 30,48 cm
Tamaño de canal de sifón: 5,08 cm
• High-efficiency, dual flush toilet—1.6 gal. or 1.0 gal. flush
• Stays cleaner longer with EverClean® surface & PowerWash™ flush
• Features No Tools™ installation
• ADA approved chair height
• Inodoro de descarga doble de alta eficiencia con descarga de 6,06 litros o 3,79 litros
• Permanece limpio por más tiempo con la superficie EverClean® y la descarga PowerWash™
• Cuenta con instalación No Tools™
• Altura de silla aprobada por ADA
Elongated
Alargada
18.5 in
46,99 cm
Chair Height
Altura de silla
16.5 in
41,91 cm
10 Year Año
Limited Warranty
Garantía limitada
$199
Everyday Low Price
CLEAN CADET 3 DUAL FLUSH CH EL H
AISLE 40 W
BAY
LOC 1
Item # 84065
WaterSense
Meets EPA Criteria
Certified by IAPMO R&T
Reorder # P117364

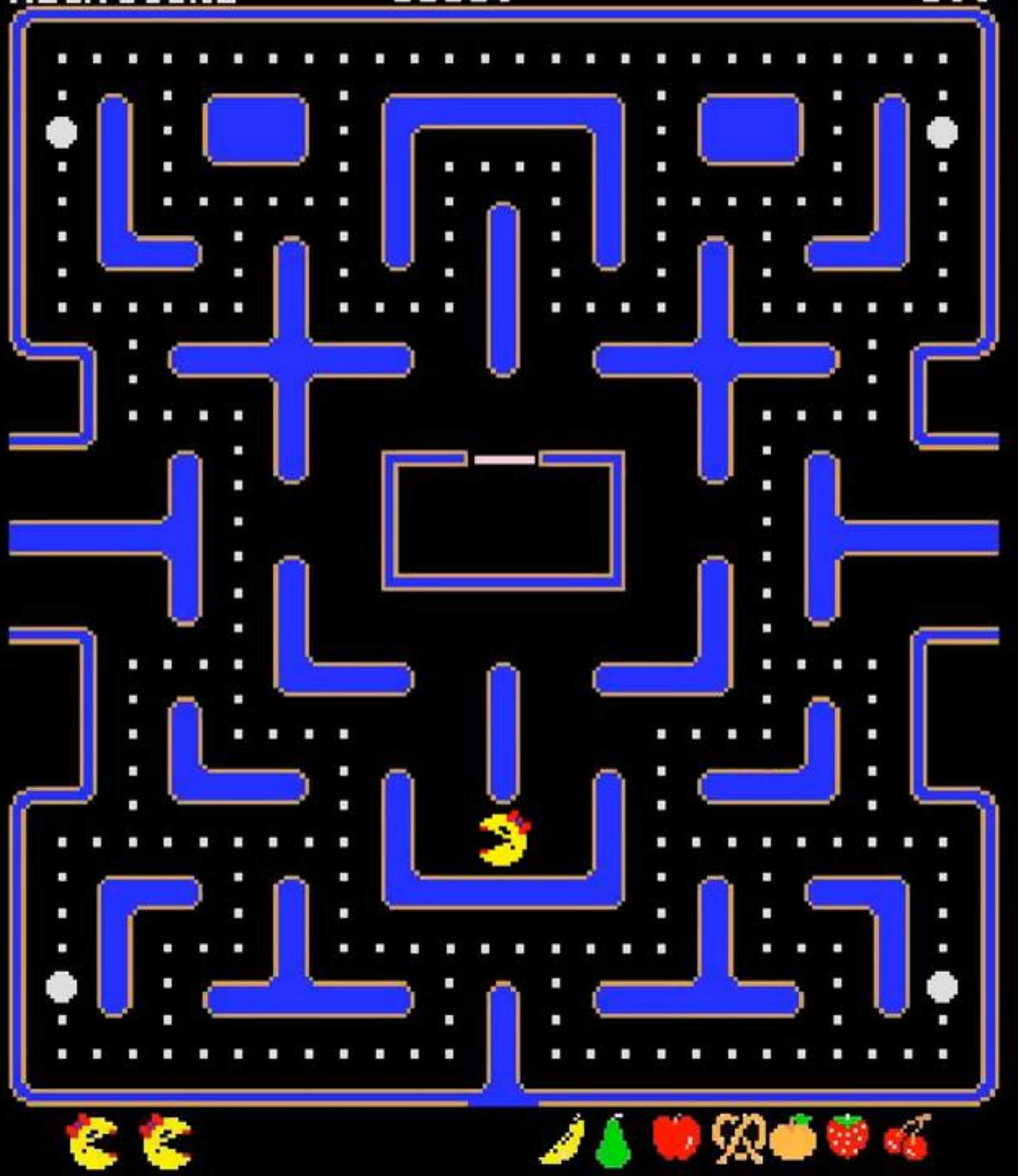

LOWE'S

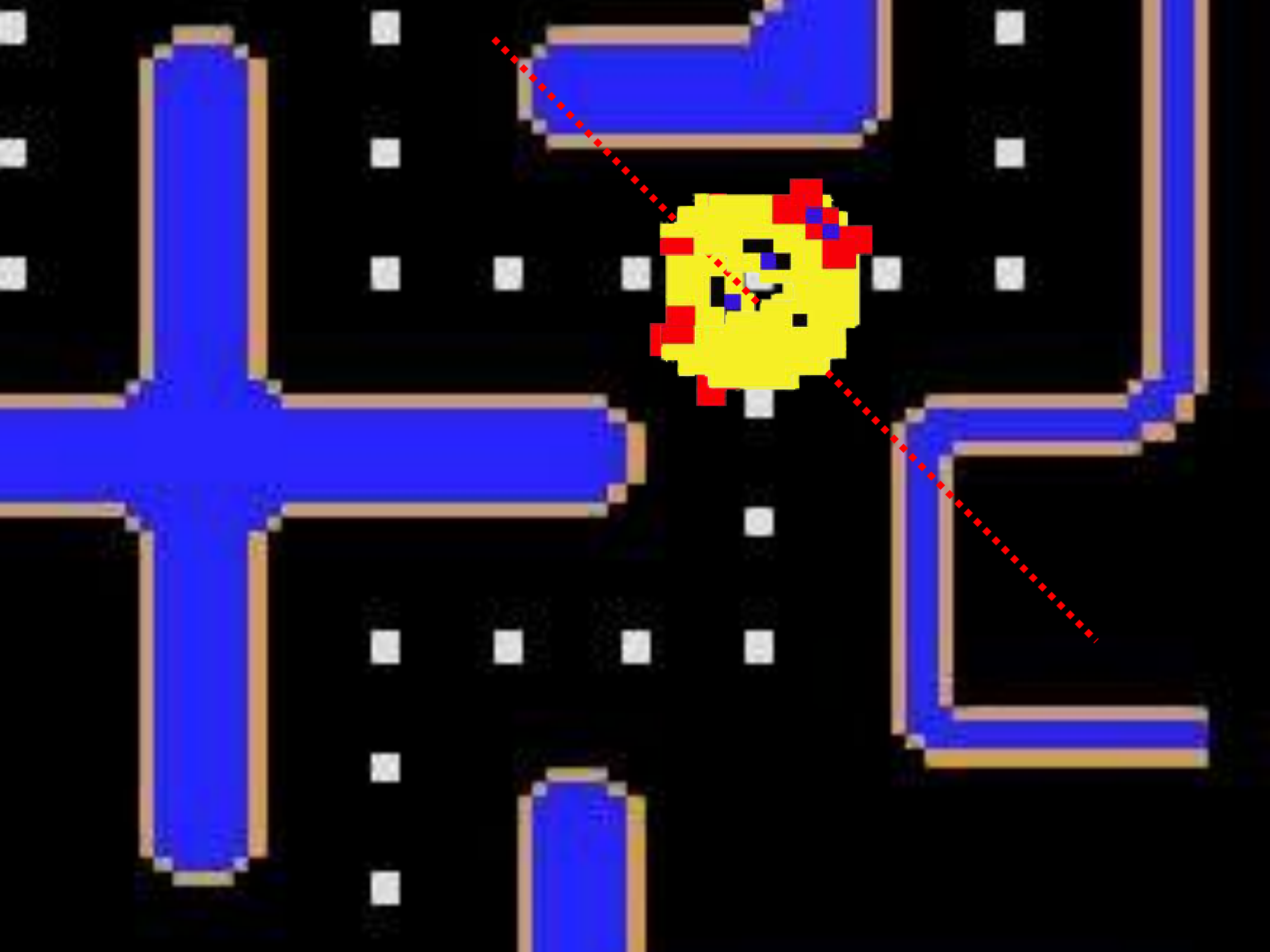

American Standard
Item | Artículo: 88575
Model | Modelo: 2514.101.020
Clean™ Cadet® 3
Overall dimensions: 15-3/4 in W x 30-3/4 in H x 30-1/4 in D
Rough-in dimensions: 12 in
Trapway size: 2-1/16 in
Dimensiones generales: 40,01 cm de ancho x 78,11 cm de alto x 76,84 cm de profundidad
Dimensiones aproximadas: 30,48 cm
Tamaño de canal de sifón: 5,24 cm
• Smooth-sided toilet design
• Stays cleaner longer with EverClean® surface & PowerWash™ flush
• Features No Tools™ installation
• ADA approved chair height
• Diseño de inodoro de lados lisos
• Permanece limpio por más tiempo con la superficie EverClean® y la descarga PowerWash™
• Cuenta con instalación No Tools™
• Altura de silla aprobada por ADA
Elongated
Alargada
18.5 in
46,99 cm
Chair Height
Altura de silla
16.5 in
41,91 cm
10 Year Año
Limited Warranty
Garantía limitada
$239
Everyday Low Price
ASD CLEAN CADET3 EL CH 1.28GPF
AISLE 40 W
BAY
LOC 5
Item # 88575
WaterSense
Meets EPA Criteria
Certified by IAPMO R&T
Reorder # P117363

PROBLEM SOLVING

- What do you do when students don't use the strategy you anticipated they would use?
- What do you do when a student comes up with a strategy for solving the problem that you do not understand?

HIGH SCORE 36550 800






USA

PROBLEM SOLVING

- What do you do when students don't use the strategy you anticipated they would use?
- What do you do when a student comes up with a strategy for solving the problem that you do not understand?
- What do you do when the answer we calculate does not match with the actual answer?
- What do you do when students get stuck during the problem solving process and are not sure what to do?

PROBLEM SOLVING

- What do you do when students don't use the strategy you anticipated they would use?
- What do you do when a student comes up with a strategy for solving the problem that you do not understand?
- What do you do when the answer we calculate does not match with the actual answer?
- What do you do when students get stuck during the problem solving process and are not sure what to do?
- What do you do when you ask students questions and few to no people are ready to respond?

PROBLEM SOLVING

- What do you do when students don't use the strategy you anticipated they would use?
- What do you do when a student comes up with a strategy for solving the problem that you do not understand?
- What do you do when the answer we calculate does not match with the actual answer?
- What do you do when students get stuck during the problem solving process and are not sure what to do?
- What do you do when you ask students questions and few to no people are ready to respond?
- What do you do when the student conclusions are low quality and/or effort?

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Present this coupon.

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Also excludes Dyson vacuums and Miele

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G47QR-V2

BBC31313

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Also excludes Dyson vacuums and Miele

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Ver. 1

What is your conclusion? How did you reach that conclusion?

IA conclusion each conclusion Each Item is good for different Items

instore purchace, exclusions

What is your conclusion? How did you reach that conclusion?

If the Item is $15 use the $5 off because

15-5 = $10 and
15 - 20% = $12

If the Item is $47 it is better to use the 20% off coupon because

47 - 5 = $42 ($5 off) 47 - 20% = 37.60 (20% off)

42 vs 37.60

$5 off 20% off
18 vs 18.40

23 - 5 = 18

23 - 20% = 18.40

	Orange Chicken	5.25	
	Chicken Lo Mein	5.25	
	Cashew Nut Chicken	5.25	
🌶	Pungent Chicken	5.25	
	Sweet & Sour Chicken	5.25	
	Curry Chicken	5.25	
	Lemon Chicken	5.25	
	Vegetable Chicken	5.25	
	Mongolian Beef	5.25	
	Broccoli Beef	5.25	
🌶	Pungent Beef	5.25	
	Sweet & Sour Pork	5.25	

🌶	Eggplant with Garlic Sauce	5.25
🌶	Ma Po Tofu	5.25
🌶	Broccoli with Garlic Sauce	5.25
🌶	String Bean with Garlic Sauce	5.25
	Vegetable Delight	5.25
	Bamboo Fungus Tofu	5.25
	Shrimp with Asparagus	6.25
	Shrimp with Lobster Sauce	6.25
🌶	Fish Fillet with Szuchuan Sauce	6.25
🌶	Fish Fillet with Black Bean Sauce	6.25
	Crab meat with Asparagus	6.25
	Sweet & Sour Shrimp	6.25

FREE ORANGE CHICKEN WITH COUPON
with purchase from $50+tax/up
Not redeemable on lunch & special dinners & party items or with any other coupon
exp. 3/31/07

FREE CHICKEN LO MEIN WITH COUPON
with purchase from $25+tax/up
Not redeemable on lunch & special dinners & party items or with any other coupon
exp. 3/31/07

FREE Cheese Wonton WITH COUPON
with purchase from $25+tax/up
Not redeemable on lunch & special dinners & party items or with any other coupon
exp. 3/31/07

10% OFF WITH COUPON
with purchase from $20+tax/up
Not redeemable on lunch & special dinners & party items or with any other coupon
exp. 3/31/07

10% OFF WITH COUPON
with purchase from $20+tax/up
Not redeemable on lunch & special dinners & party items or with any other coupon
exp. 3/31/07

Free ~~lo~~ chicken lomein
if spended $25 and not redeemable
on lunch, special dinners and
Party Items

and chicken to main.

What is your conclusion? How did you reach that conclusion?

The 10% coupon is best with high Prices and small orders is best with the free chicken lomein or chesse wonton

What is your conclusion? How did you reach that conclusion?

You can use the 10% off when you pay 20-24.99 or more the Free chicken LoMein when you pay 25-49.99 or more and the Free orange Chiken when you pay 50 or more

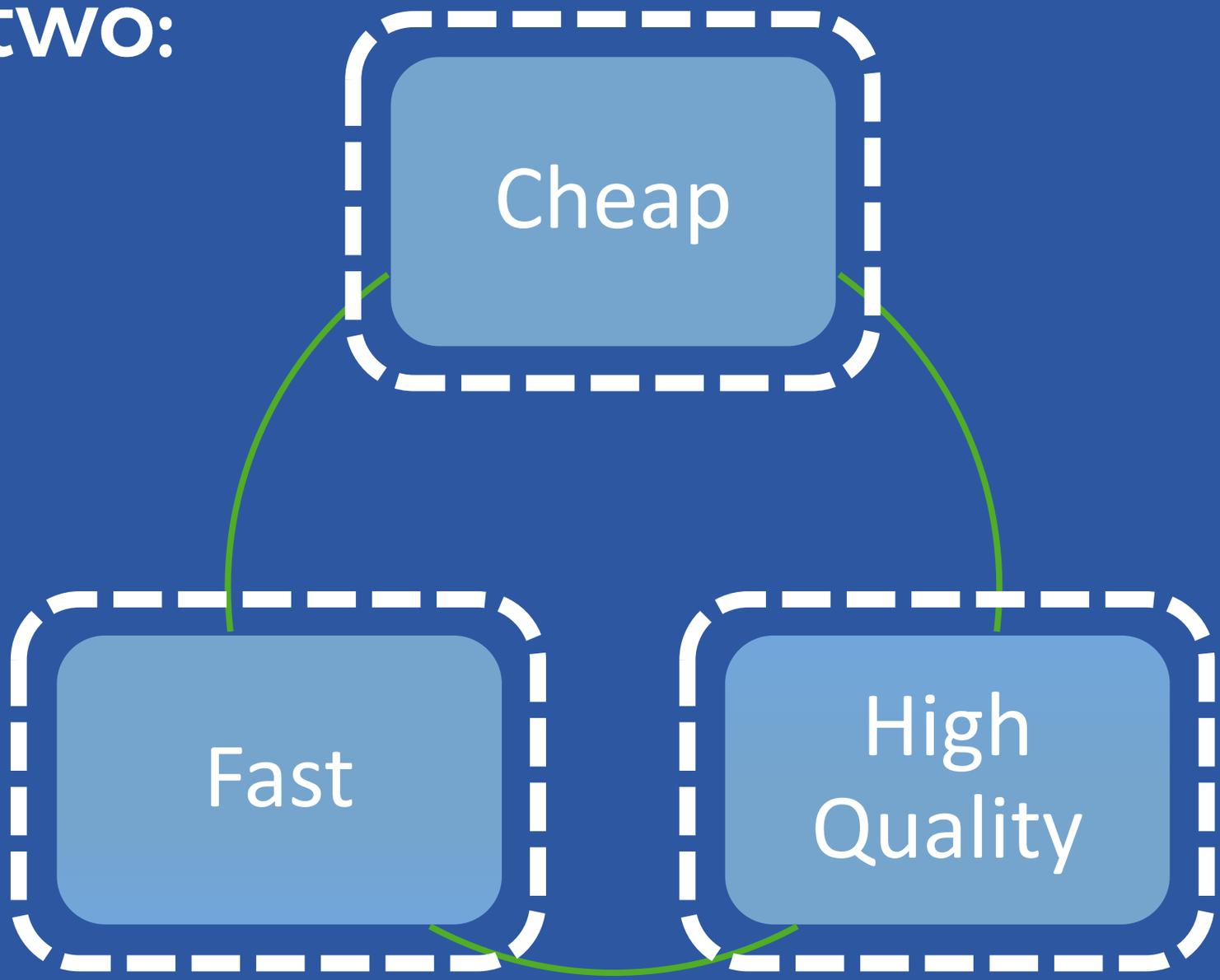
GOALS

- ☑ ENGAGING PROBLEM SOLVING
- ☑ REAL WORLD PROBLEM-BASED LEARNING
- ☑ HIGHER DEPTH OF KNOWLEDGE PROBLEMS
- ☑ BETTER IMPLEMENTATION
- ☑ IMPROVE QUESTION ASKING
- ☑ PRACTICE PREPARING FOR A LESSON
- ☑ DEAL WITH UNCOMFORTABLE SITUATIONS

RobertKaplinsky.com

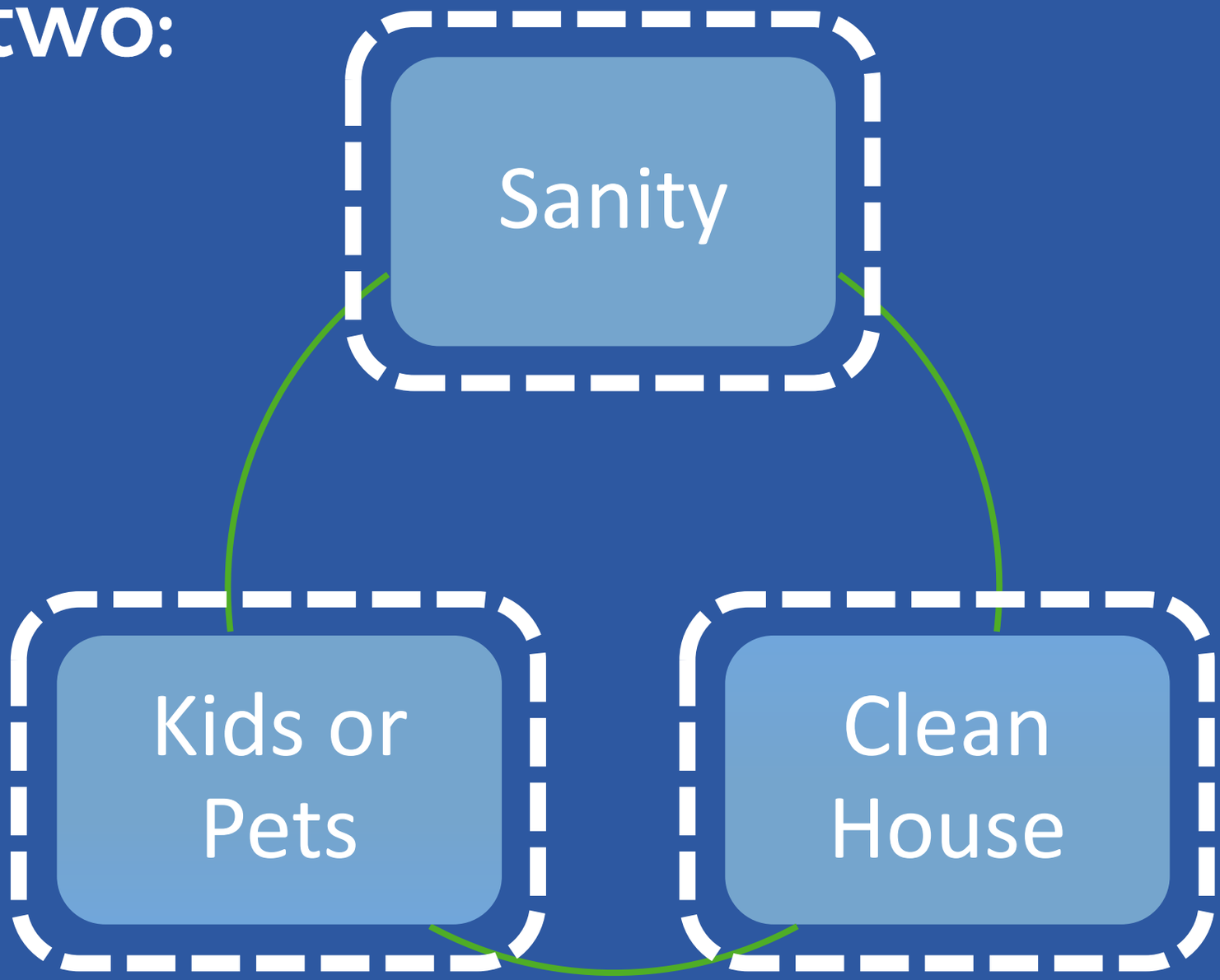
CONSTRUCTION

- Pick two:



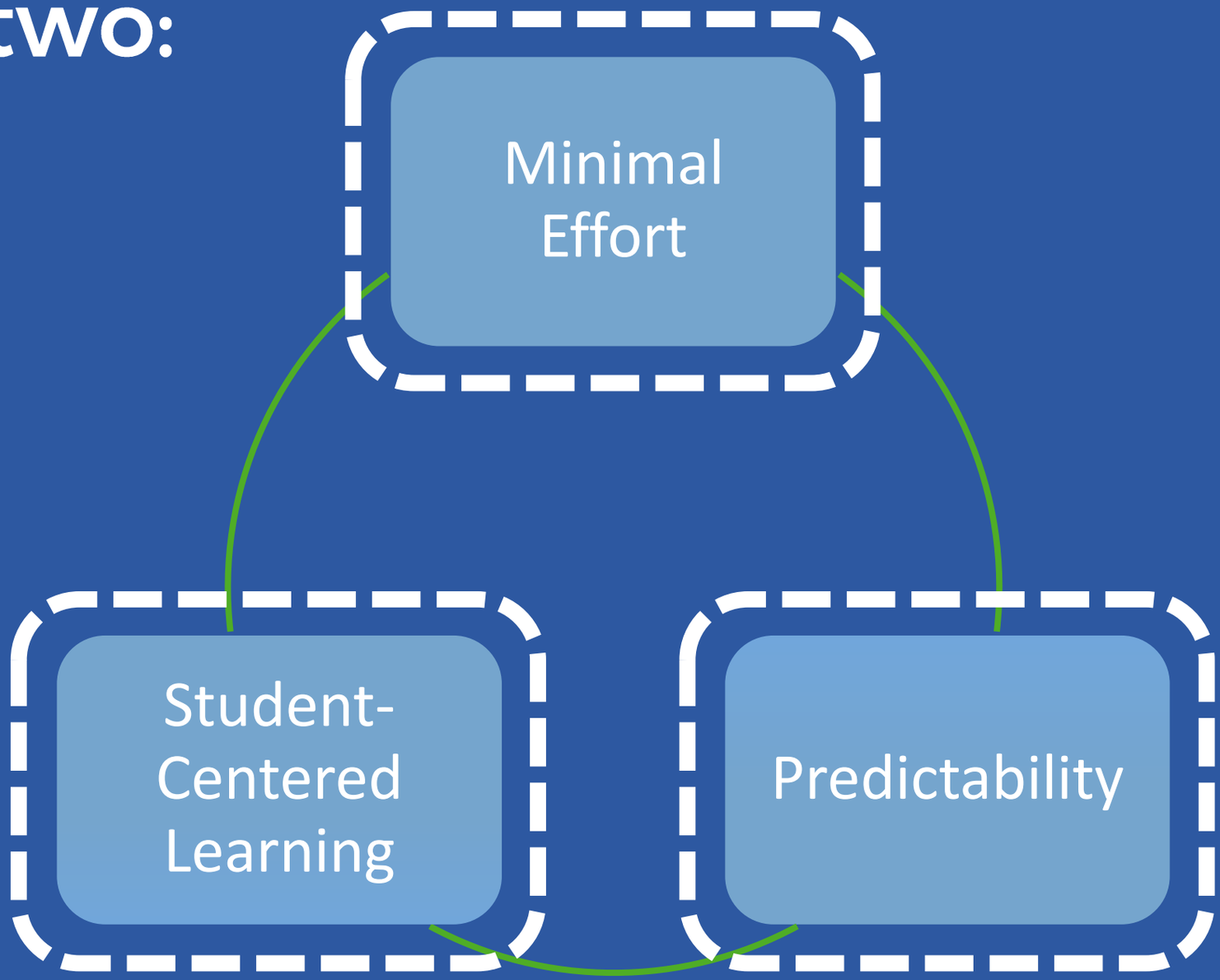
FAMILY

- Pick two:



PROBLEM-BASED LEARNING

- Pick two:



CALL TO ACTION

- Implement one problem-based lesson in your classroom in the next two weeks of school.
- Implement one DOK 2 or DOK 3 problem in your classroom in the next two weeks of school.

EMPOWERED PROBLEM SOLVING

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