RICH REAL WORLD PROBLEMS

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GOALS

- ❑ WHAT IS A REAL WORLD PROBLEM?
- ❑ HOW DO STUDENTS RESPOND?
- ❑ WHY DO PEOPLE USE THEM?
- ❑ HOW DO I INCORPORATE THEM?
- ❑ FREQUENTLY ASKED QUESTIONS
- ❑ WHERE CAN I FIND MORE?

ALTO

SINKHOLE DIMENSIONS

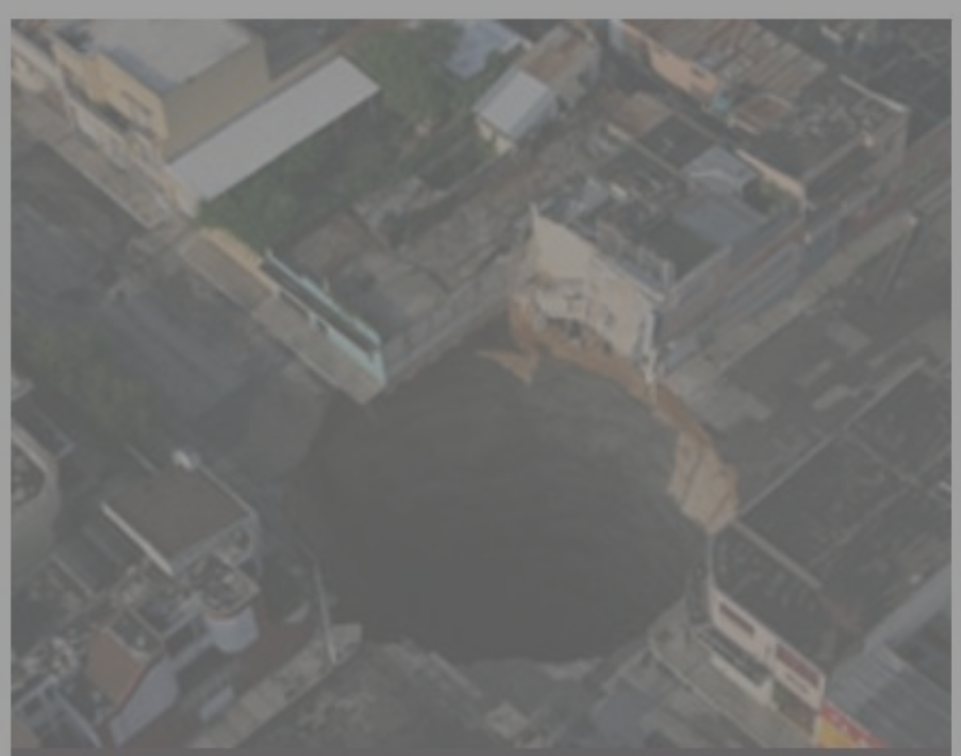
- Slate Magazine
  - “A sinkhole, 65 feet across and 100 feet deep”

How To Fix a Giant Sinkhole

The cement method vs. the graded-filter technique.

18 0

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.

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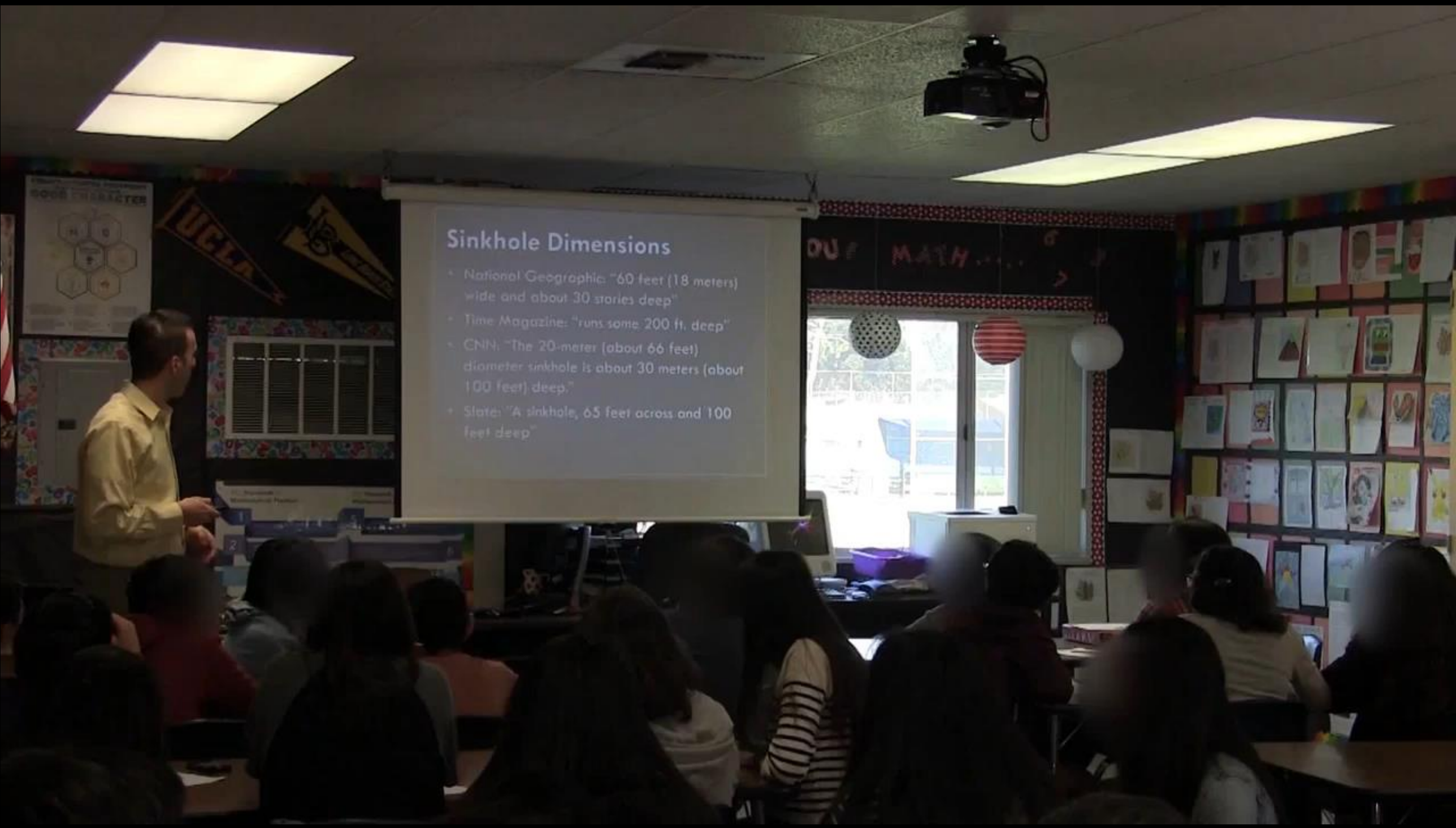
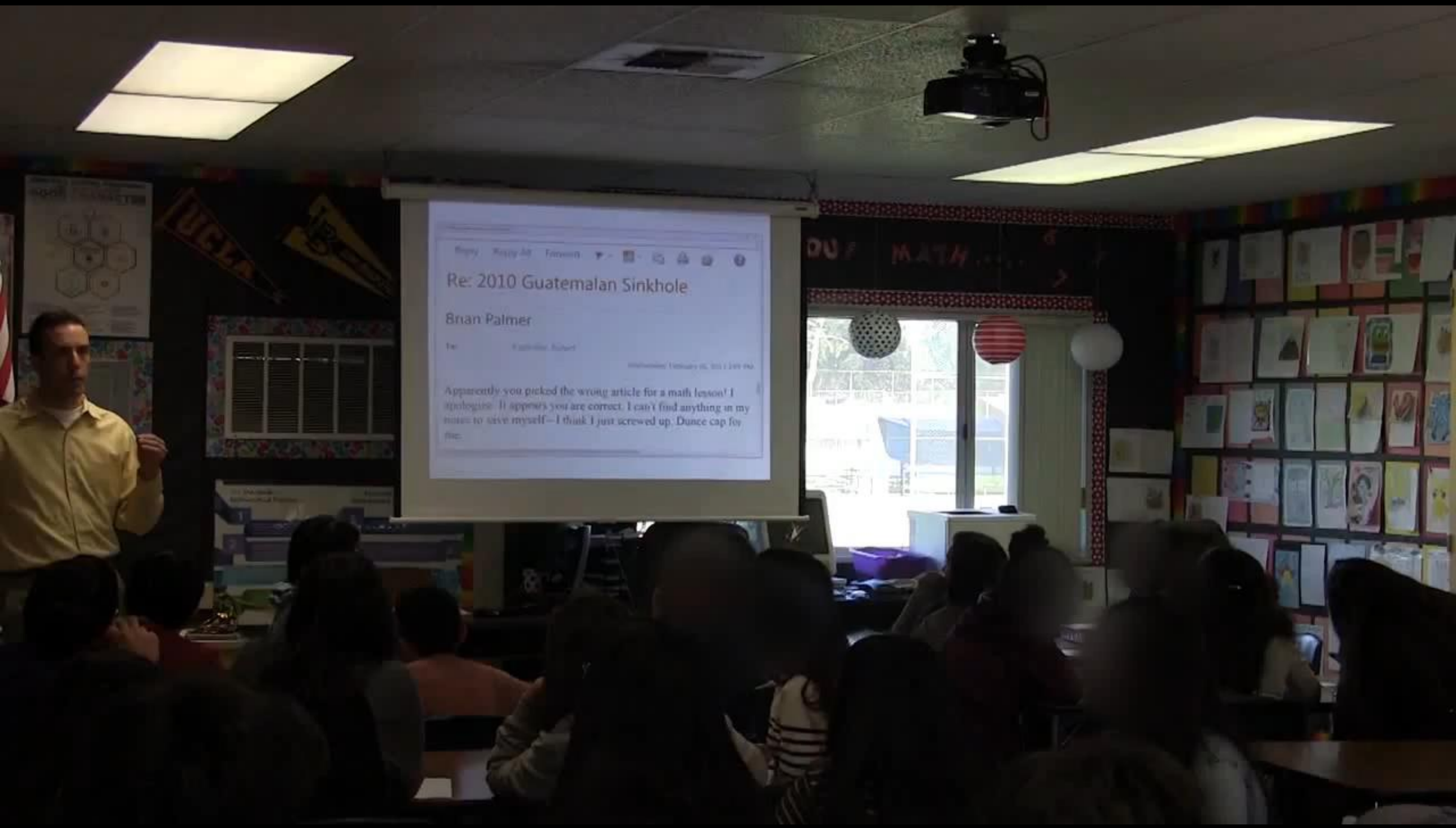

Sinkhole Dimensions
• National Geographic: "60 feet (18 meters) wide and about 30 stories deep"
• Time Magazine: "runs some 200 ft. deep"
• CNN: "The 20-meter (about 66 feet) diameter sinkhole is about 30 meters (about 100 feet) deep."
• Slate: "A sinkhole, 65 feet across and 100 feet deep"


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

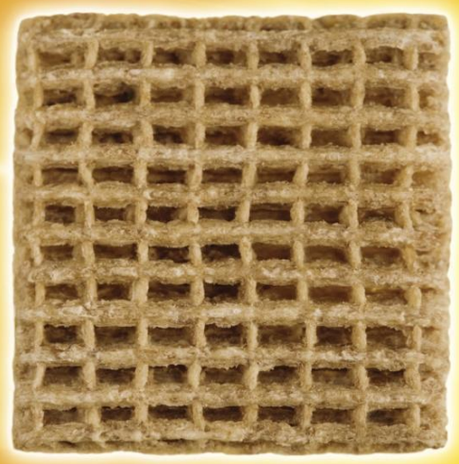
- “I didn’t say anything when we were shown the ‘right’ answer because I thought that it must be right because he’s the author, but I knew in my mind he was actually wrong.”
- “I think that I should be the one who argues for my opinion, not just listening to others and accepting that my answer is wrong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

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

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

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WHY ARE YOU USING?

Introduce a new concept

- Best Case:
  - Great context for beginning a unit
- Worst Case:
  - What was the purpose of this problem?
  - Why didn't you finish it?
  - Why didn't you let students struggle through it?
  - Did the teacher end the problem because he or she was confused and gave up?

WHY ARE YOU USING?

Productive struggle

- Best Case:
  - Students worked hard and made connections
- Worst Case:
  - Why did the teacher let the students sit there confused instead of telling them what to do?
  - Did the students even learn anything because they never figured out the answer?
  - Why didn't the teacher finish the problem? Did she lose track of time?

WHY ARE YOU USING?

Problem completion

- Best Case:
  - Everyone experienced a complete problem.
- Worst Case:
  - Who did the work today: the students or teacher?
  - Why did the teacher not see all those great opportunities for students to make their own connections and take advantage of them?
  - Why did the teacher give such obvious hints and tell them what to do?

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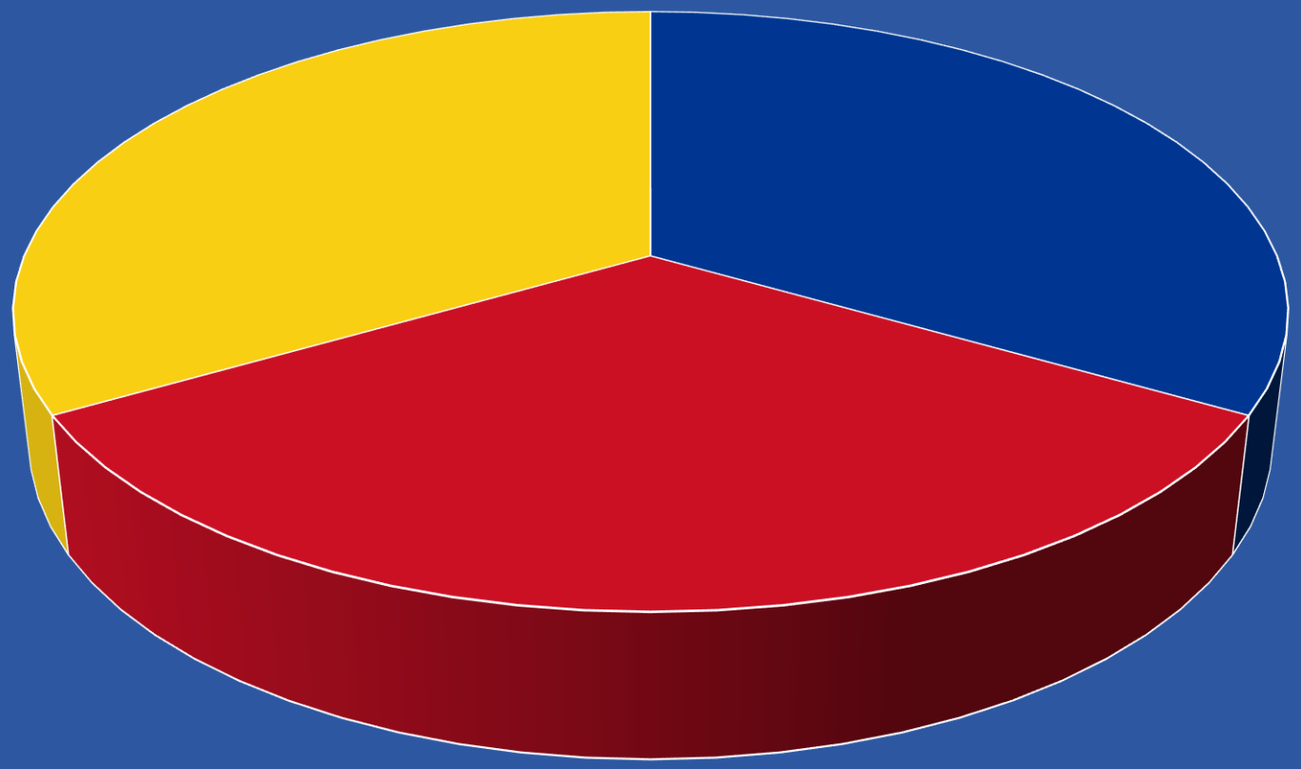
h

πr^2

CCSS 8.G.9

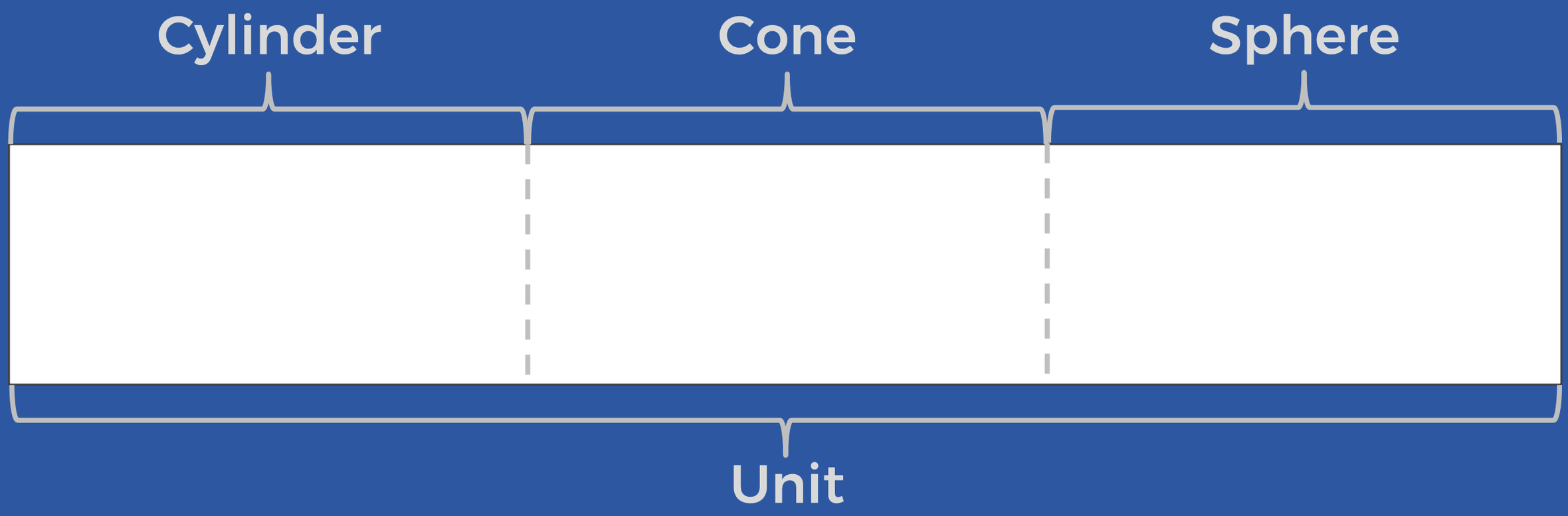
- Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

INTENSITY BREAKDOWN



- Procedural Skills & Fluency
- Conceptual Understanding
- Application

SETTING UP THE UNIT

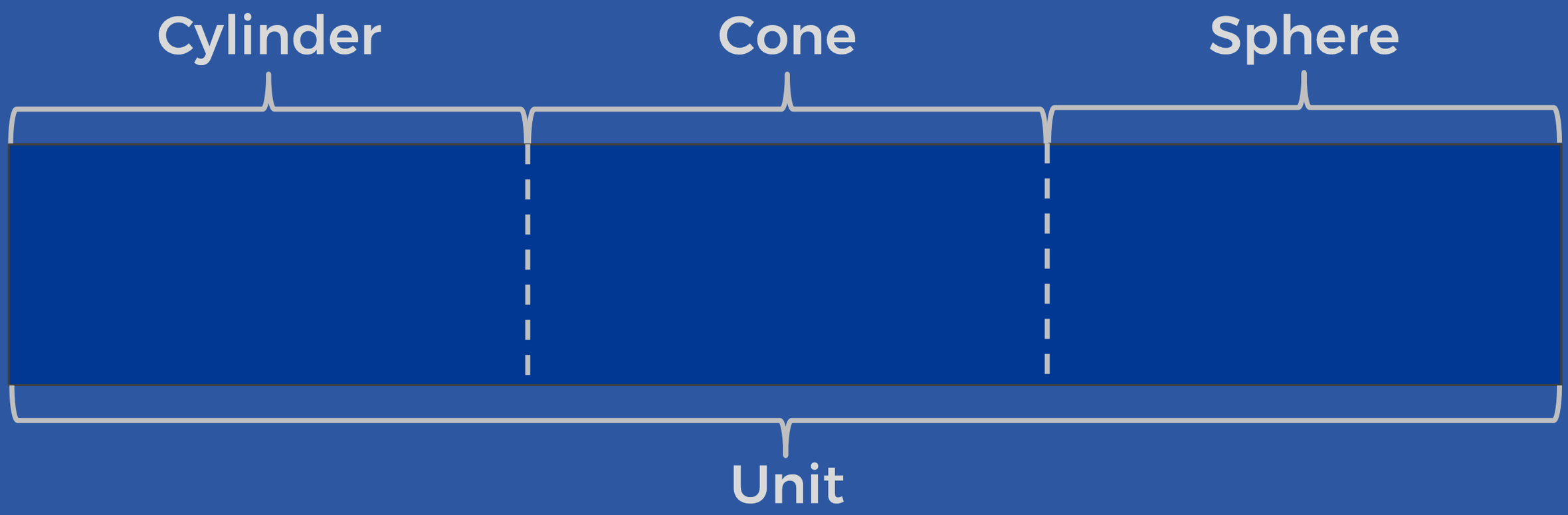


Procedural

Conceptual

Application

HOW I USED TO TEACH

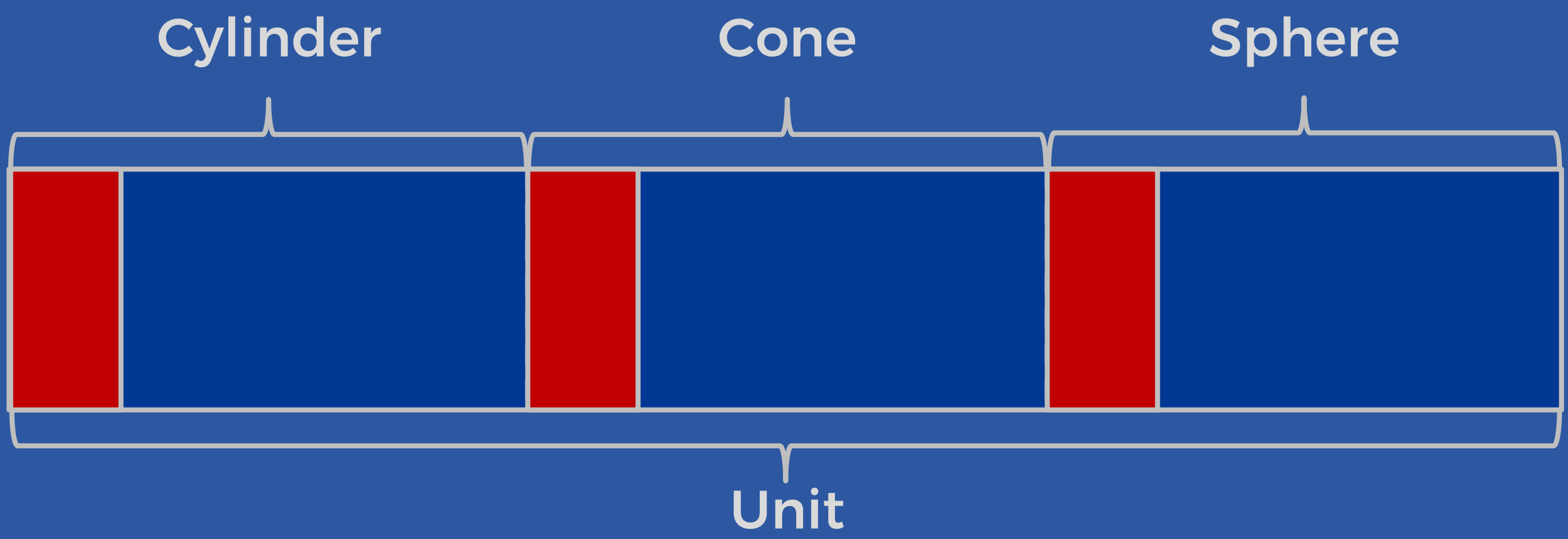


Procedural

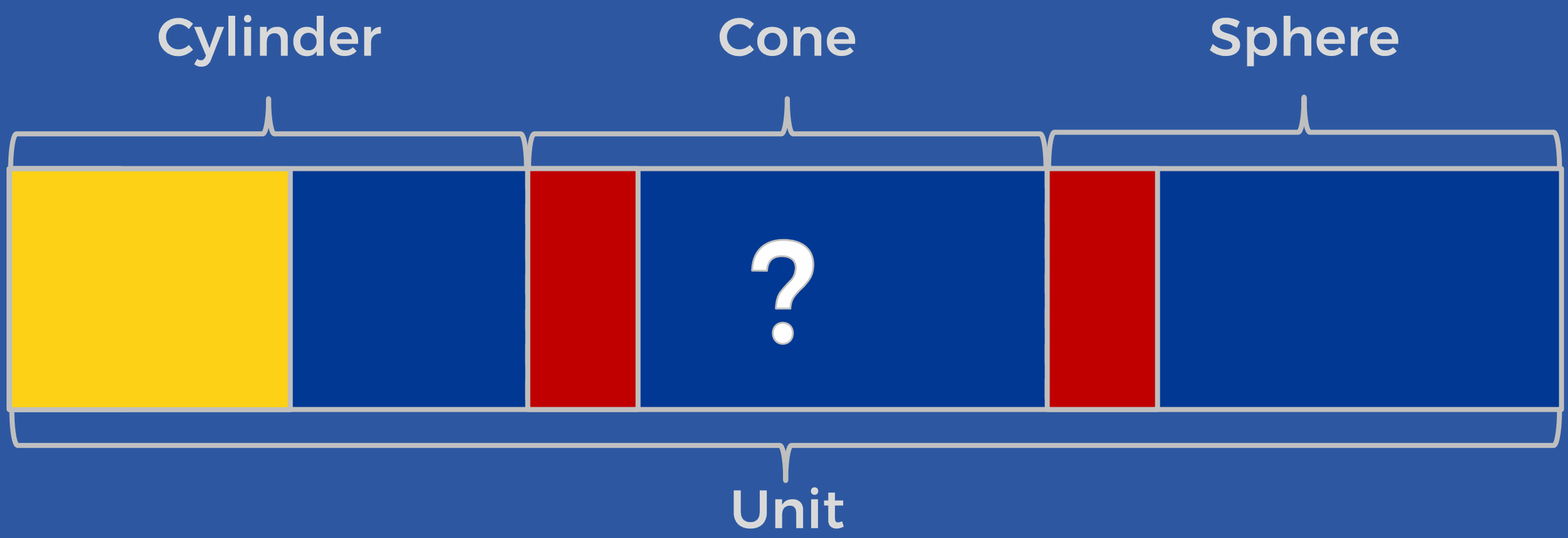
Conceptual

Application

NEXT CAME CONCEPTUAL



WHERE'S APPLICATION?

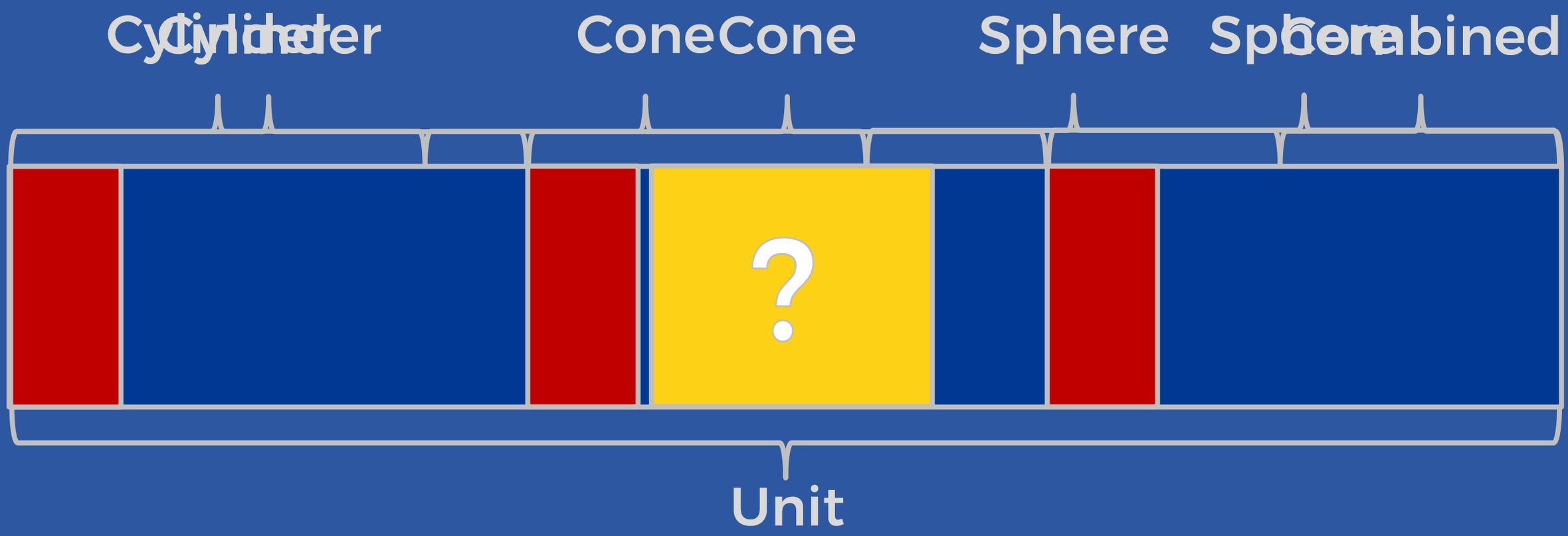


Procedural

Conceptual

Application

OPTION 1: DO AT THE END

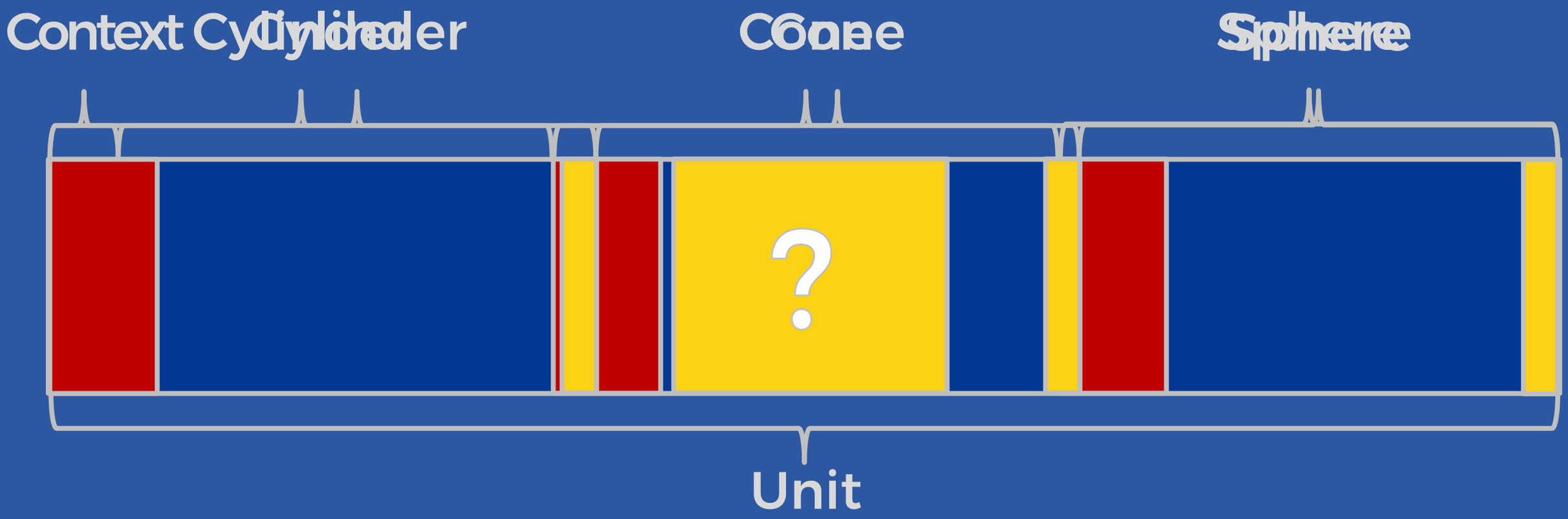


Procedural

Conceptual

Application

OPTION 2: EVERYWHERE



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PROBLEM-BASED FAQ

- How long do problem based lessons take?
- How do I write an objective for a problem-based lesson?

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)

PROBLEM-BASED FAQ

- How long do problem based lessons take?
- How do I write an objective for a problem-based lesson?
- How is problem-based learning assessed?

ASSESSING WORK?

- Option #1 – Don’t assess the problem
- Option #2 – Use general purpose rubric
- Option #3 – Use a problem-specific rubric
- Option #4 – Use a practice-specific rubric

GENERAL PURPOSE

- One point for reaching the correct conclusion
- One point for providing sufficient reasoning to support the conclusion.

What is your conclusion?

In order to solve this problem, you need the width and the height of the hole. Once you have it you plug them into the equation $r^2\pi.h$ which is to find the volume. Once you find the volume you will know how much cement you will need to order so that you could fill that hole, which in this case would be 342, 119 feet of cement.

What is your conclusion?

This particular sinkhole in Guatemala City, was about 20 meters (66 feet) in diameter and about 30 meters (100 feet) deep. We are trying to find the volume of the hole to figure out how much material is needed to fill it. I used the cylinder volume formula ($V = \pi r^2 h$). When you plug in the radius and the height, you get $V = \pi (33)^2 (100)$. I did not use 66 as my radius, because that is my diameter. Radius is half of the diameter. After you solve, you are left with 342,119.44 ft^3. You don't use ft^2 or ft because the hole is 3 dimensional. From here on, you just use the material cost and amount to find the price of the job.

What is your conclusion?

In order to fill the sinkhole with cement. They will need 342,119 ft^3 of cement. How is this possible?

Diameter - 66 feet, but we are looking for radius.

66/2 = 33 Now we got our radius which is 33.

r=33

Depth = 100 feet.

So we have a radius and height. we can use the volume of a cylinder formula. which is $V = \pi r^2 h$

$V = \pi(33)^2 \cdot 100$

$V = \pi(1089) \cdot 100$

$V = 3421.20$

$V = 342119.44$

PROBLEM-SPECIFIC

Requirement	Points Possible	Points Earned
Student finds the correct numerical value based on the dimensions used.	3	
Student uses the correct units (i.e., cubic feet/meters for volume and feet/meters for length).	1	
Student correctly uses half the diameter for the radius & explains why.	2	
Student creates a narrative using sentences to explain his or her reasoning.	2	

Correct # value	___ / 3	Explains $\frac{d}{2} = r$	___ / 2
Correct units	___ / 1	Narrative w/ sentences	___ / 2

What is your conclusion?

In order to solve this problem, you need the width and the height of the hole. Once you have it you plug them into the equation $r^2\pi.h$ which is to find the volume. Once you find the volume you will know how much ~~concrete~~ cement you will need to order so that you could fill that ~~hole~~ cement hole, which in this case would be 342, 119 feet of ~~concrete~~ cement.

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PRACTICE-SPECIFIC

Requirement	Points Possible	Points Earned
Student explains how equations, words, pictures, and/or symbols are connected.	2	
Student does not just state steps taken, but convinces reader that the steps they took are a correct way to approach problem.	2	
Student carefully specifies units of measure and uses it consistently in conclusion.	1	
Student accurately calculates a numerical value for the answer.	3	

Explained connections	___ / 2	Convinced others	___ / 2
Calculated accurately	___ / 3	Specified units	___ / 1

What is your conclusion?

In order to solve this problem, you need the width and the height of the hole. Once you have it you plug them into the equation $r^2\pi.h$ which is to find the volume. Once you find the volume you will know how much [redacted]e you will need to order so that you could fill that [redacted] cement hole, which in this case would be 342, 119 feet of [redacted] cement.

Explained connections	___ / 2	Convinced others	___ / 2
Calculated accurately	___ / 3	Specified units	___ / 1

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Calculated accurately	___ / 3	Specified units	___ / 1

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PROBLEM-BASED FAQ

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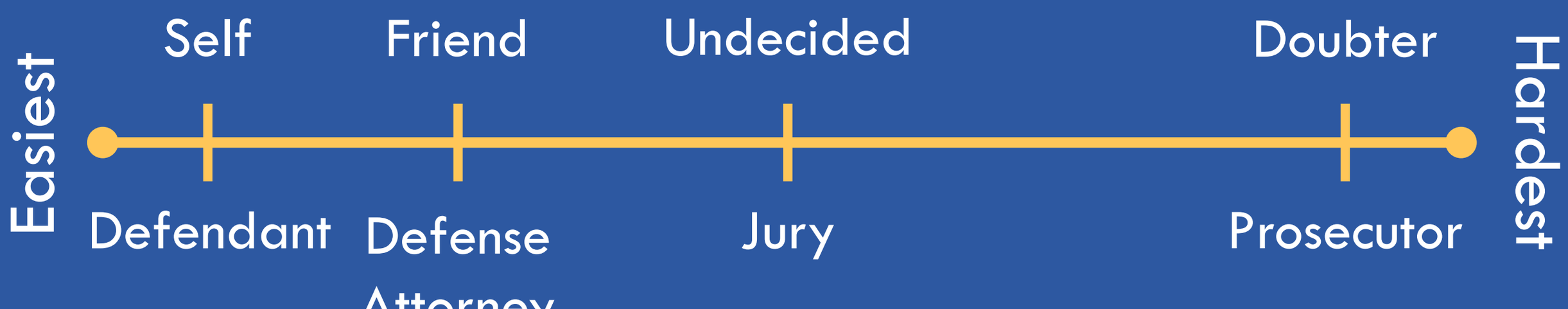
LEVELS OF CONVINCING



Construct a viable argument

Critique the reasoning of others

Inspired by *Connecting Mathematical Ideas* by Jo Boaler and Cathy Humphreys

RobertKaplinsky.com

PROBLEM-BASED FAQ

- How long do problem based lessons take?
- How do I write an objective for a problem-based lesson?
- How is problem-based learning assessed?
- How do I get students to explain their reasoning?
- Why shouldn't I use other problem solving methods?

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

What problem are you trying to figure out?	What guesses do you have?
What do you already know from the problem?	**What do you need to know to solve the problem?**

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

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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.

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

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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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

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robertkaplinsky.com/addingitup

@robertkaplinsky