Rich Real World Problems

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ALTO

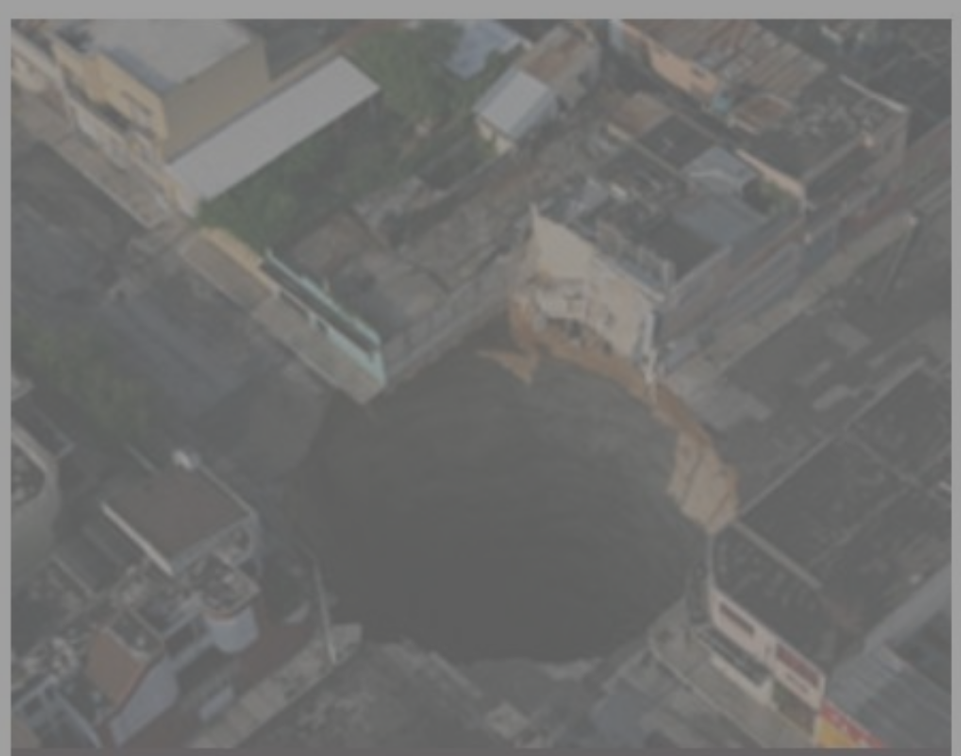
Sinkhole Dimensions

- 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”

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

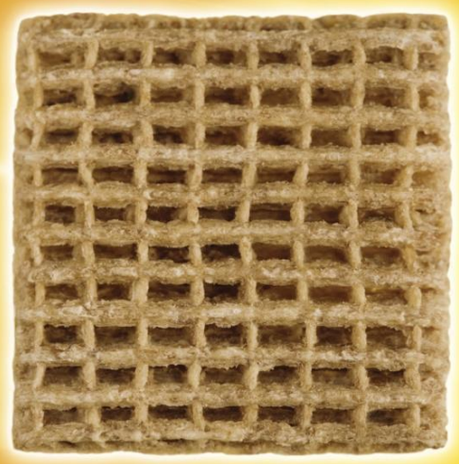
Re: 2010 Guatemalan Sinkhole

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.



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

h

πr^2

The Reality

- Some students felt anxious about not having the exact dimensions.
- Depending on how much extra information I gave them, students modeled the problem differently:
  - Cylinder
  - Semi-sphere
  - Truncated cone
- Students struggled with precision when dealing with multiple units:
  - feet vs. square feet vs. cubic feet
  - feet vs. meters vs. stories
- Many students doubted themselves when they saw that the “answer” was 6,500 cubic feet.

STUDENT WORK

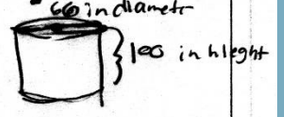
What problem are you trying to figure out?

What is the volumen of the sink hole

What do you already know from the problem?	What do you need to know to solve the problem?
-It needs to be filled with materials such as rocks, cement and dirt. -Circular Shape (cylinder)	· How deep is it? - How wide? - How much materials are used to fill the hole?

What is your conclusion?

First In order to gain a general idea of my question I drew an image to represent my given measurements.



Then I used the equation formula to find the volume of a cylinder. Which was $\pi r^2 . h$. I use this equation because I needed to find how much cement was need to fill the hole. My equation looks like this $\pi 33 r^2 . 100$ (radius, height). Then I pluged it into my calculator and I got $342,119 ft^3$.

How Do We Assess Student Work?

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

Option #2 - General Purpose Rubric

- For full credit (2 points):
  - Student reaches the correct conclusion.

    AND
  - Student provides sufficient reasoning to support this conclusion.
- For partial credit (1 point):
  - Student reaches the correct conclusion but does not provide sufficient reasoning to support this conclusion.

    OR
  - Student does not reach the correct conclusion but provides reasoning to support this conclusion that contains a minor conceptual or computation error.

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 $V = \pi r^2 h$

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

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

$V = 3421.20$

$V = 342119.44$

Option #3 - Problem-Specific Rubric

Requirement	Possible Points	Points Earned
Student finds the correct answer 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 and explains why.	2	
Student creates a narrative using sentences to explain his or her reasoning.	2	

Correct answer	___ / 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 [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.

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

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.

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

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.

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Problem-Based Lesson Resources

- Problem-based lesson search engine: http://robertkaplinsky.com/prbl-search-engine/
- My lessons: http://www.robertkaplinsky.com/lessons
- Dan Meyer: http://threeacts.mrmeyer.com
- Andrew Stadel: http://tinyurl.com/mrstadel
- Graham Fletcher: http://gfletchy.com/3-act-lessons/
- Geoff Krall: http://tinyurl.com/PrBLmaps
- Dan Meyer's TED talk: http://tinyurl.com/meyer-TED

Why Choose Us?

1 Math content expert

Robert graduated from University of California, Los Angeles (UCLA) with a Bachelors of Science in Mathematics. He has taught mathematics to students at the elementary, middle, and high school levels. As an instructor for UCLA, he also taught math

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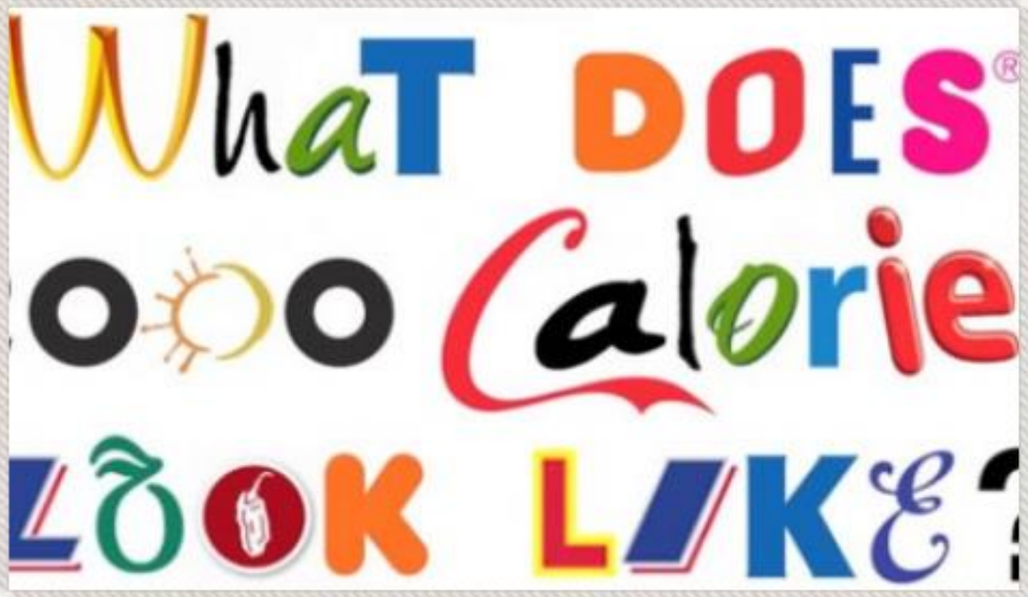
All Kinder 1st 2nd 3rd 4th 5th 6th 7th 8th Alg Func Geo Modeling Numb & Quant Stats & Prob

How Many Hot Dogs And Buns Should He Buy?



What Does 2000 Calories Look Like?

Robert Kaplinsky's Problem-Based Lessons

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

	A	B	C	D	E	F
1	Task Name	Concept / Skill	Standard 1	Standard 2	Standard 3	Standard 4
2	How Can We Water All Of The Grass?	Circles, Pythagorean Theorem, trigonometric ratios	7.G.4	8.G.7	G-SRT.8	G-MG.1
3	How Much Money IS That?!	Volume of rectangular prism	5.MD.3	5.MD.4	5.MD.5	5.MD.5b
4	How Much Money Should Dr. Evil Demand?	Exponential Growth	N-RN.2	A-SSE.1	A-SSE.3c	A-SSE.4
5	How Tall Is Mini-Me?	Scale and Dividing Decimals	5.NF.5	5.NF.5a	5.NF.5b	6.NS.3
6	How Did They Make Ms. Pac-Man?	Transformations (Rotations, Reflections, and Translations)	8.G.1	8.G.2	8.G.3	8.G.4
7	Which Ticket Option Is The Best Deal?	Unit Rates and Ratios	6.RP.2	6.RP.3	6.RP.3a	6.RP.3b
8	How Far Apart Are The Freeway Exits?	Fractions on a Number Line and Subtracting Fractions	3.NF.2	3.NF.2b	4.NF.2	4.NF.3a
9	Do We Have Enough Paint?	Area	3.MD.5	3.MD.6	3.MD.7	
10	How Many Stars Are There In The Universe?	Scientific Notation	8.EE.3	8.EE.4		
11	What Rides Can You Go On?	Inequalities and Measurement	2.MD.1	6.NS.7a	6.NS.7b	
12	Do You Have Enough Money?	Money	2.MD.8			
13	Which Bed Bath & Beyond Coupon Should You Use?	Percent Discount	7.RP.3			
14	Is Gas Cheaper With Cash Or Credit Card?	Percent Discount	7.RP.3			
15	Where's The Nearest Toys R Us?	Pythagorean Theorem (Distance in coordinate system)	8.G.8	G-SRT.8	G-GPE.7	
16	How Sharp Is The iPhone 5's Retina Display?	Pythagorean Theorem (Length of a side)	8.G.7	G-SRT.8	G-GPE.7	
17	When Should She Take Her Medicine?	Operations with Time Intervals	4.MD.2			
18	How Big Are Sunspots?	Converting Units, Proportions, and Scientific Notation	5.MD.1	7.RP.2	7.G.4	8.EE.4
19	What Michael's Coupon Should I Use?	Percent Discount	7.RP.3	A-CED.3		
20	Is It Cheaper To Pay Monthly or Annually?	Decimal Operations and/or Systems of Equations	5.NBT.7	8.EE.8c	A-CED.3	A-REI.11
21	How Big Is The 2010 Guatemalan Sinkhole?	Volume of Cylinder	5.MD.3	5.MD.4	5.MD.5	8.G.9
22	How Can You Win Every Prize At Chuck E. Cheese's?	Decomposing Numbers and/or Systems of Equations	2.NBT.7	3.NBT.2	3.NBT.3	8.EE.8c
23	How Many Royal Flushes Will You Get?	Probability	7.SP.5	7.SP.6	7.SP.7	S-MD.5
24	How Much Does The Paint On A Space Shuttle Weigh?	Surface Area	6.G.4	7.G.6	8.G.7	G-MG.1
25	How Did Motel 6 Go From $6 to $66?	Percent Increase and Compound Interest	7.RP.3	A-SSE.1b	F-BF.1	F-IF.8b
26	How Much Does The Aluminum Foil Prank Cost?	Surface Area and Unit Rates	6.G.4	6.RP.2	6.RP.3	7.G.6
27	How Many Laps Is A 5k Race?	Perimeter	4.MD.3			
28	Which Toilet Uses Less Water?	Systems of Equations/Inequalities	8.EE.8c	A-CED.3	A-REI.11	F-BF.1
29	How Did Someone Get A $103,000 Speeding Ticket In Finland?	Linear Equations	A-CED.2	F-BF.1	F-IF.4	F-IF.6
30	Which Pizza Is A Better Deal?	Area or Circle, Square, and Unit Rates	3.MD.5	3.MD.6	3.MD.7	4.MD.3
31	How Big Is The World's Largest Deliverable Pizza?	Area of Square	3.MD.5	3.MD.6	3.MD.7	4.NBT.3
32	How Many Sheets Do You Need To Break Out Of Prison?	Integer Operations	5.NBT.6			
33	Do Hybrid Cars Pay For Themselves?	Systems of Equations or Rates	6.RP.2	6.RP.3	8.EE.8c	A-CED.3
34	How Many Hot Dogs Did They Eat?!	Linear and Quadratic Functions	8.F.3	8.F.4	F-BF.1	F-BF.2
35	How Much Purple Ribbon Will You Need?	Perimeter & Circumference	3.MD.8	4.MD.3	7.G.4	
36	Are We There Yet?	Adding Times	3.MD.1	4.MD.2		
37	Which Chinese Food Coupon Should I Use?	Percent Discount	7.RP.3			
38	How Big Is The Vehicle That Uses Those Tires?	Ratio and Proportions	7.RP.2			
39	Where Would The Angry Birds Have Landed?	Create Equation From Quadratic Graph	A-CED.1	F-BF.1	F-IF.4	F-IF.7a
40	How Many Movies Can You See In One Day?	Adding Times	3.MD.1	4.MD.2		
41	Which Carrots Should You Buy?	Unit Rates	6.RP.1	6.RP.2	6.RP.3	
42	How Fast Can You Throw A Baseball?	Converting Units and Unit Rates	5.MD.1	6.RP.2		

Problem-Based Lesson Search Engine

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

Submit

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

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

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