# Hall County Schools

Robert Kaplinsky

July 30, 2014


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

| | |
|---|---|
| DblDbl | 2.65 |
| 98 Meat Pty XChz | 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

| | |
|---|---|
| DblDbl | |
| 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 |

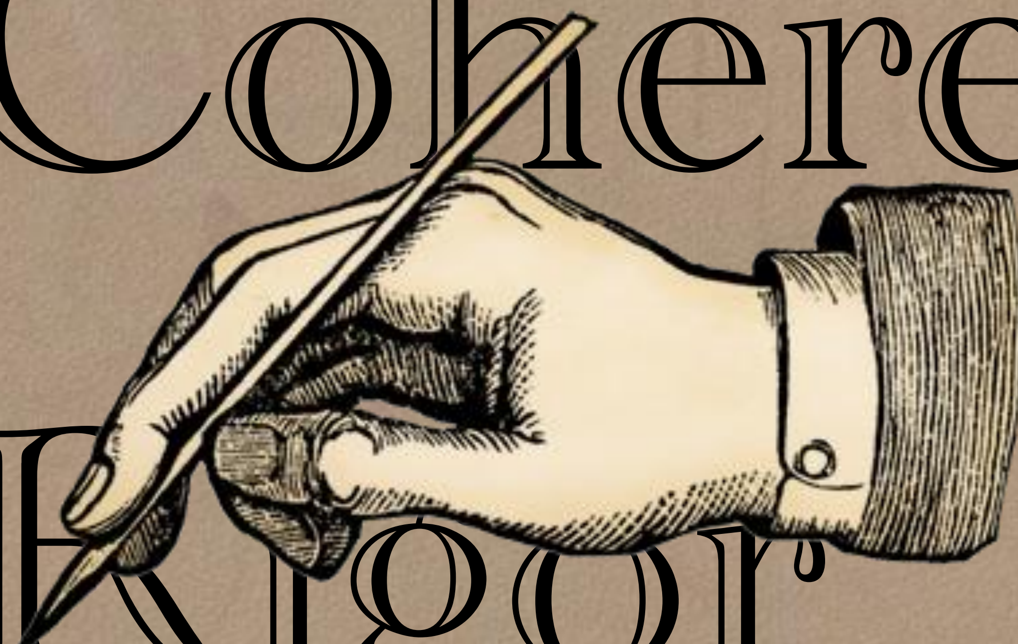
2004-10-31

8:21 PM

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

- Fo

- 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 |

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

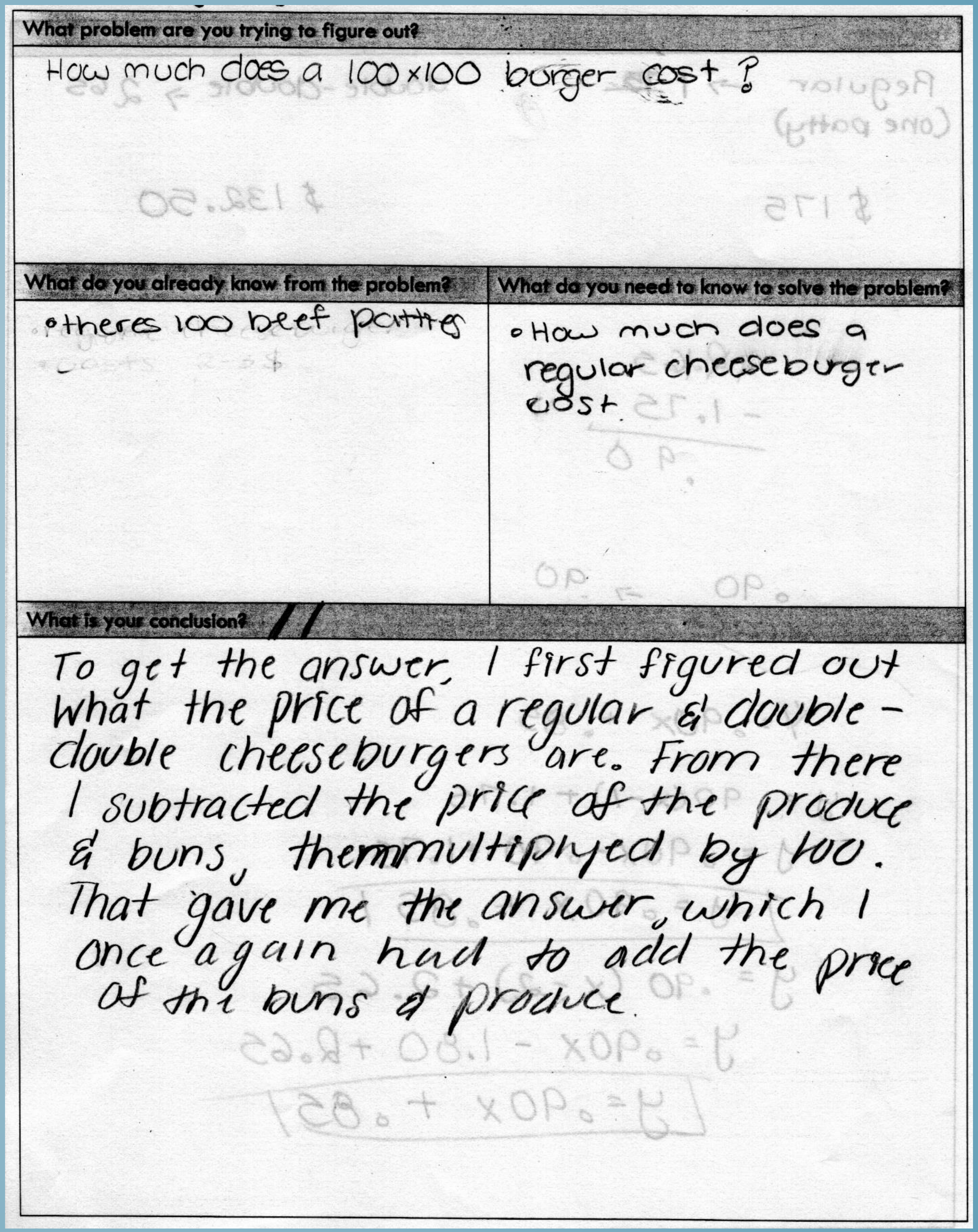
bun + produce + meat + cheese = \$1.75

meat + cheese = \$0.90

# The Reality

- Students needed guidance to figure out a layer's cost
- Not every class is ready to go straight to 100x100
- Common wrong answers included:
  - $175.00 ($1.75 x 100 cheeseburgers)
  - $132.50 ($2.65 x 50 Double-Doubles)
- Students had equations that had more than X patties
- Students were surprised to see three different equations:
  - Starting with a Double-Double
  - Starting with a cheeseburger
  - Starting with produce and bun only

# STUDENT WORK



**What problem are you trying to figure out?**

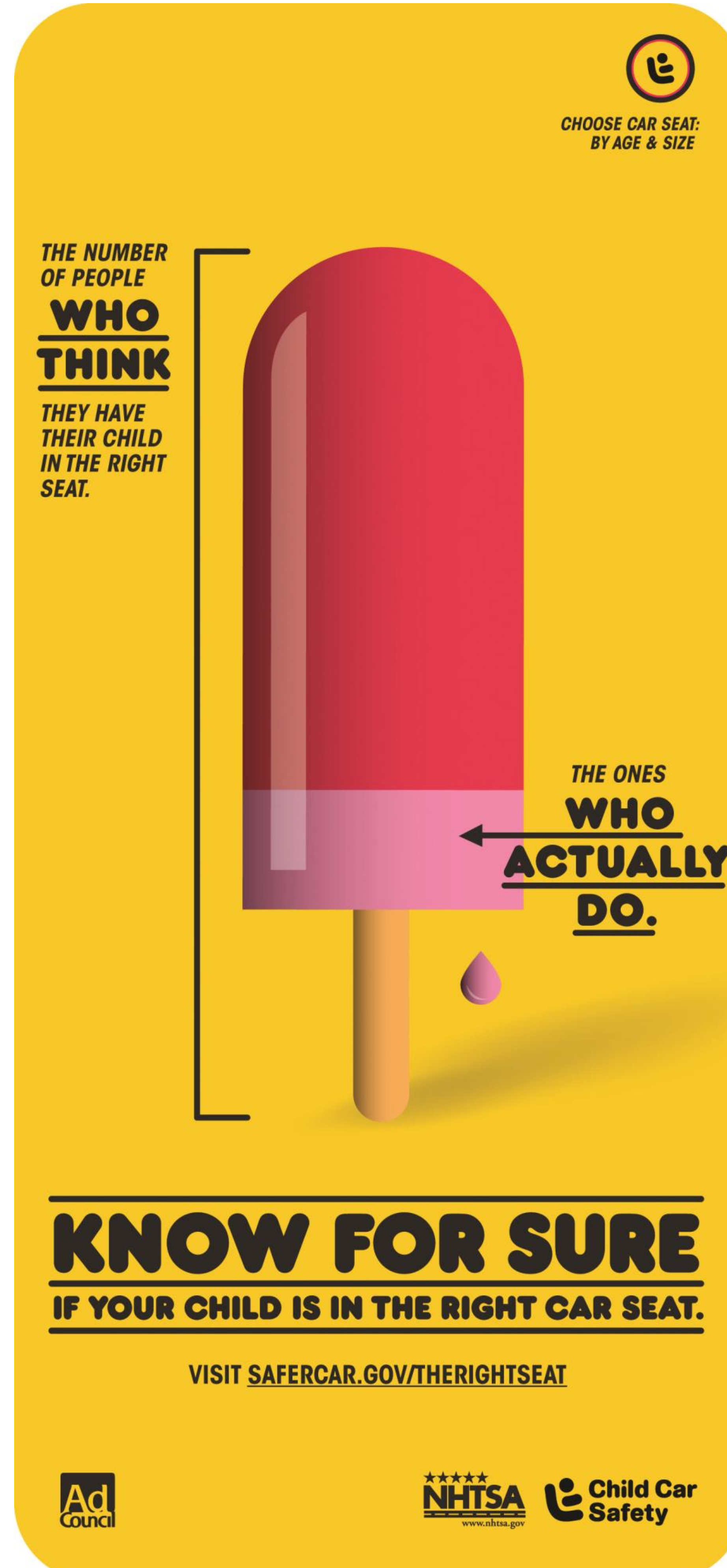
How much does a 100×100 burger cost?

| 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.


CHOOSE CAR SEAT: BY AGE & SIZE
THE NUMBER OF PEOPLE WHO THINK THEY HAVE THEIR CHILD IN THE RIGHT SEAT.
ML
THE ONES WHO ACTUALLY DO.
KNOW FOR SURE
IF YOUR CHILD IS IN THE RIGHT CAR SEAT.
Ad Council
VISIT SAFERCAR.GOV/THERIGHTSEAT
NHTSA
www.nhtsa.gov
Child Car Safety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# Math Question

- Solve the problem on your own.  Do not work or share your answer with anyone else.
- You will have 30 seconds to complete it.
- Write your answer down on a paper.
- Pay attention to the emotions you feel while solving the problem and write those emotions down as well.

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

# What does it look like when students make sense of problems?

# Of the 32 students I interviewed…

- 75% of them gave me numerical responses
- 2 students calculated the answer to be 130 (125 + 5)
- 2 students calculated the answer to be 120 (125 – 5)
- 12 students calculated the answer to be 25 (125 ÷ 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?

**<u>Key Statistics and Consumer Insights:</u>**

- 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.

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[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”


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THE NUMBER OF PEOPLE WHO THINK THEIR CAR SEATS ARE BEING USED CORRECTLY.
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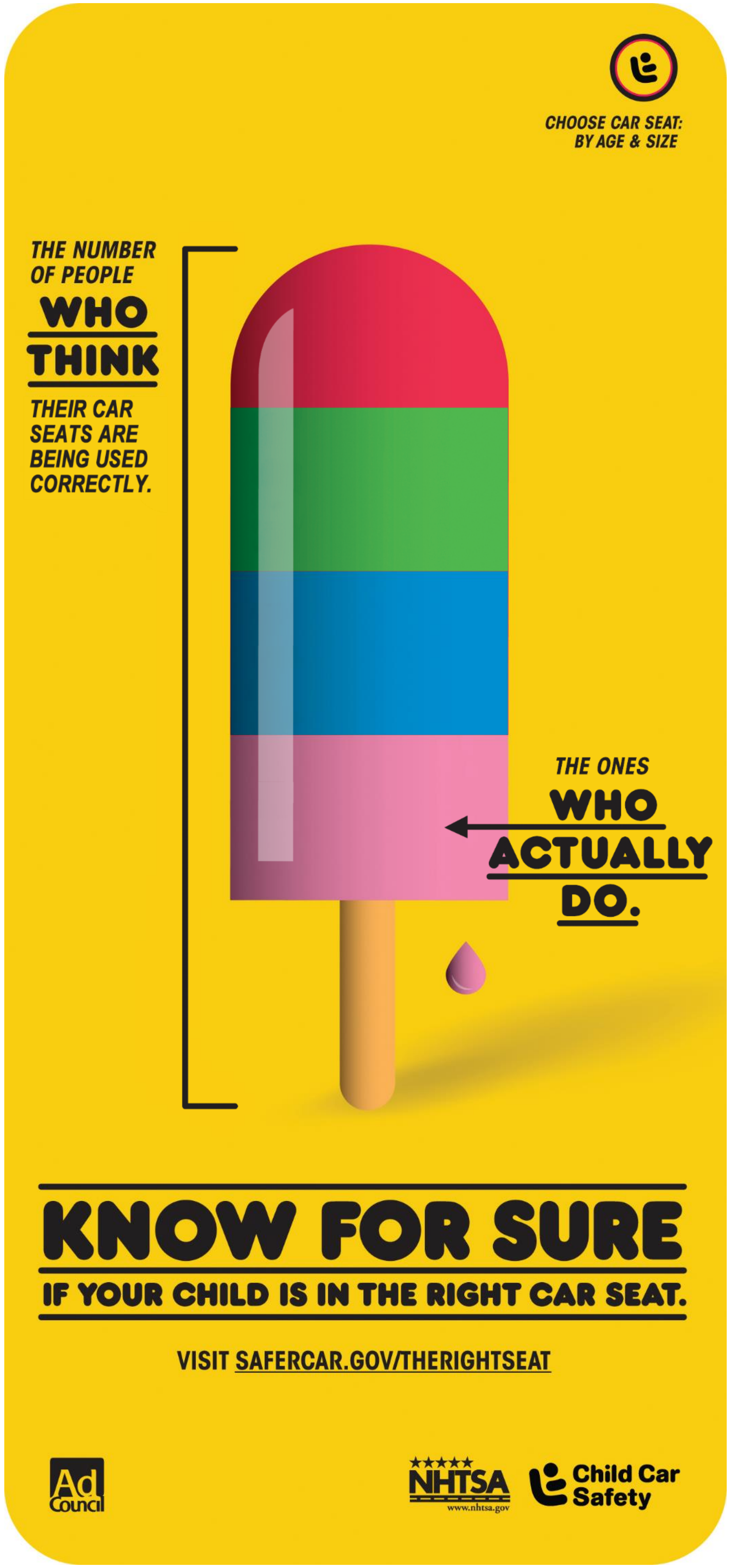
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FOX

# Solving Real-World Geometry Problems

## High School

- G-MG.1 – Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
- G-GMD.3 – Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

## Middle School

- 8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
- 7.G.6 – Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects.
- 6.G.2 –Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

## Elementary School

- 5.MD.5 – Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.
- 4.MD.3 – Apply the area and perimeter formulas for rectangles in real world and mathematical problems
- 3.MD.7d – Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems.
- 2.MD.1 – Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
- 1.MD.2 – Express the length of an object as a whole number of length units.
- K.MD.1 – Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

# WHAT ISN'T MATHEMATICAL MODELING?

- *It is not modeling in the sense of, "I do; now you do."*
- *It is not modeling in the sense of using manipulatives to represent mathematical concepts.*
- *It is not modeling in the sense of a "model" being just a graph, equation, or function.*
- *It is not just starting with a real world situation and solving a math problem.*
- *It is not beginning with the mathematics and then moving to the real world.*

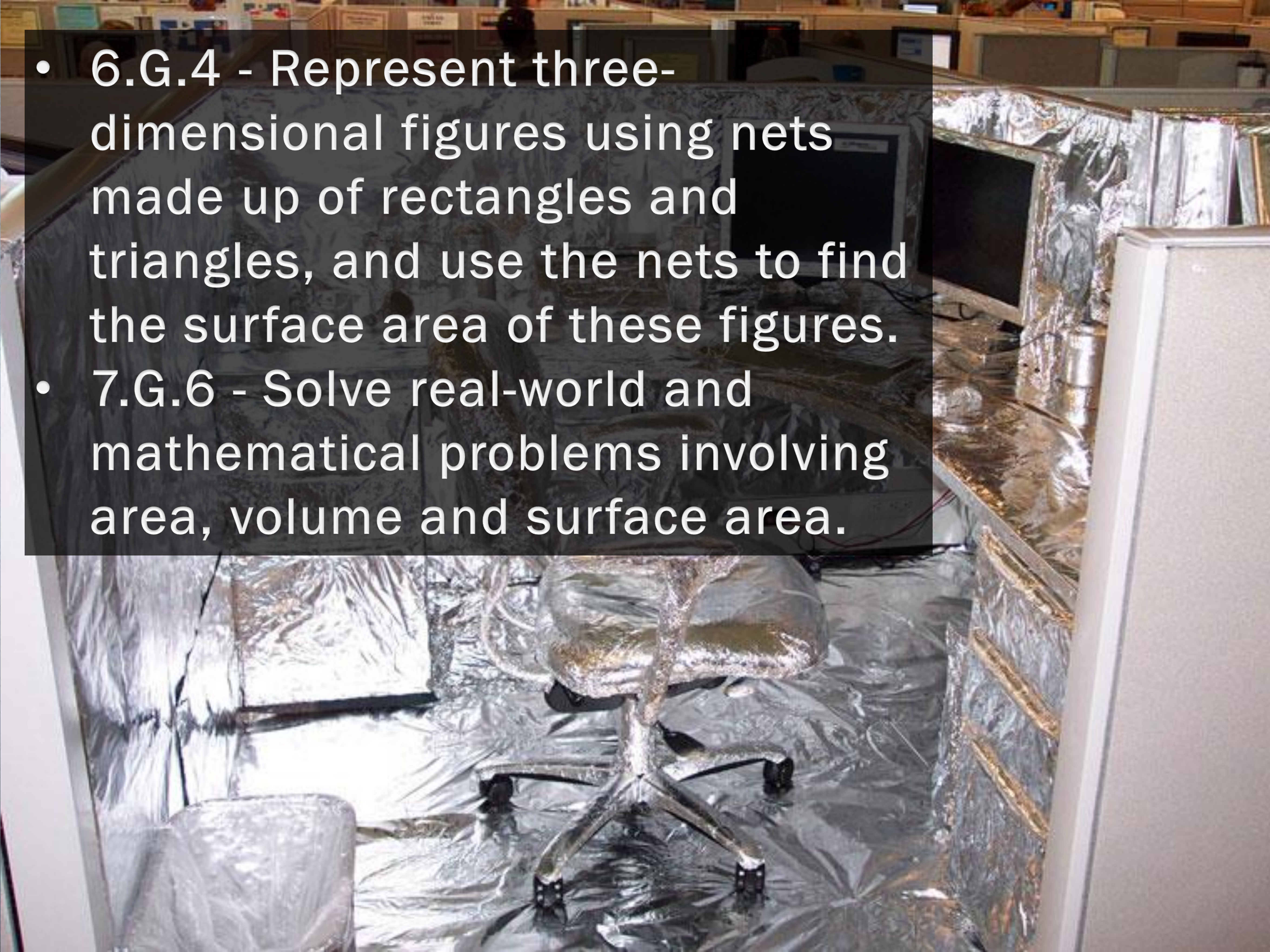
Source: http://www.cde.ca.gov/be/cc/cd/documents/modelingaprilreview.pdf

# PROBLEM-BASED LEARNING FAQ

- *How often do teachers do problem-based learning?*
- *How long do problem based lessons take?*
- *Do teachers use problem-based lessons to introduce a topic or after you've already taught it?*
- *How is problem-based learning assessed?*
- *How much time does it take to create a problem-based lesson?*

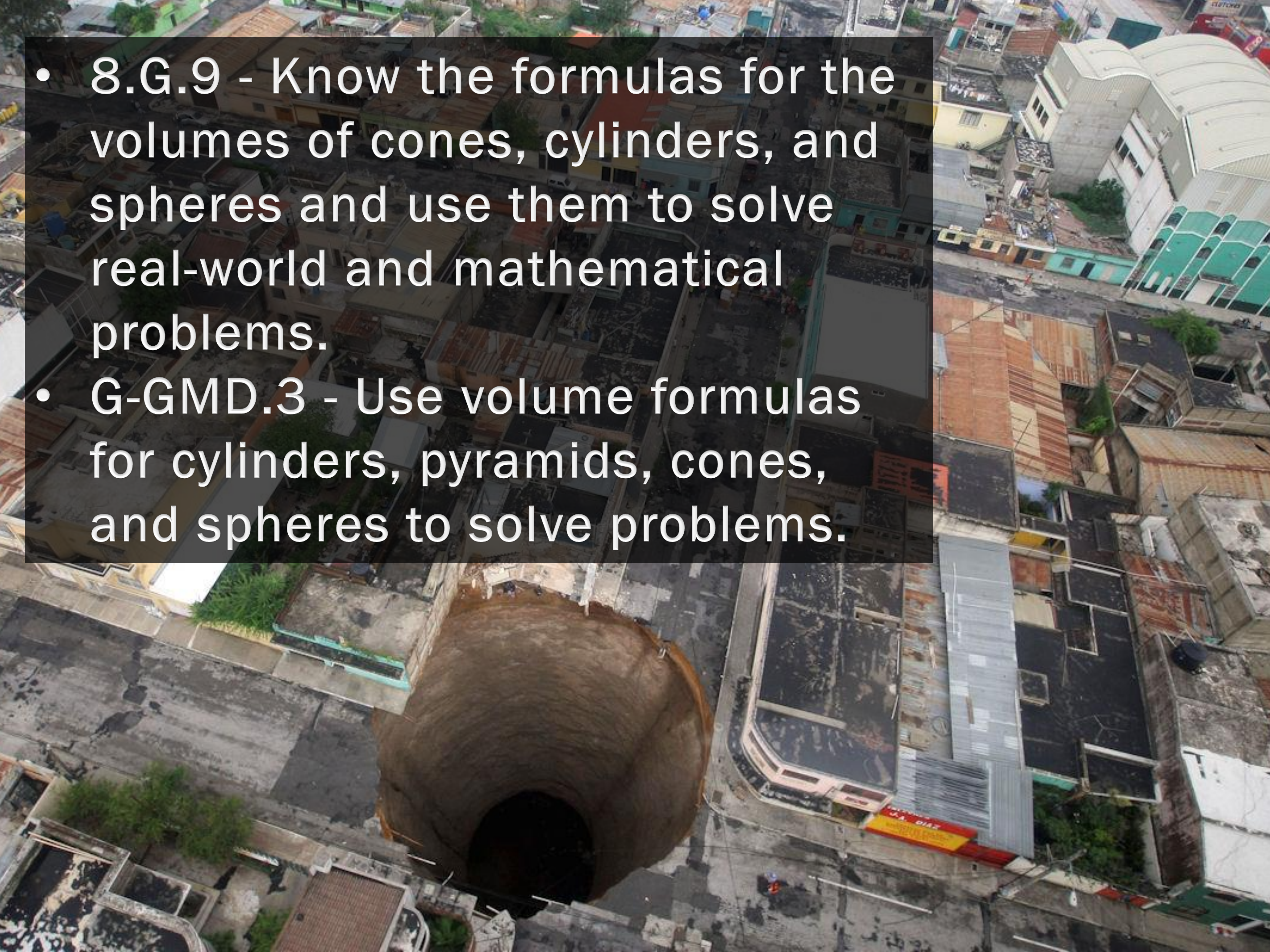
# The Four C's

- Communication
- Curiosity

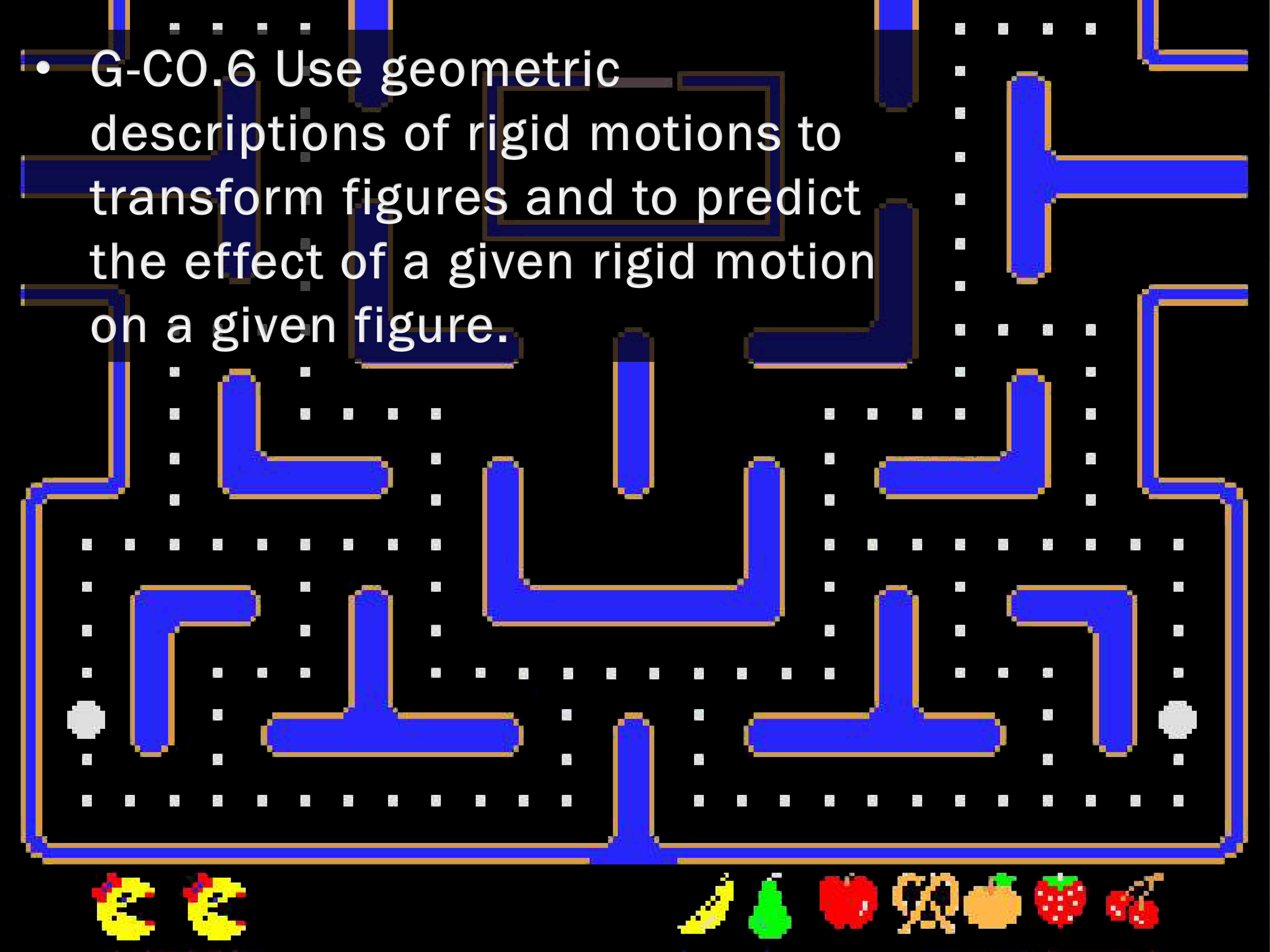


- 6.G.4 - Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.
- 7.G.6 - Solve real-world and mathematical problems involving area, volume and surface area.

- 8.G.9 - Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
- G-GMD.3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.



- 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

Name: ____________________ Period: __________ Date: ____________

| 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 should we title this lesson? |
|---|
| |

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

# The Four C's

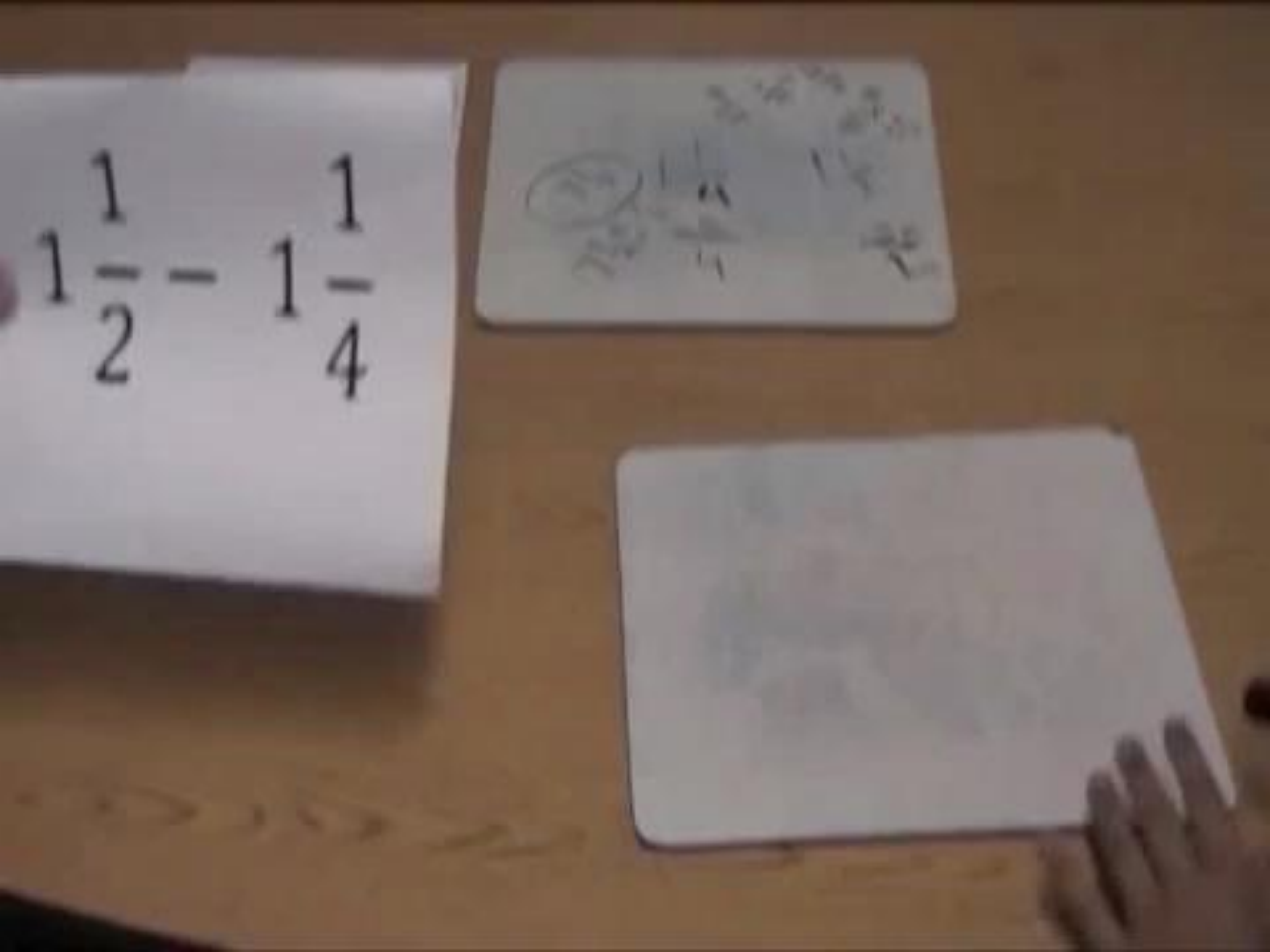
- Communication
- Curiosity
- Critical Thinking
- Content Knowledge

# WHAT DOES IT LOOK LIKE…

- when students have procedural skill but not conceptual understanding or the ability to apply mathematics?
- when students struggle to process mathematics at a higher depth of knowledge?

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

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


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

# Questioning Scenarios

- The activity begins with teachers in groups of three taking the roles of teacher, student, or observer.
- The individuals playing the role of teacher and student each receive a slip of paper describing their scenario.
- The individual playing the role of observer waits to record all of the teacher's questions to the student.
- Once the activity begins, the teacher will talk to the student in the context of the scenario they read about on the slips of paper.

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

4 pi

Great. Do you have any questions?

No

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

4 pi

Great. How did you get your answer?

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

# Depth of Knowledge

- What?

# Depth of Knowledge Examples

Perimeter

- DOK 1 – What is the perimeter of a rectangle with that measures 8 units by 4 units?
- DOK 2 – List the dimensions of a rectangle with a perimeter of 24 units.
- DOK 3 – Of all the rectangles with a perimeter of 24 units, which one has the most area?

Surface Area

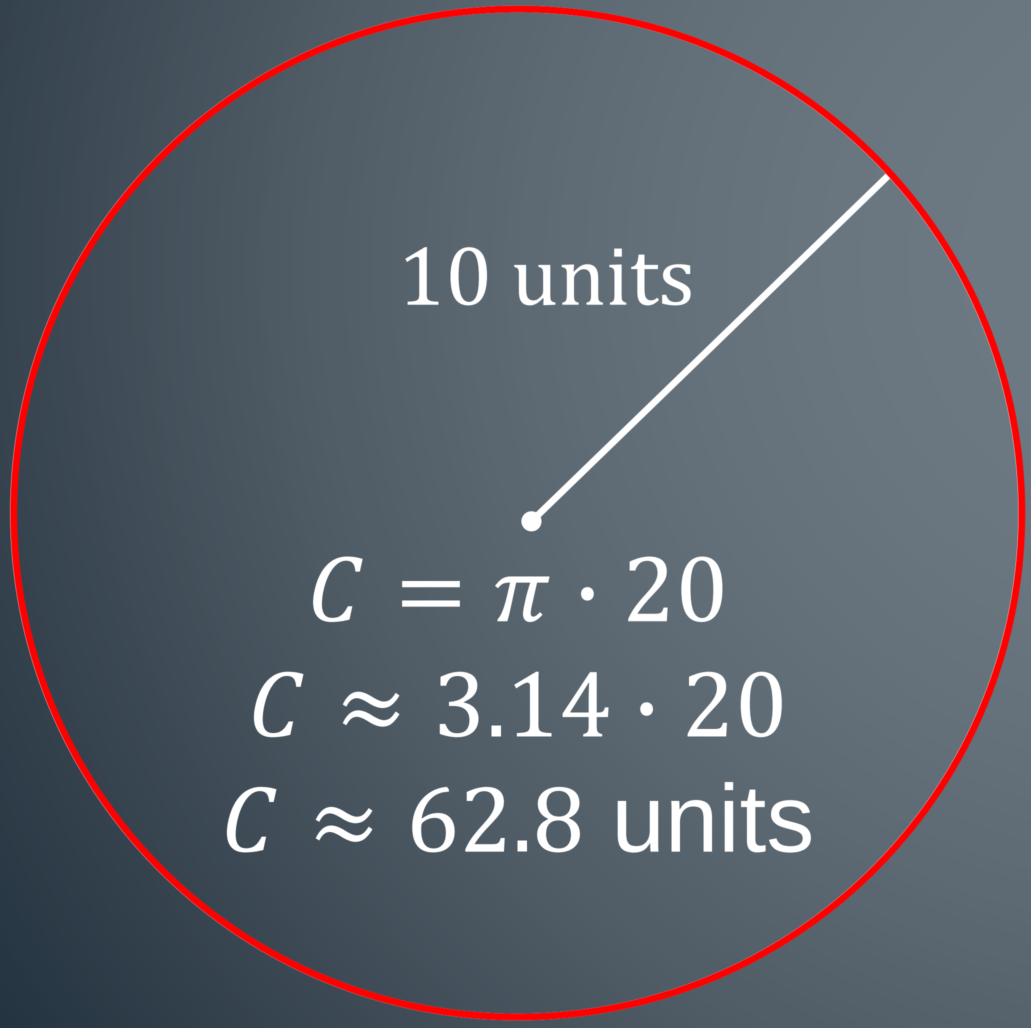
- DOK 1 – What is the surface area of a rectangular prism that measures 8 units by 4 units by 3 units?
- DOK 2 – List the dimensions of a rectangular prism with a surface area of 20 square units.
- DOK 3 – Of all the rectangular prisms with a surface area of 20 square units, which one has the most volume?

# Depth of Knowledge

- What?
- How?
- Why?

# Depth of Knowledge – Level One

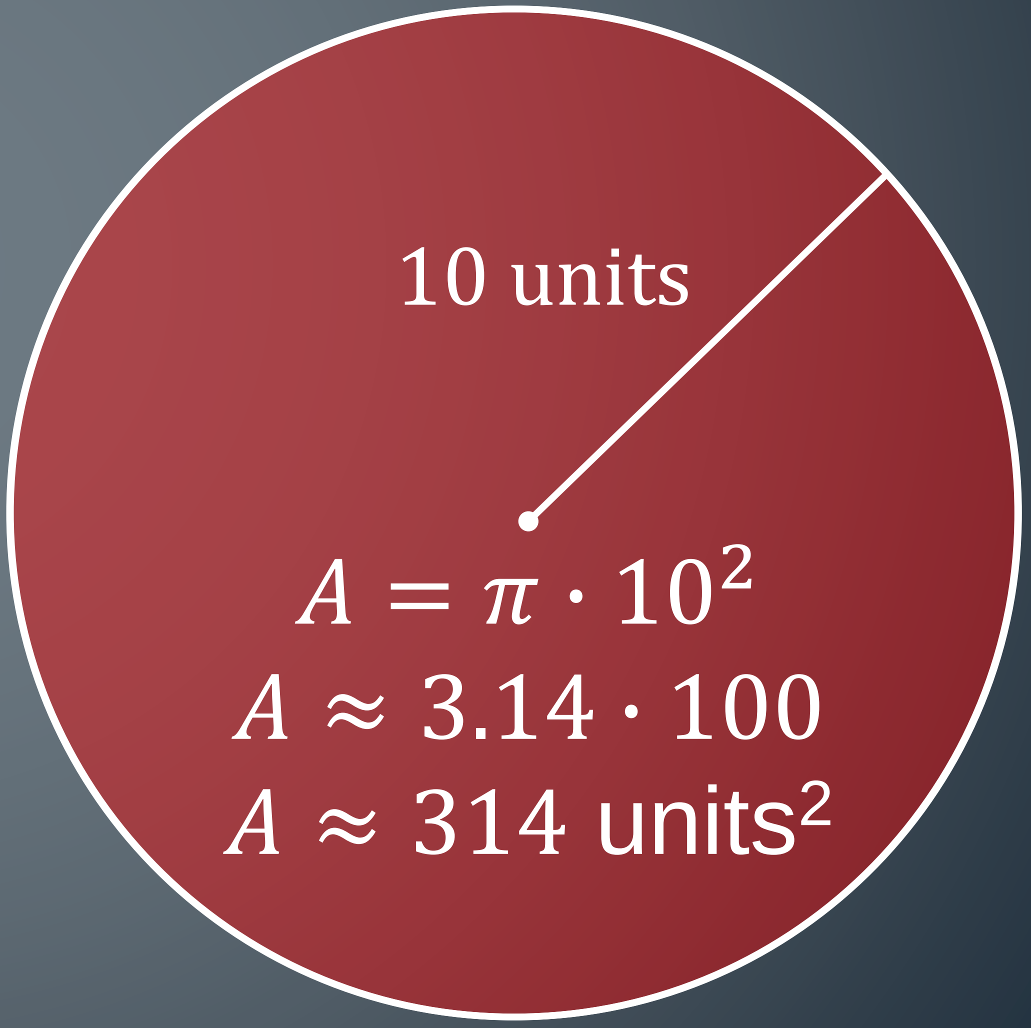
What is the circle's circumference? $\pi \approx 3.14$




$$C = \pi \cdot 20$$
$$C \approx 3.14 \cdot 20$$
$$C \approx 62.8 \text{ units}$$

$$C = \pi d \text{ or } C = 2\pi r$$

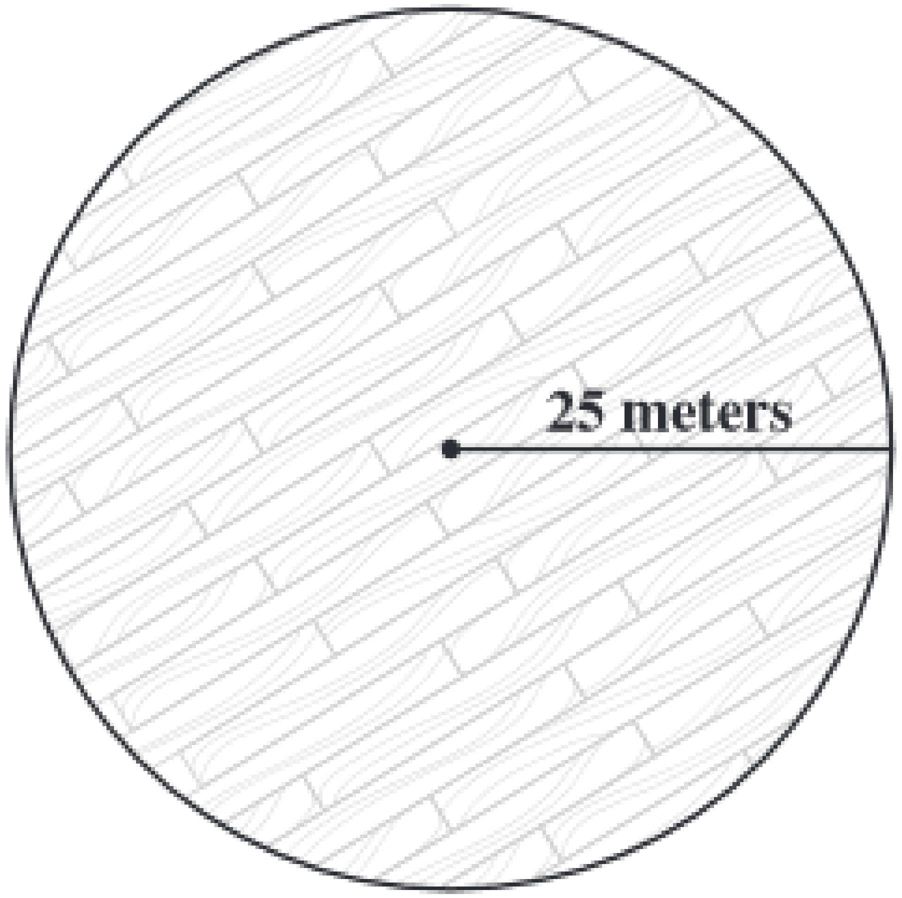
What is the circle's area? $\pi \approx 3.14$




$$A = \pi \cdot 10^2$$
$$A \approx 3.14 \cdot 100$$
$$A \approx 314 \text{ units}^2$$

$$A = \pi r^2$$

**70** This circular stage has a radius of 25 meters.




Which equation could be used to find the area of the stage in square meters?

A $A = 25\pi$

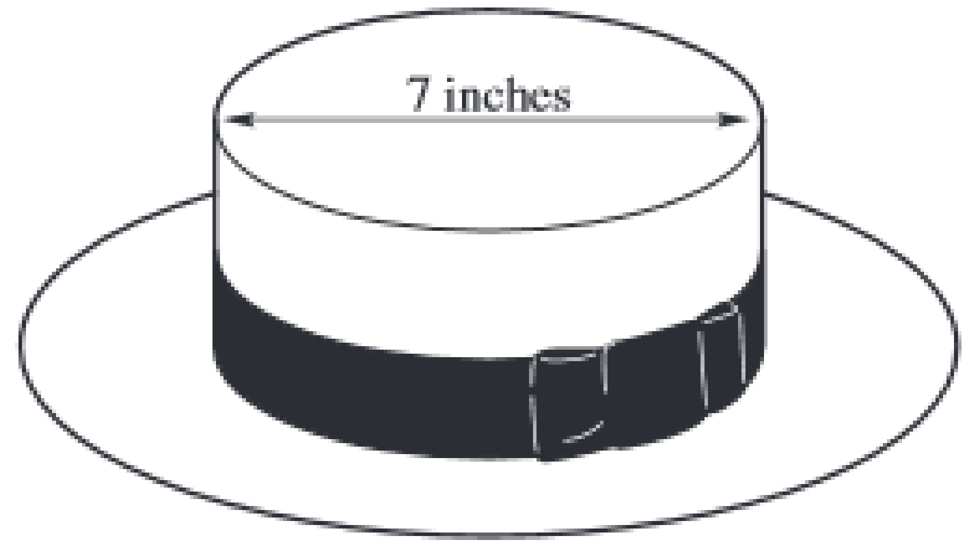
B $A = 50\pi$

C $A = \pi \bullet 25^2$

D $A = \pi \bullet 50^2$

CSM02059

**72** The top part of this hat is shaped like a cylinder with a diameter of 7 inches.




Which measure is *closest* to the length of the band that goes around the outside of the hat?

A 10.1 inches

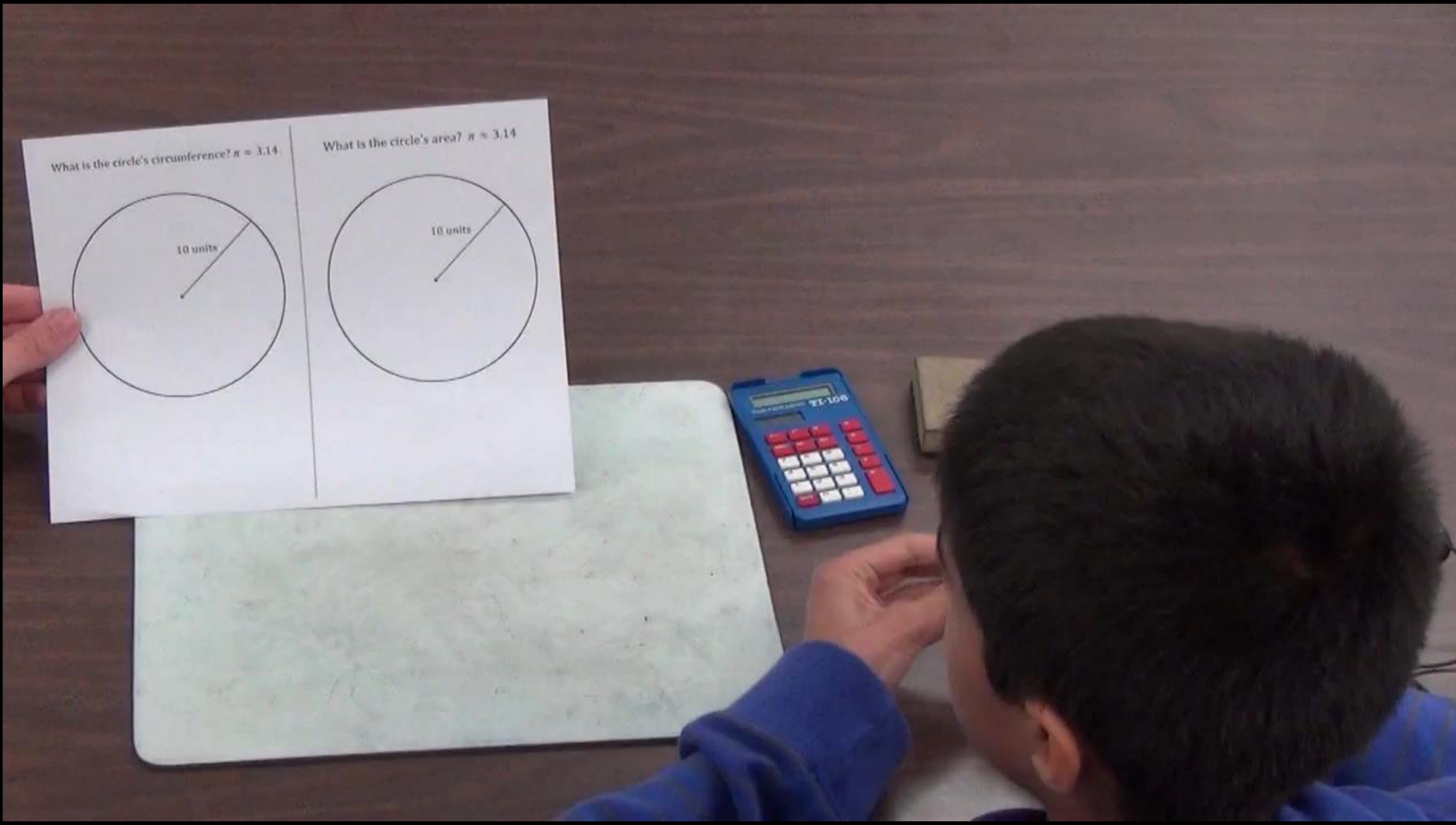
B 11.0 inches

C 22.0 inches

D 38.5 inches

CSM00268

Source: 6th Grade CST Released Test Questions - http://www.cde.ca.gov/ta/tg/sr/documents/cstrtqmath6.pdf

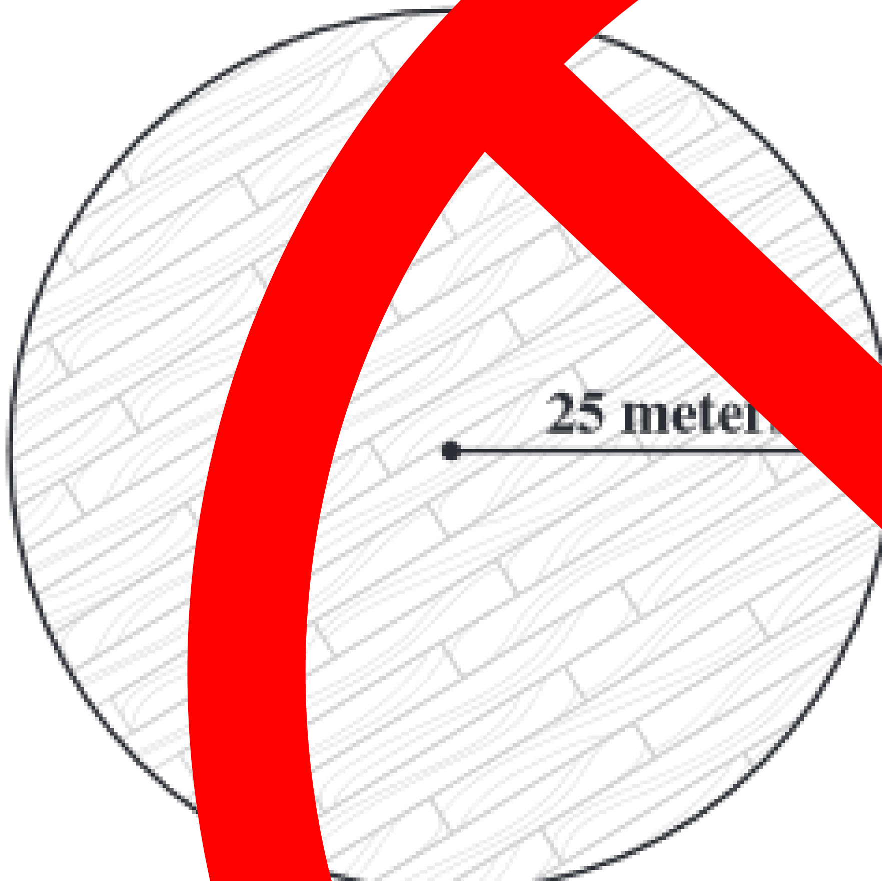

What is the circle's circumference? π ≈ 3.14
10 units
What is the circle's area? π ≈ 3.14
10 units
TI-106

# Student Data Facts

- 396 seventh grade students were assessed
- 68.26% correctly answered the circumference question
- 78.59% correctly answered the area question

| Claim | Content Category | Assessment Targets | DOK | Minimum # Scored Tasks | | Minimum # Items per Item Type | | Min/Max Number of Items |
|---|---|---|---|---|---|---|---|---|
| | | | | CAT | PT/ECR | SR | CR | |
| | | A. Analyze proportional relationships and use them to solve real-world and mathematical problems. | 1,2 | p(9)=1.0 | | | | |
| Supporting | | E. Draw, construct, and describe geometrical figures and describe the relationship between them. | 2,3 | | | | | |
| | | F. Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. | 1,2 | | | | | |
| | | problems involving angle measure, area, surface area, and volume. | 1,2 | | | | | |
| | Supporting Cluster | G. Use random sampling to draw inferences about a population. | 1,2 | p(2)=1.0 | 0 | 2 | 1 | 5/8 |
| | | H. Draw informal comparative inferences about two populations. | 1,2 | | | | | |
| | | I. Investigate chance processes and develop, use, and evaluate probability models. | 1,2 | | | | | |

**70** This circular stage has a rad[illegible]meters.




Which equat[illegible]uld be used to find the area of the stage in [illegible]re meters?

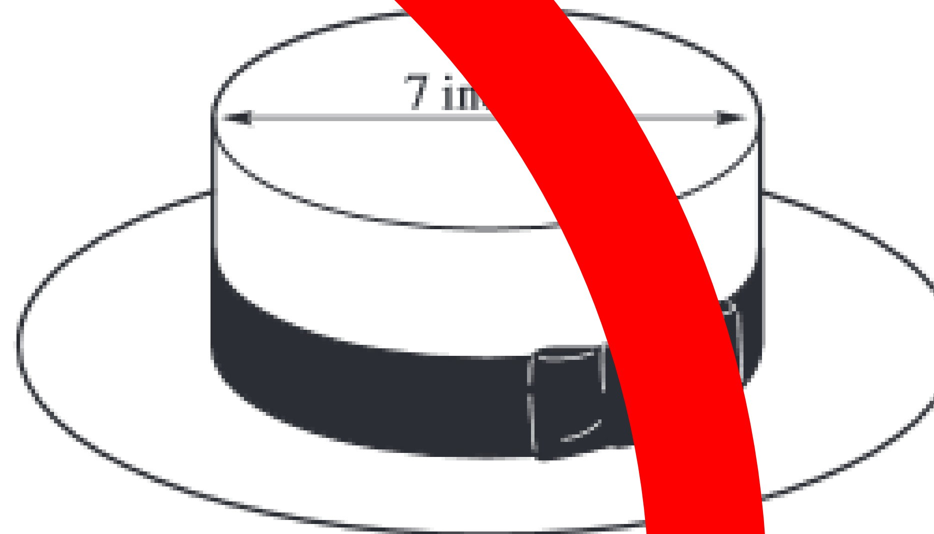
A $A = 25\pi$

B $A = 50\pi$

C $A = \pi \bullet 25^2$

D $A = \pi \bullet 50^2$

**72** The [illegible]f this hat is shaped like a cylinder with a dia[illegible]f 7 inches.




Which measure is *closest* to [illegible]ength of the band that goes around the [illegible]e of the hat?

A [illegible]0.1 inches

B [illegible] inches

C 22[illegible]

D 38.5 in[illegible]

CSM00268

# Depth of Knowledge – Level Two

Which circle is bigger? How do you know?

Circle A

Area = 36 units$^2$

$$C = \pi \cdot 2 \cdot r$$

$$36 \approx 6.28 \cdot r$$

$$\frac{36}{6.28} \approx r$$

$$5.73\, units \approx r$$

Circle B

Circumference = 36 units

$$A = \pi \cdot r^2$$

$$A \approx 3.14 \cdot 5.73^2$$

$$A \approx 3.14 \cdot 32.83$$

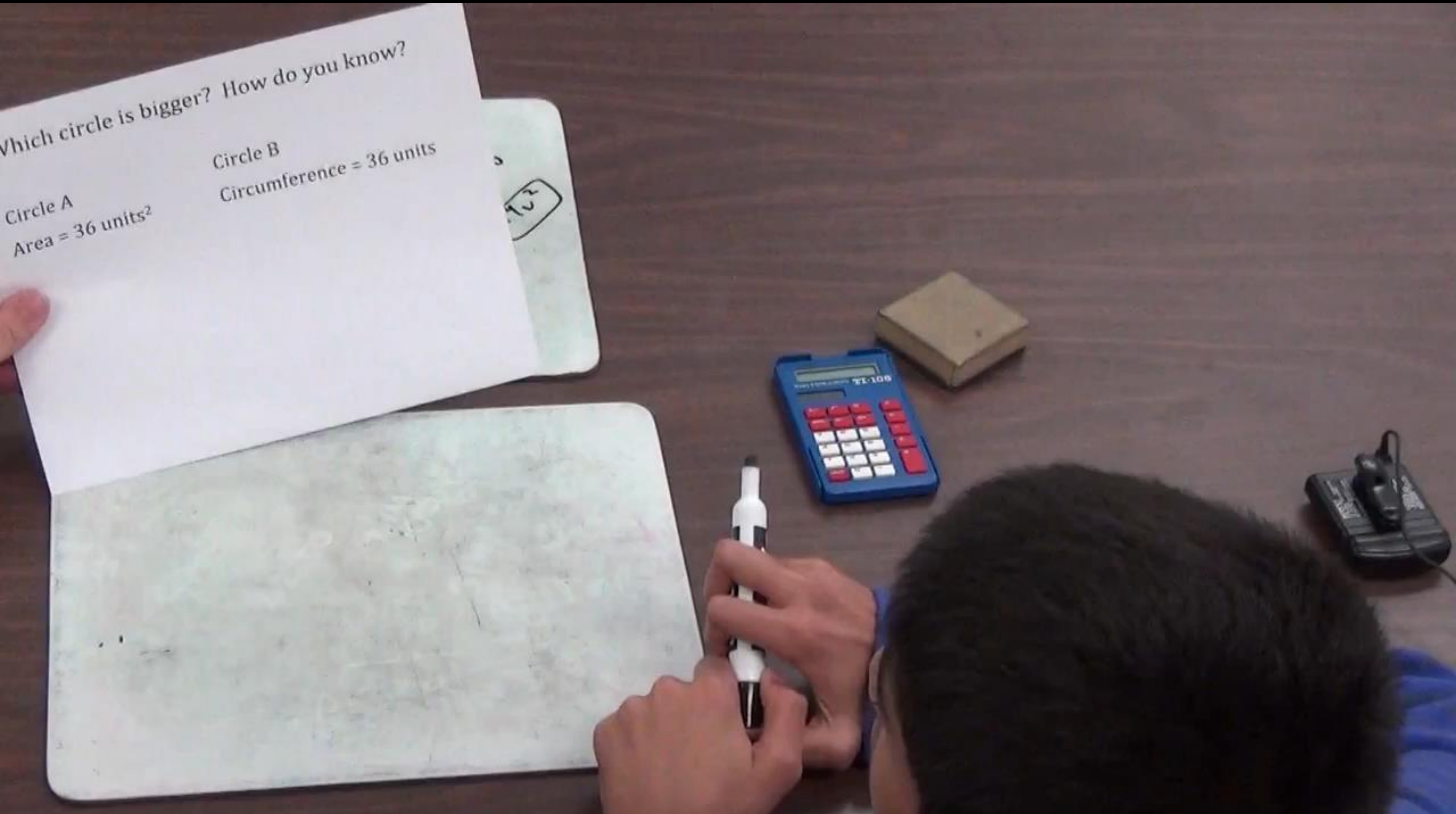
$$A \approx 103.15\, units^2$$

# SBAC Constructed Response 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.


Which circle is bigger? How do you know?
Circle A
Area = 36 units²
Circle B
Circumference = 36 units
TI-108

# Video Facts

- Of the ten students interviewed:
  - Ten correctly answered both of the DOK 1 questions.
  - One earned two points on the DOK 2 question.
  - Six earned one point on the DOK 2 question.
  - Three earned zero points on the DOK 2 question.

# Student Data Facts

- Of the 396 seventh grade students who were assessed, 12.12% earned two points on the DOK 2 question.
- 97.92% of the students who correctly answered the DOK 2 question also correctly answered both of the two DOK 1 questions.
- 10.61% of the students who correctly answered both of the two DOK 1 questions also correctly answered the DOK 2 question.

# More Student Data Facts

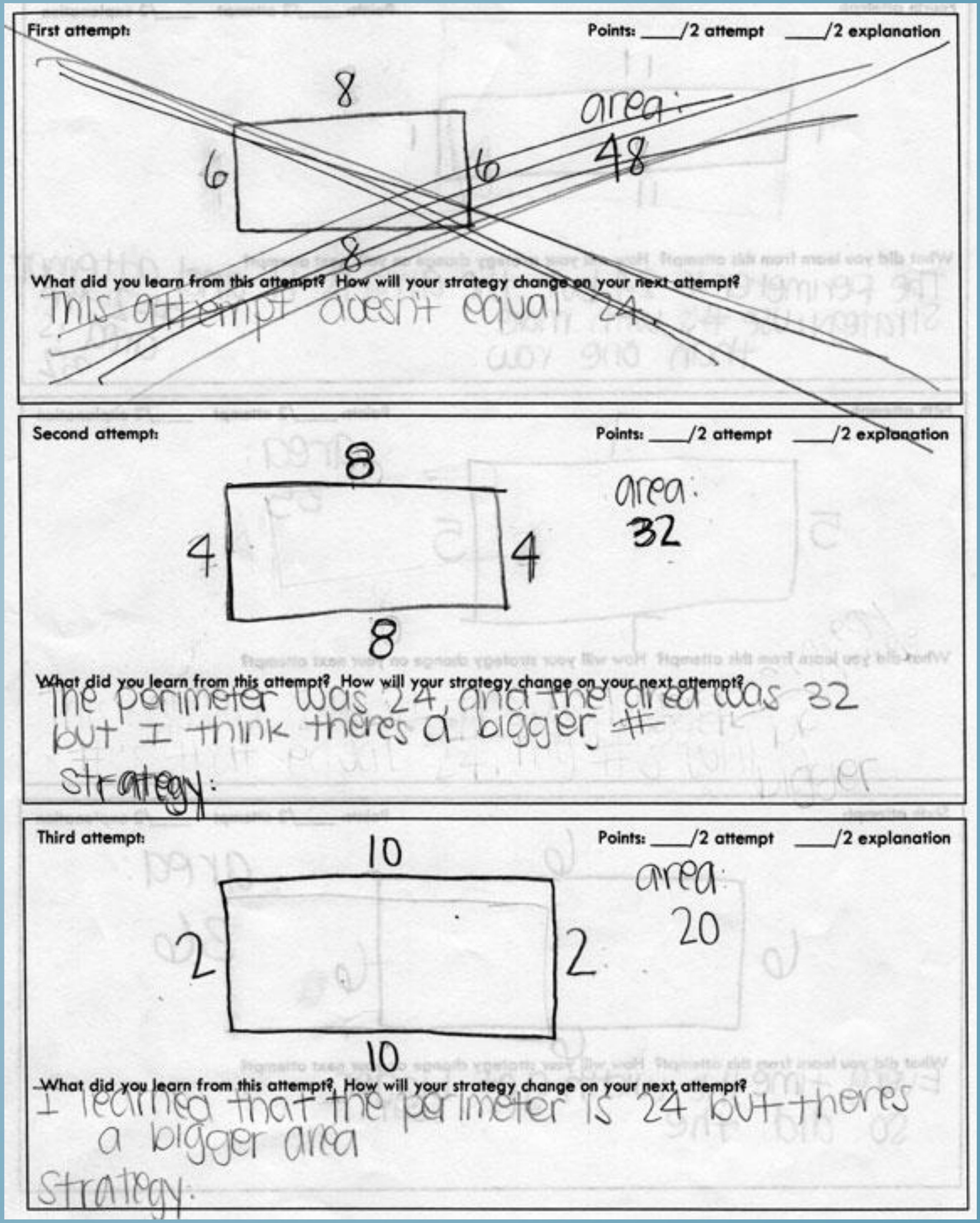
- 28.28% of the students earned only one point.
- All of them earned one point by choosing Circle B and providing insufficient reasoning.
- 59.59% of the students earned no points.

# Assessing Deeper Understanding

Make the smallest difference using the numbers 1 through 9 no more than one time each.

$$\square\frac{\square}{\square} - \square\frac{\square}{\square}$$

# STUDENT WORK



# Open Middle Problems

- Open middle problems require a higher depth of knowledge than most problems that assess procedural and conceptual understanding.
- They often have a “closed beginning” meaning that they all start with the same initial problem
- They often have a “closed end” meaning that they all end with the same answer
- They have an “open middle” meaning that there are multiple ways to approach and ultimately solve the problem

www.openmiddle.com

# Problem-Based Lesson Resources

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

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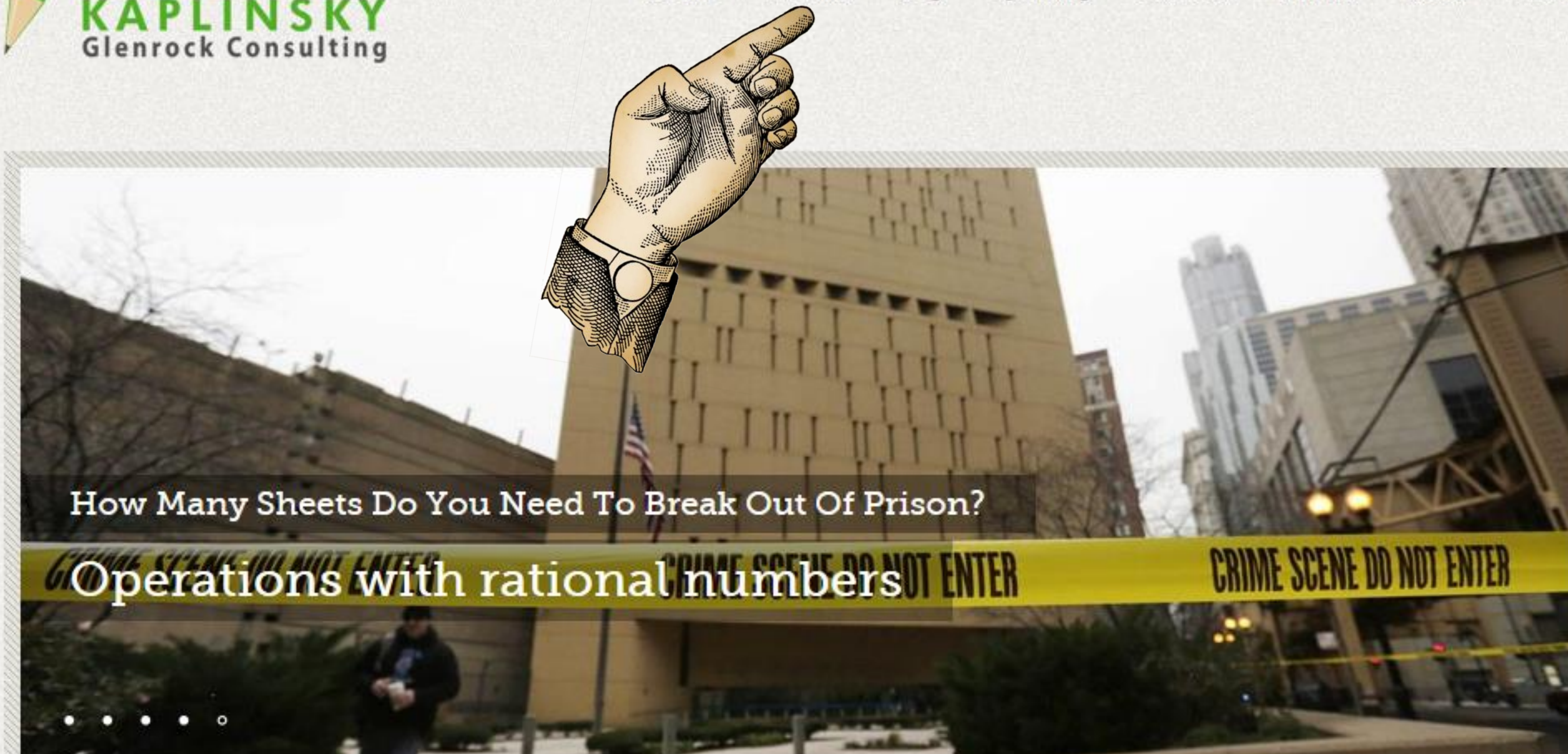


## Why Choose Us?

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

## Lessons

Robert KAPLINSKY Glenrock Consulting

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All 2nd 3rd 4th 5th 6th 7th 8th Algebra Functions Geometry Modeling Numb & Quant Stats & Prob


How Much Is One Third Of A Cup Of Butter?

How Do Skytypers Write Messages?


Robert Kaplinsky's Problem-Based Lessons

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

| | A | B | C | D | E | F | |
|---|---|---|---|---|---|---|---|
| 1 | Task Name | Concept / Skill | Standard 1 | Standard 2 | Standard 3 | Standard 4 | Sta |
| 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 | G-M |
| 3 | How Much Money IS That?! | Volume of rectangular prism | 5.MD.3 | 5.MD.4 | 5.MD.5 | 5.MD.5b | 5.M |
| 4 | How Much Money Should Dr. Evil Demand? | Exponential Growth | N-RN.2 | A-SSE.1 | A-SSE.3c | A-SSE.4 | A-R |
| 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 | G-S |
| 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 | 4.N |
| 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 | G-M |
| 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 | F-B |
| 21 | How Big Is The 2010 Guatemalan Sinkhole? | Volume of Cylinder | 5.MD.3 | 5.MD.4 | 5.MD.5 | 8.G.9 | G-C |
| 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 | A-C |
| 23 | How Many Royal Flushes Will You Get? | Probability | 7.SP.5 | 7.SP.6 | 7.SP.7 | S-MD.5 | S-M |
| 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 | G-M |
| 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 | F-L |
| 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 | 6.R |
| 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 | 4.M |
| 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 | F-B |
| 34 | How Many Hot Dogs Did They Eat?! | Linear and Quadratic Functions | 8.F.3 | 8.F.4 | F-BF.1 | F-BF.2 | F-I |
| 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 | F-L |
| 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 | | | |

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