THE FOUR STEPS TO CREATE A CLASSROOM WHERE STUDENTS ARE EXCITED TO LEARN MATHEMATICS

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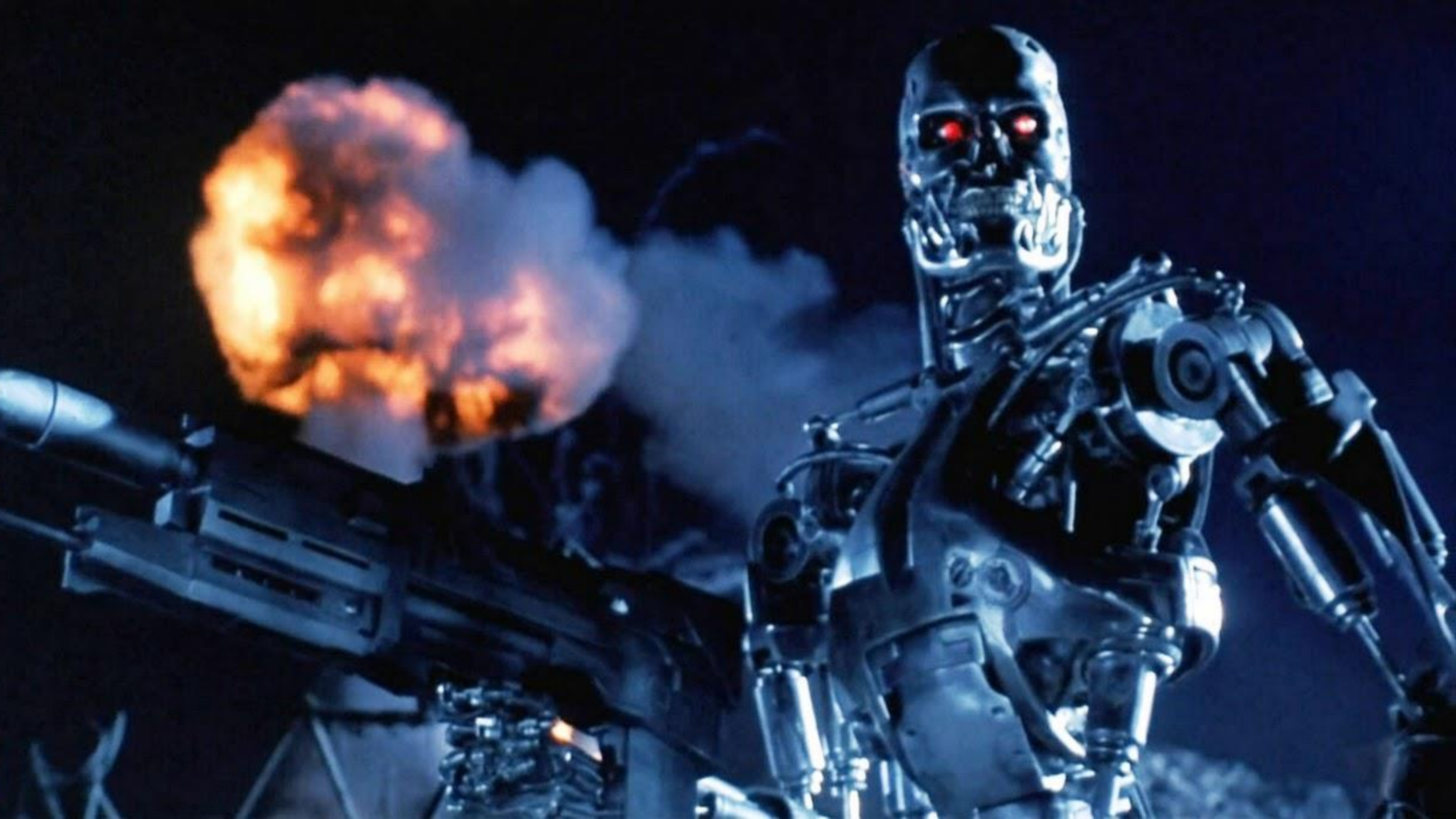
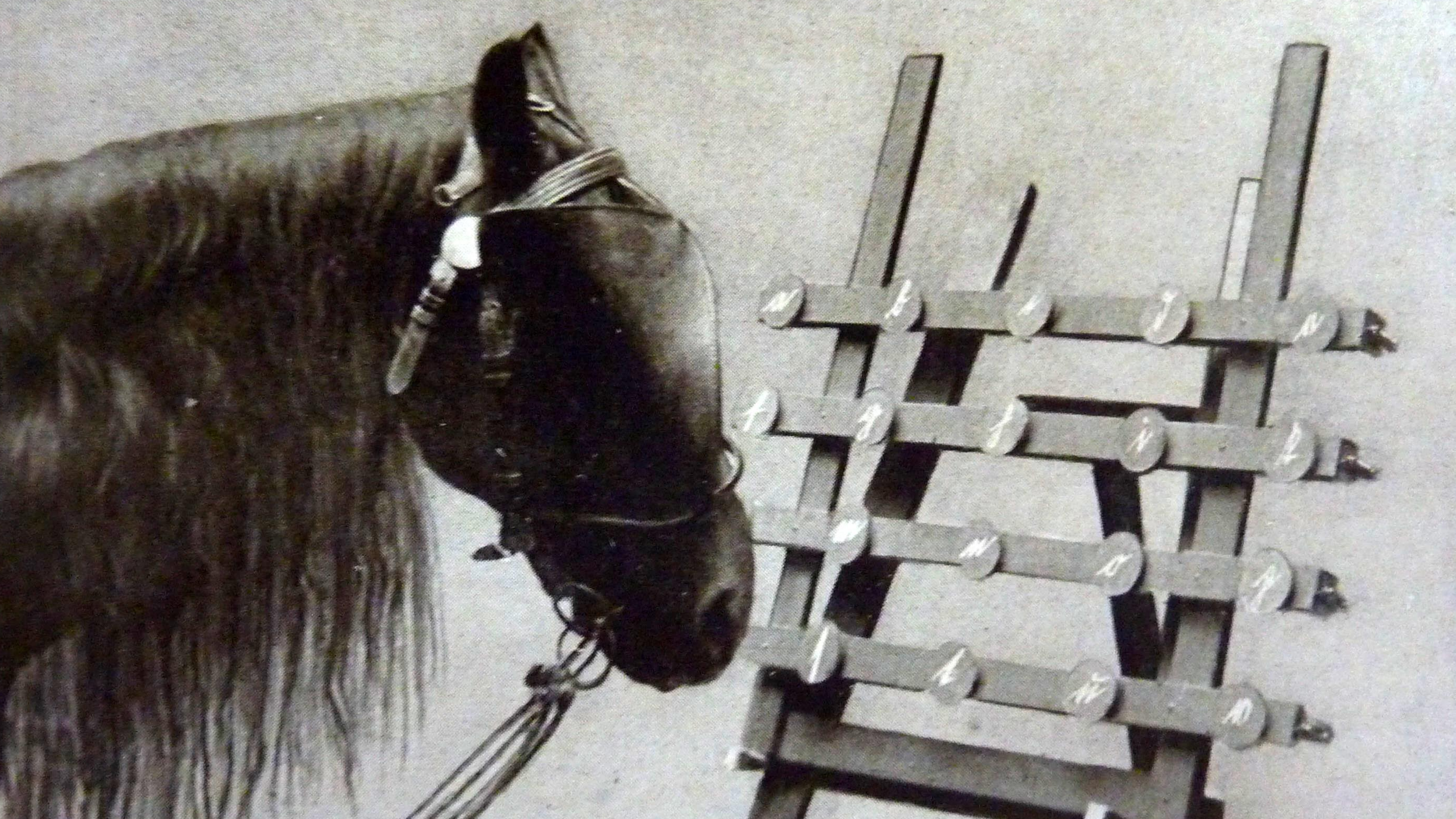
paradigm shift

GOALS

- ❑ CORRECT ANSWERS + UNDERSTANDING
- ❑ MAKE OUR LESSONS UNFORGETTABLE
- ❑ RECONSIDER USING WORD PROBLEMS
- ❑ MAKE MATH CHALLENGING + ACCESSIBLE




2/3 + 3/4 =
26743 : 8 =

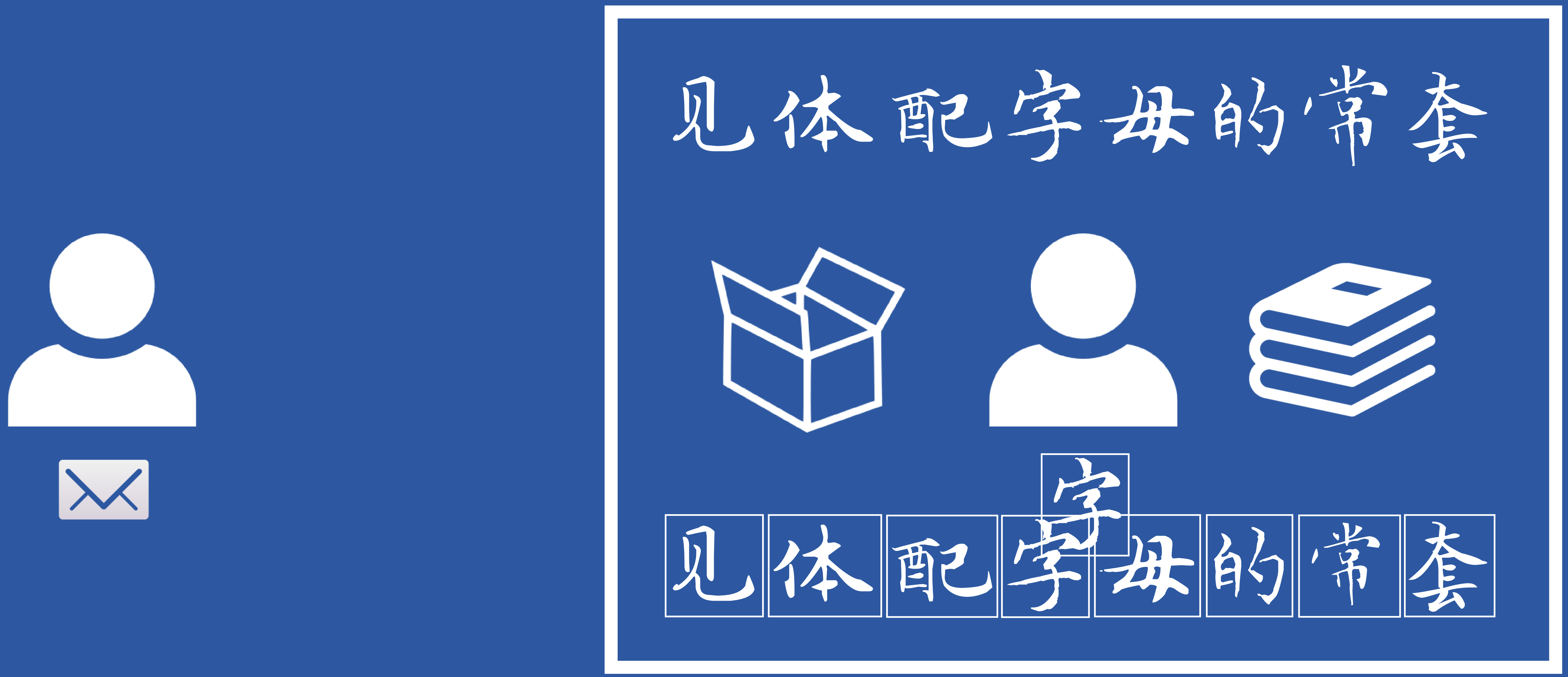


Yes… no… uh… yes… maybe?

MANY STUDENTS

TURING TEST

CHINESE ROOM

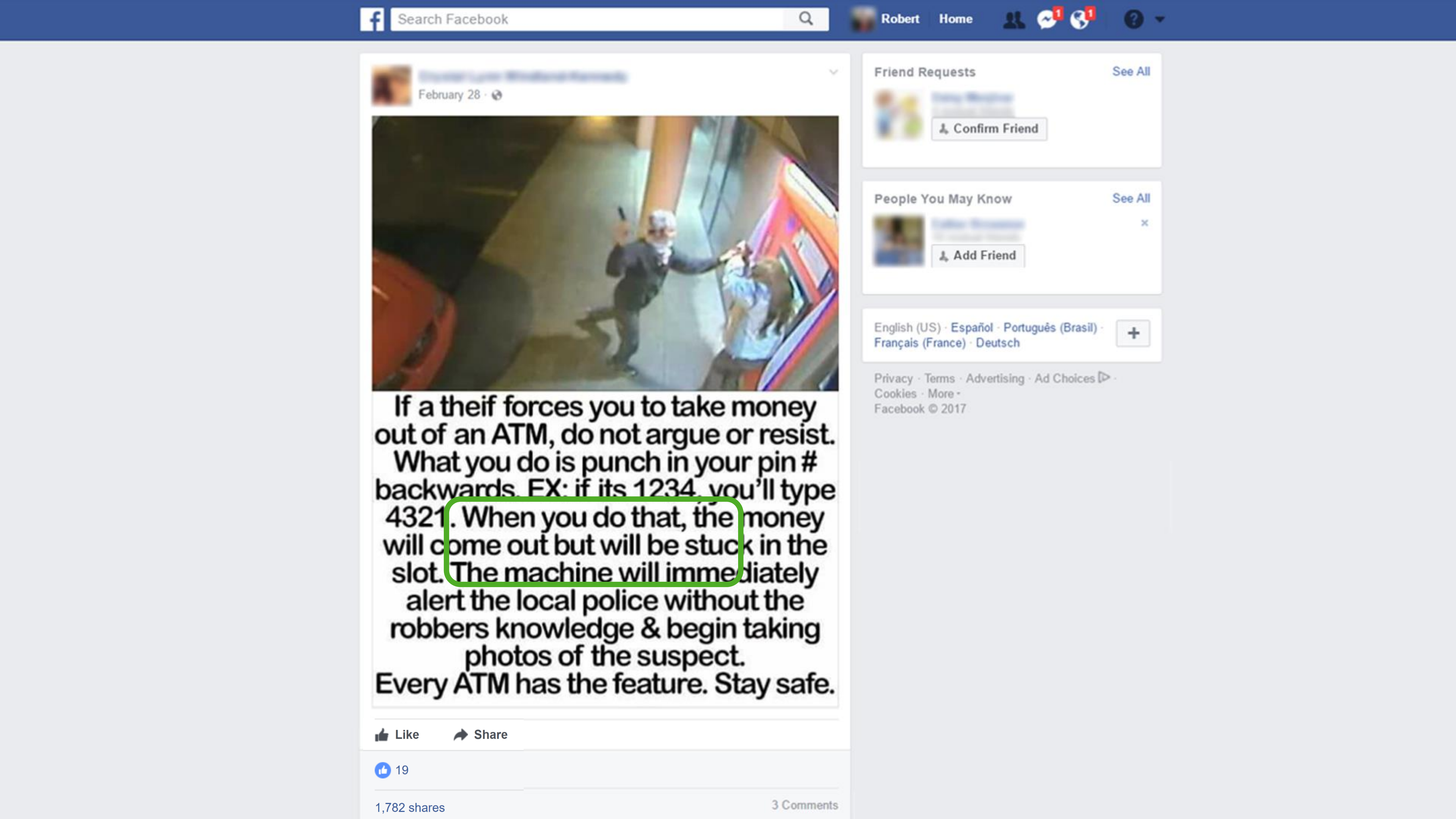


DISCUSSION TIME

- How is it possible for students to get correct answers yet not understand what they did?
- How can we tell if the problems we use are Chinese room and horse proof?

GOALS

- [x] CORRECT ANSWERS + UNDERSTANDING
- [ ] MAKE OUR LESSONS UNFORGETTABLE
- [ ] RECONSIDER USING WORD PROBLEMS
- [ ] MAKE MATH CHALLENGING + ACCESSIBLE


Search Facebook
Robert
Home
February 28
If a theif forces you to take money out of an ATM, do not argue or resist. What you do is punch in your pin # backwards. EX: if its 1234, you'll type 4321. When you do that, the money will come out but will be stuck in the slot. The machine will immediately alert the local police without the robbers knowledge & begin taking photos of the suspect.
Every ATM has the feature. Stay safe.
Like
Share
19
1,782 shares
3 Comments
Friend Requests
See All
Confirm Friend
People You May Know
See All
Add Friend
English (US) · Español · Português (Brasil) · Français (France) · Deutsch
Privacy · Terms · Advertising · Ad Choices · Cookies · More ·
Facebook © 2017

Will Entering Your PIN in Reverse at an ATM Summon the Police?

Entering your PIN in reverse at any ATM will not automatically send an alarm to local police -- the idea is nothing more than an old and unimplemented suggestion.

CLAIM

Entering your PIN in reverse at any ATM will automatically summon the police.
See Example(s)

RATING

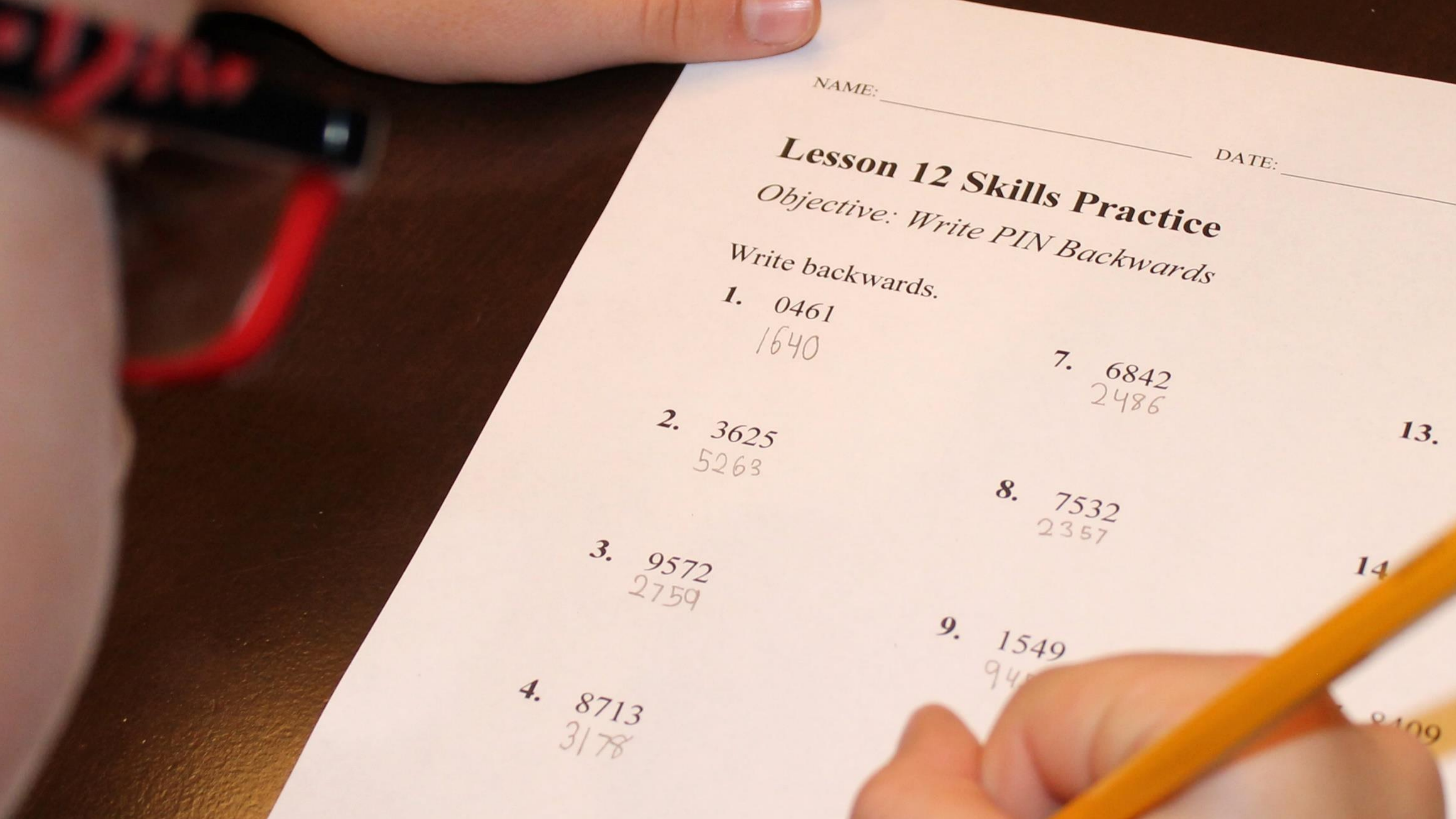
FALSE

ORIGIN

Messages offering a seemingly helpful heads-up about how to deal with a situation in which one is forced to hand over money withdrawn from an ATM under duress began circulating on the Internet in September 2006:

Tell them what you're going to tell them. Tell it to them. Then tell them what you told them.

UNKNOWN


NAME:
DATE:
Lesson 12 Skills Practice
Objective: Write PIN Backwards
Write backwards.
1. 0461
1640
7. 6842
2486
13.
2. 3625
5263
8. 7532
2357
3. 9572
2759
9. 1549
4. 8713
3178

Presentation

- Tell them what you're going to tell them.
- Tell it to them.
- Then tell them what you told them.

Lesson

- State the lesson objectives.
- Teach the lesson.
- Review the lesson objectives.

The definition of insanity is doing the same thing over and over again but expecting different results.

UNKNOWN

Why Some Ideas Survive and Others Die...

MADE to STICK

Chip Heath & Dan Heath

- Understood
- Remembered
- Lasting impact

STICKY ATTRIBUTES

- ❑ SIMPLE
- ❑ UNEXPECTED
- ❑ CONCRETE
- ❑ CREDIBLE
- ❑ EMOTIONAL
- ❑ STORIES

Simplify.

$$(x^2 + 3)(2x^3 - 7x + 4)$$

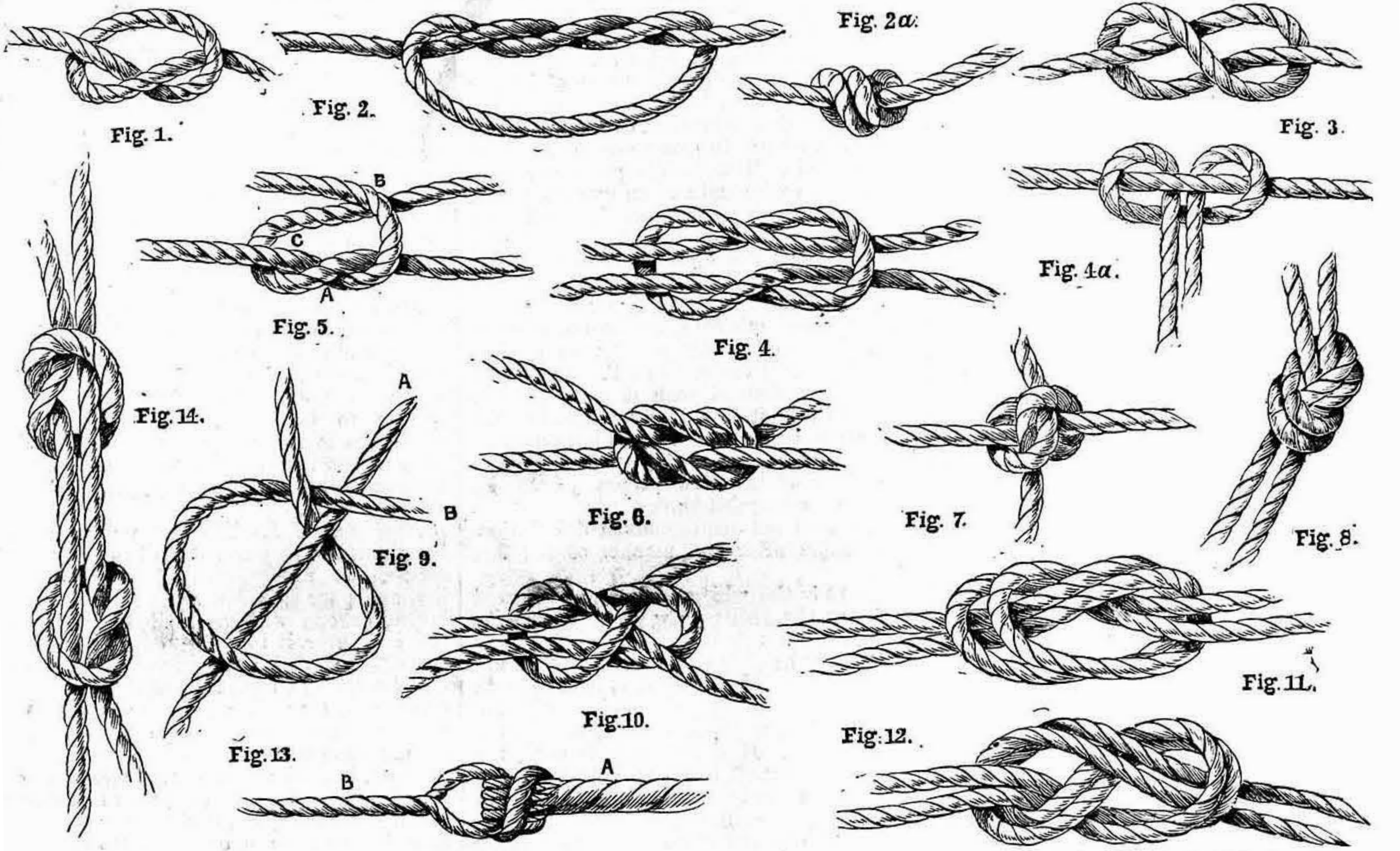
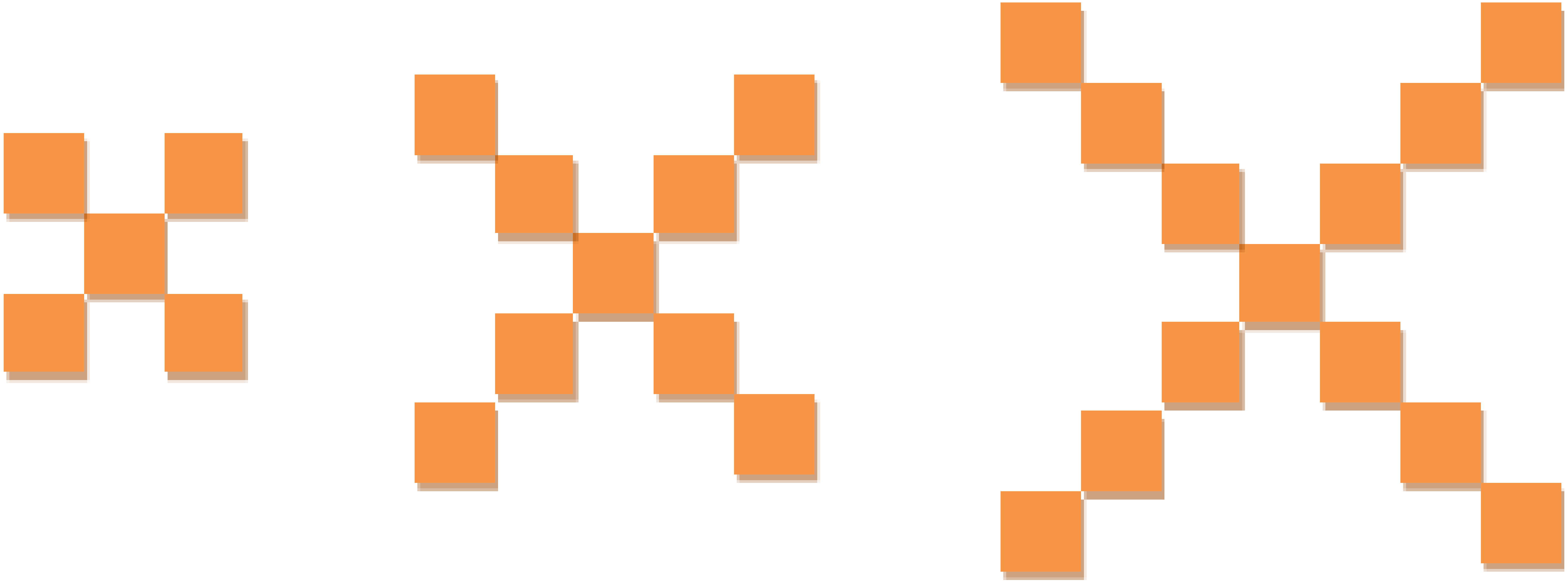


Fig. 1.
Fig. 2.
Fig. 2a.
Fig. 3.
Fig. 4.
Fig. 4a.
Fig. 5.
A
B
C
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
A
B
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
A
B
Fig. 14.

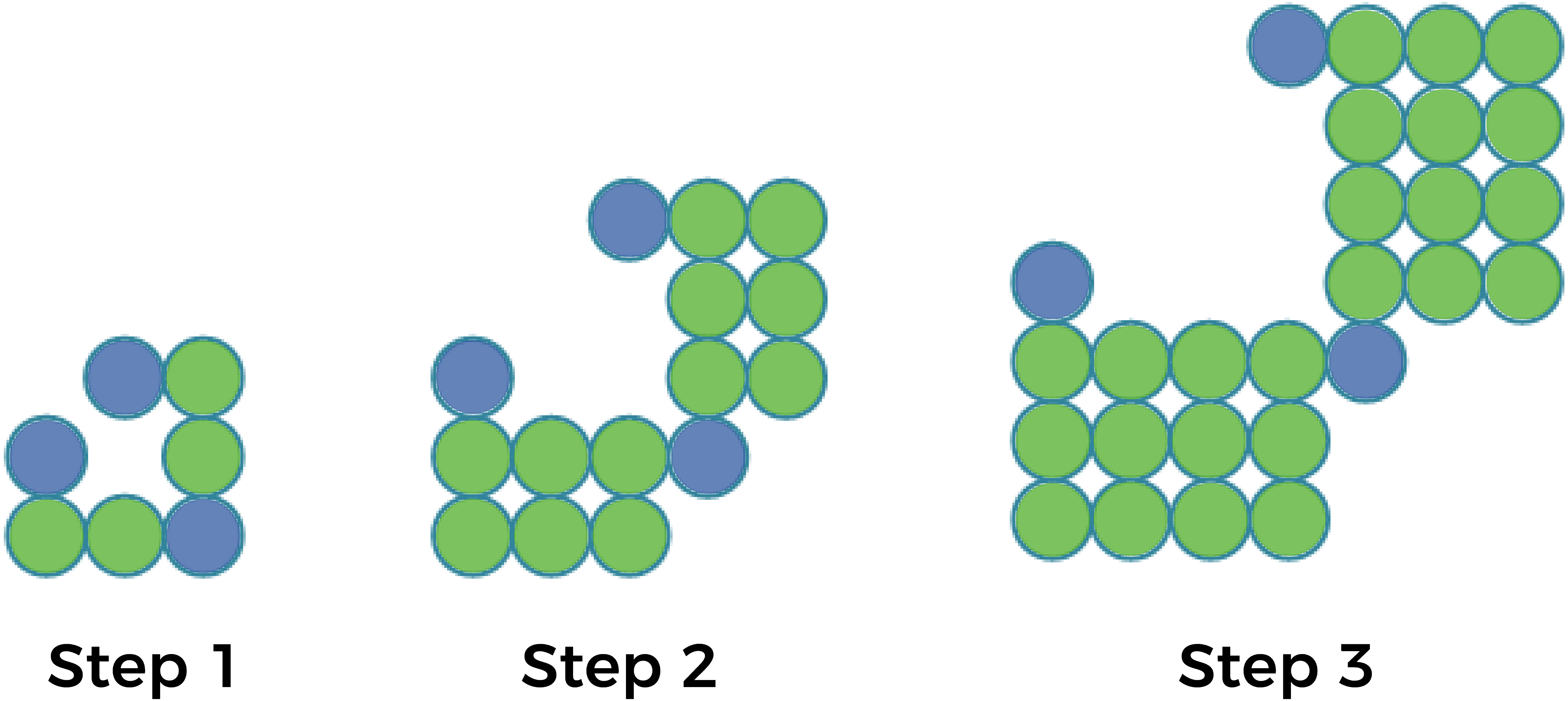
If math is the aspirin, then how do you create the headache?

DAN MEYER

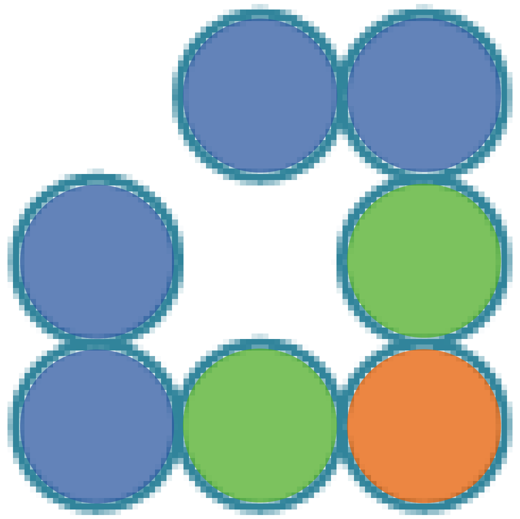


Step 1 Step 2 Step 3

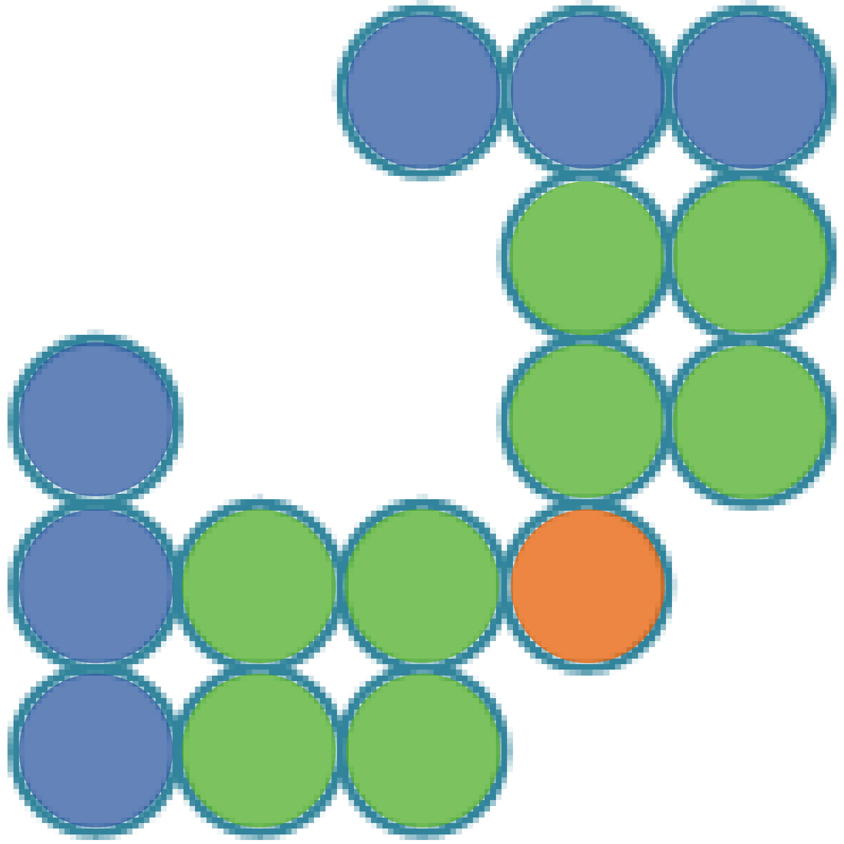
Source: visualpatterns.org



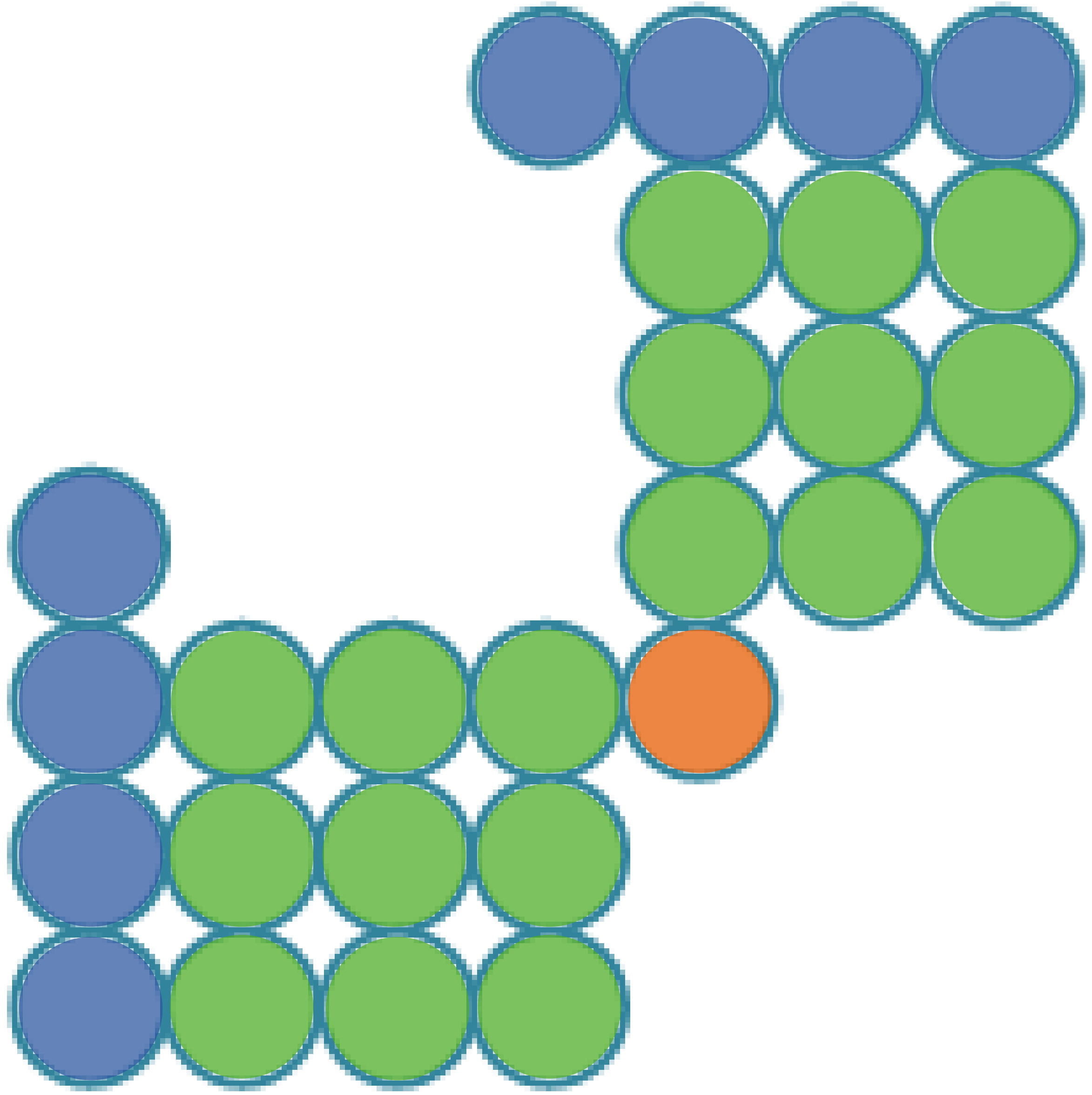
Source: visualpatterns.org



Step 1



Step 2



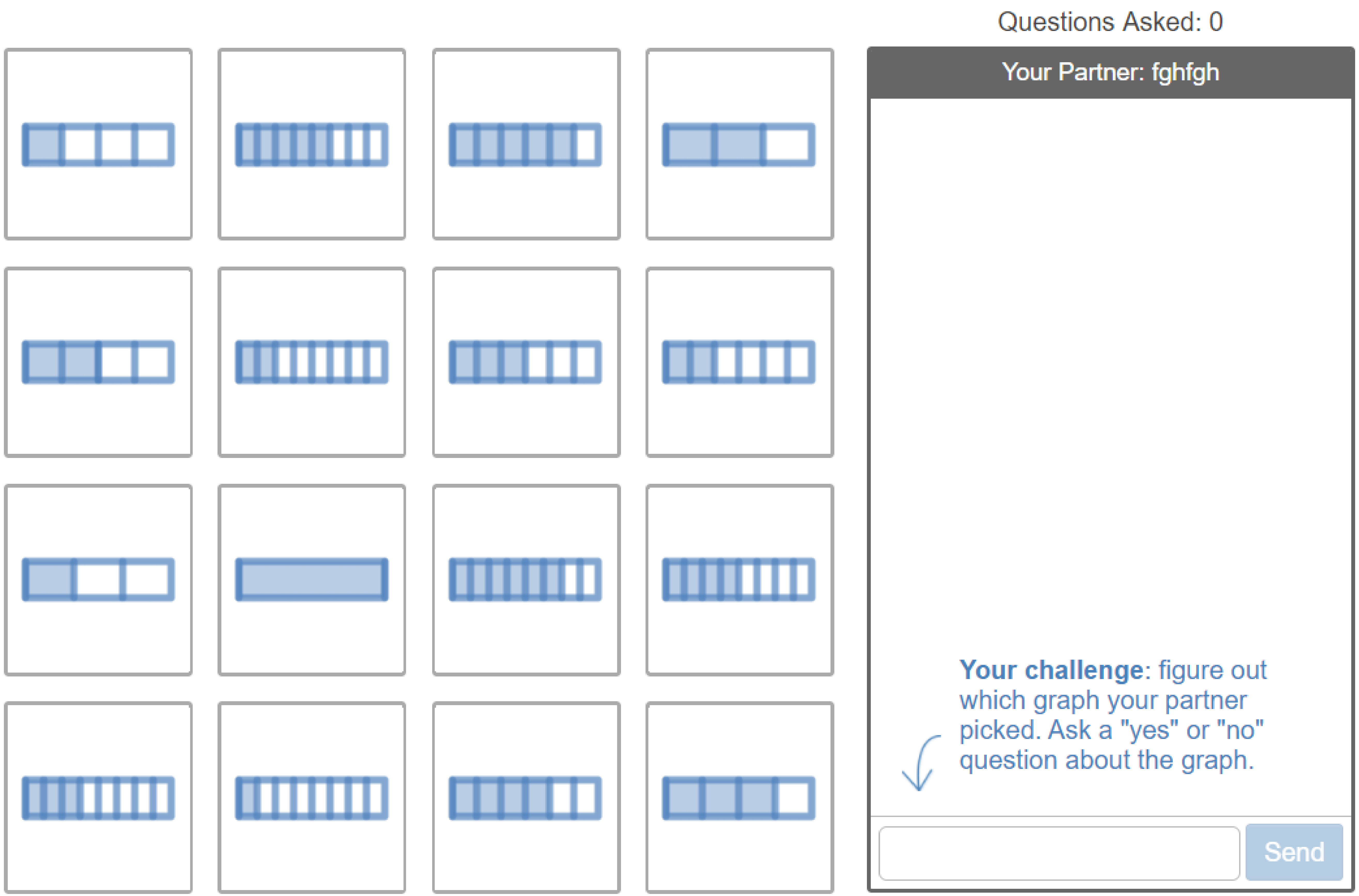
Step 3

Source: visualpatterns.org

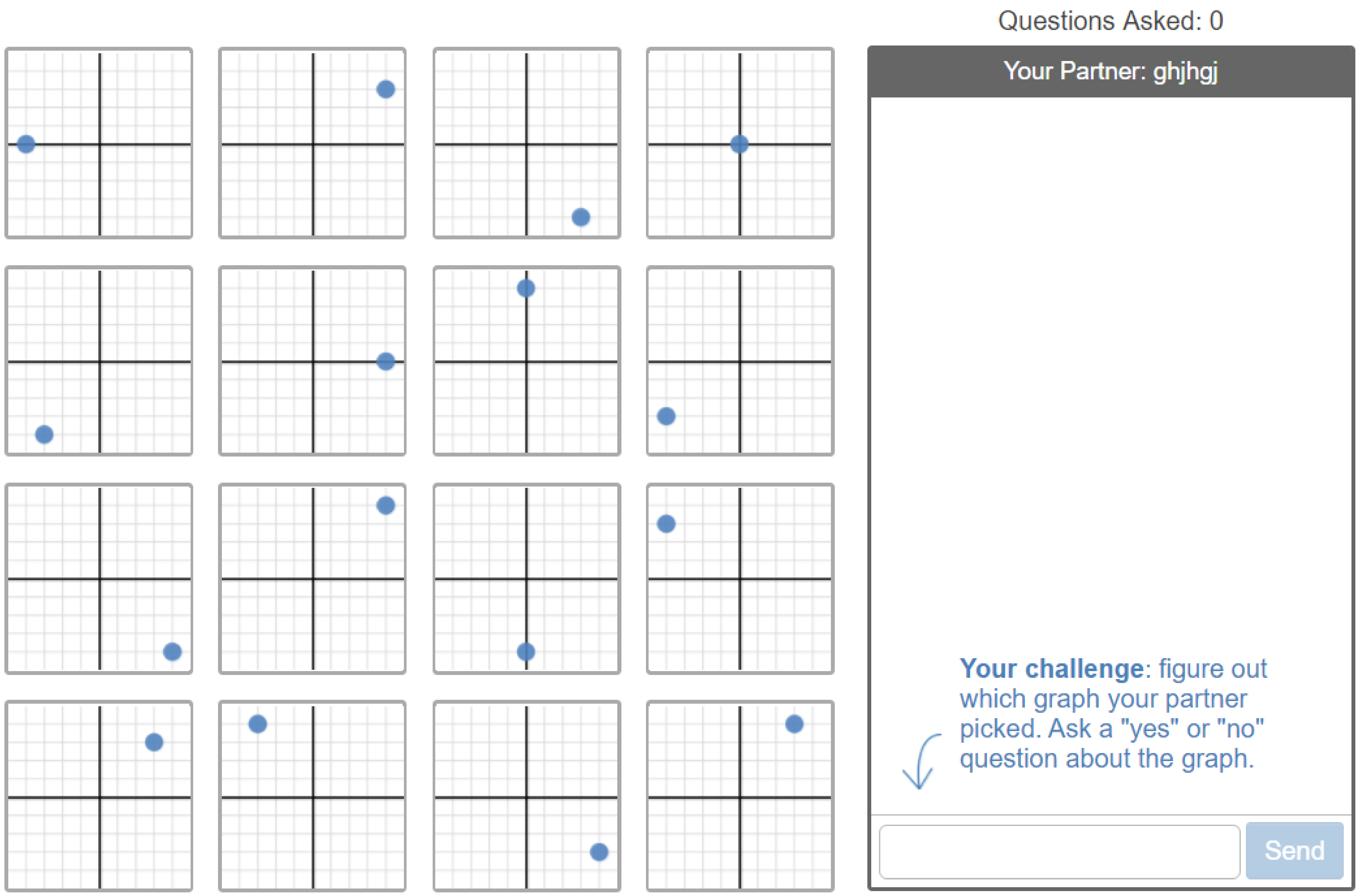
Select a person that's special to you for any reason. Next

Skip the practice round.

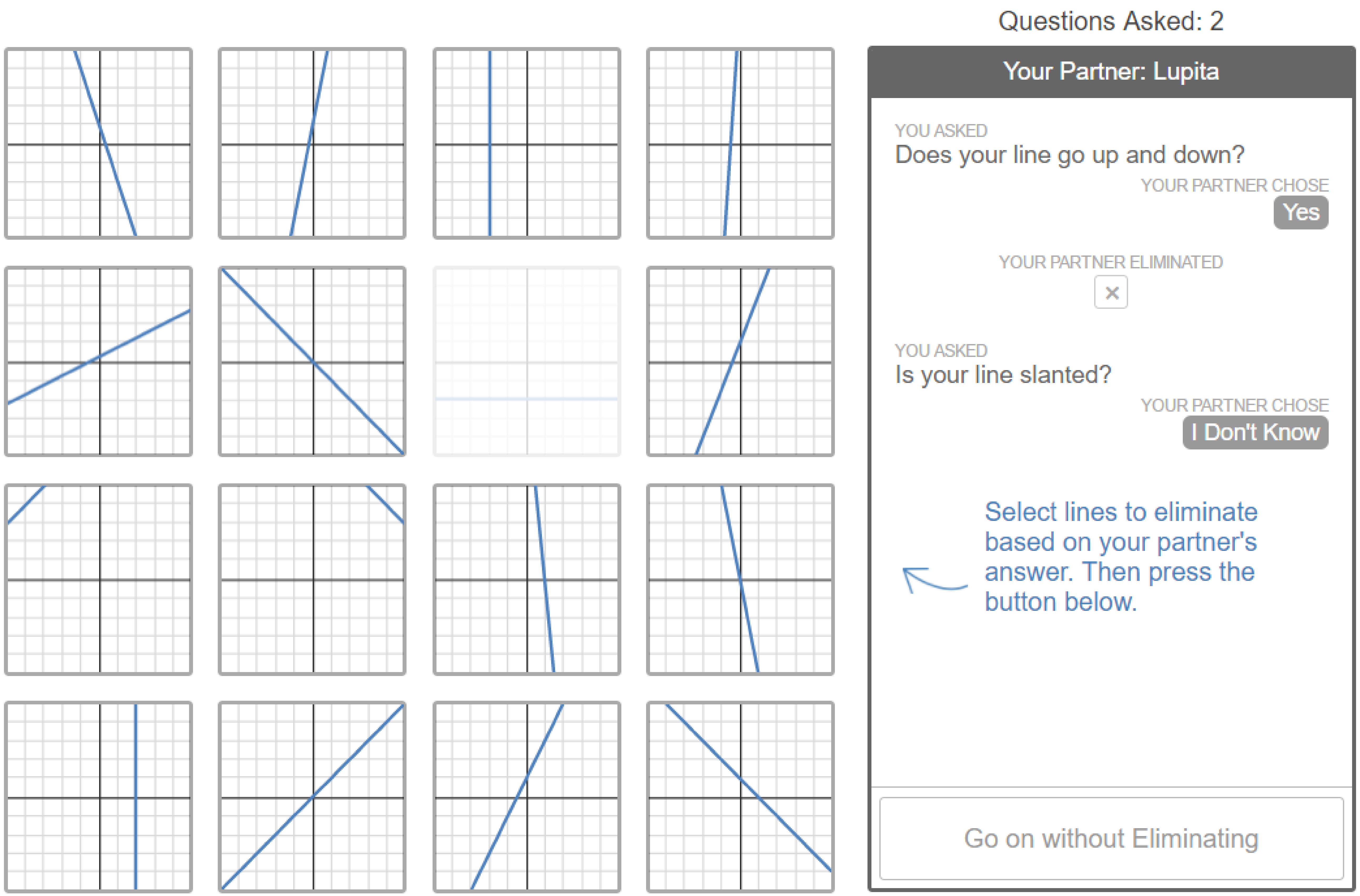
Source: teacher.desmos.com/polygraph



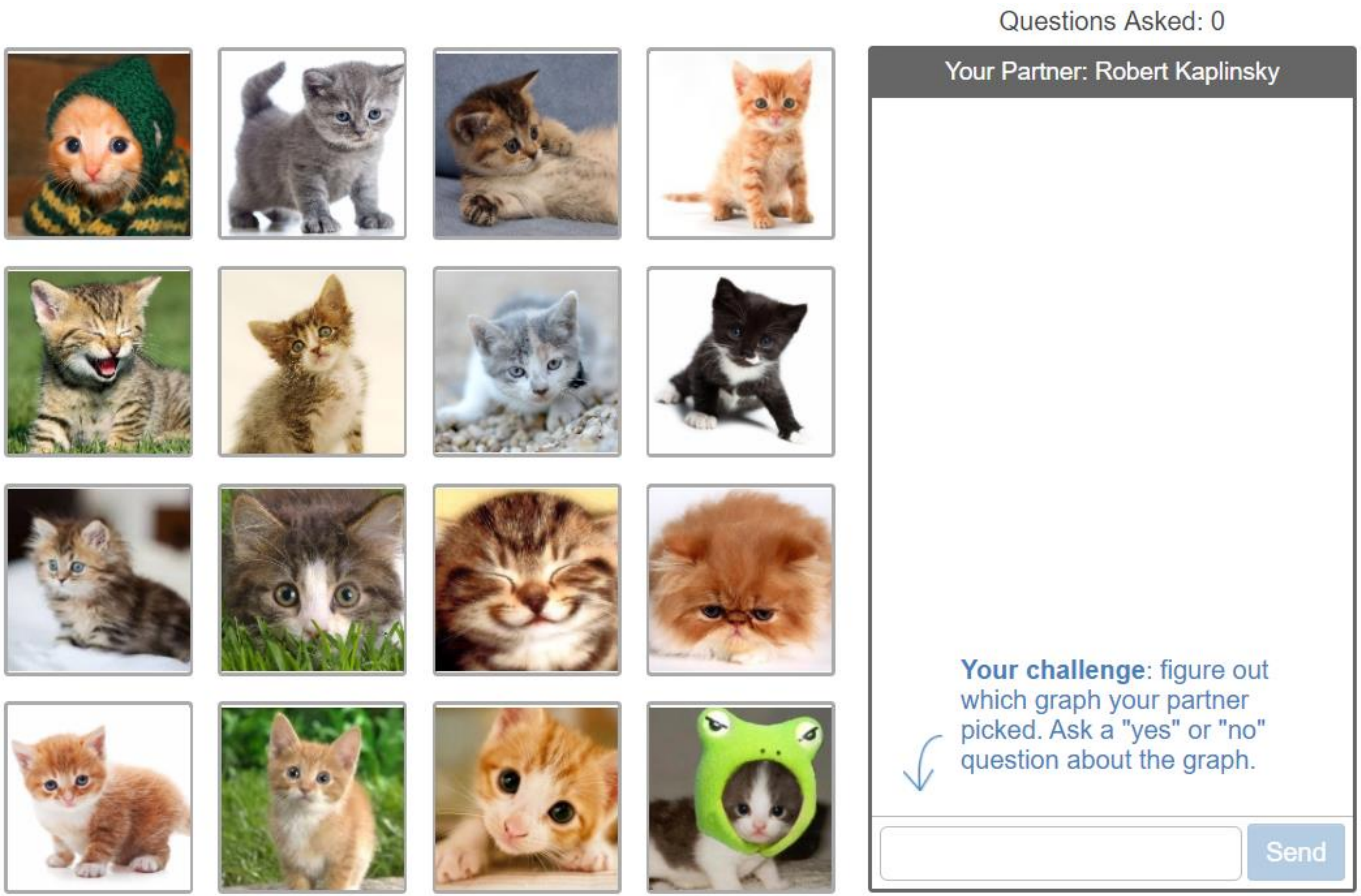
Source: teacher.desmos.com/polygraph



Source: teacher.desmos.com/polygraph

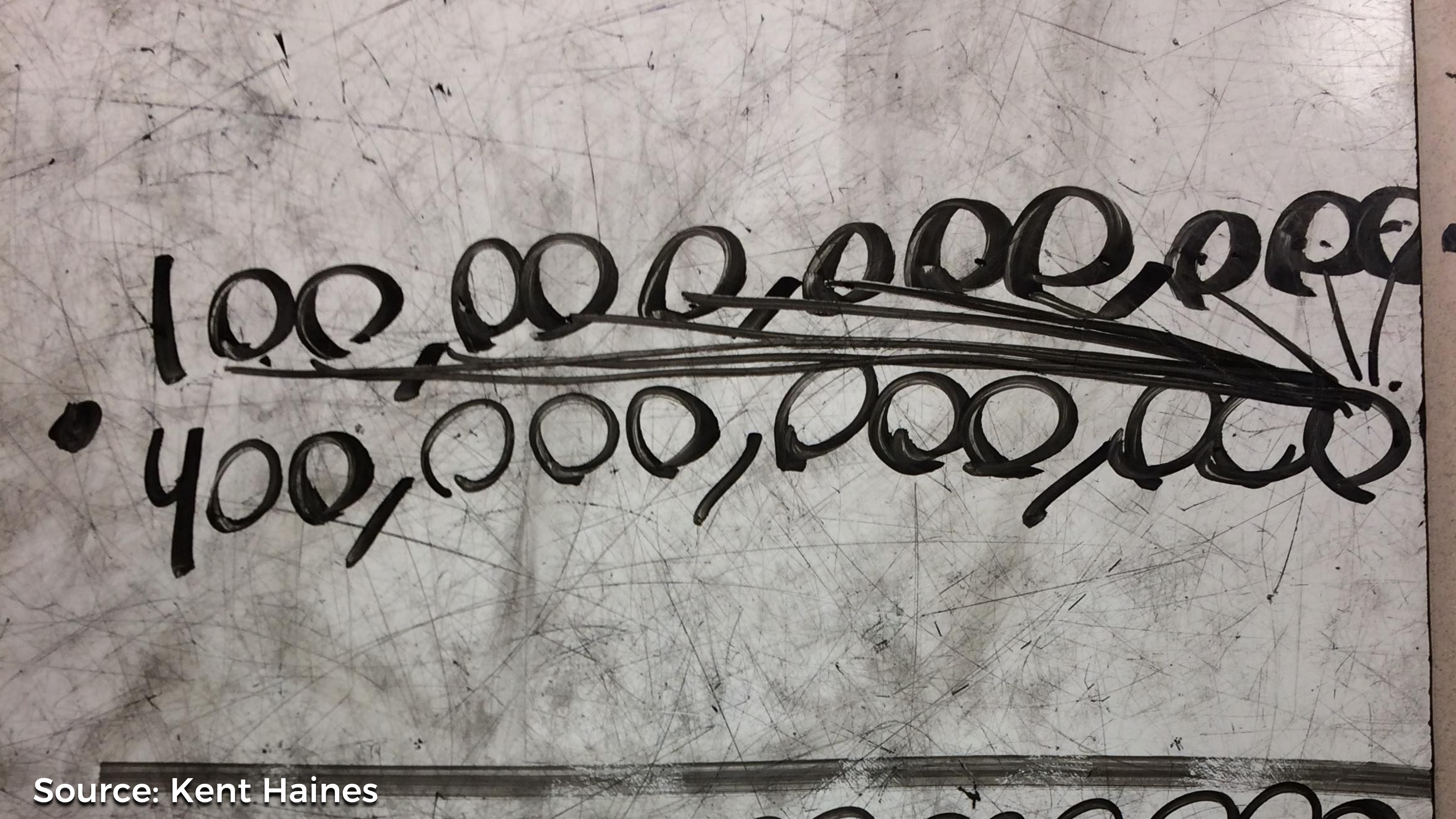


Source: teacher.desmos.com/polygraph



Source: teacher.desmos.com/polygraph

Source: robertkaplinsky.com/lessons



Source: Kent Haines

Source: robertkaplinsky.com/lessons

STICKY ATTRIBUTES

- [x] SIMPLE
- [ ] UNEXPECTED
- [ ] CONCRETE
- [ ] CREDIBLE
- [ ] EMOTIONAL
- [ ] STORIES

Source: reasonandwonder.com

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Source: reasonandwonder.com

Source: reasonandwonder.com

Source: reasonandwonder.com

Source: reasonandwonder.com

Source: reasonandwonder.com

Source: reasonandwonder.com

THINKING TIME

Source: reasonandwonder.com

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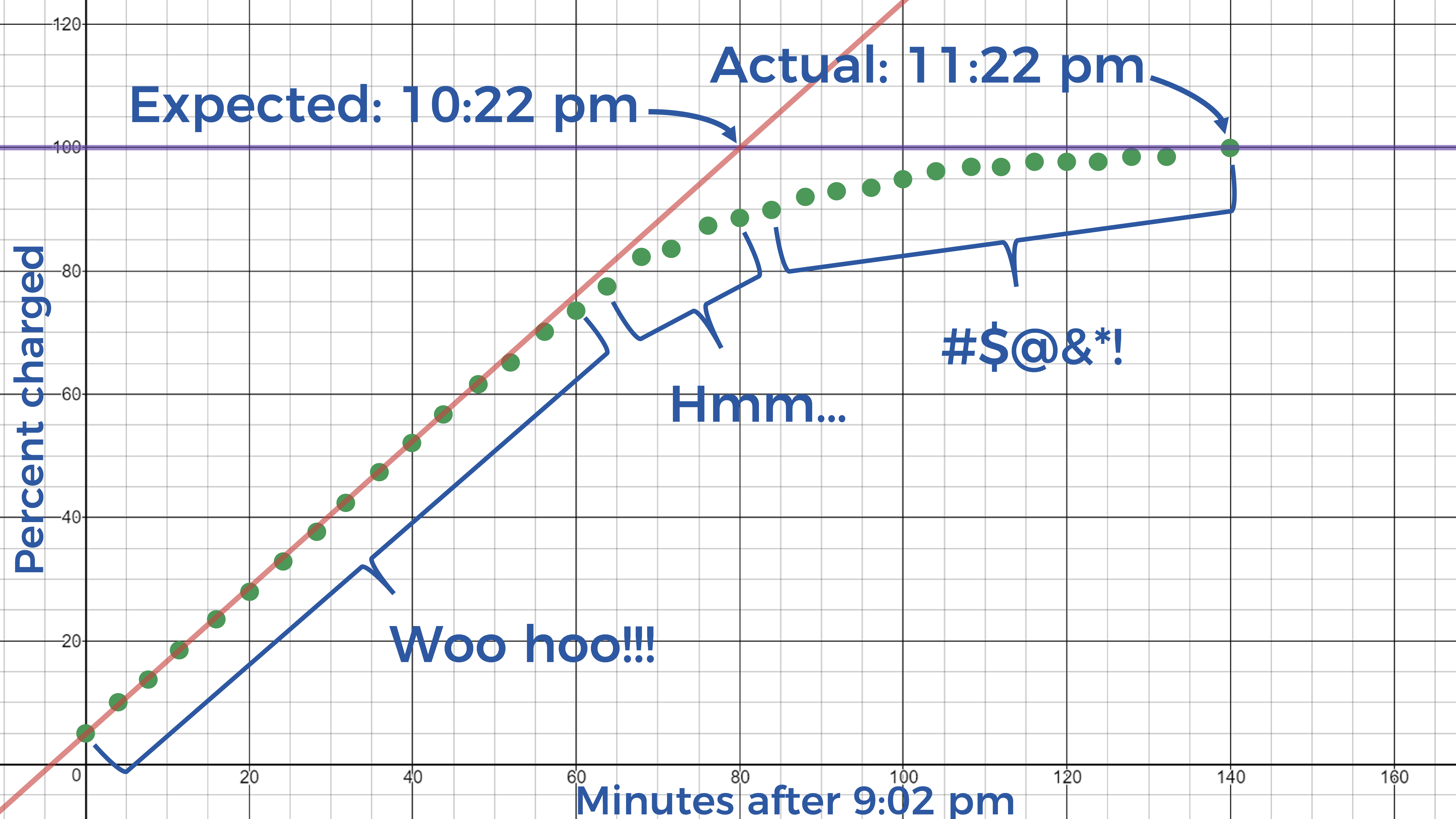
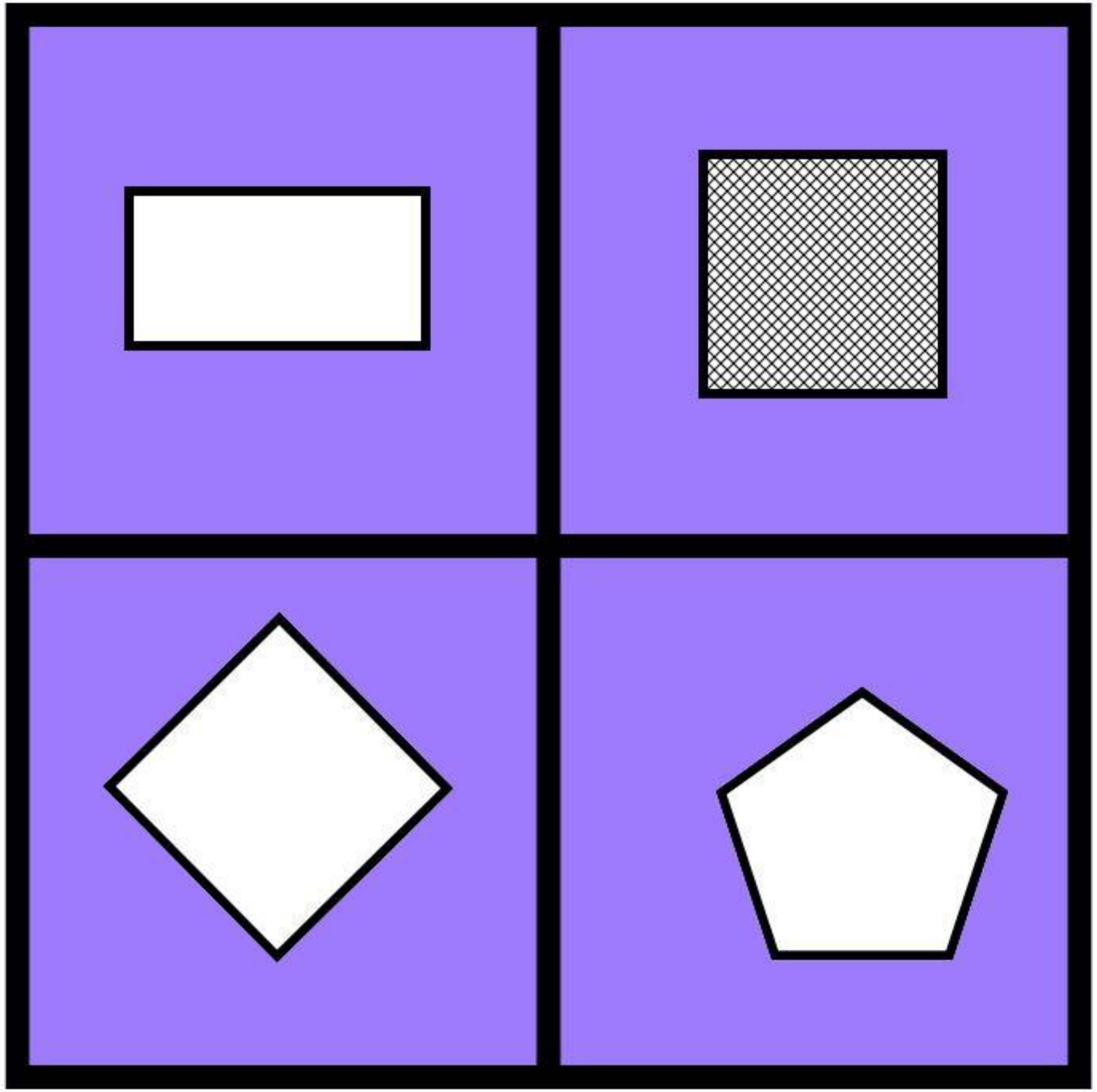

Expected: 10:22 pm
Actual: 11:22 pm
Woo hoo!!!
Hmm...
#$@&*!
Percent charged
Minutes after 9:02 pm
0
20
40
60
80
100
120
140
160

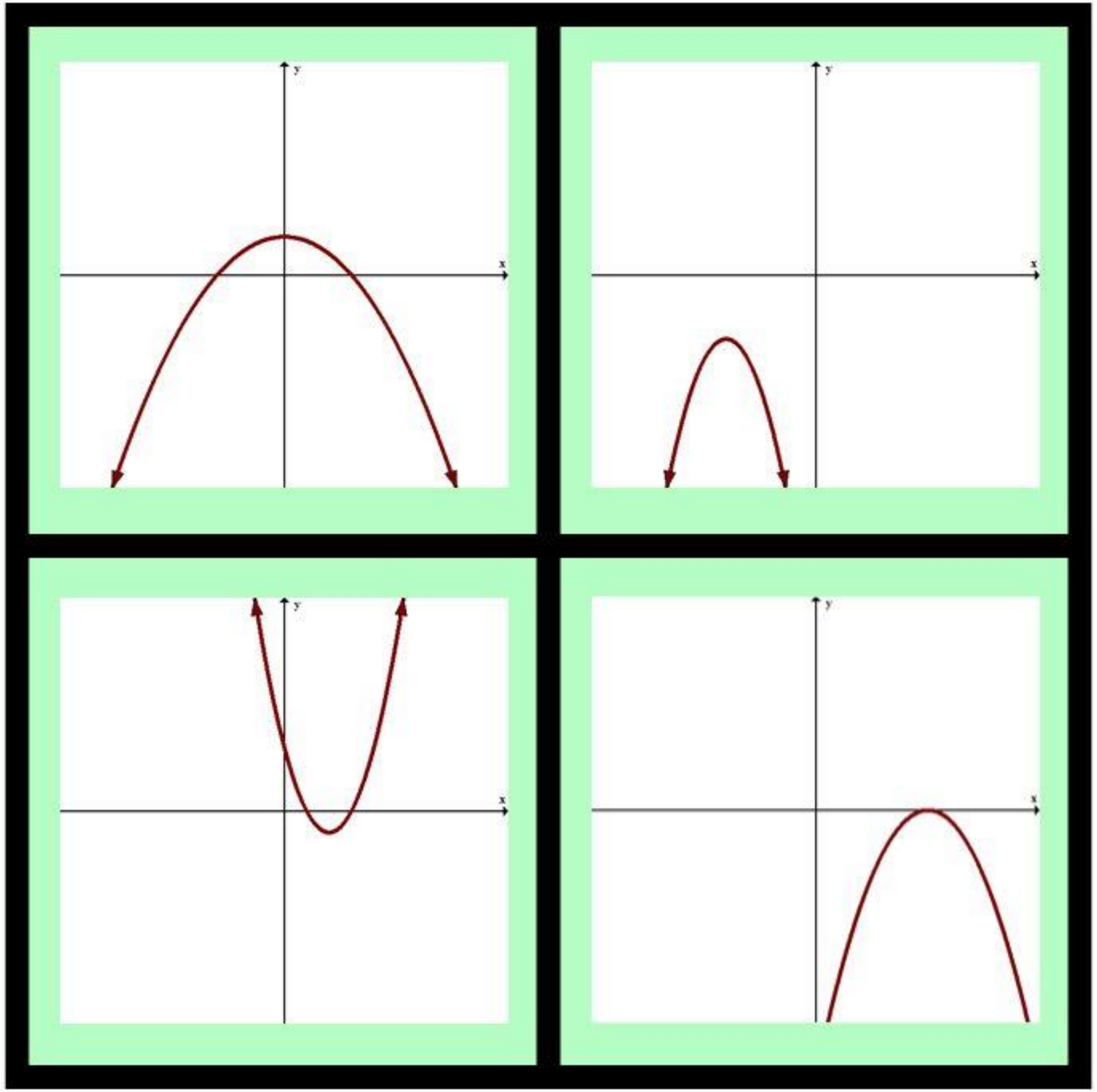
UNEXPECTED

- ❏ PATTERN BREAKING
- ❏ COUNTERINTUITIVE
- ❏ KNOWLEDGE GAPS
- ❏ OPEN MIDDLE



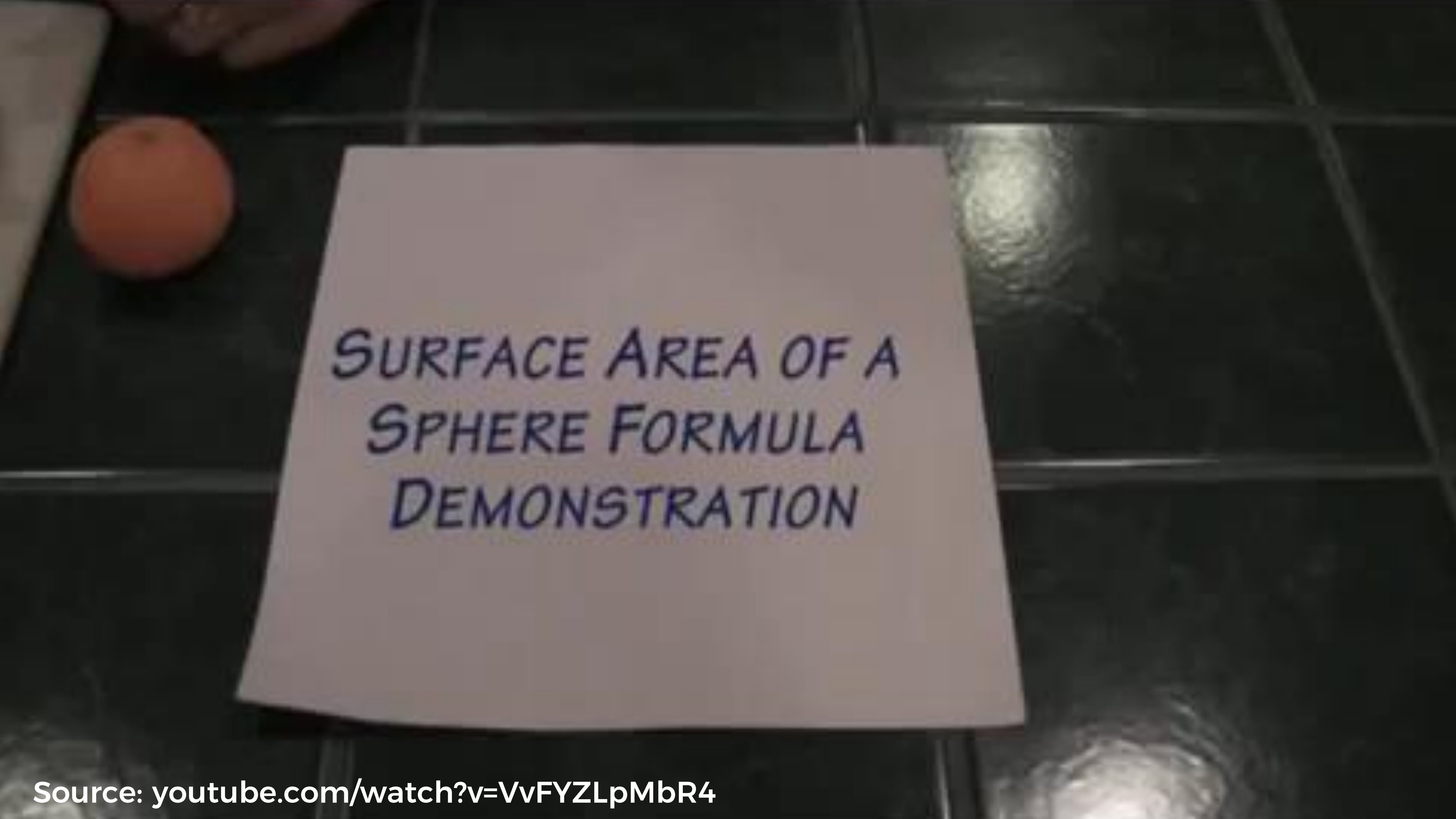
Source: wodb.ca

Source: wodb.ca


y
x
y
x
y
x
y
x

UNEXPECTED

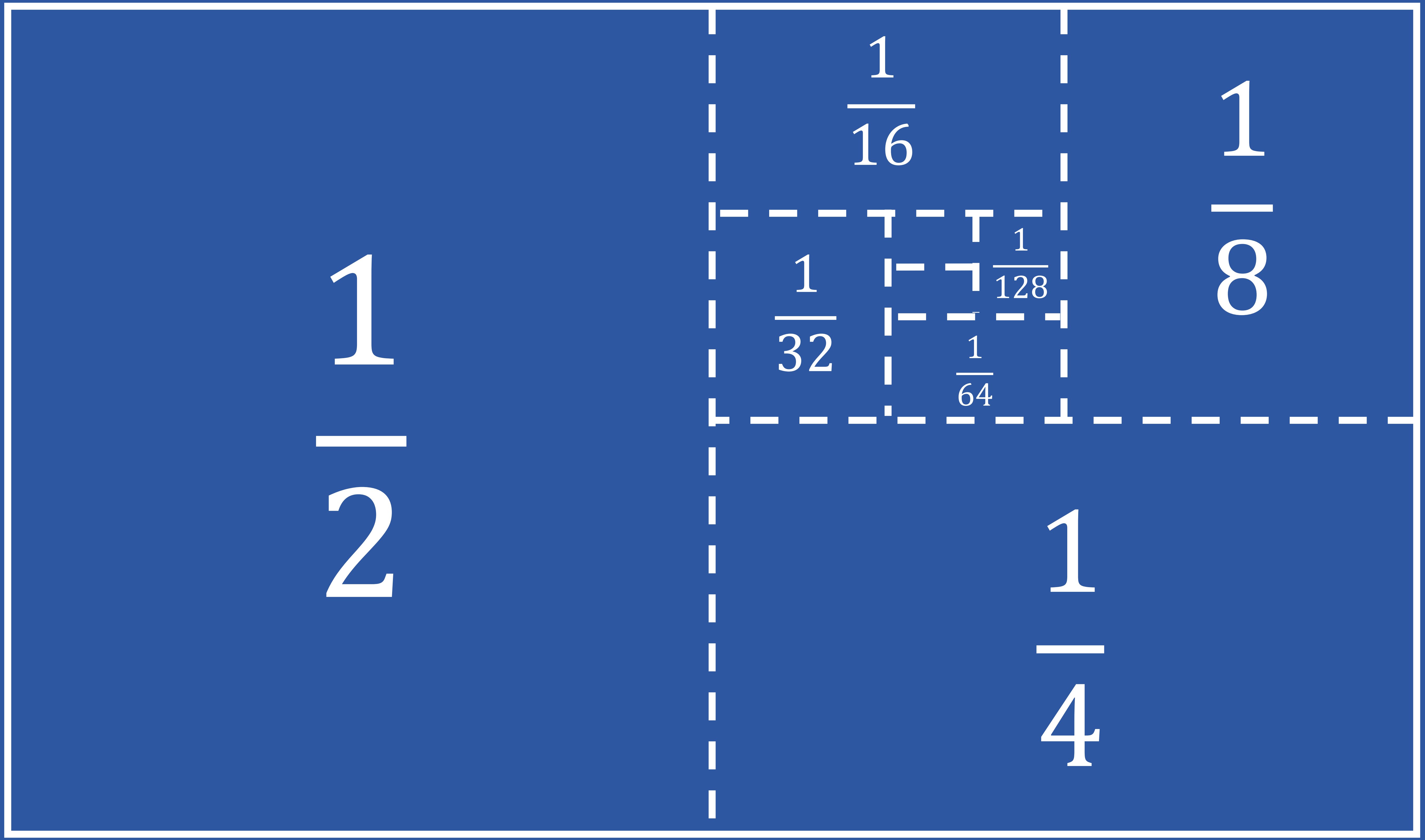
- [x] PATTERN BREAKING
- [ ] COUNTERINTUITIVE
- [ ] KNOWLEDGE GAPS
- [ ] OPEN MIDDLE



Source: youtube.com/watch?v=VvFYZLpMbR4

$$\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\frac{1}{32}+\cdots$$

$$\approx 1$$


1/2
1/4
1/8
1/16
1/32
1/64
1/128

Source: Kyle Pearce - youtube.com/watch?v=Yr53Ji4SZDg

UNEXPECTED

- [x] PATTERN BREAKING
- [x] COUNTERINTUITIVE
- [ ] KNOWLEDGE GAPS
- [ ] OPEN MIDDLE

Curiosity… arises from the perception of a gap in knowledge or understanding.

GEORGE LOEWENSTEIN

Source: robertkaplinsky.com/lessons

Source: robertkaplinsky.com/lessons

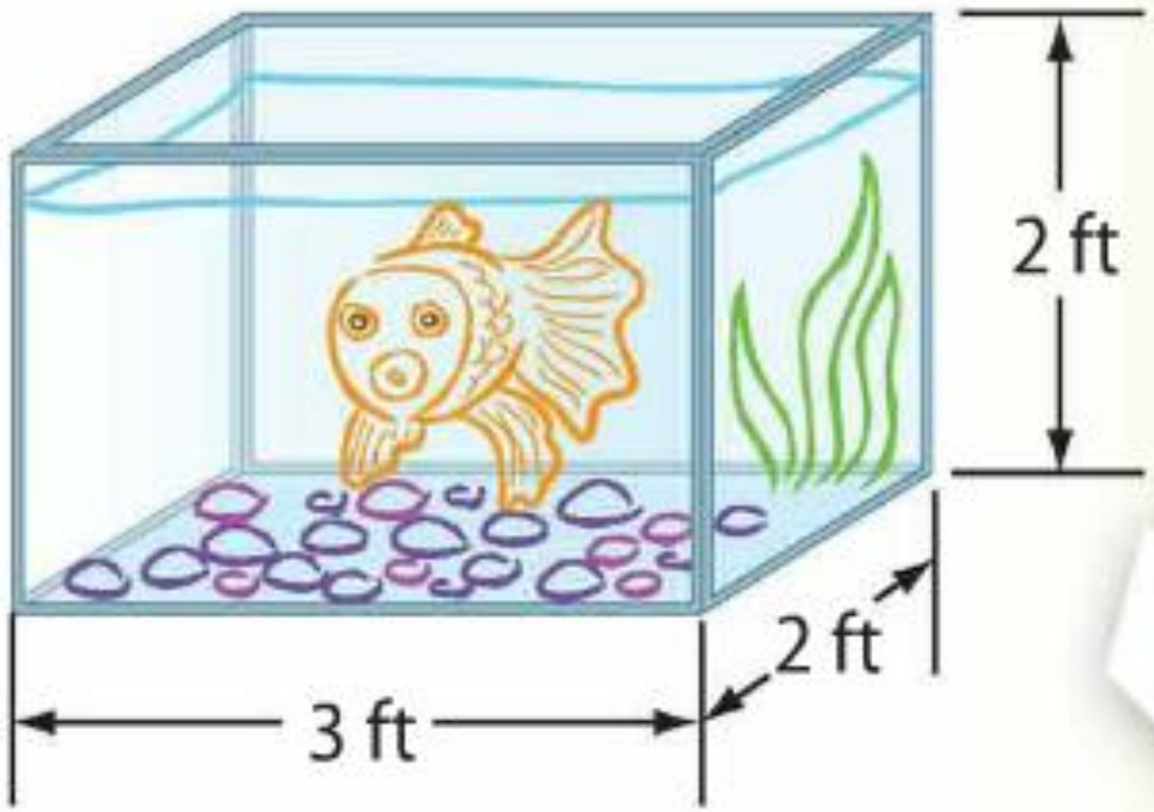
Source: robertkaplinsky.com/lessons

Source: robertkaplinsky.com/lessons

Real-World Link

Watch

Aquarium The dimensions of an aquarium are shown.



1. What is the area of the base of the aquarium? ______________

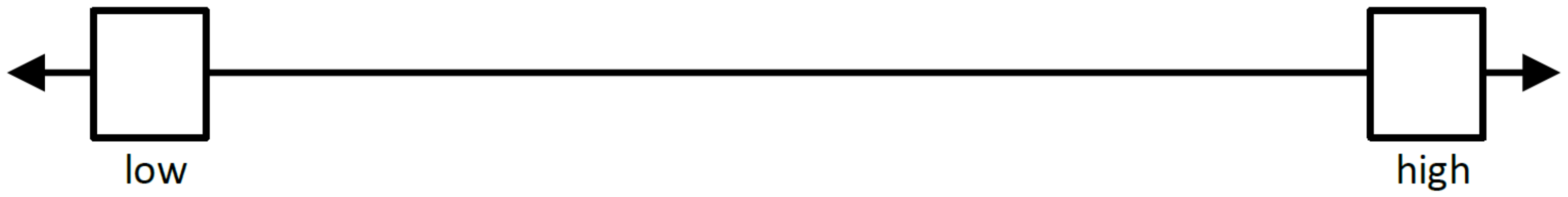
2. What is the height of the aquarium? ______________

3. Fill in the blanks to find the volume.

   ______ × ______ × ______ $= 12\ \text{ft}^3$

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?

UNEXPECTED

- ☑ PATTERN BREAKING
- ☑ COUNTERINTUITIVE
- ☑ KNOWLEDGE GAPS
- ☐ OPEN MIDDLE

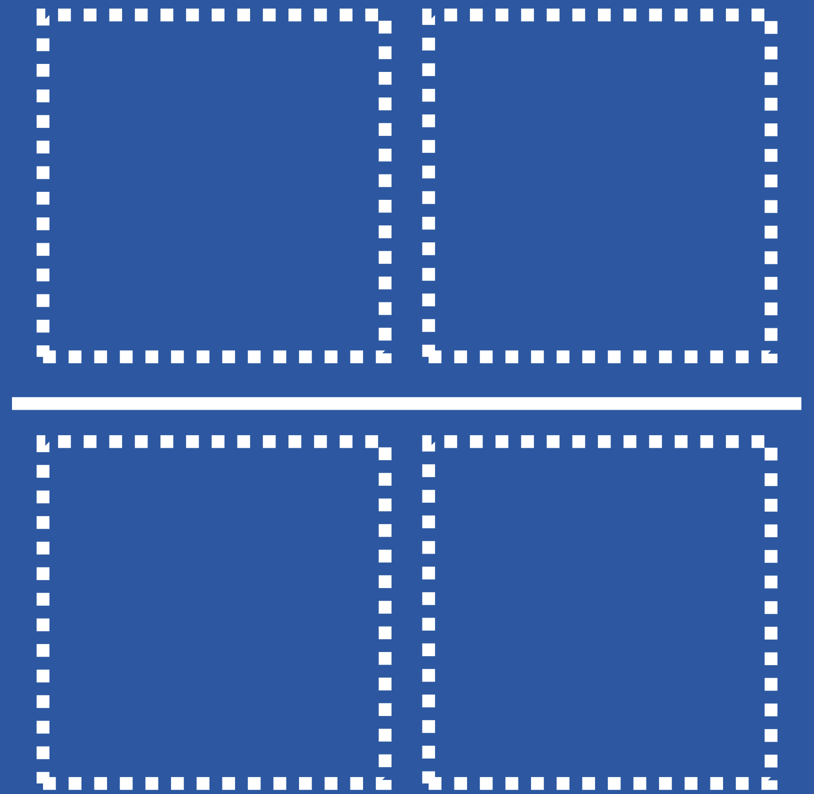

N

Google Maps My Village to Treasure Chest Travel 3621 miles, 21 days, 4 hours

My Village

	Treasure Map	Google Maps
Beginning	Closed	Closed
Middle	Open	Closed
End	Closed	Closed

Using the digits 1-9, at most one time each, fill in the boxes to create a fraction that is as close to one as possible.



Extension: How many ways can you prove that you are correct?

Source: Peter Morris on openmiddle.com

	Open Middle	Closed Middle
Beginning	Closed	Closed
Middle	Open	Closed
End	Closed	Closed

Name ______________________ My Homework ______________________

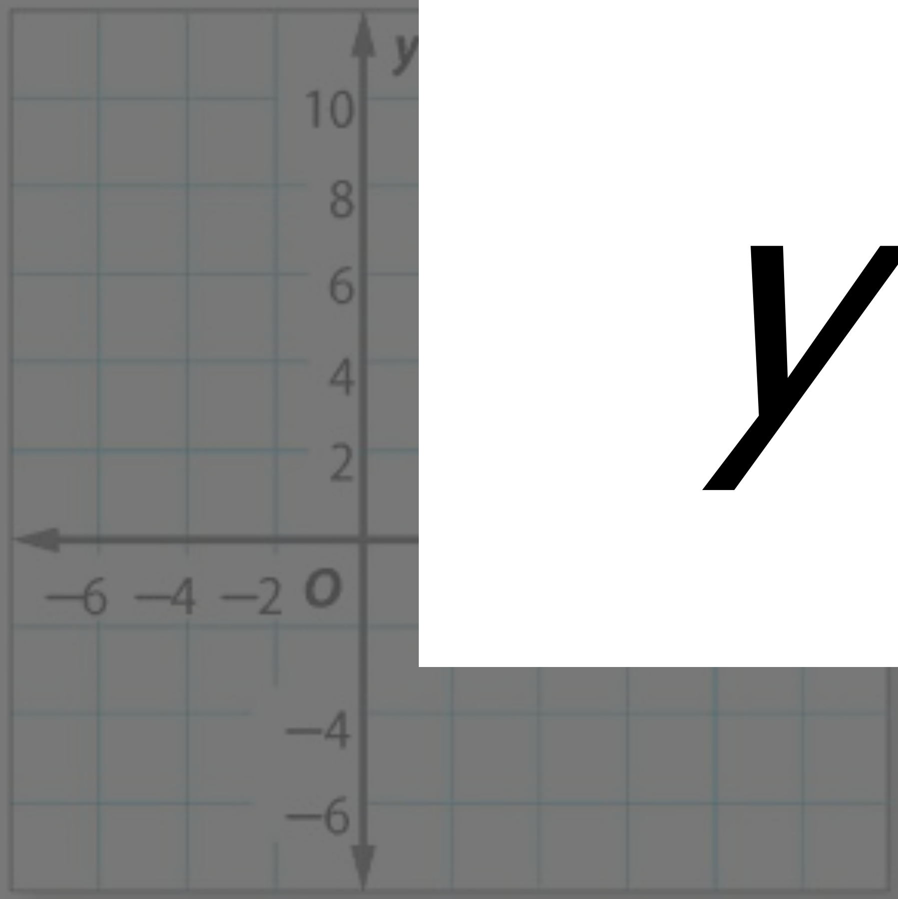
Independent Practice

Solve each syst

1. $y = x$

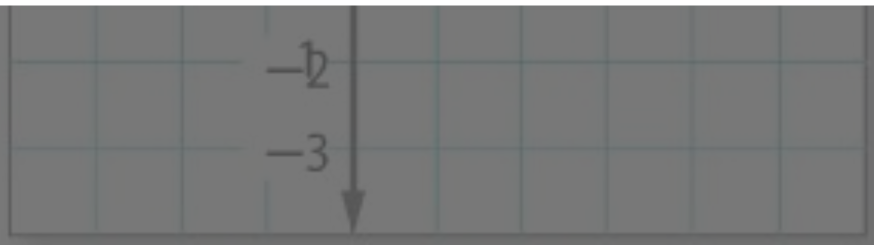
$y = 2x - 4$

Show your work.



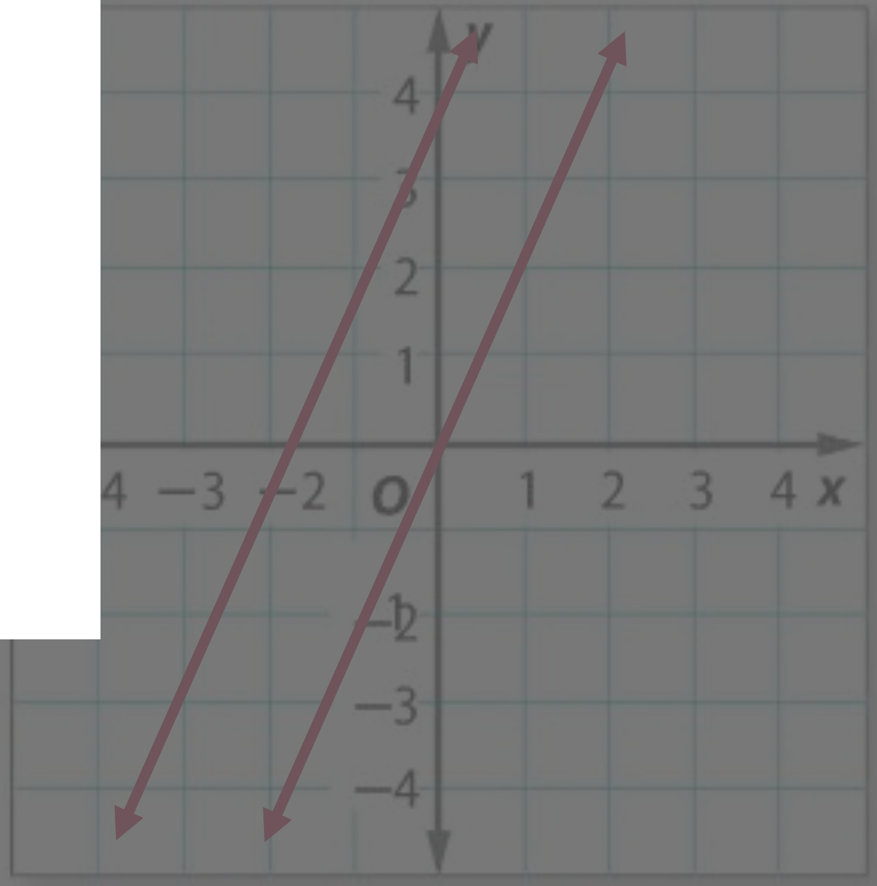
$$0 \neq 4$$

$$y = 2x$$

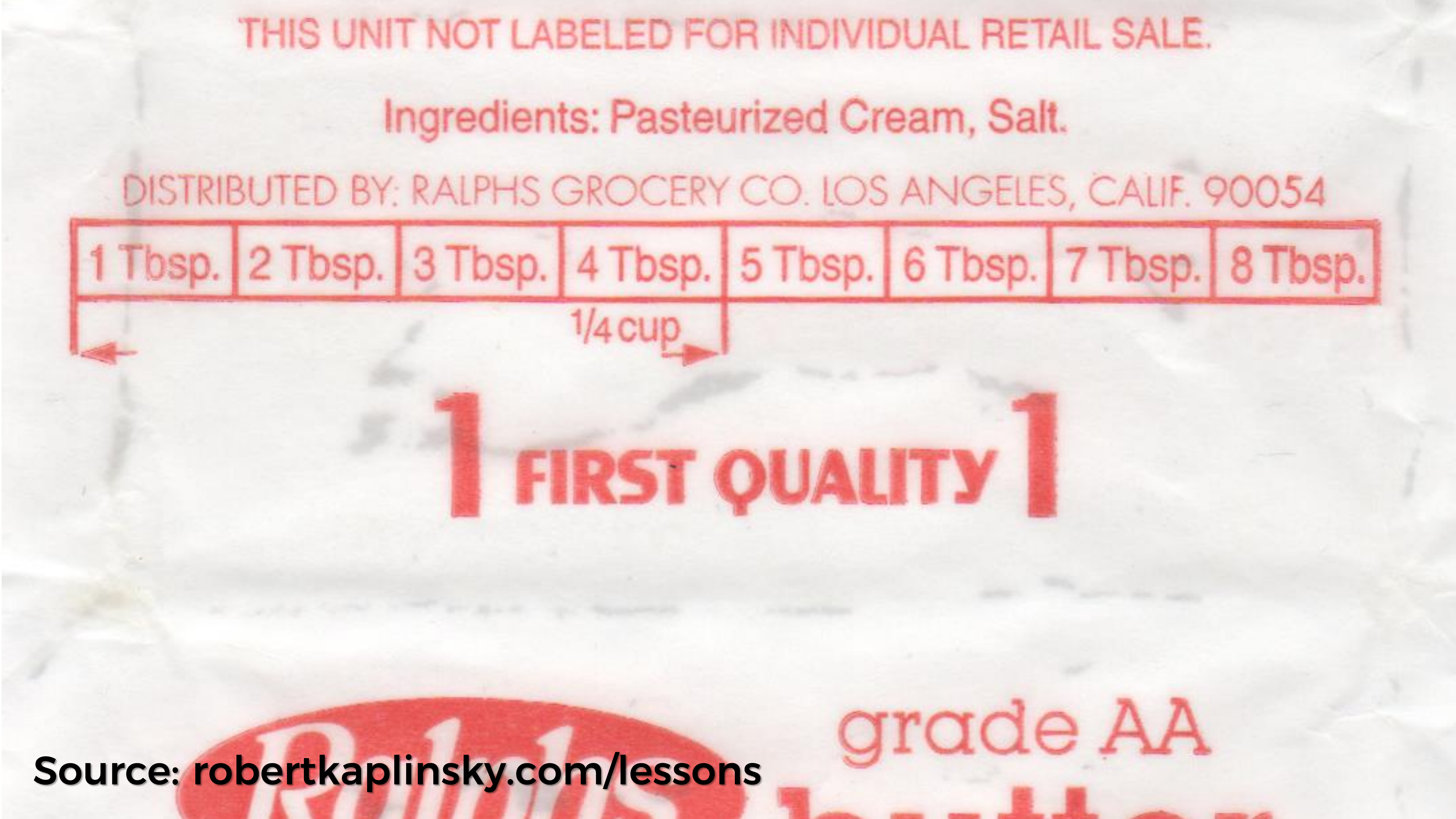


$y - 2x = 4$

$y = 2x$



Source: robertkaplinsky.com/lessons

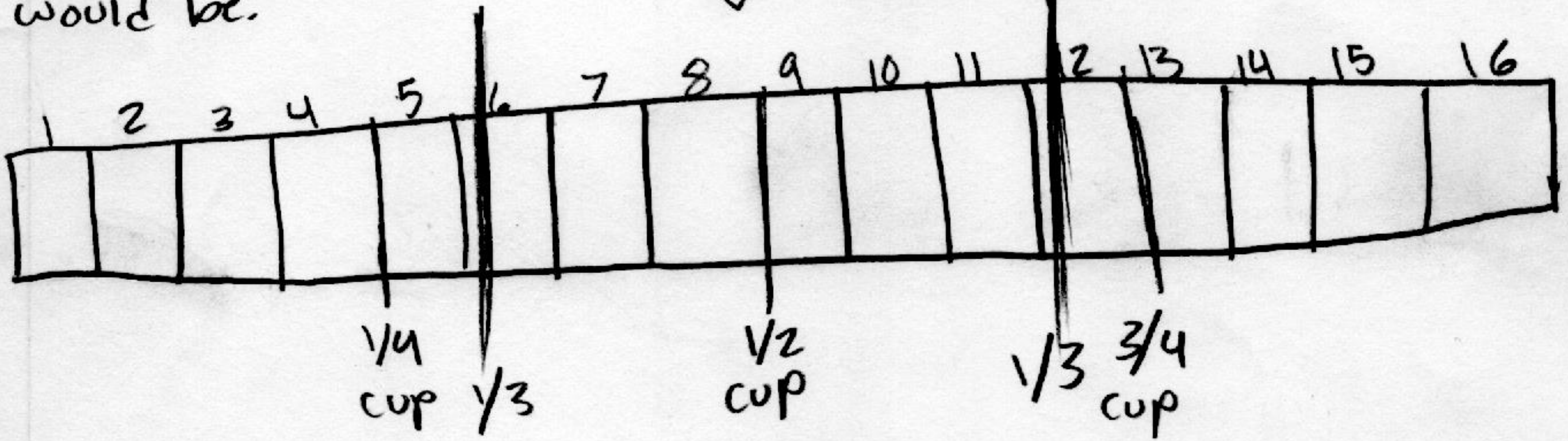


Source: robertkaplinsky.com/lessons


THIS UNIT NOT LABELED FOR INDIVIDUAL RETAIL SALE.
Ingredients: Pasteurized Cream, Salt.
DISTRIBUTED BY: RALPHS GROCERY CO. LOS ANGELES, CALIF. 90054
Tbsp. 2 Tbsp. 3 Tbsp. 4 Tbsp. 5 Tbsp. 6 Tbsp. 7 Tbsp. 8 Tbsp.
1/4 cup
1/3 cup
1/2 cup
1 FIRST QUALITY 1
THIS UNIT NOT LABELED FOR INDIVIDUAL RETAIL SALE.
Ingredients: Pasteurized Cream, Salt.
DISTRIBUTED BY: RALPHS GROCERY CO. LOS ANGELES, CALIF. 90054
1 Tbsp. 2 Tbsp. 3 Tbsp. 4 Tbsp. 5 Tbsp. 6 Tbsp. 7 Tbsp. 8 Tbsp.
1/4 cup
1/3 cup
1/2 cup
1 FIRST QUALITY 1
Source: robertkaplinsky.com/lessons

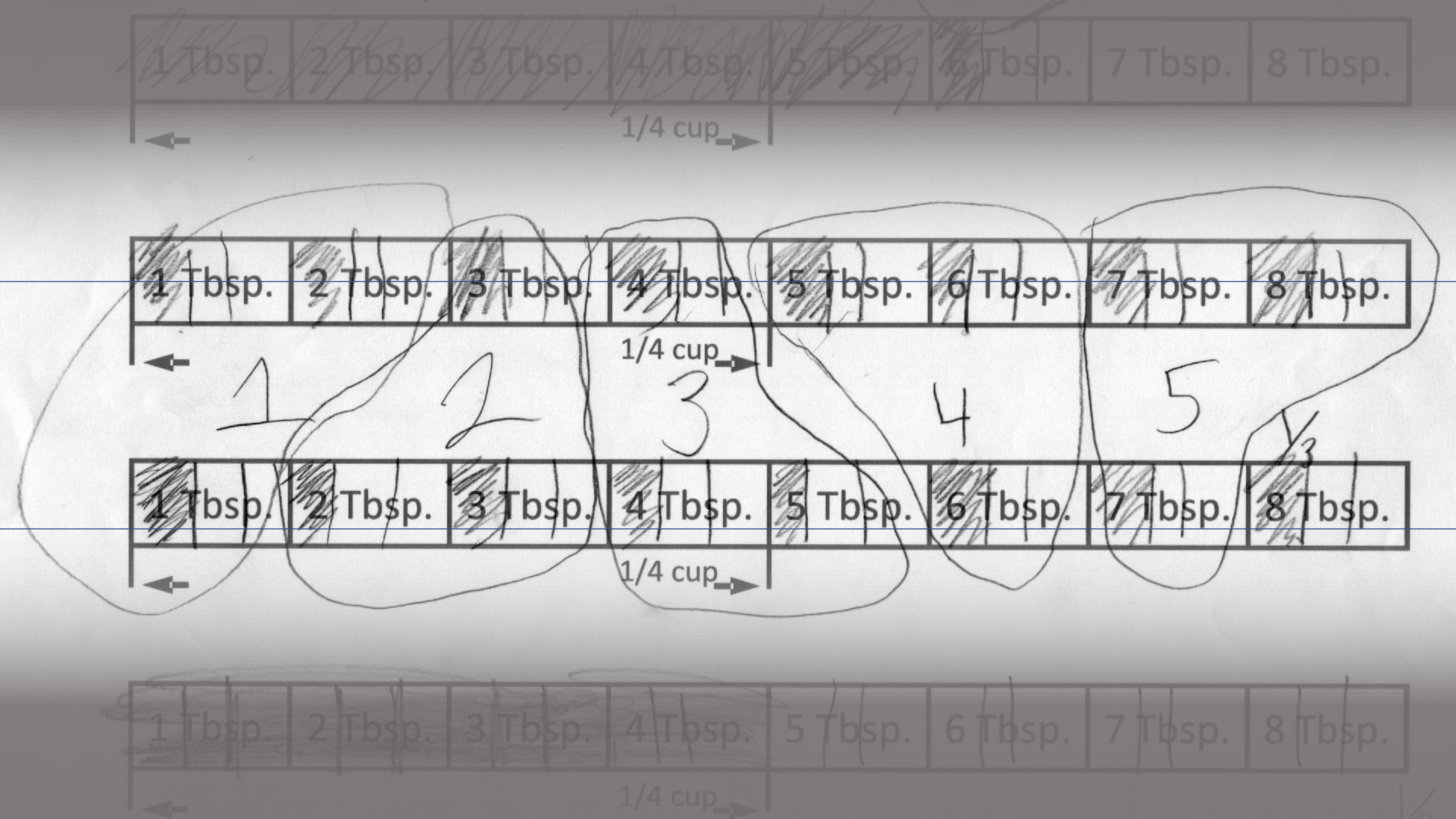
What is your conclusion? How did you reach that conclusion?

I reached my answer by drawing a picture of 16 Tbsp and estimated where on the picture would the 1/3 cup would be.



I also divided 16 by 3. →

$$\begin{array}{r} 5.1 \\ 3\overline{)16} \\ \underline{15} \\ 1 \end{array}$$


1 Tbsp.
2 Tbsp.
3 Tbsp.
4 Tbsp.
5 Tbsp.
6 Tbsp.
7 Tbsp.
8 Tbsp.
1/4 cup
1
2
3
4
5
1/3
1 Tbsp.
2 Tbsp.
3 Tbsp.
4 Tbsp.
5 Tbsp.
6 Tbsp.
7 Tbsp.
8 Tbsp.
1/4 cup

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

First, I got the total amount of tablespoons that equal a cup, which is 16 tbsp. After that, I divided 16 by 3 to find 1/3 of a cup. My quotient was 5 with a remainder of 1. So I divided the remainder to all three equal groups. My answer was that 1/3 of a cup of butter is 5.33 or 5 1/3 cups. To check, I multiplied 5.33 by 3 and my answer was 15.99. If you round that, you get 16.00 as the answer.

UNEXPECTED

- ☑ PATTERN BREAKING
- ☑ COUNTERINTUITIVE
- ☑ KNOWLEDGE GAPS
- ☑ OPEN MIDDLE

STICKY ATTRIBUTES

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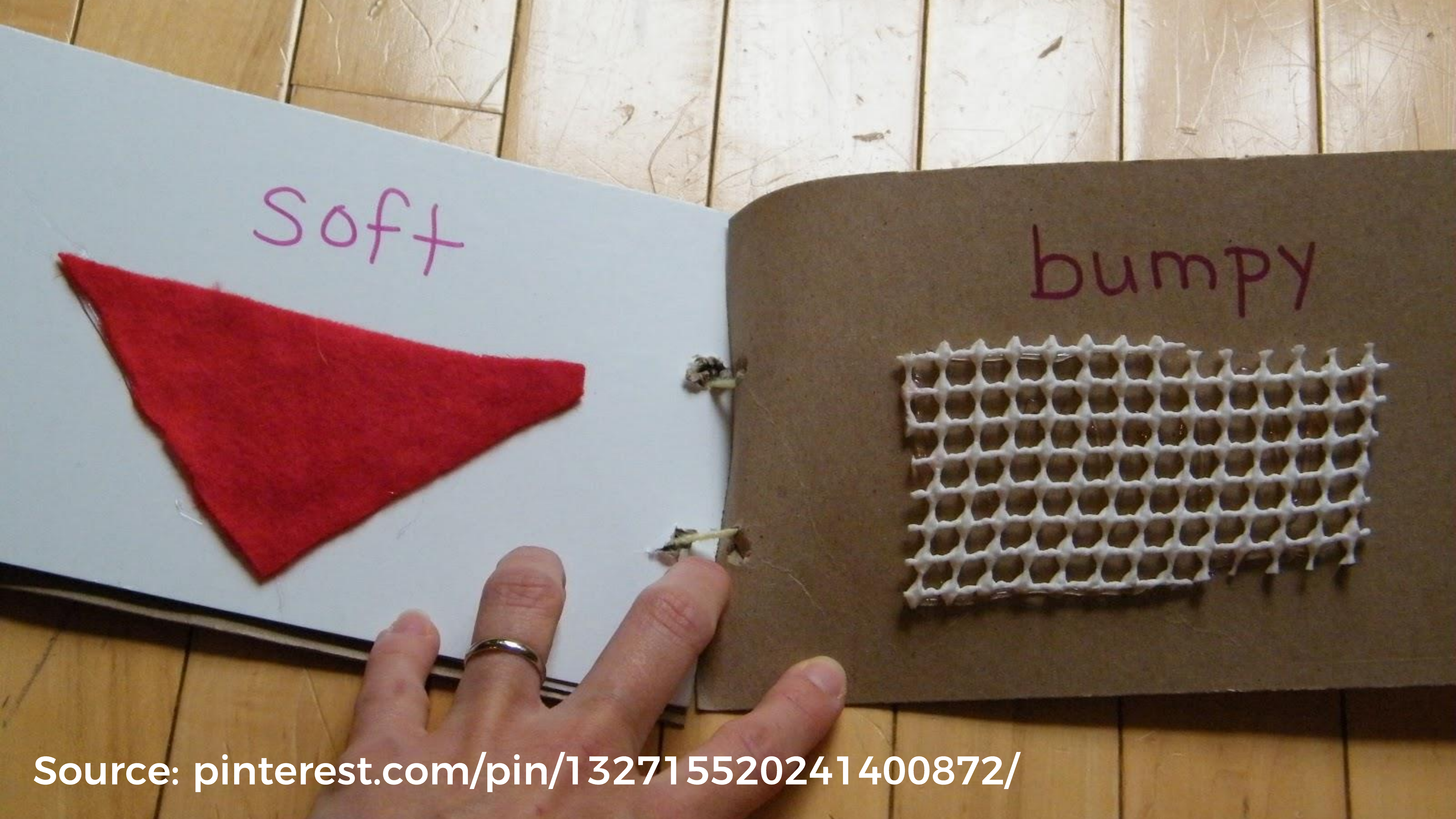


Source: pinterest.com/pin/132715520241400872/

Yellow the fragrant flowers,

Yellow the stinky socks,

Source: Color Dog


HunterDouglas
HunterDouglas
WINDOW FASHIONS
VICTORIA
15553
PRESIDENT'S
MINI BRIE
19.6 OUNCES
5.99
4988
VALLEY SUN
SUN-DRIED TOMATOES
JULIENNE CUT 32 OUNCE
UNIT PRICE PER OUNCE
.234
SELL PRICE
7.49
PRESIDENT
COMPOST

NAME: ______________________________ DATE: ________________ PERIOD: ________

Lesson 7 Skills Practice

Objective: Divide Decimals by Decimals

Divide.

1. $4.86 \div 0.2$

7. $2.25 \div 0.15$

13. $7.52 \div 0.74$

2. $628.2 \div 34.9$

8. $421.6 \div 0.4$

14. $0.105 \div 0.6$


BOXING

Fans stream Nelly to help him pay off $2.4 million debt

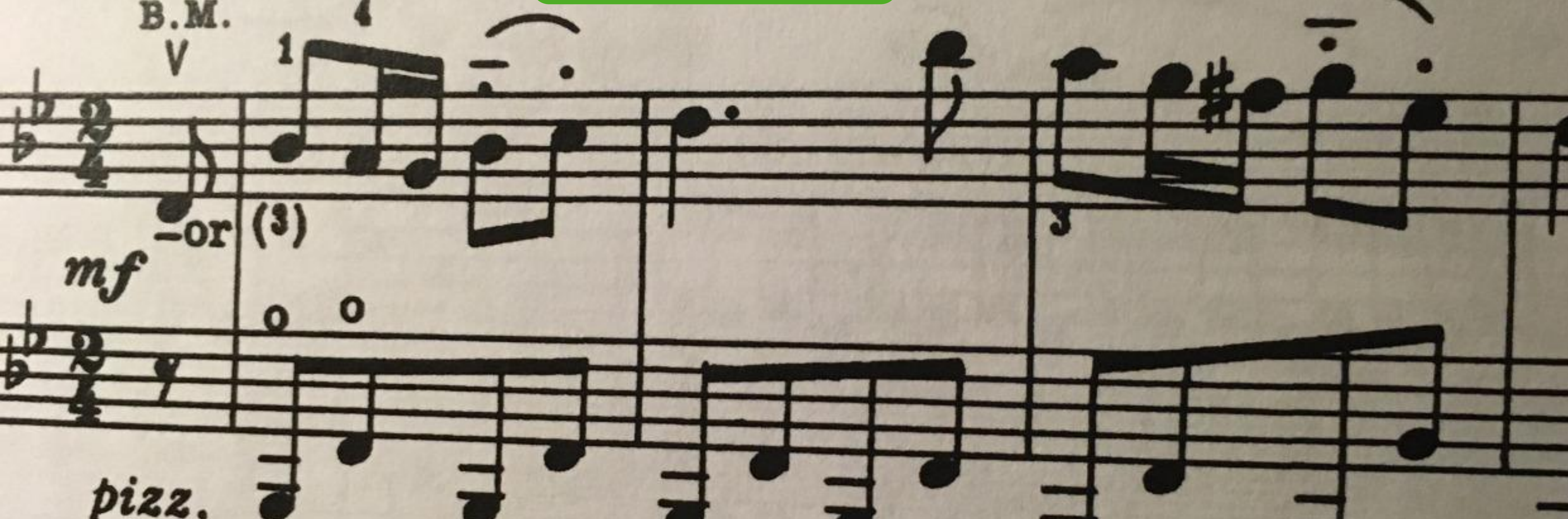
by Lisa Respers France @CNNMoney

September 13, 2016: 2:47 PM ET

- How many $0.006 are there in $2,400,000?
- How many 6 are there in 24?

9. Canzonett

In moderate time-with sparkle (Key of G minor)



LESSON 19-1

Stretching, Compressing, and Reflecting Sine and Cosine Graphs

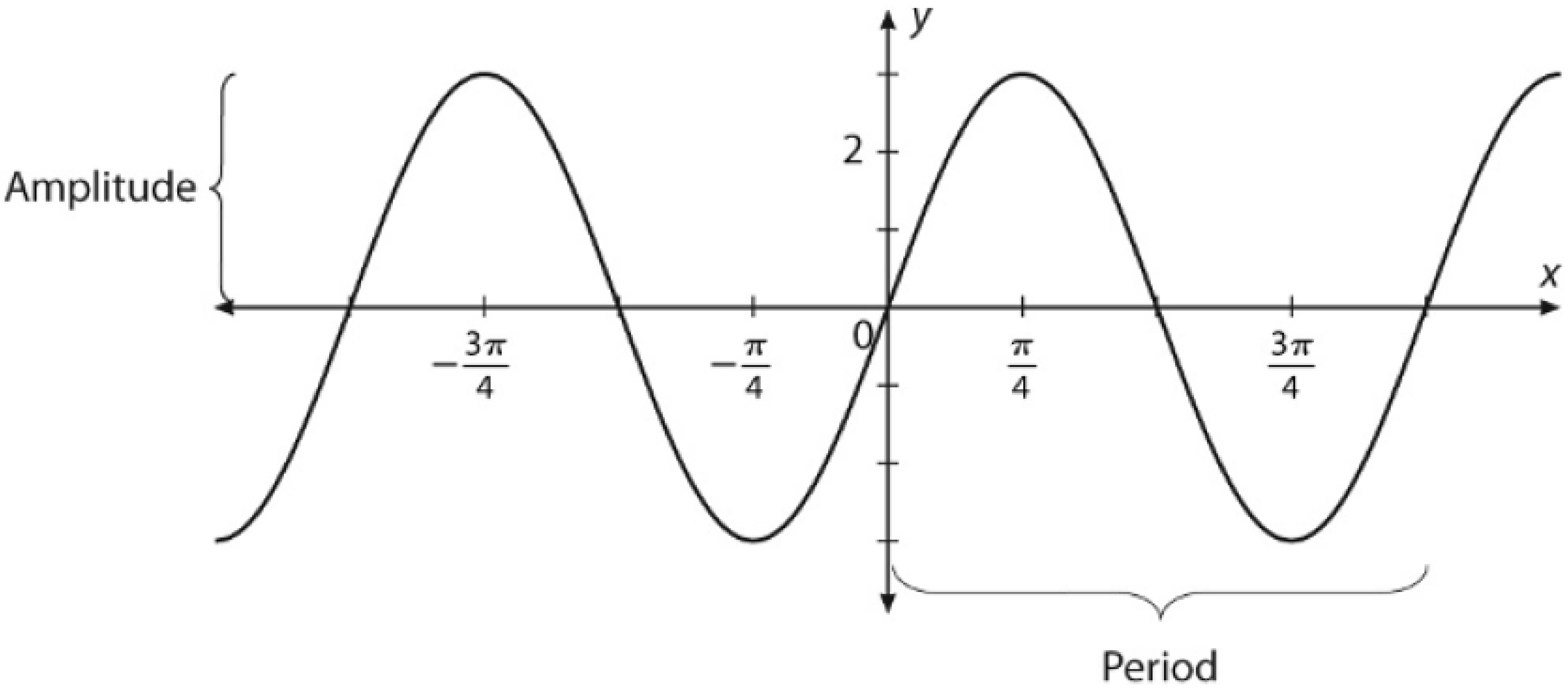
Reteach

For a sine function, $y = a\sin\left(\frac{1}{b}x\right)$.

Amplitude $= |a|$

Period $= 2\pi \bullet b$

If $a < 0$, the graph is reflected across the x-axis.



Example Write the function shown in the graph above.

Source: graphingstories.com

$$P = 2L + 2R$$

$$A = \pi r^2$$

$$A = \frac{1}{2}bh$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

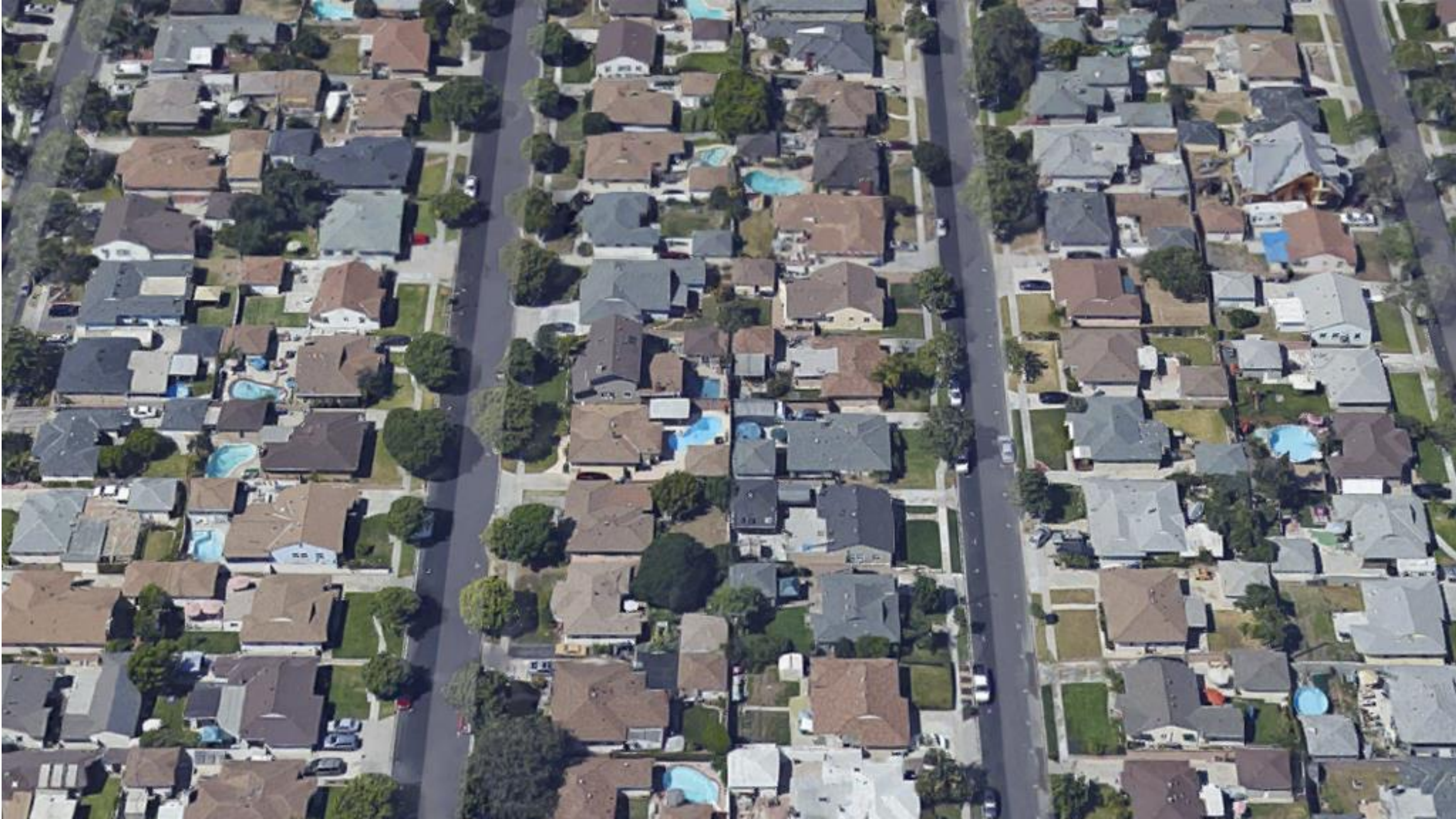
$$\log_b(x^y) = y \cdot \log_b(x)$$

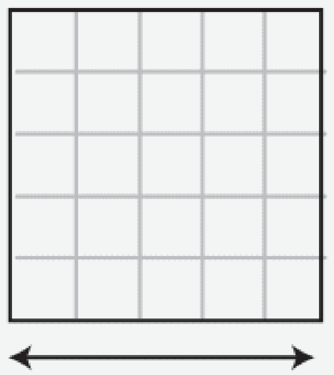
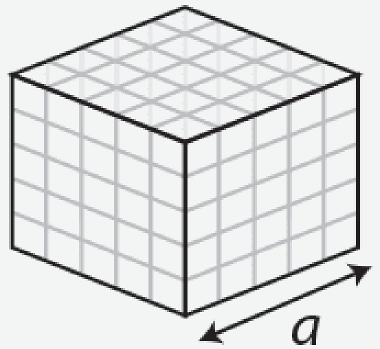
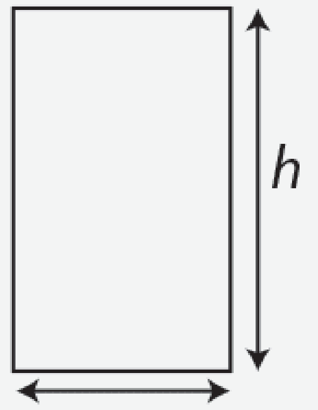
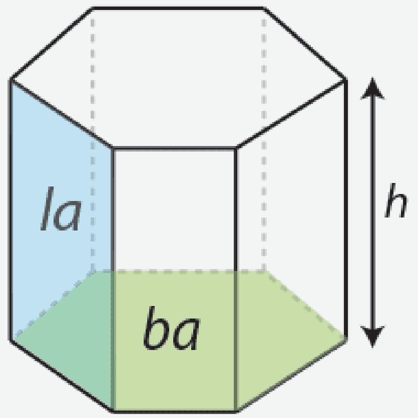
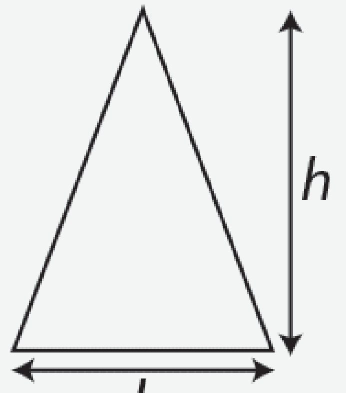
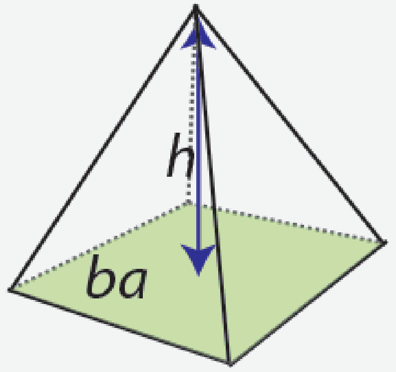
$$e^{i\pi} + 1 = 0$$

$$a^2 + b^2 = c^2$$

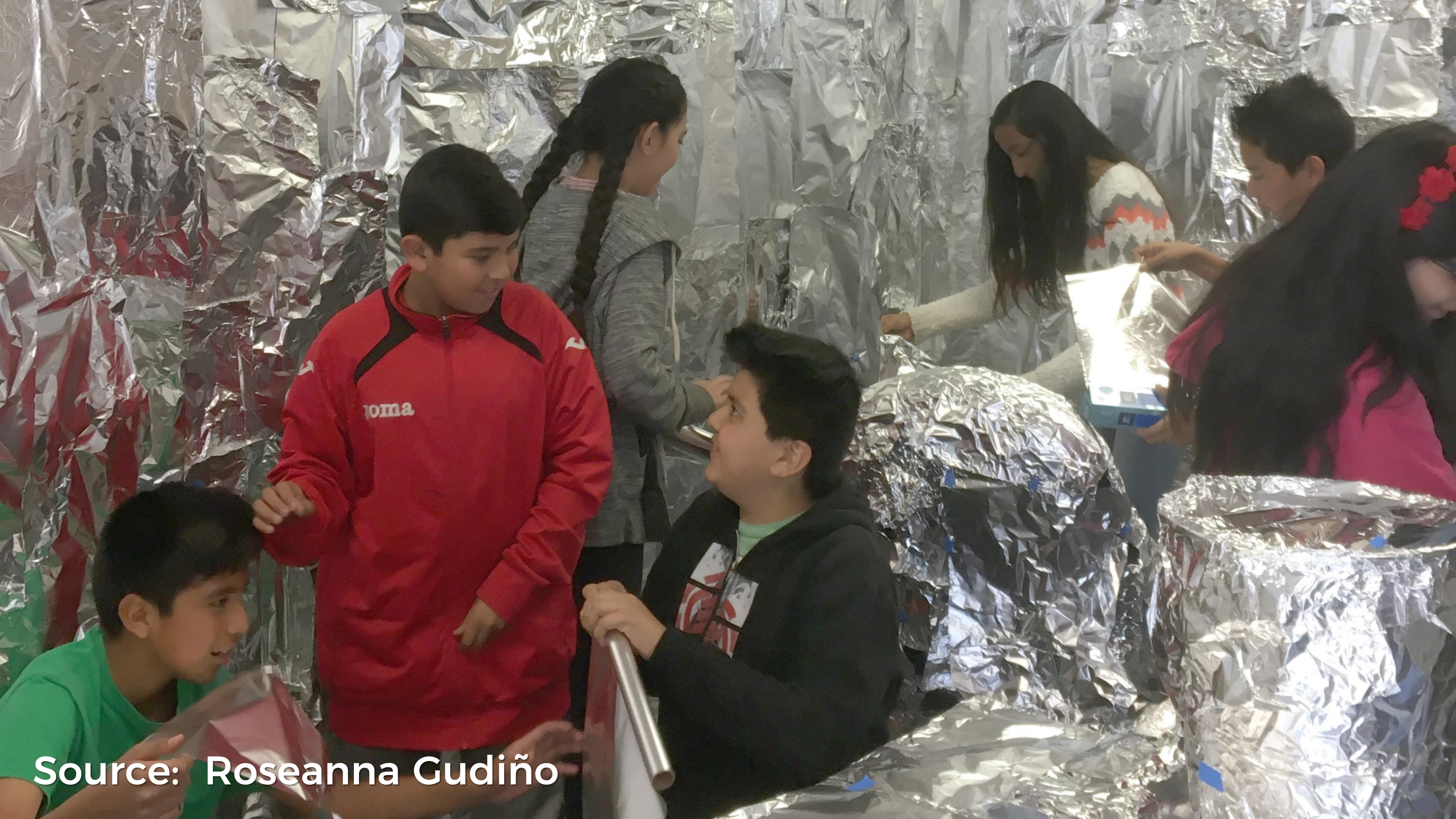
"Wait, was it a negative plus a negative or a negative times a negative that equals a positive."

TOO MANY STUDENTS



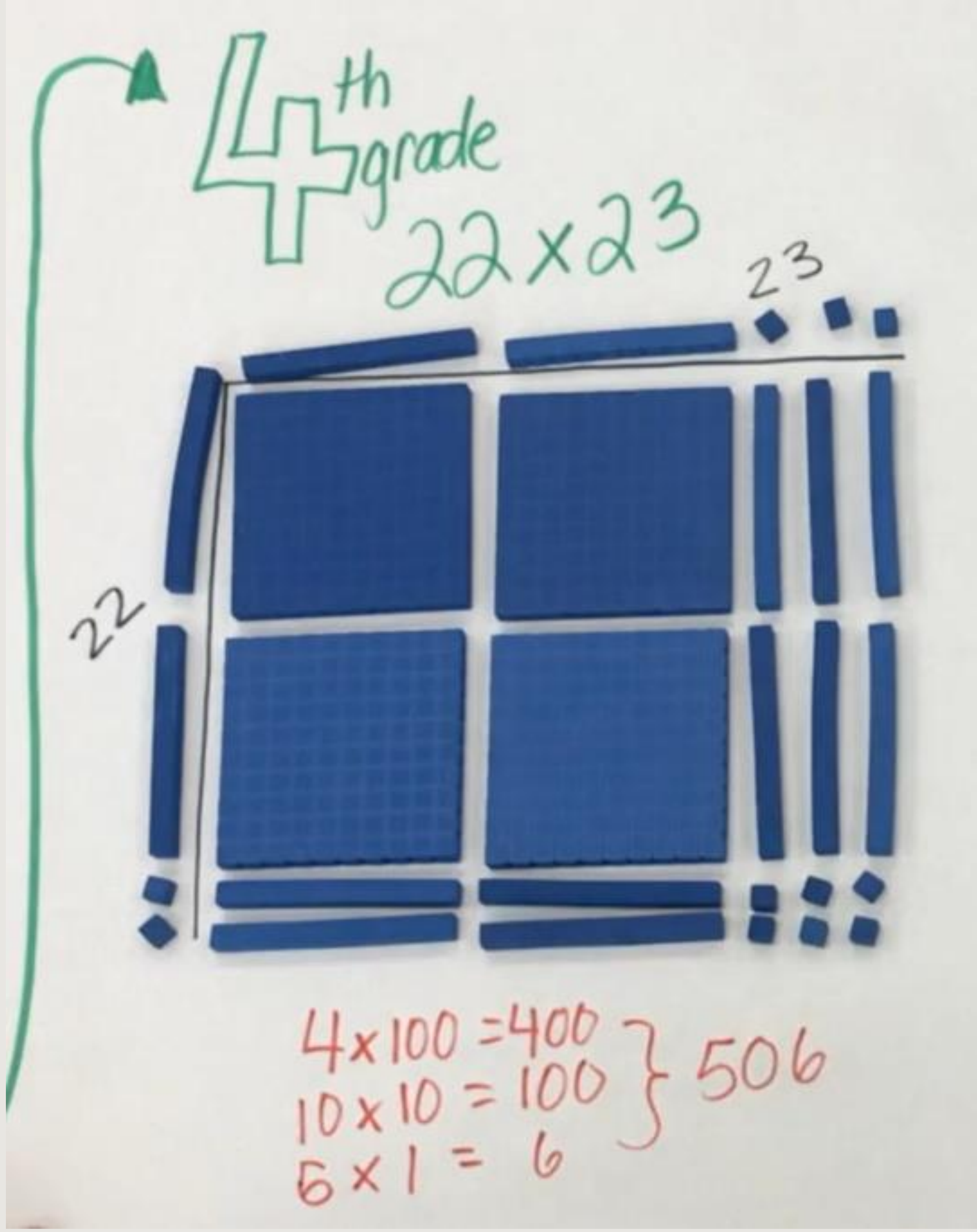
Two-dimensional plane shapes	**Area** *The measure of how many squares will fit into a shape.* ***Units²***	Three-dimensional solid shapes	**Surface Area** *The measure of the area of all outward facing sides.* ***Units²***	**Volume** *The measure of how many cubes will fit into a shape.* ***Units³***
Square 	Area $= a^2$ or $a \times a$ **Example:** *$a = 5cm$* *Area $= 5^2 = 25cm^2$*	**Cube** 	Surface Area $= 6 \times a^2$ **Example:** *$a = 5cm$* *Surface Area $= 150cm^2$*	Volume $= a^3$ or $a \times a \times a$ **Example:** *$a = 5cm$.* *Volume $= 125cm^3$*
Rectangle 	Area $= w \times h$ **Example:** *w = width=10cm* *height=20cm* *Area $=10 \times 20 = 200cm^2$*	**Prism** 	Surface Area $= 2 \times ba + la$ **Example:** *ba = base area $= 20cm^2$* *la = lateral area (all sides) $= 60cm^2$* *Surface area =* *$2 \times 20 + 60 = 100cm^2$*	Volume $= ba \times h$ **Example:** *ba = base area $= 20cm^2$* *h = height = 5cm* *Volume $= 20 \times 5 = 100cm^3$*
Triangle 	Area $= b \times h \times 0.5$ **Example:** *b = base = 20cm* *h = vertical height = 15cm* *Area $= 20 \times 15 \times 0.5 =150cm^2$*	**Pyramid** 	Surface Area $= ba + la$ **Example:** *ba = base area $= 16cm^2$* *la = lateral area (all sides) $= 60cm^2$* *Surface area $= 16 + 60 = 76cm^2$*	Volume $= ba \times h \times 1/3$ **Example:** *ba = base area $= 16cm^2$* *h = height = 9cm* *Volume $= 16 \times 9 \times 1/3 = 48cm^3$*
n	Area $= n \times s \times a \times 0.5$	on	Surface Area $=$ fa $\times$ s	

Source: robertkaplinsky.com/lessons

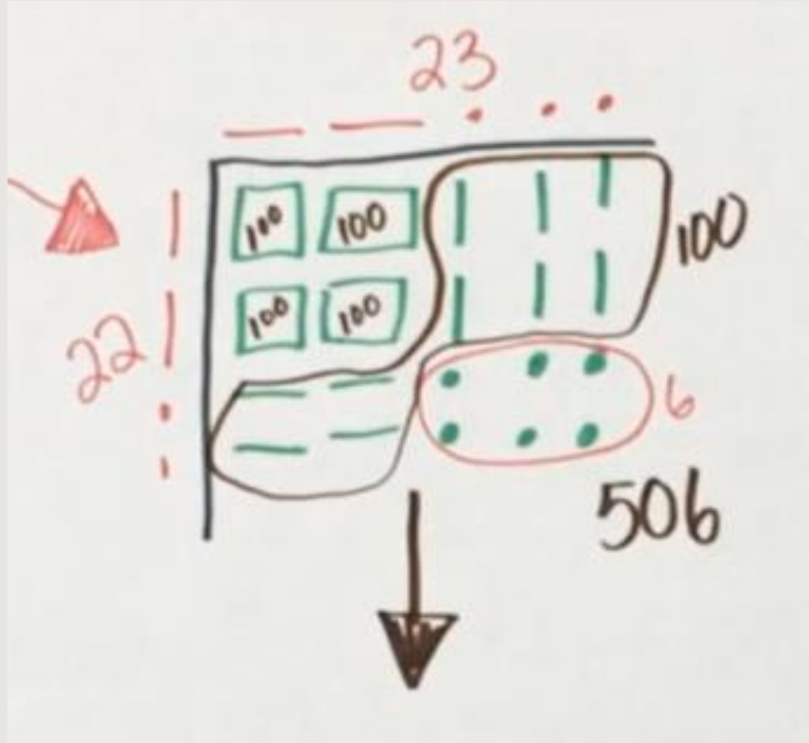


Source: Roseanna Gudiño

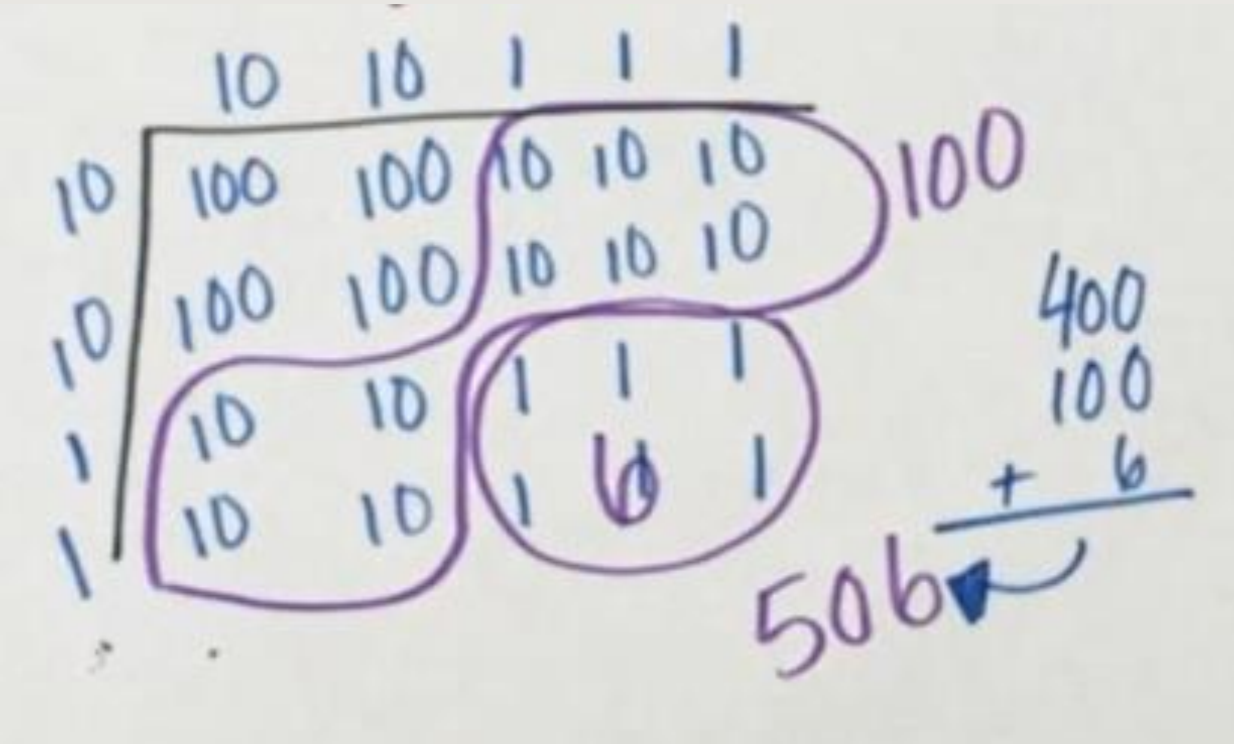
Source: gfletchy.com/progression-videos



Concrete



Representational



Abstract

Source: gfletchy.com

MY OLD METHODS

$$4(x+3)$$

$$4(x)+4(3)$$

$$(x+3)(x-1)$$

F $x(x)$

O $x(-1)$

I $3(x)$

L $3(-1)$

$$= x^2 - x + 3x - 3$$

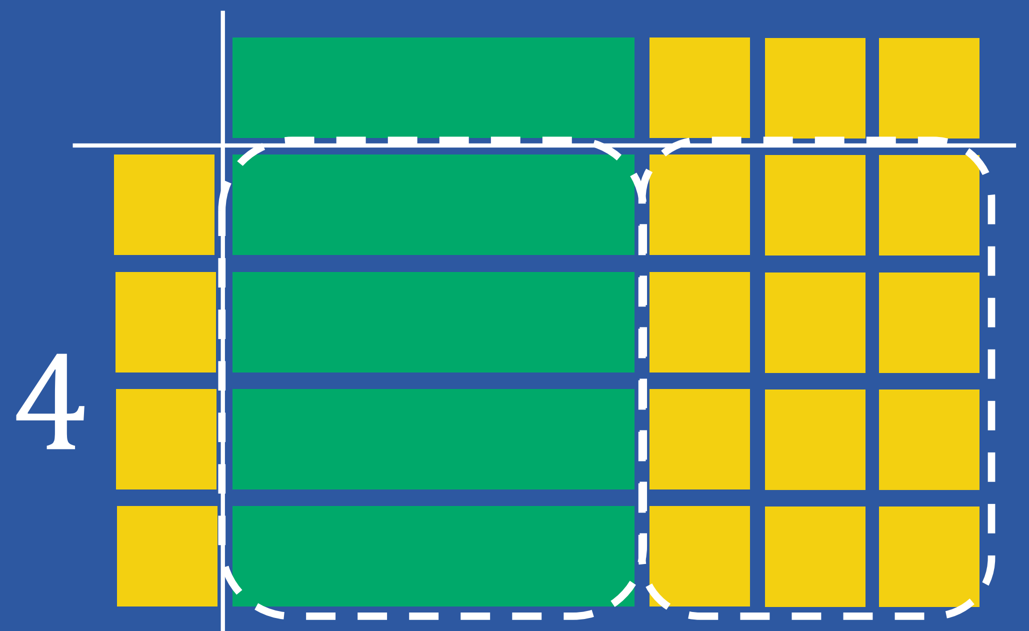
$$= x^2 + 2x - 3$$

DISTRIBUTIVE PROPERTY

$$4(x+3)$$

Concrete

$x \quad + \quad 3$



$4x + 12$

Representational

	x	$+\ 3$
4	$4x$	12

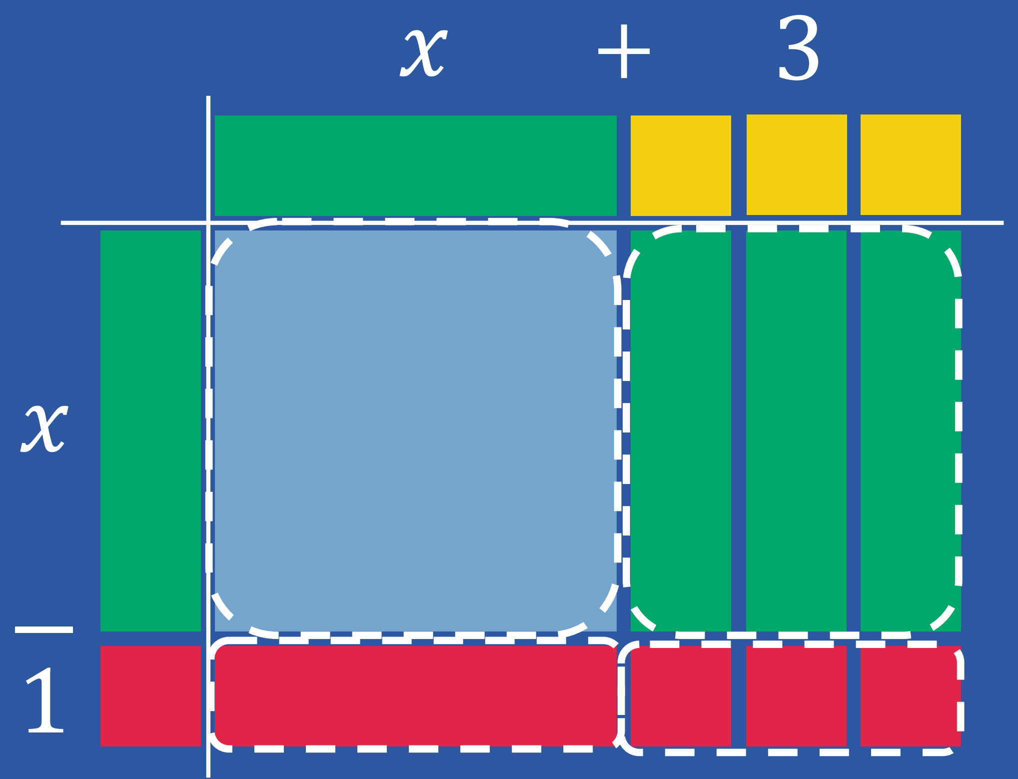
Abstract

$$4(x+3)$$
$$= 4(x) + 4(3)$$
$$= 4x + 12$$

BINOMIAL MULTIPLICATION

$$(x+3)(x-1)$$

Concrete



$$x^2 - x + 3x - 3$$

$$x^2 + 2x - 3$$

Representational

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

$$x^2 - x + 3x - 3$$

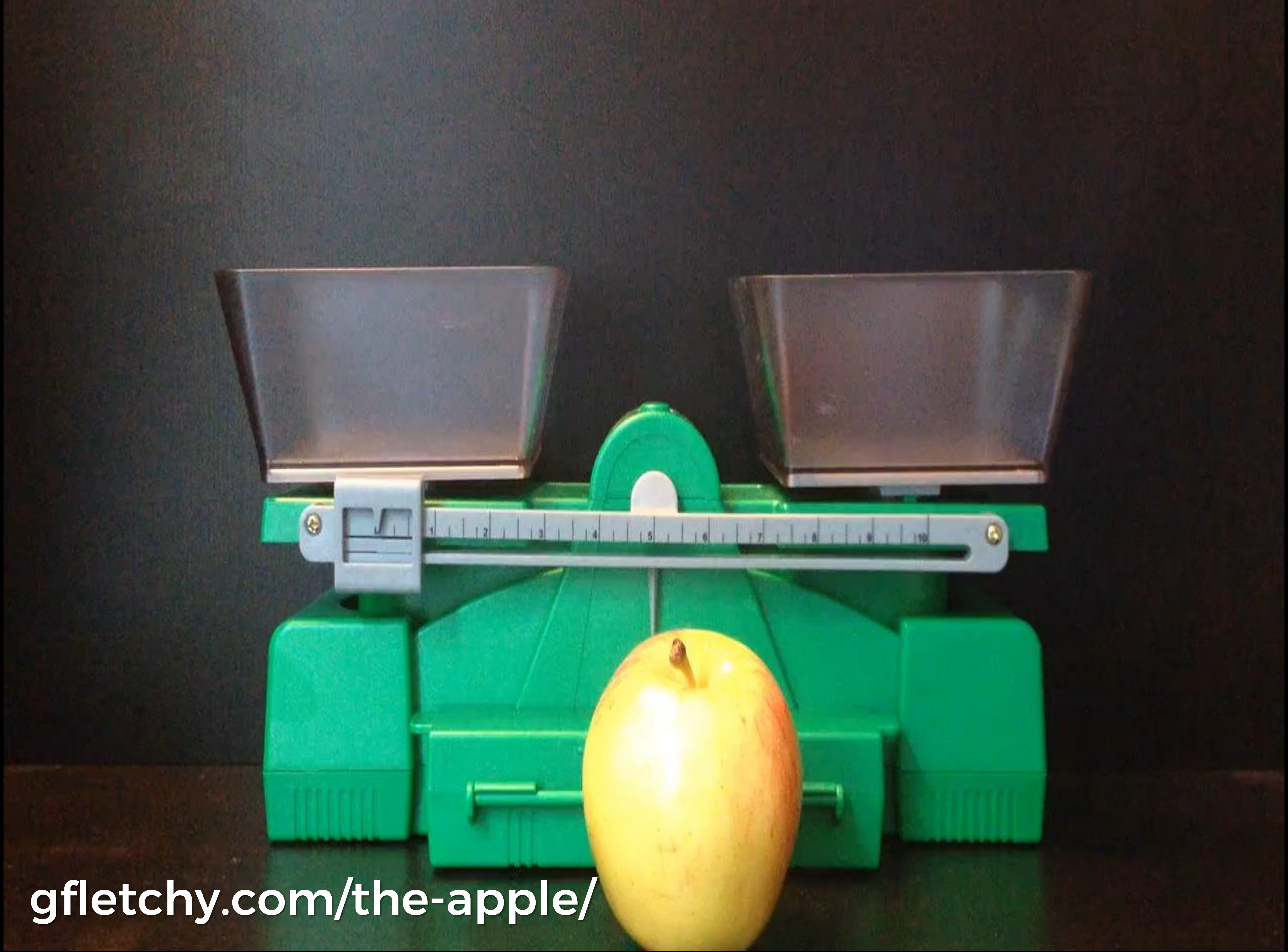
$$x^2 + 2x - 3$$

Abstract

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

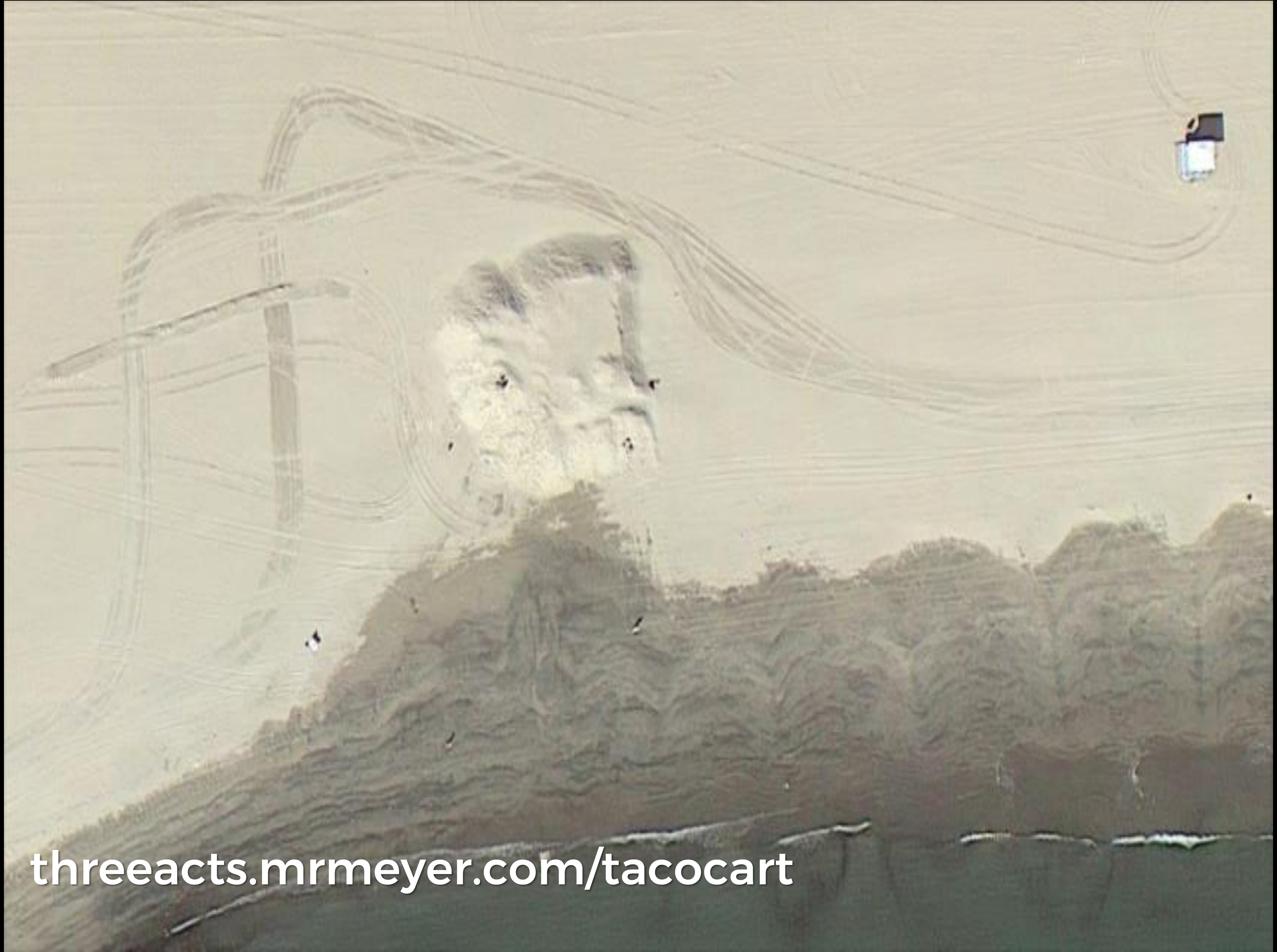
STICKY ATTRIBUTES

- [x] SIMPLE
- [x] UNEXPECTED
- [x] CONCRETE
- [ ] CREDIBLE
- [ ] EMOTIONAL
- [ ] STORIES

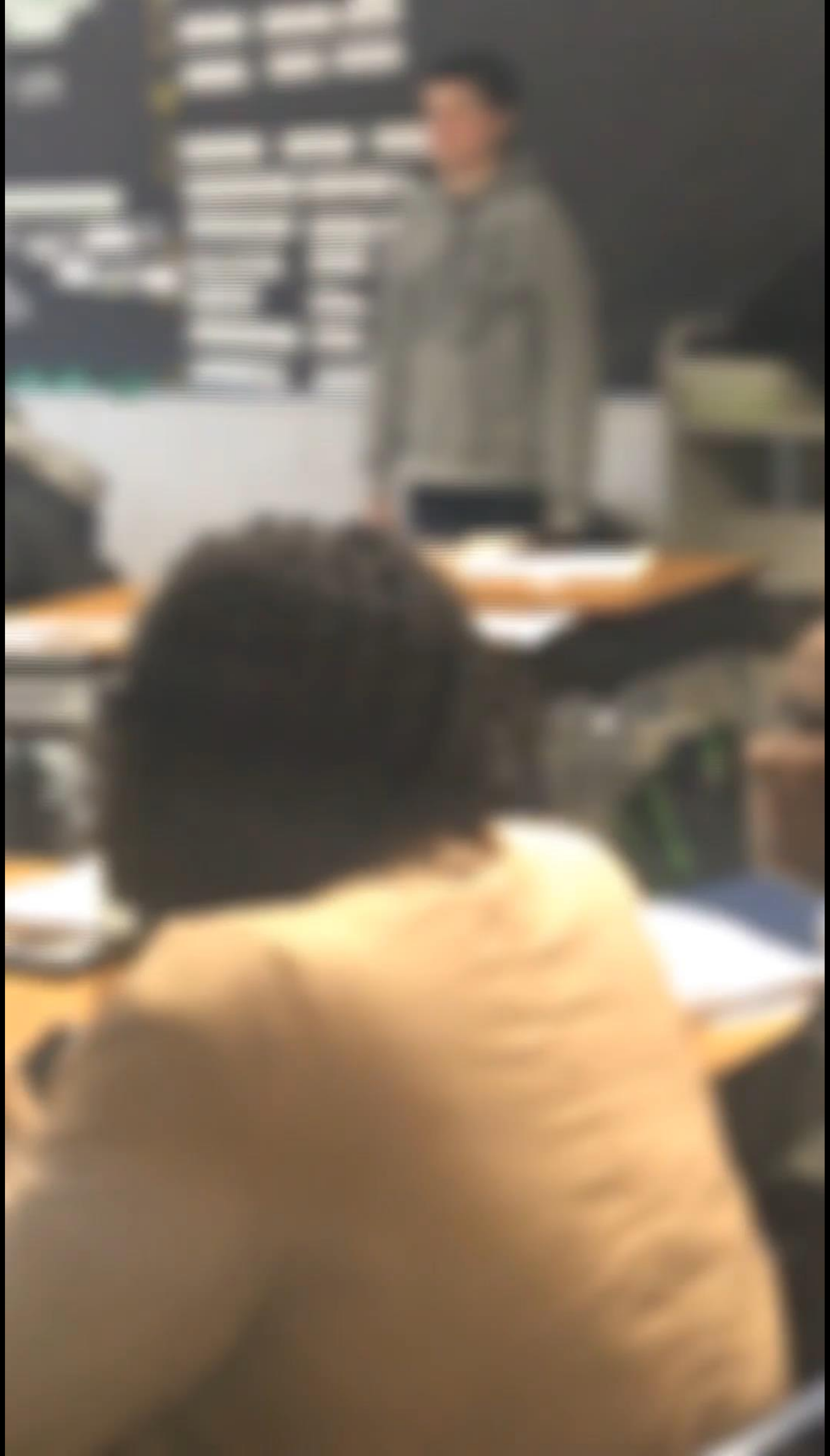


Source: gfletchy.com/the-apple/

Source: JJ Martinez



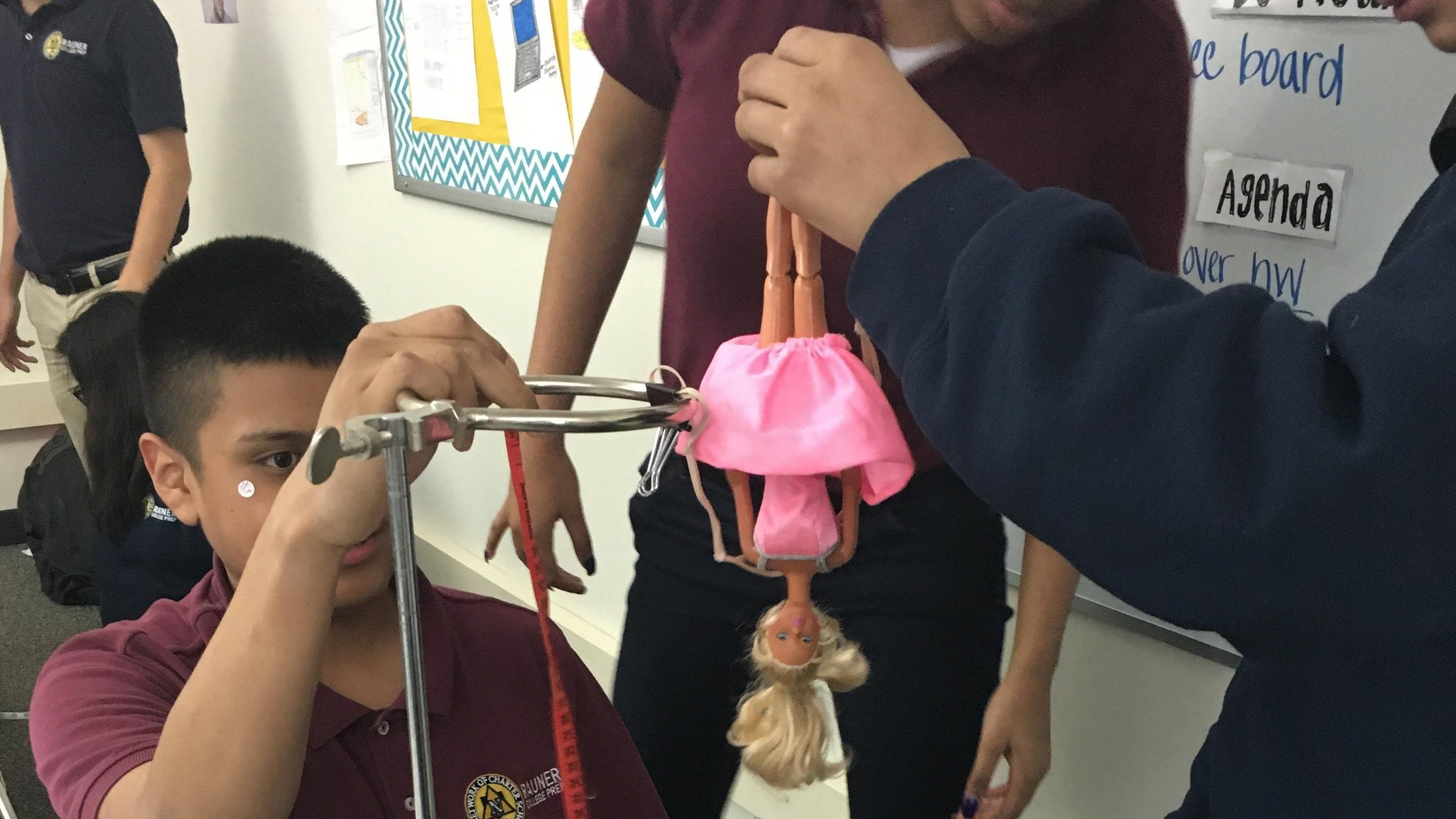
Source: threeacts.mrmeyer.com/tacocart



Source:
Jenise Sexton

Source: Tom Ward

Source: Tom Ward


board
Agenda
over hw
RAUNER
COLLEGE PREP

Source:
Fawn Nguyen


Division
Pain Relief Fever Reduction
NSAID
200 Tablets 200 mg
Functions
Pain Reliever/ Fever Reducer
Caffeine-Free
200 tablets
325 mg each
Extra Strength
Perimeter
Pain Reliever/ Fever Reducer
200 Capsules 500 mg. each
Medication
No Refill
Prescriptio
TAKE TWO TABL
ONCE PER DAY
90 tablets

Act 1	Engaging Opener
Act 2	Get Info. Solve Problem.
Act 3	Big Reveal

Source: estimation180.com

Source: estimation180.com

STICKY ATTRIBUTES

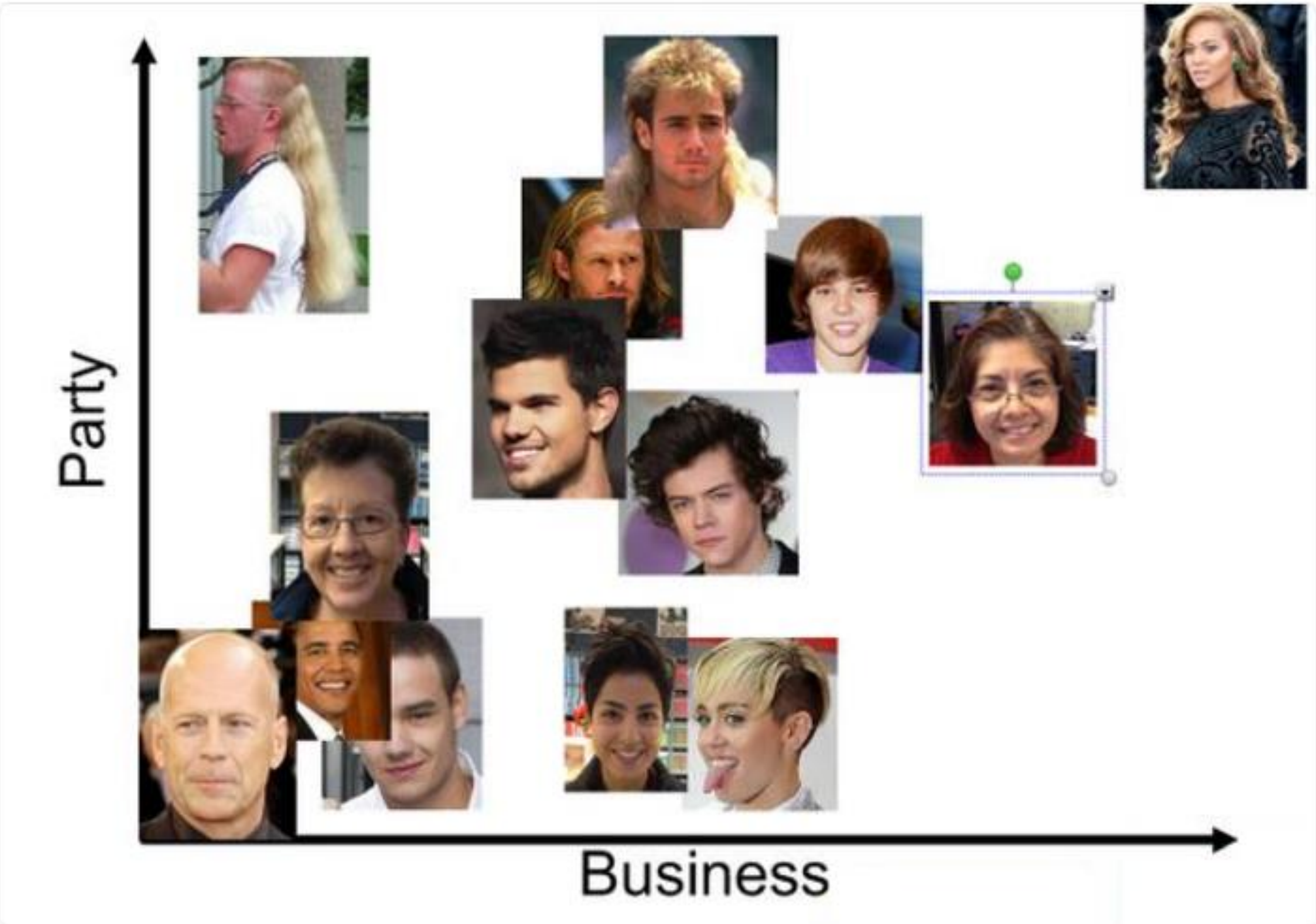
- [x] SIMPLE
- [x] UNEXPECTED
- [x] CONCRETE
- [x] CREDIBLE
- [ ] EMOTIONAL
- [ ] STORIES

Source: mrvaudrey.com

Matt Vaudrey
@MrVaudrey

Following

Things I never thought I'd say: "So you're saying that Thor has less party than Justin Bieber, but more than Obama?"



RETWEETS 4 LIKES 7

GREEN BAY

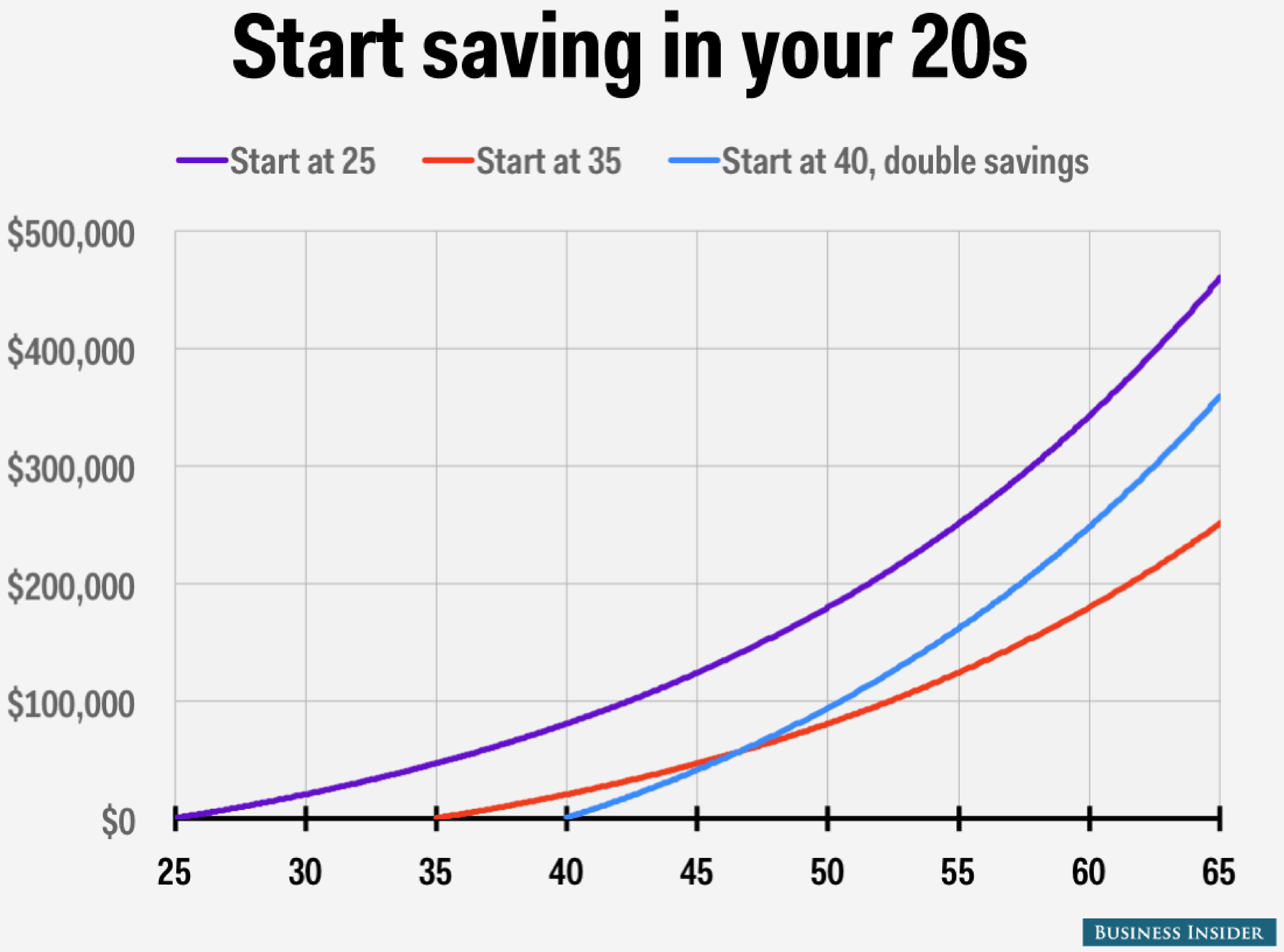
ARIZONA

	7	6	3	2	1	9	8	5	4	0
2	Vila	ROB S	SHEP	ROB S	SHEP CO.	PAPA	K+R	Vila	ROB S	DB
7	DB	DB	DB	K+R	ROB S	BILL	SHEP CO	SHEP	SHEP CO.	DB.
8	K+R	ROB S	KB	CHRIS C	PAPA	RICK	ROB S	SHEP CO	ROB S	KB
3	ROB S	SHEP	ROB S	DB	BILL	CHRIS C	SCHWEITZLOCK	Vila	SHEP	SHEP CO.
4	SHEP CO	DB	SHEP	RICK	ROB S	BILL	THE SCHWEITZ	THE SCHWEITZ	THE SCHWEITZ	THE SCHWEITZ
9	PAPA	ROB S	CHRIS C	CHRIS C	CHRIS C	KB	THE SCHWEITZ	DB	BILL	SHEP
0	DB.	SHEP CO	K+R	RICK	DB	ROB S	DB	Vila	RICK	Vila
5	BILL	DB	ROB S	ROB S	Vila	Vila	ROB S	KB	ROB S	K+R
[illegible]	[illegible]	ROB	[illegible]	Vila	ROB	[illegible]	[illegible]	[illegible]	Vila	SHEP

· PAYOUTS ·

1ST QUARTER	$25
HALFTIME	$50
3RD QUARTER	$25
FINAL	$100

$2 SQUARES


Start saving in your 20s
Start at 25
Start at 35
Start at 40, double savings
$500,000
$400,000
$300,000
$200,000
$100,000
$0
25
30
35
40
45
50
55
60
65
BUSINESS INSIDER

Source: robertkaplinsky.com/lessons

tangible > magnitude

STICKY ATTRIBUTES

- ☑ SIMPLE
- ☑ UNEXPECTED
- ☑ CONCRETE
- ☑ CREDIBLE
- ☑ EMOTIONAL
- ☐ STORIES

Source: robertkaplinsky.com/lessons

20. **Crime** Two men used ropes made from sheets to escape from a tall prison in Chicago. If they needed to make a total of 150 feet of rope and each sheet made 6 feet of rope, how many sheets did they need?

Source: If You Hopped Like A Frog by David M. Schwartz

The Doorbell Rang

by Pat Hutchins

MULBERRY BOOKS

DO YOU SEE IT?

Via: Sara VanDerWerf

RobertKaplinsky.com

IMPORTANCE OF CONTEXT

- Play four songs
- Tapped out
- Write down song names
- Share answers with neighbors
- Listen again with song names

SONG #1

SONG #2

SONG #3

SONG #4

SONG #1

Itsy Bitsy Spider

SONG #2

Wheels On The Bus

SONG #3

Row Row Row Your Boat

SONG #4

Take Me Out To The Ballgame

Robert Kaplinsky
@robertkaplinsky

Random favor: please listen to me tapping out 4 songs and try to guess the name. Should take < 2 min. It's not easy!

Recognizing Tapped Songs
Please listen to each of the four songs, type in the name of the song, and the click submit. You may have no clue about what the song is called. If that happens, just write something like, "I don't...
docs.google.com

RETWEET
1

2:47 PM - 13 Jun 2017

TAKEAWAYS (PART ONE)

- Of 192 people surveyed:
    - Itsy Bitsy Spider: ~41%
    - Wheels on the Bus: ~29%
    - Row Your Boat: ~25%
    - Take Me Out to the Ballgame: ~3%

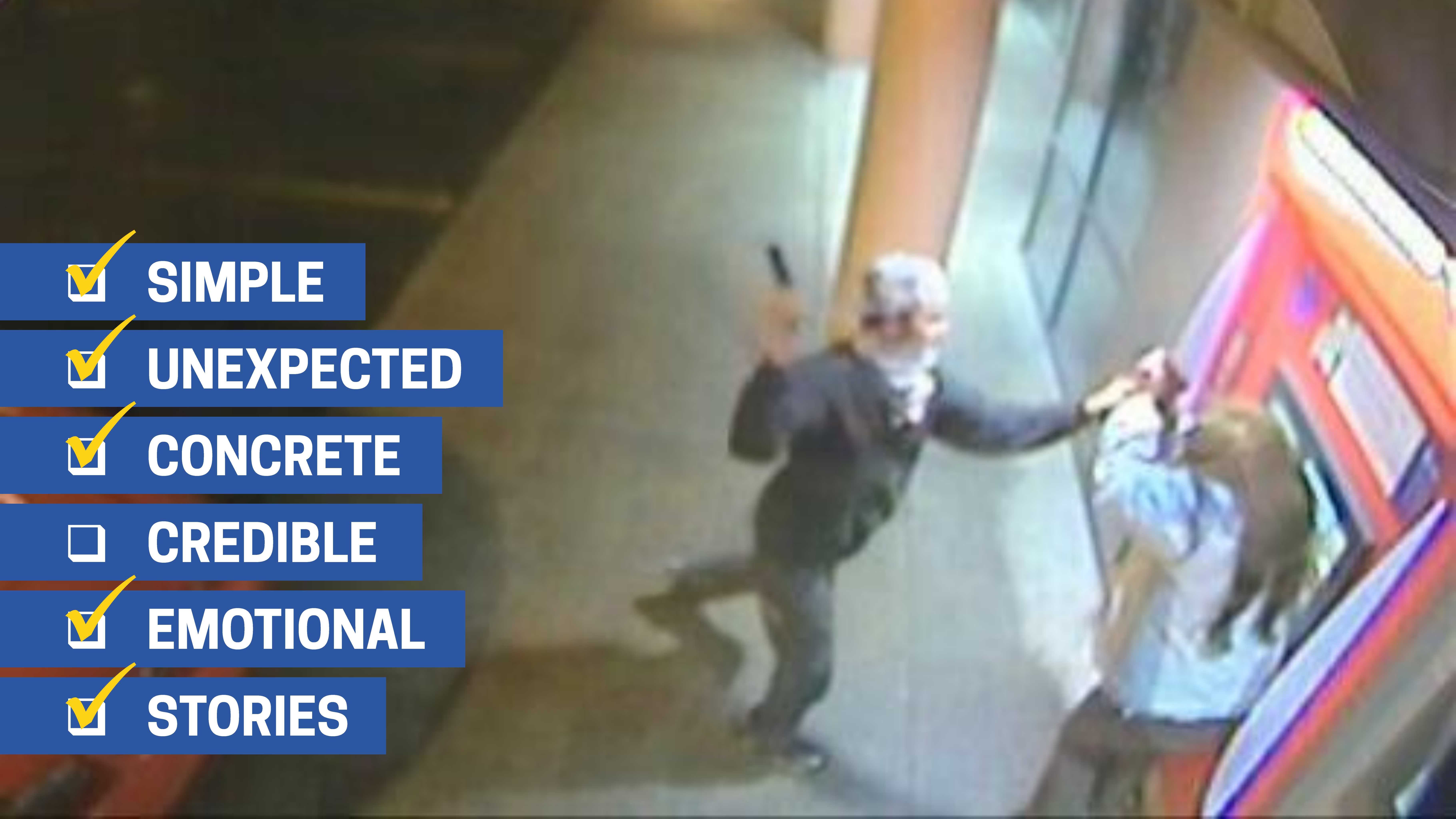
TAKEAWAYS (PART TWO)

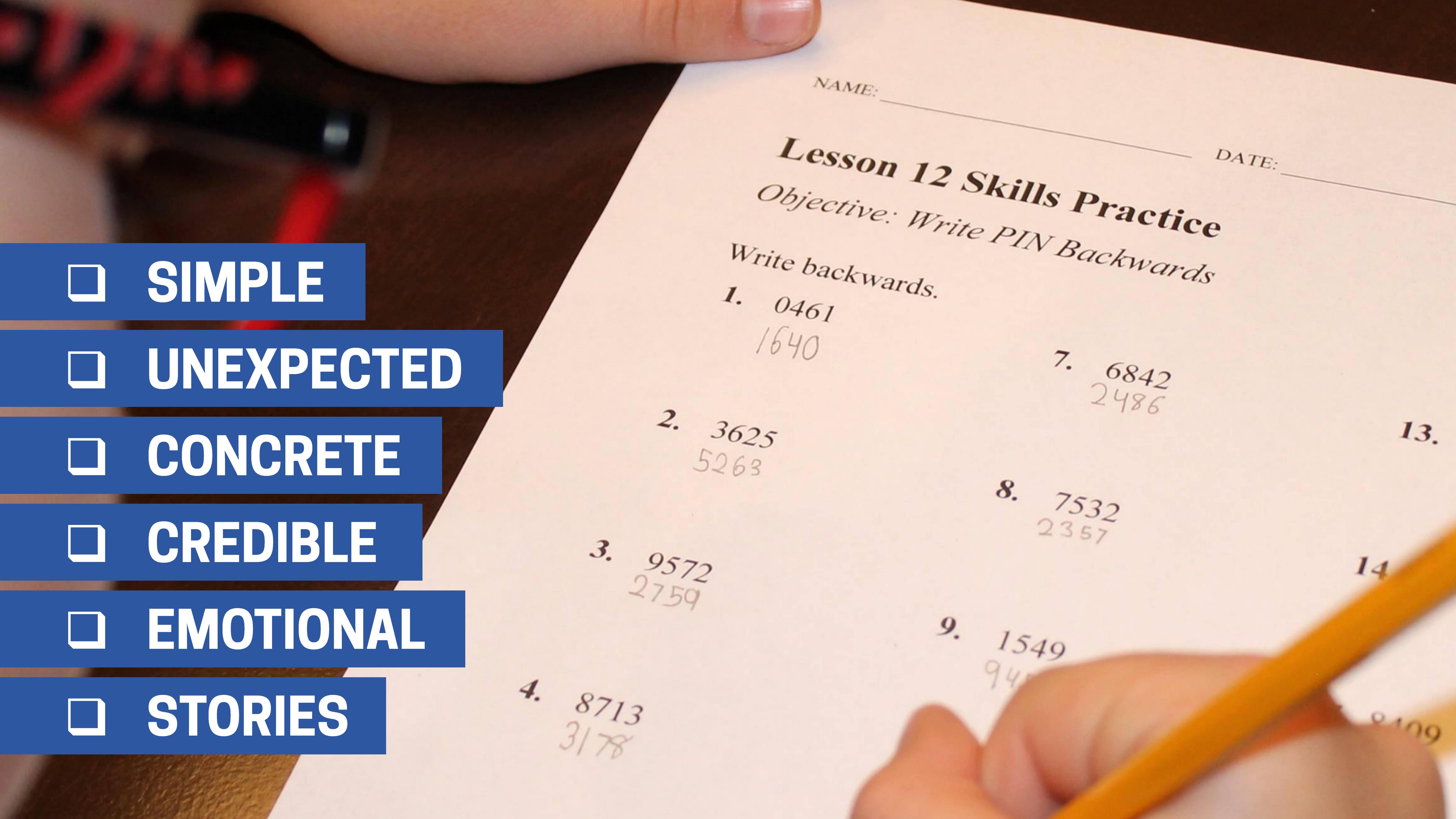
- Many said, “I’m sorry. I don’t know.”
- Many said, “I’m not good at this.”
- Many said, “I don’t like this.”

CURSE OF KNOWLEDGE

STICKY ATTRIBUTES

- ☑ SIMPLE
- ☑ UNEXPECTED
- ☑ CONCRETE
- ☑ CREDIBLE
- ☑ EMOTIONAL
- ☑ STORIES


☑ SIMPLE
☑ UNEXPECTED
☑ CONCRETE
☐ CREDIBLE
☑ EMOTIONAL
☑ STORIES



❑ SIMPLE

❑ UNEXPECTED

❑ CONCRETE

❑ CREDIBLE

❑ EMOTIONAL

❑ STORIES

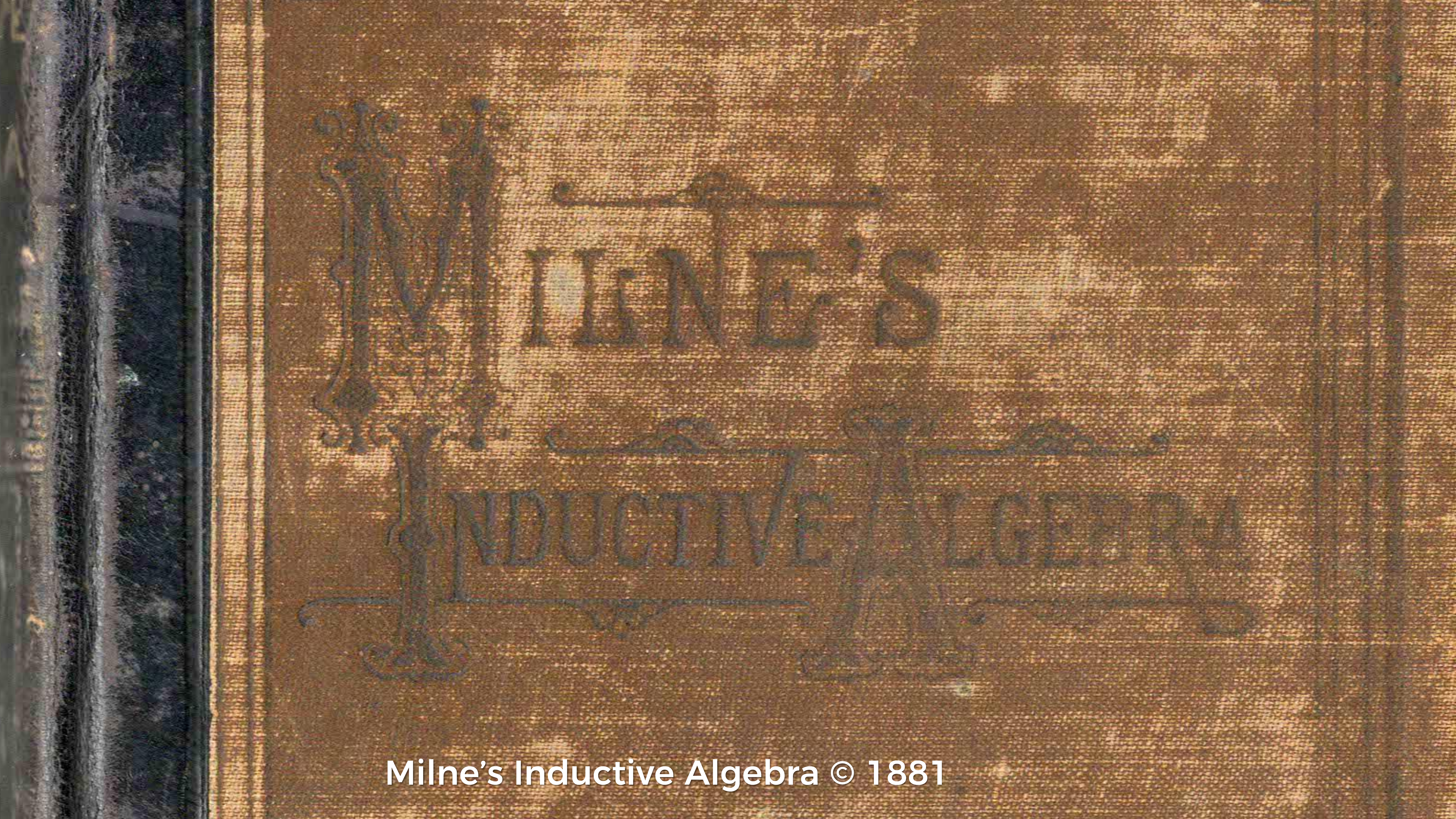
DISCUSSION TIME

- Why are urban legends so much easier to remember?
- How can we use that knowledge to make math easier to remember too?

GOALS

- [x] CORRECT ANSWERS + UNDERSTANDING
- [x] MAKE OUR LESSONS UNFORGETTABLE
- [ ] RECONSIDER USING WORD PROBLEMS
- [ ] MAKE MATH CHALLENGING + ACCESSIBLE

Why do we have word problems?



Milne's Inductive Algebra © 1881

183. Directions for Solving.—*Represent one of the unknown quantities by x, and from the conditions of the problem find an expression for each of the other quantities given.*

Find from the problem two expressions that are equal, and express them as an equation.

Solve the equation.

51. When the half of a certain number is added to the number, the sum is as much more than 60 as the number is less than 65. What is the number? 50 ans.

52. The difference between two numbers is 8, and the quotient arising from dividing the greater by the less is 3. What are the numbers?

53. A man left one-half of his property to his wife, one-sixth to his children, a twelfth to his brother, and the rest, which was $600, to charitable purposes. How much property had he?

C CIRCLE the numbers

U UNDERLINE the question

B BOX the key words

E ~~ELIMINATE~~ info not needed

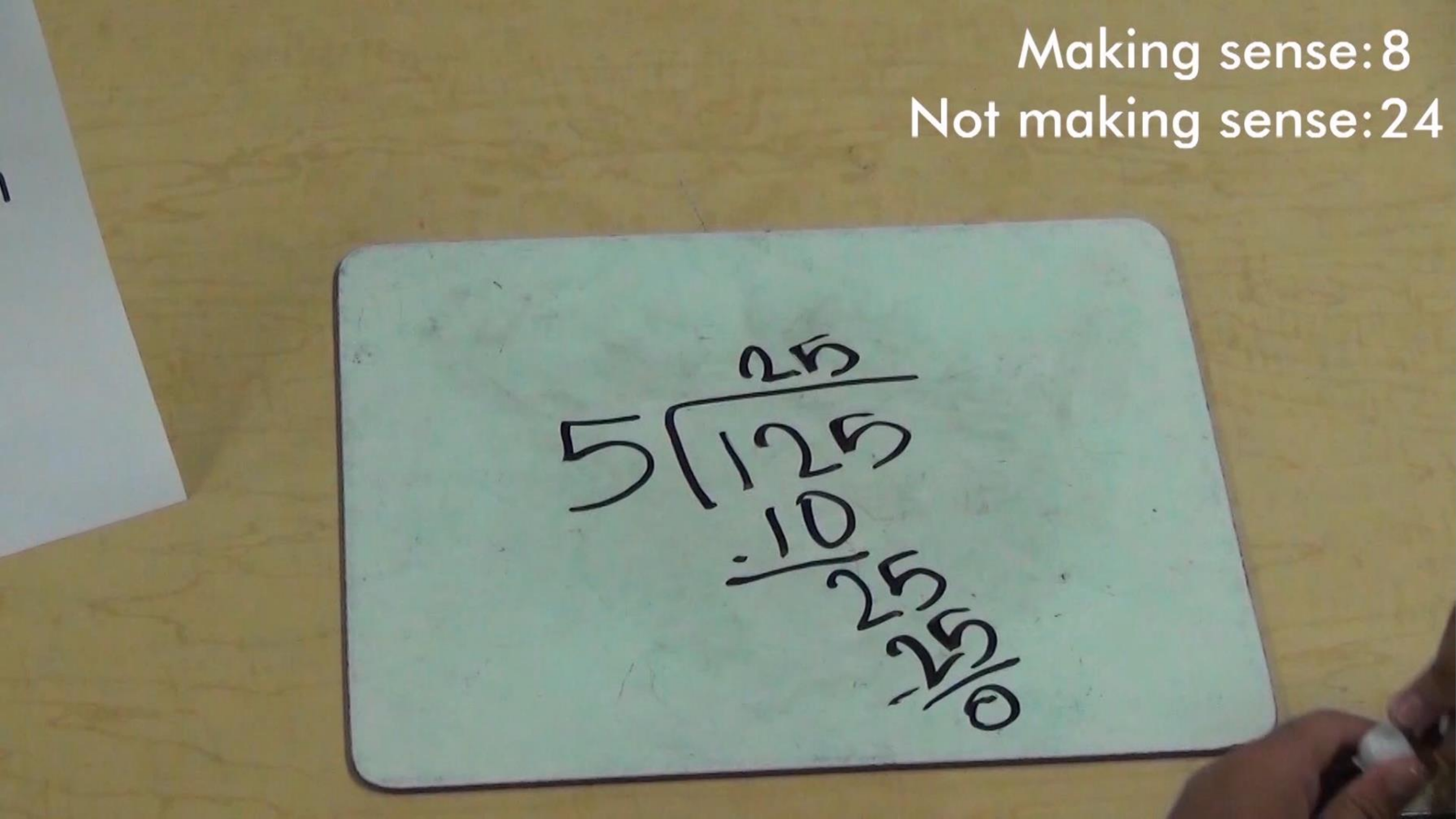
S SOLVE and check ✓

~~In a class of~~ 30 ~~children, there are~~ 3 ~~girls for every~~ 2 ~~boys.~~ How many girls are there altogether?

Source: Marilyn Burns

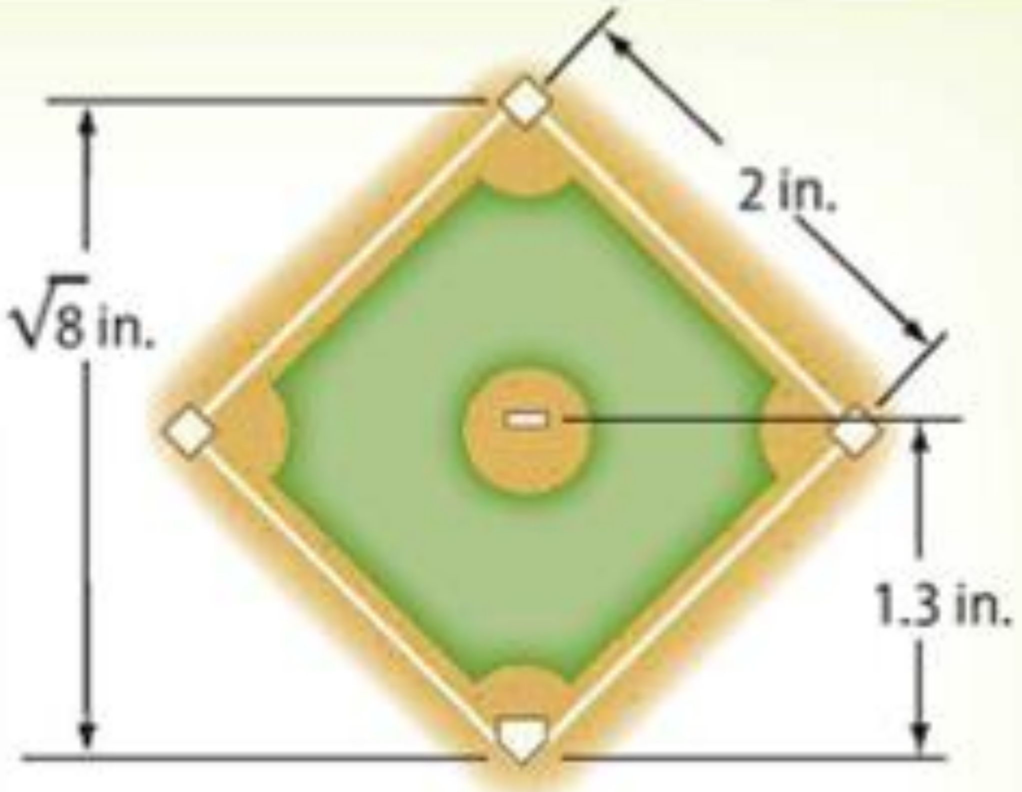
There are 125 sheep and 5 dogs in a flock. How old is the shepherd?

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


Making sense: 8
Not making sense: 24
25
5 125
-10
25
-25
0

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

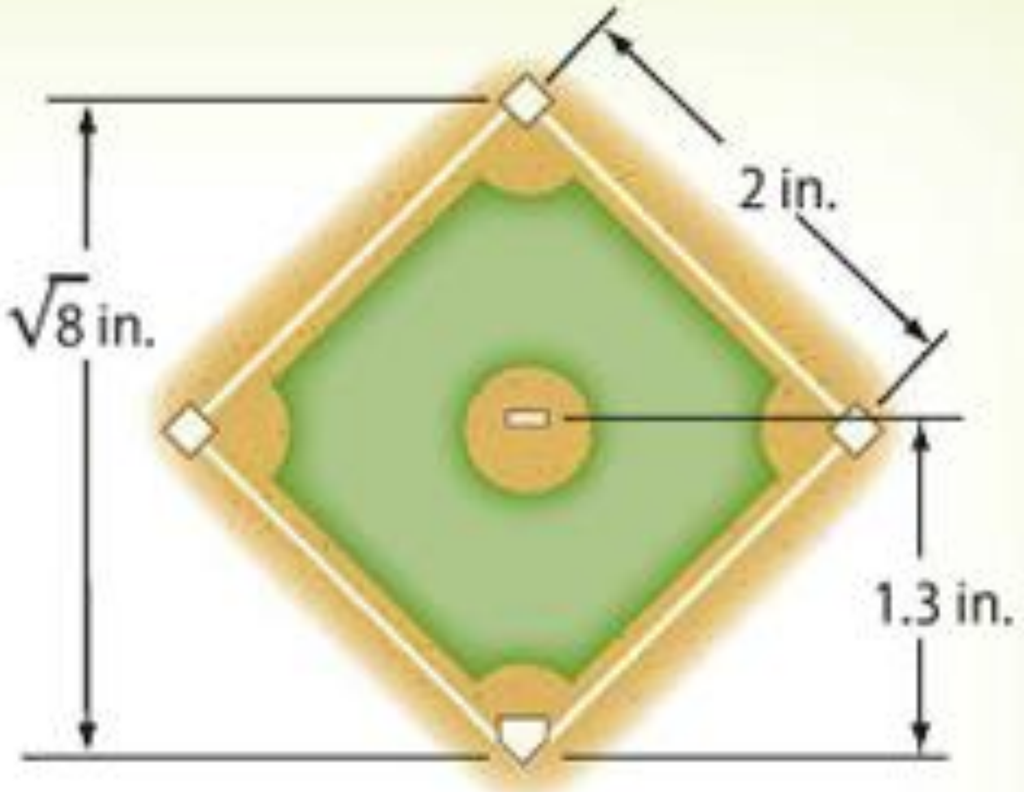
CCSS Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



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8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Puffs
Cheetos
Crunchy
Doritos® BRAND & Cheetos® BRAND Mix
20 Singles
DORITOS® Nacho Cheese Flavored Tortilla Chips 1 OZ. EA. DORITOS® COOL RANCH® Flavored Tortilla Chips1 OZ. EA. CHEETOS® Puffs Cheese Flavored Snacks ⅞ OZ. EA. CHEETOS® Crunchy Cheese Flavored Snacks 1 OZ. EA.
20 INDIVIDUAL BAGS: ⅞ OZ. EACH, 1 OZ. EACH, TOTAL NET WT. 19⅝ OZ. (1 LB. 3⅝ OZ.) 556.3 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

THINKING TIME

- Why did many of you expect there to be five of each?
- Why was it not five of each?
- How might they decide on this combination?

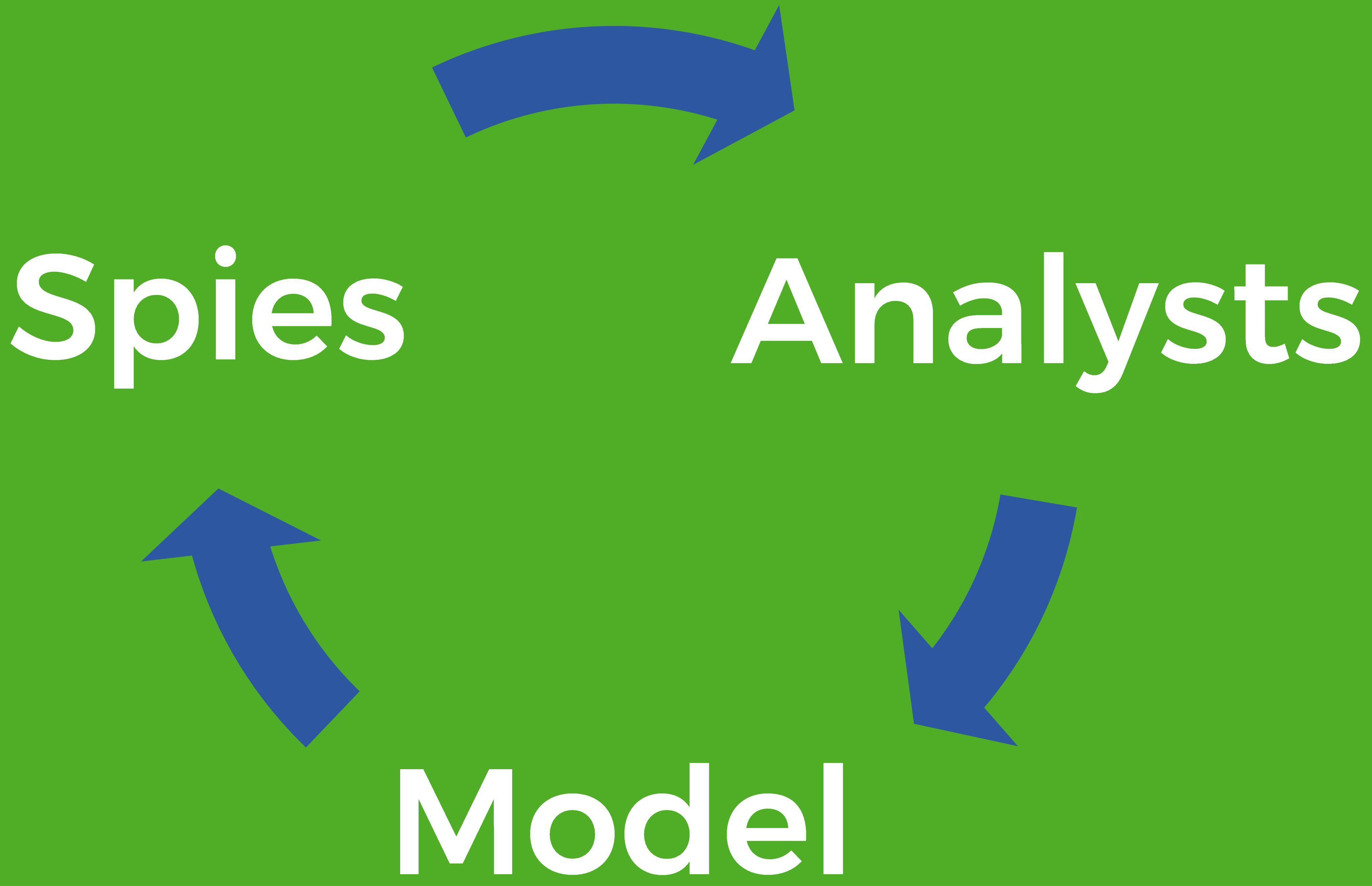

Lay's
Classic
Potato Chips
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
BRAND
The ORIGINAL
CORN CHIPS
Classic Mix
20
Singles
LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

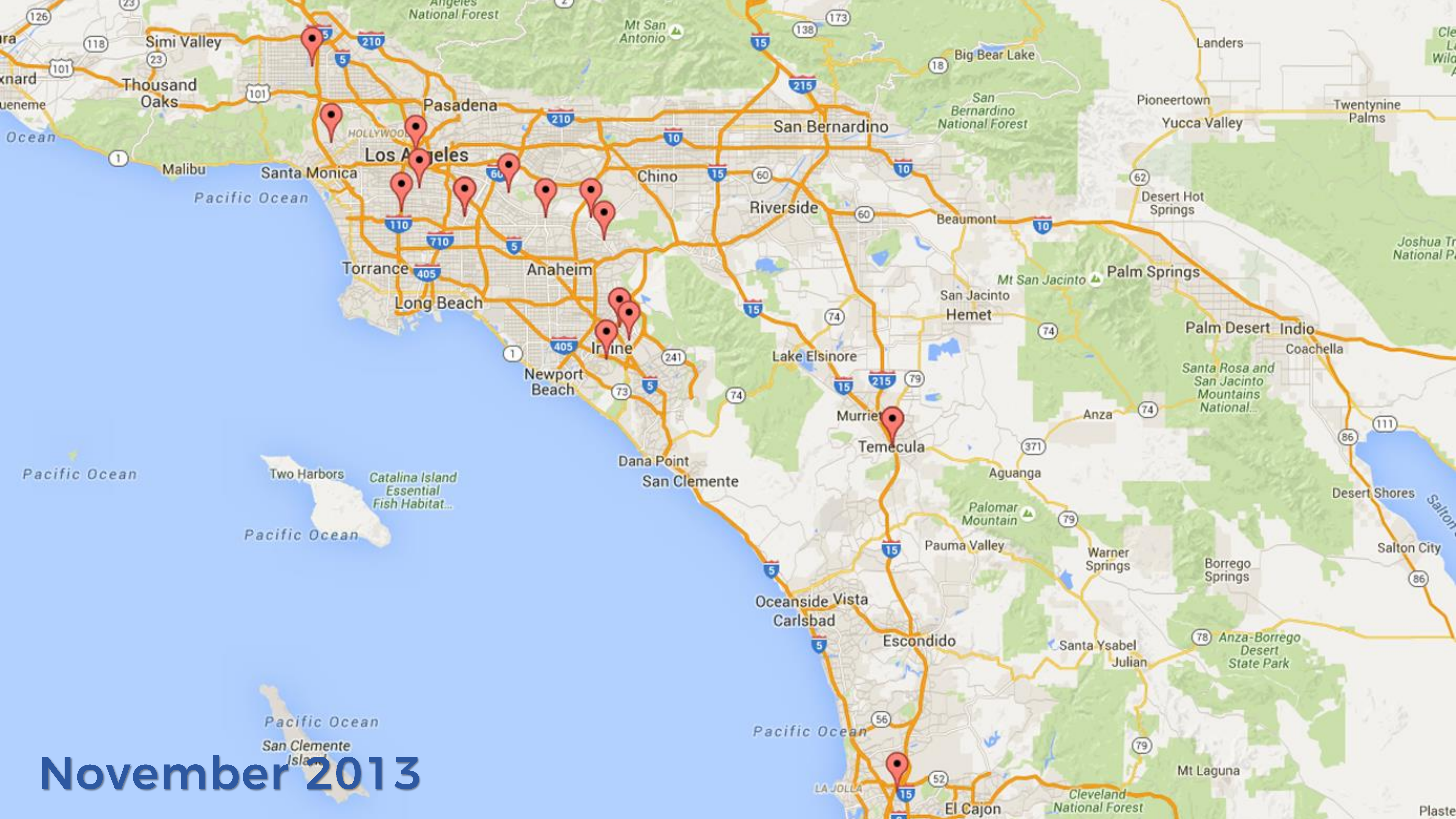
MATH MODELING

- ❑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ❑ IS IT JUST ANSWERING QUESTIONS?
- ❑ HOW IS MATH MODELING USED IN REAL LIFE?
- ❑ HOW DO WE HELP OUR STUDENTS IMPROVE?

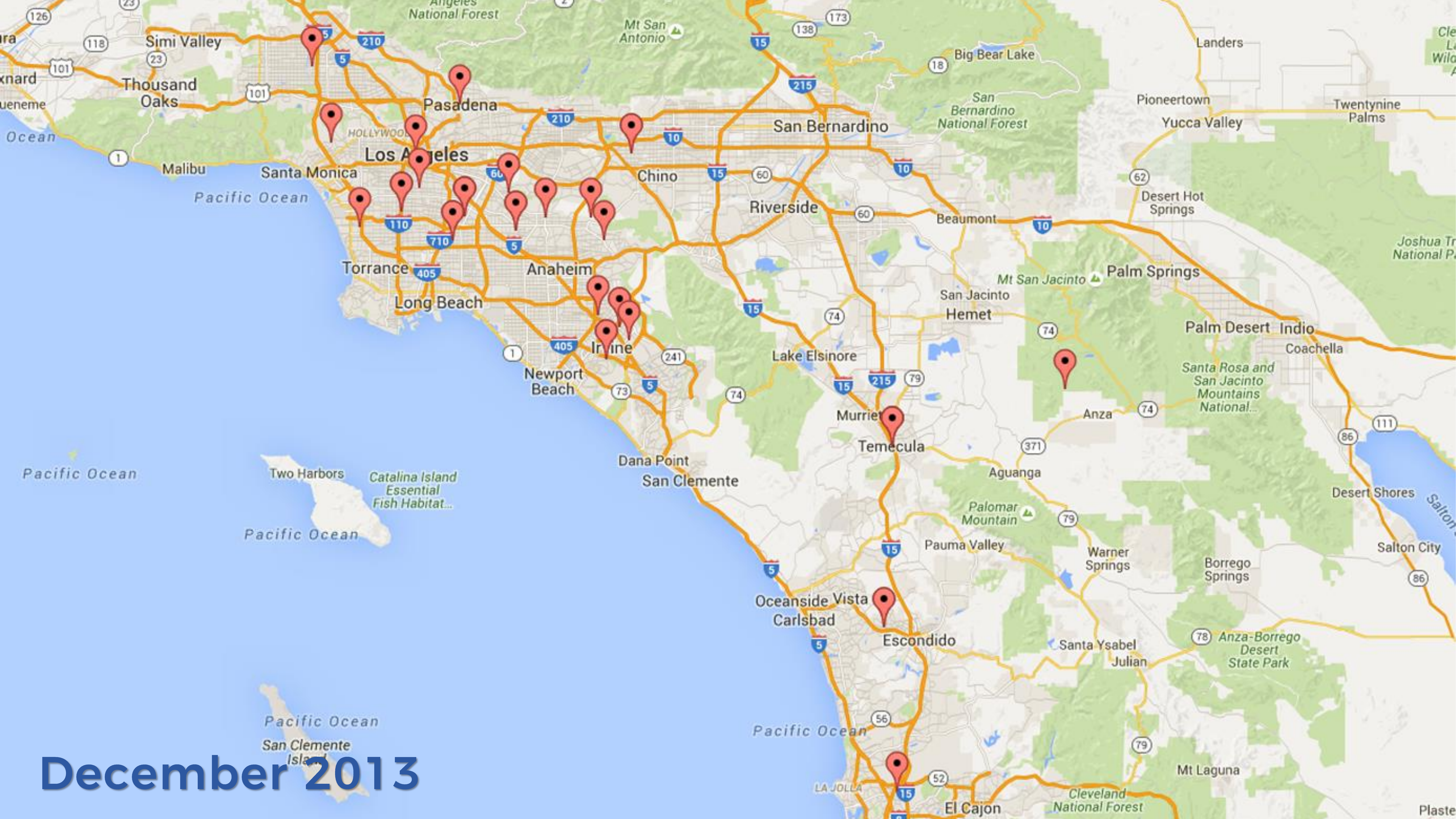
CENTRAL INTELLIGENCE AGENCY

UNITED STATES OF AMERICA

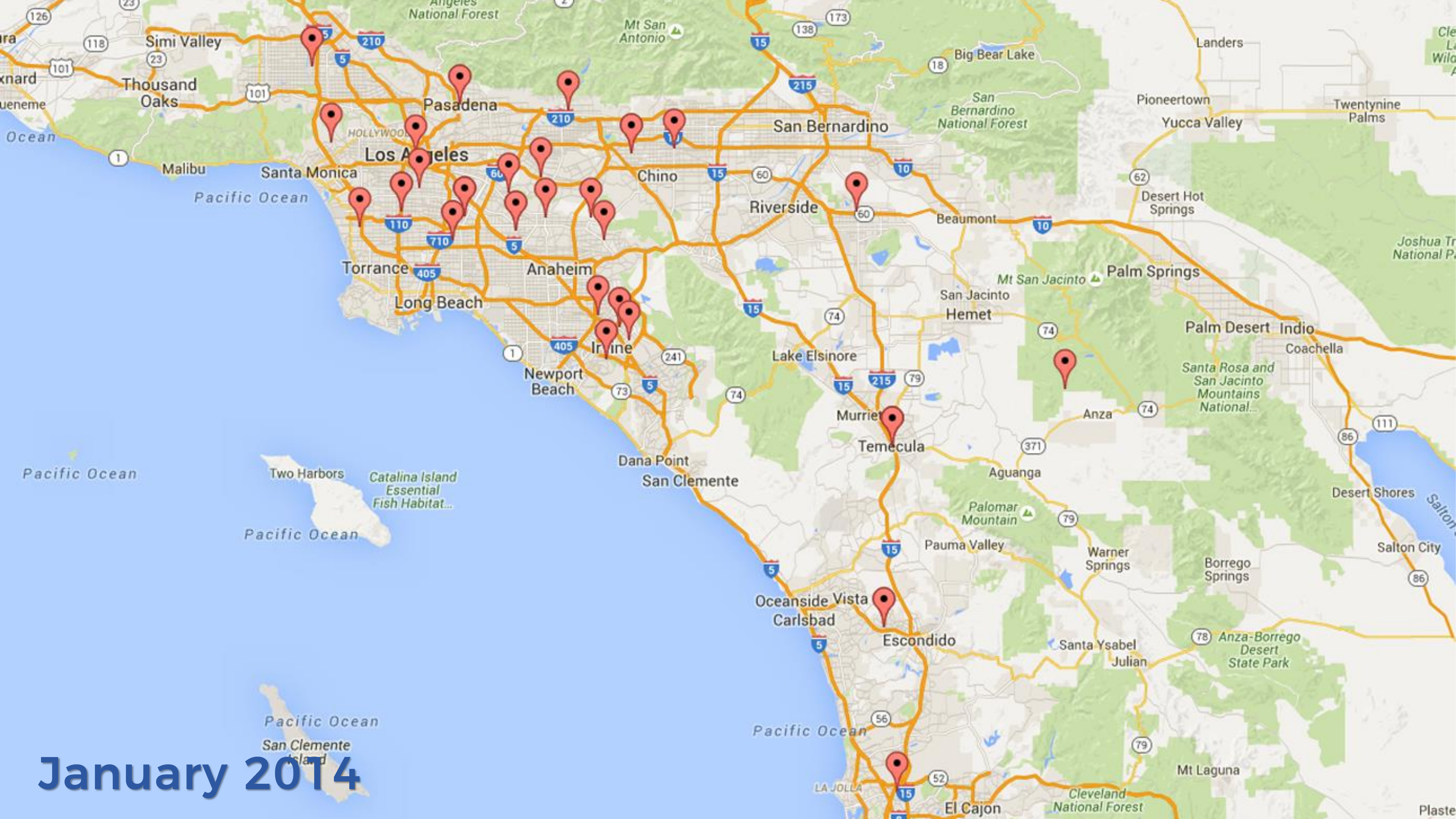

Spies
Analysts
Model



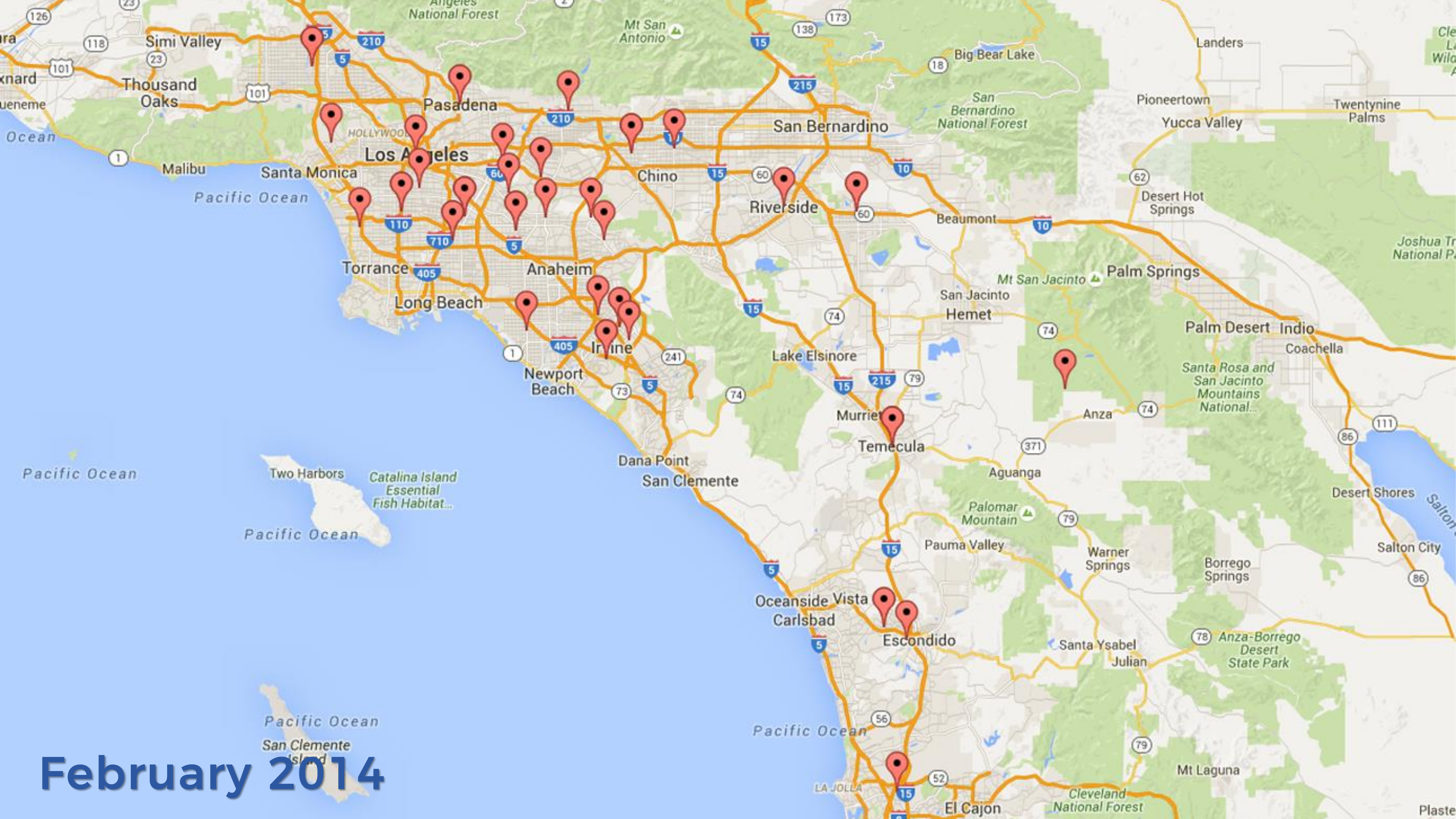
November 2013



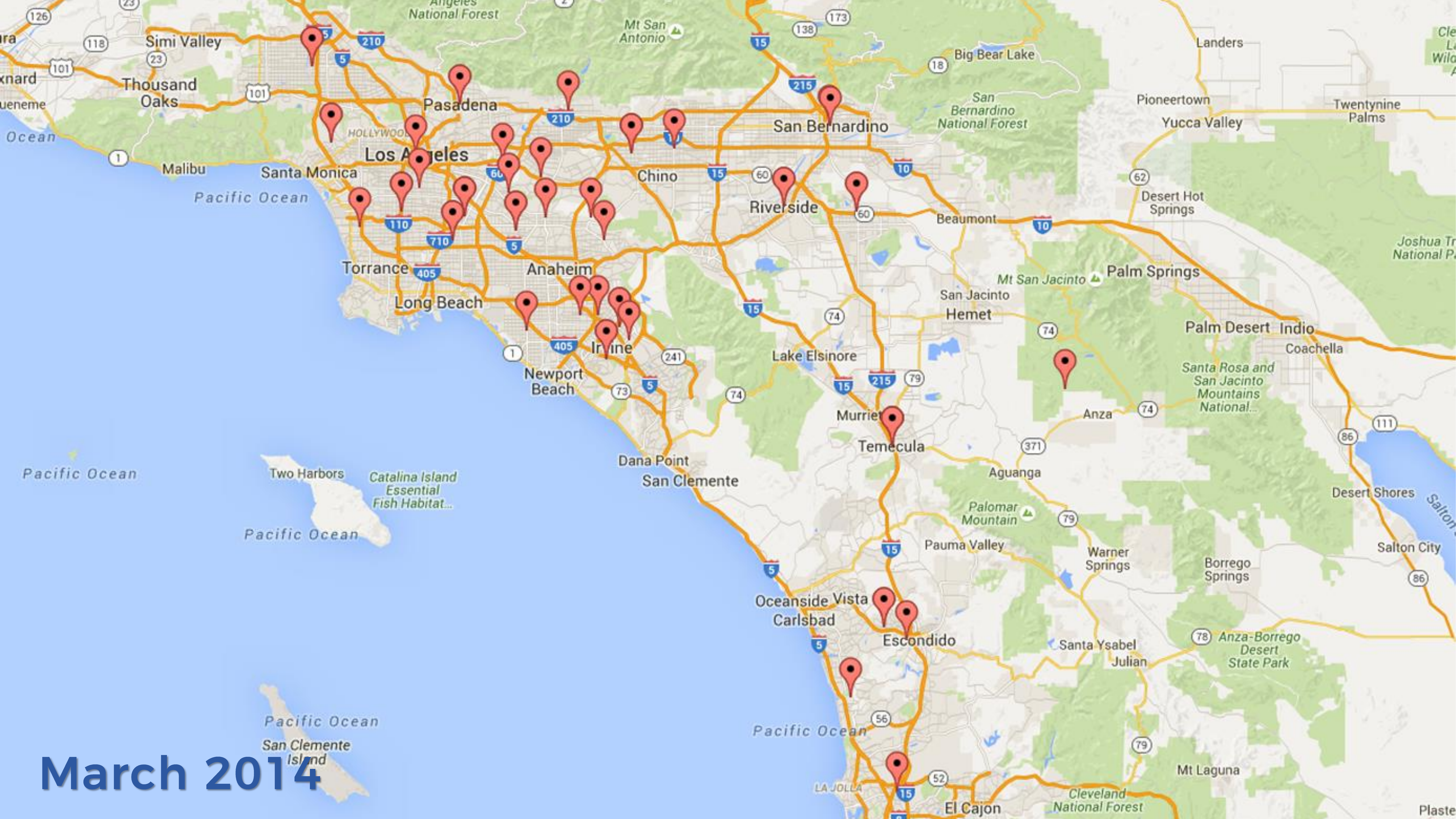
December 2013



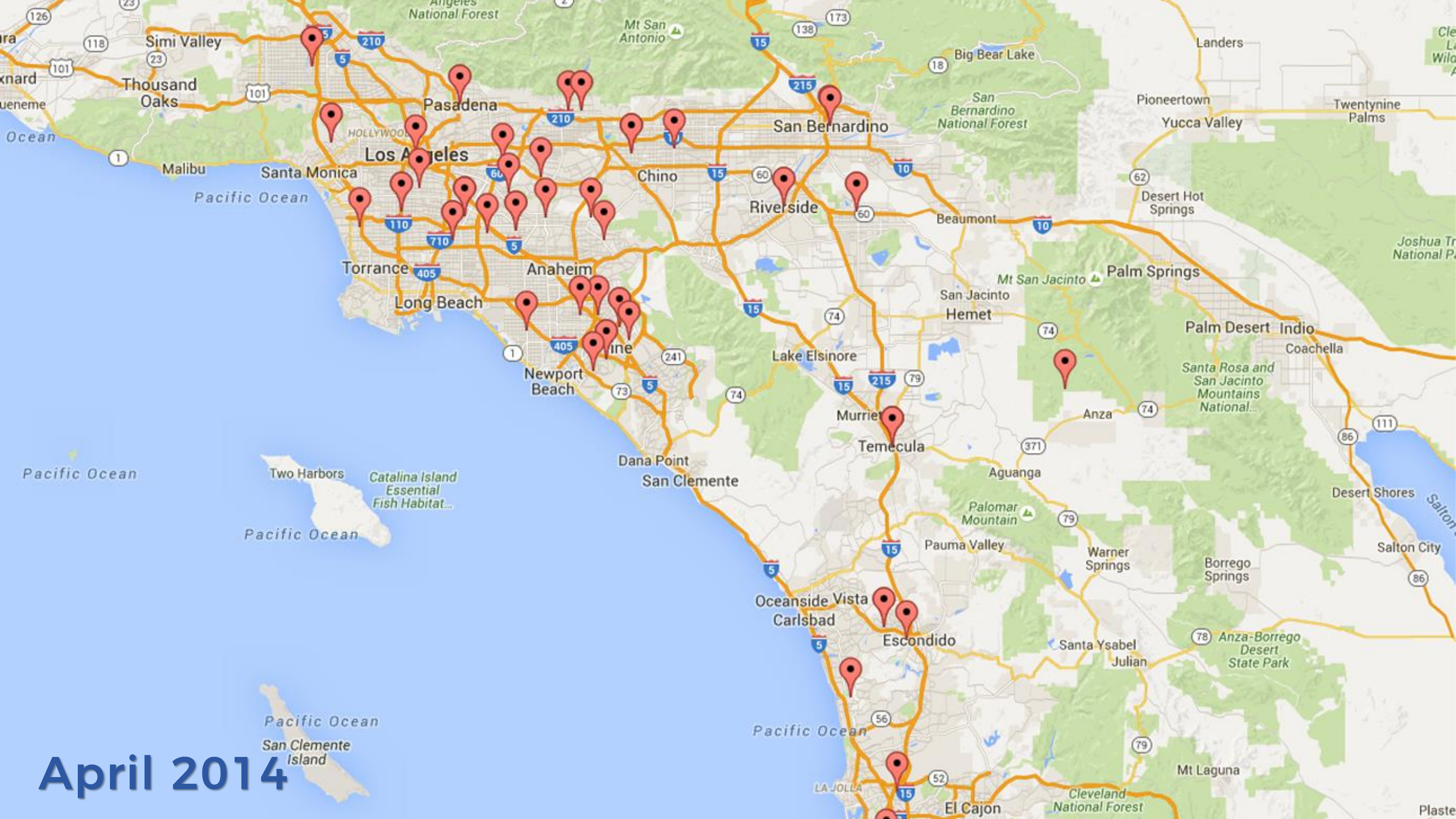
January 2014



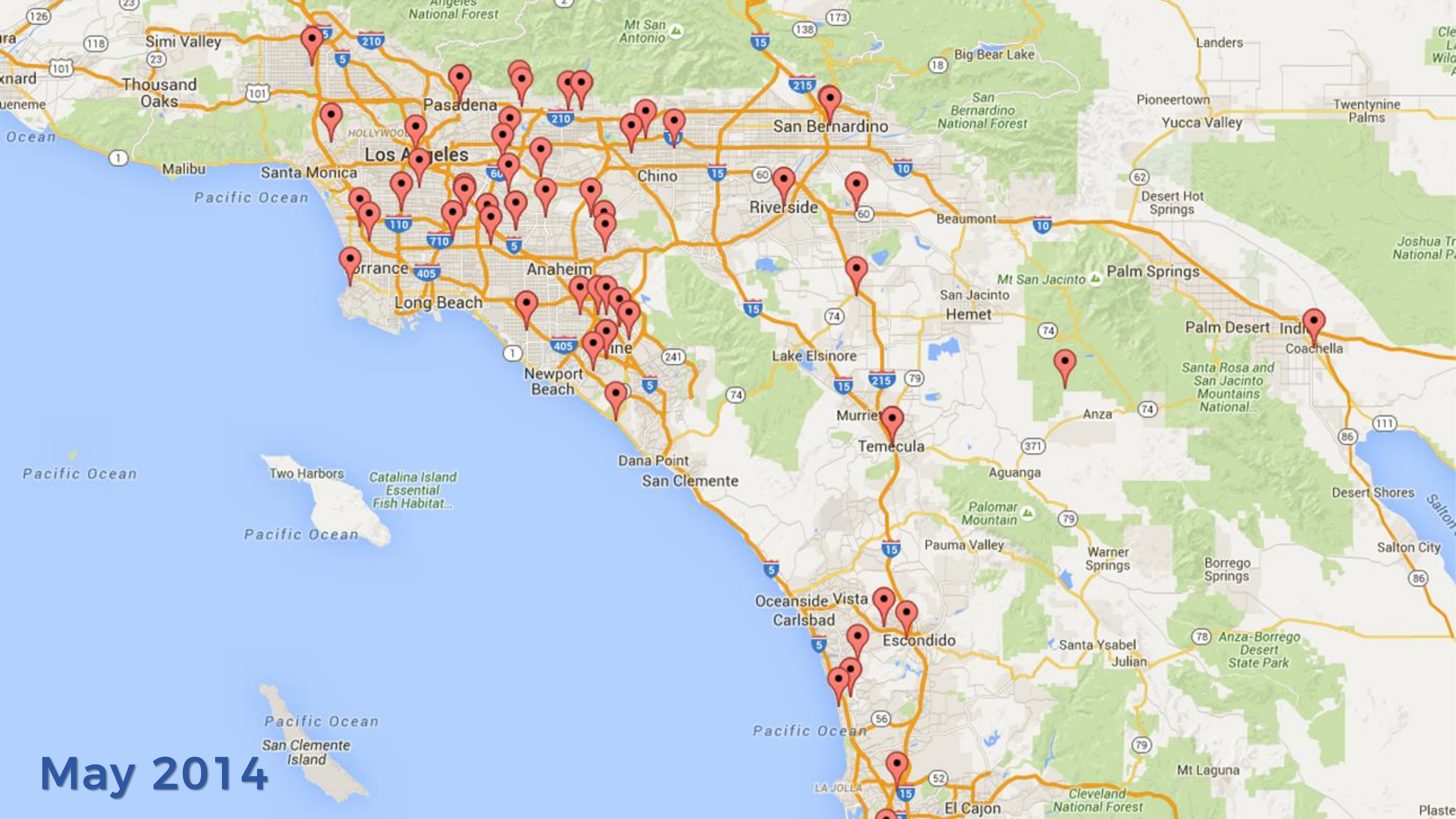
February 2014


Simi Valley
Thousand Oaks
Pasadena
San Bernardino
Big Bear Lake
Landers
Pioneertown
Yucca Valley
Twentynine Palms
San Bernardino National Forest
Mt San Antonio
Los Angeles
Santa Monica
Malibu
Pacific Ocean
Chino
Riverside
Beaumont
Desert Hot Springs
Joshua Tree National Park
Palm Springs
Mt San Jacinto
Torrance
Long Beach
Anaheim
Irvine
Newport Beach
San Jacinto
Hemet
Palm Desert
Indio
Coachella
Lake Elsinore
Santa Rosa and San Jacinto Mountains National...
Anza
Murrieta
Temecula
Aguanga
Dana Point
San Clemente
Two Harbors
Catalina Island Essential Fish Habitat...
Palomar Mountain
Pauma Valley
Warner Springs
Borrego Springs
Desert Shores
Salton City
Oceanside
Vista
Carlsbad
Escondido
Santa Ysabel
Julian
Anza-Borrego Desert State Park
San Clemente Island
La Jolla
Mt Laguna
El Cajon
Cleveland National Forest

March 2014


National Forest
Mt San Antonio
Simi Valley
Thousand Oaks
Oxnard
Hueneme
Ocean
Pasadena
HOLLYWOOD
Los Angeles
Malibu
Santa Monica
Pacific Ocean
Torrance
Long Beach
Anaheim
Newport Beach
Chino
San Bernardino
Riverside
Big Bear Lake
San Bernardino National Forest
Landers
Pioneertown
Yucca Valley
Twentynine Palms
Beaumont
Desert Hot Springs
Joshua Tree National Park
Mt San Jacinto
Palm Springs
San Jacinto
Hemet
Palm Desert
Indio
Coachella
Lake Elsinore
Murrieta
Temecula
Anza
Santa Rosa and San Jacinto Mountains National...
Dana Point
San Clemente
Aguanga
Palomar Mountain
Pauma Valley
Warner Springs
Borrego Springs
Desert Shores
Salton City
Two Harbors
Catalina Island Essential Fish Habitat...
Pacific Ocean
Oceanside
Vista
Carlsbad
Escondido
Santa Ysabel
Julian
Anza-Borrego Desert State Park
Pacific Ocean
San Clemente Island
Pacific Ocean
LA JOLLA
Mt Laguna
El Cajon
Cleveland National Forest

April 2014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Pasadena
Los Angeles
Santa Monica
Malibu
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Big Bear Lake
Landers
Pioneertown
Yucca Valley
Twentynine Palms
San Bernardino
San Bernardino National Forest
Chino
Riverside
Beaumont
Desert Hot Springs
Joshua Tree National Park
Palm Springs
Mt San Jacinto
San Jacinto
Hemet
Palm Desert
Coachella
Anaheim
Long Beach
Newport Beach
Lake Elsinore
Murrieta
Temecula
Anza
Aguanga
Santa Rosa and San Jacinto Mountains National...
Dana Point
San Clemente
Two Harbors
Catalina Island Essential Fish Habitat...
Palomar Mountain
Pauma Valley
Warner Springs
Borrego Springs
Desert Shores
Salton City
Oceanside
Vista
Carlsbad
Escondido
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Julian
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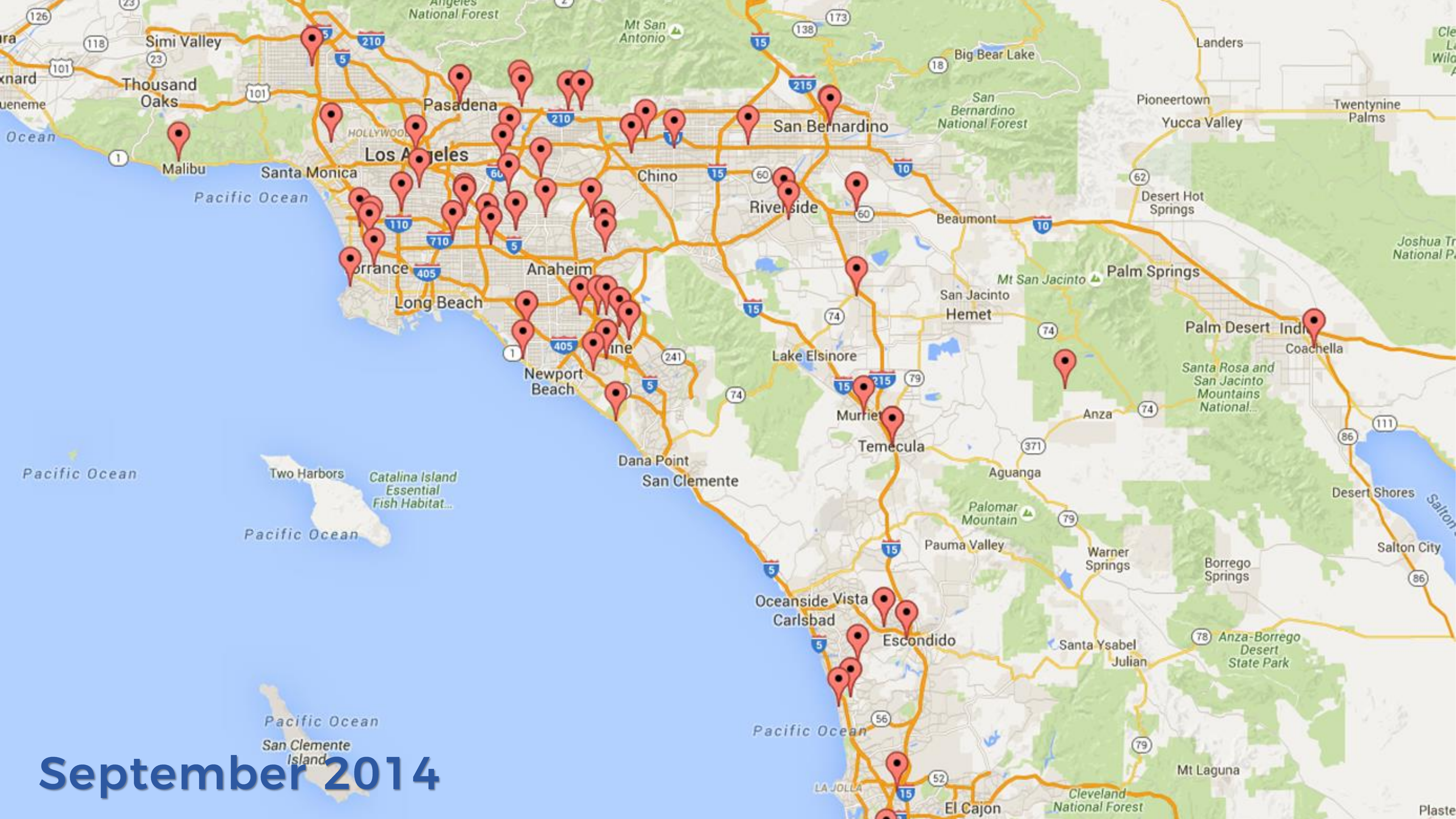
El Cajon
Cleveland National Forest
May 2014



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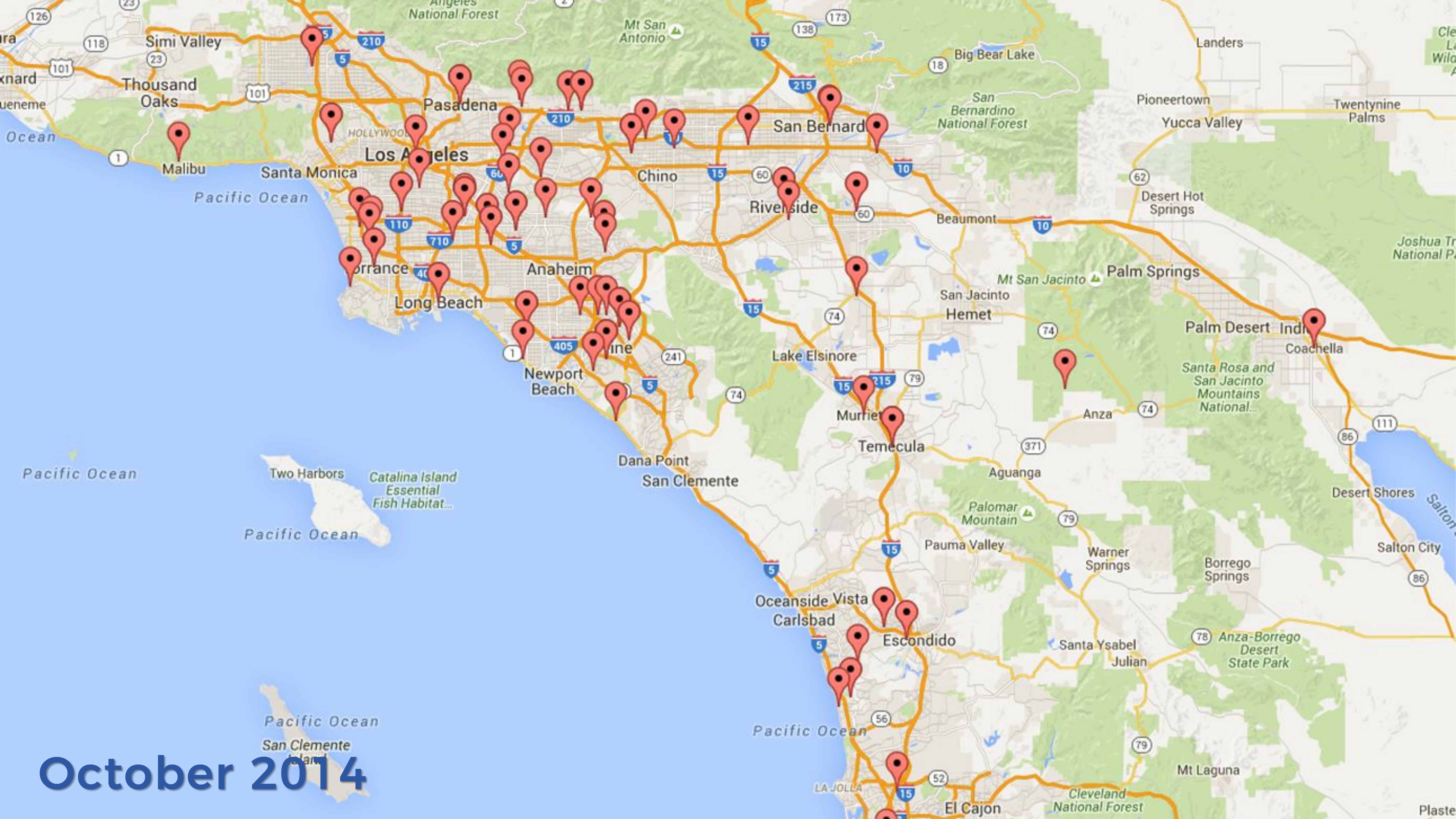

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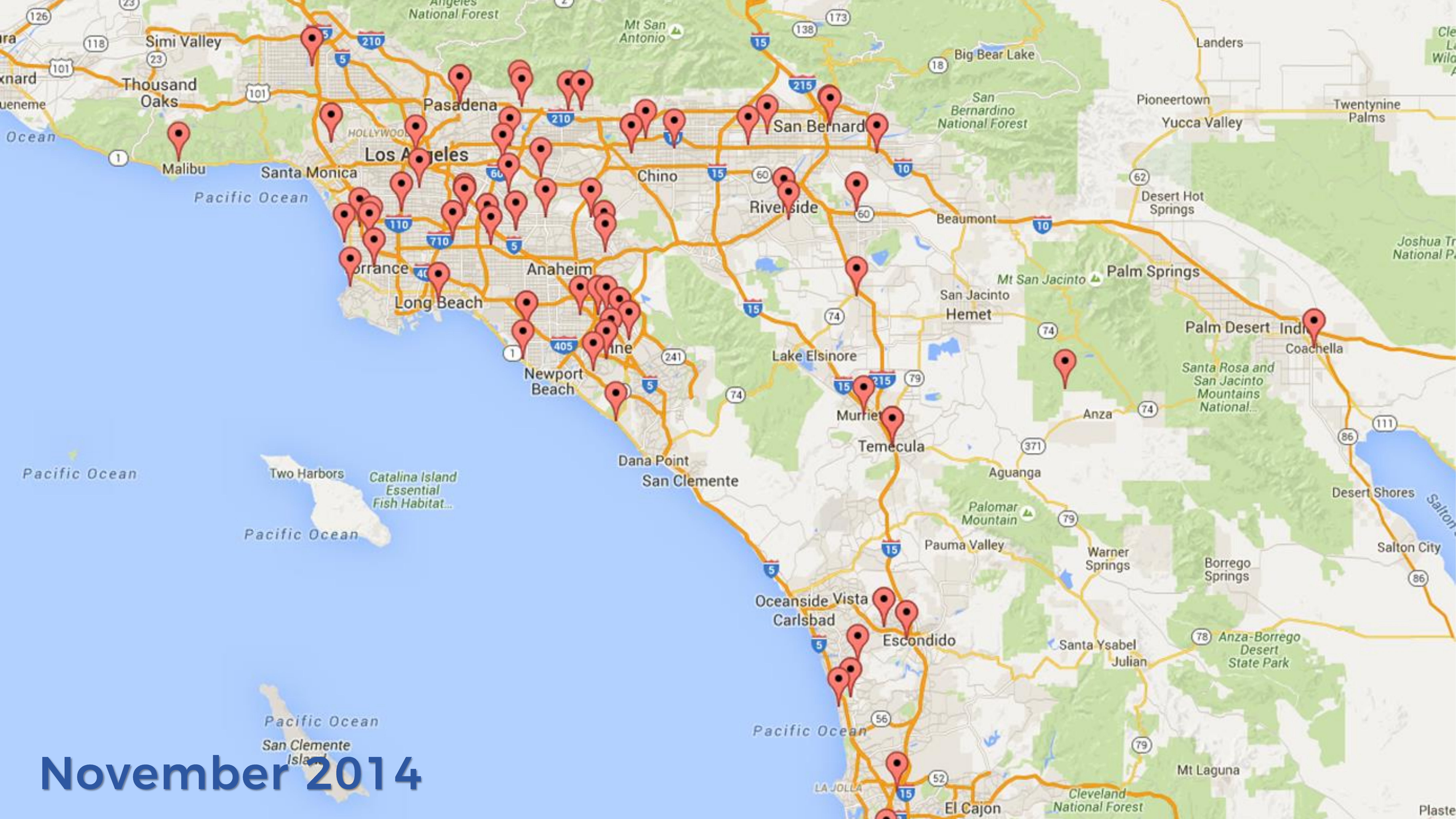

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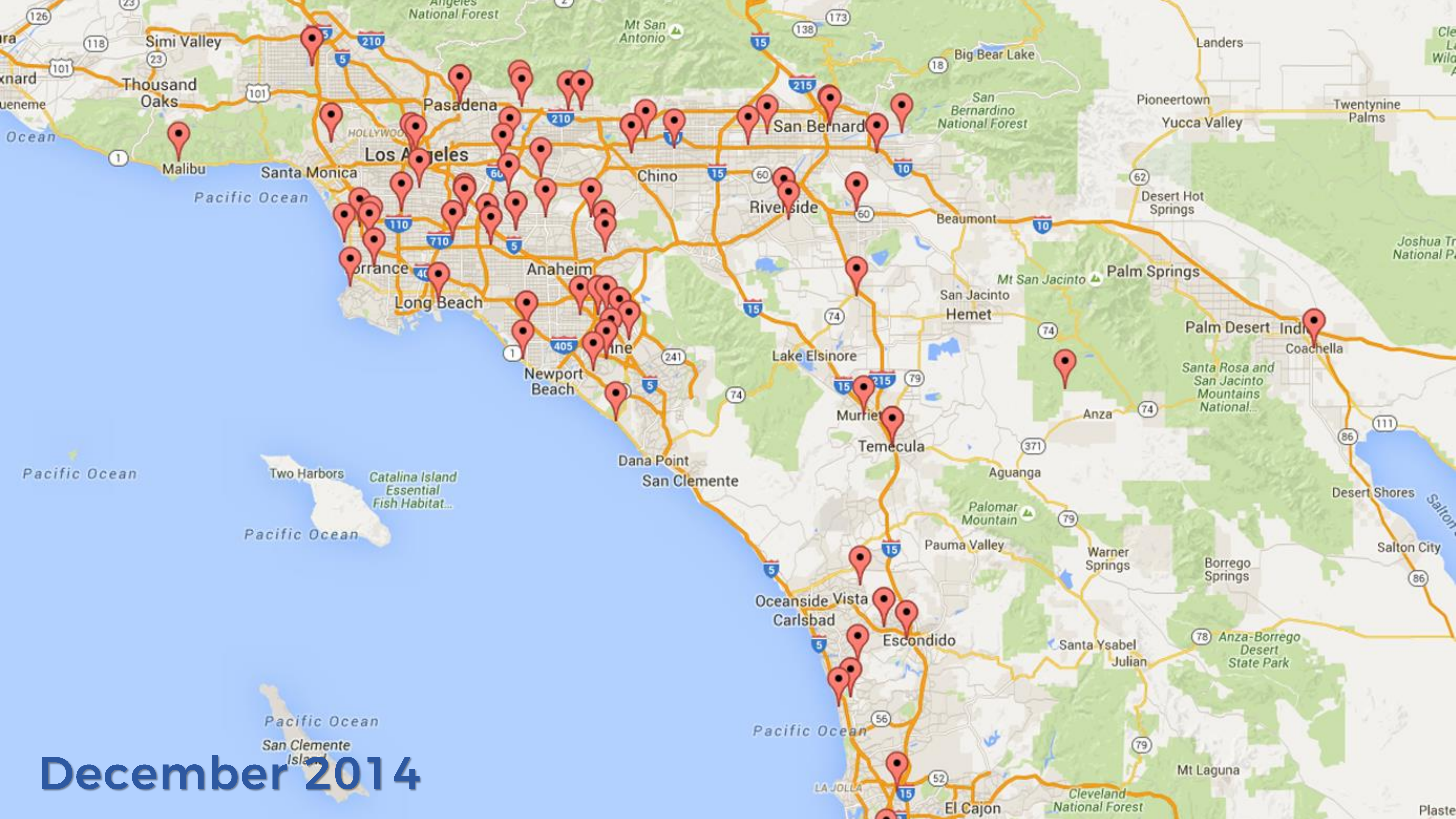

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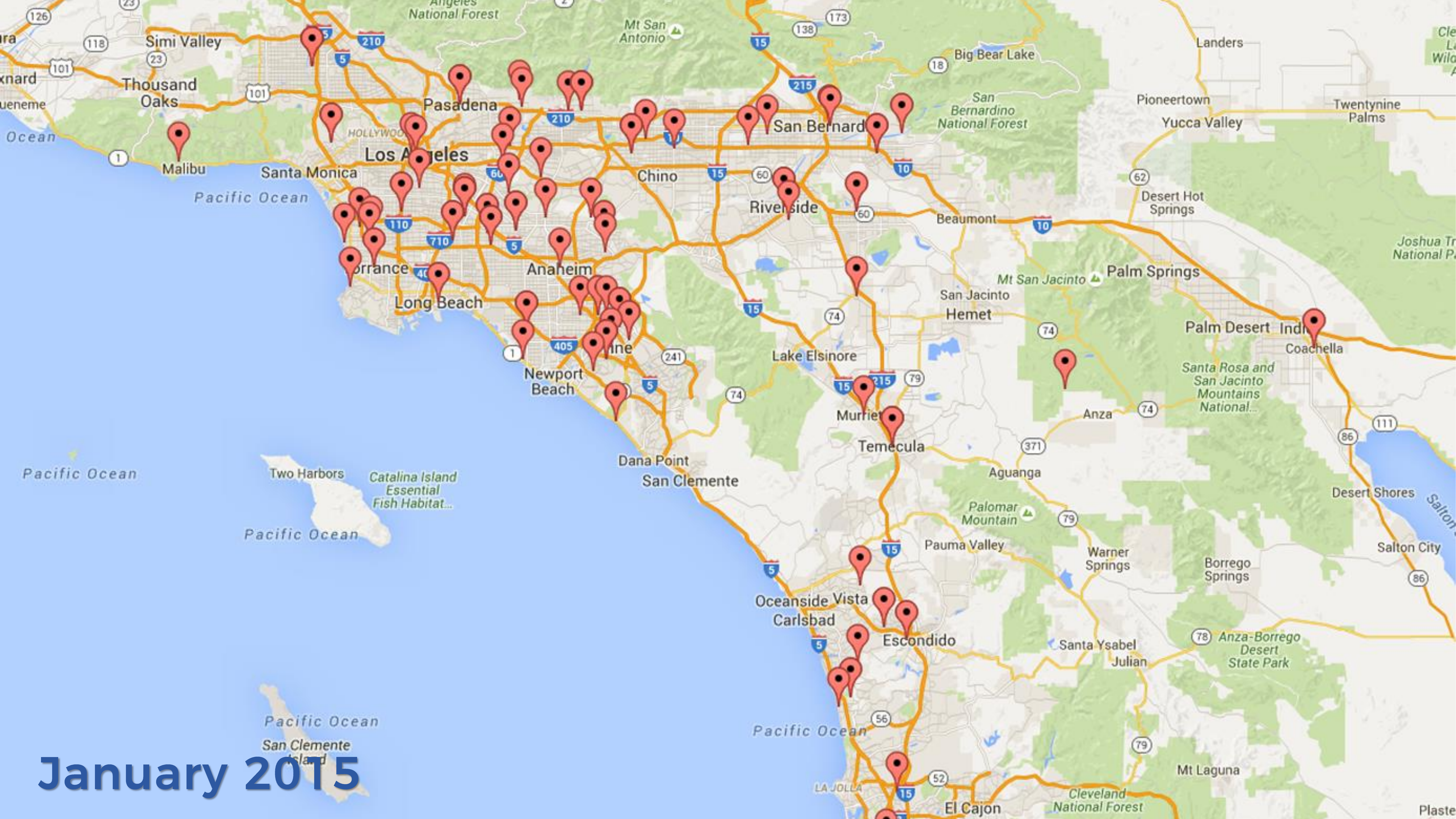

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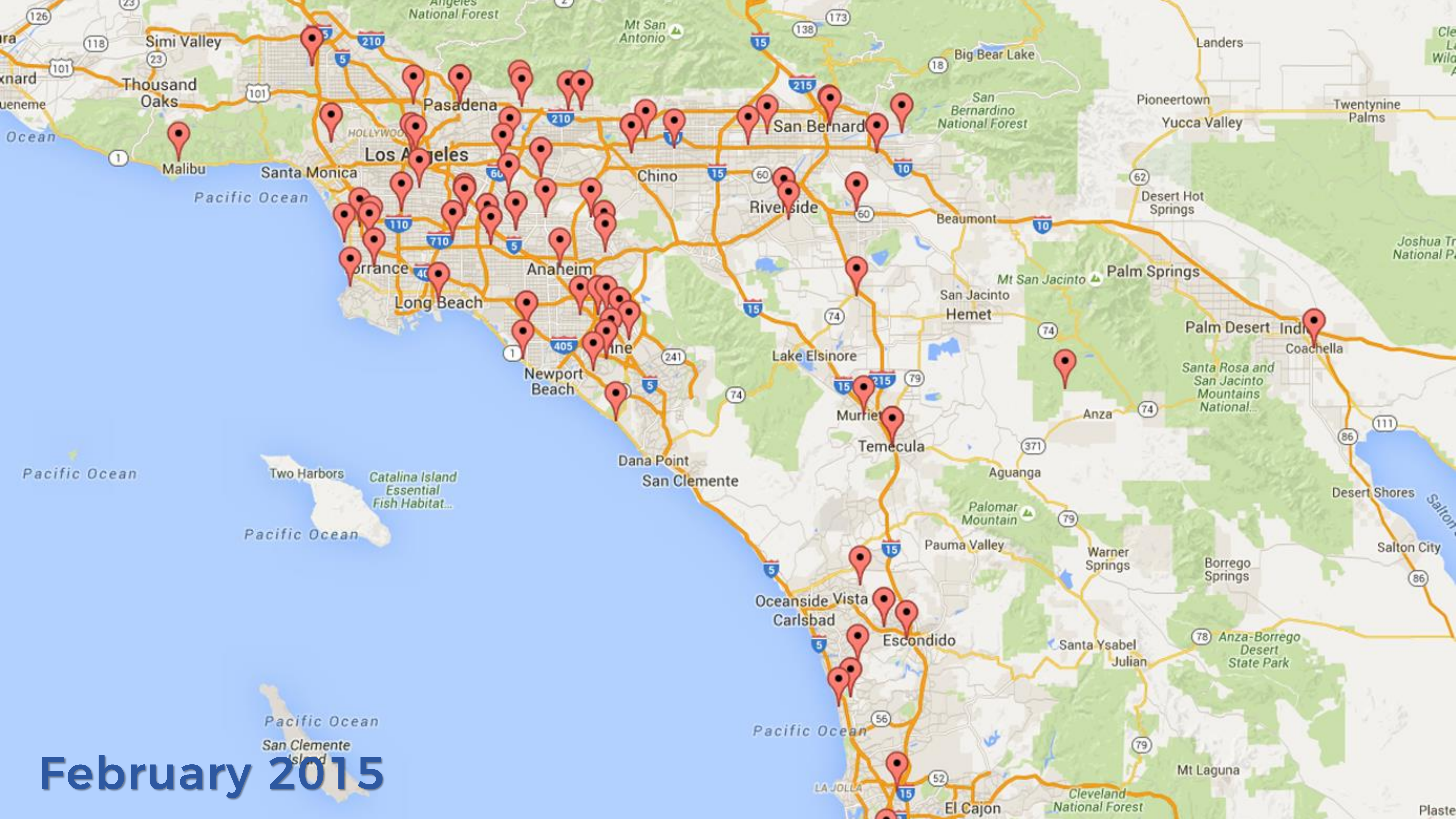

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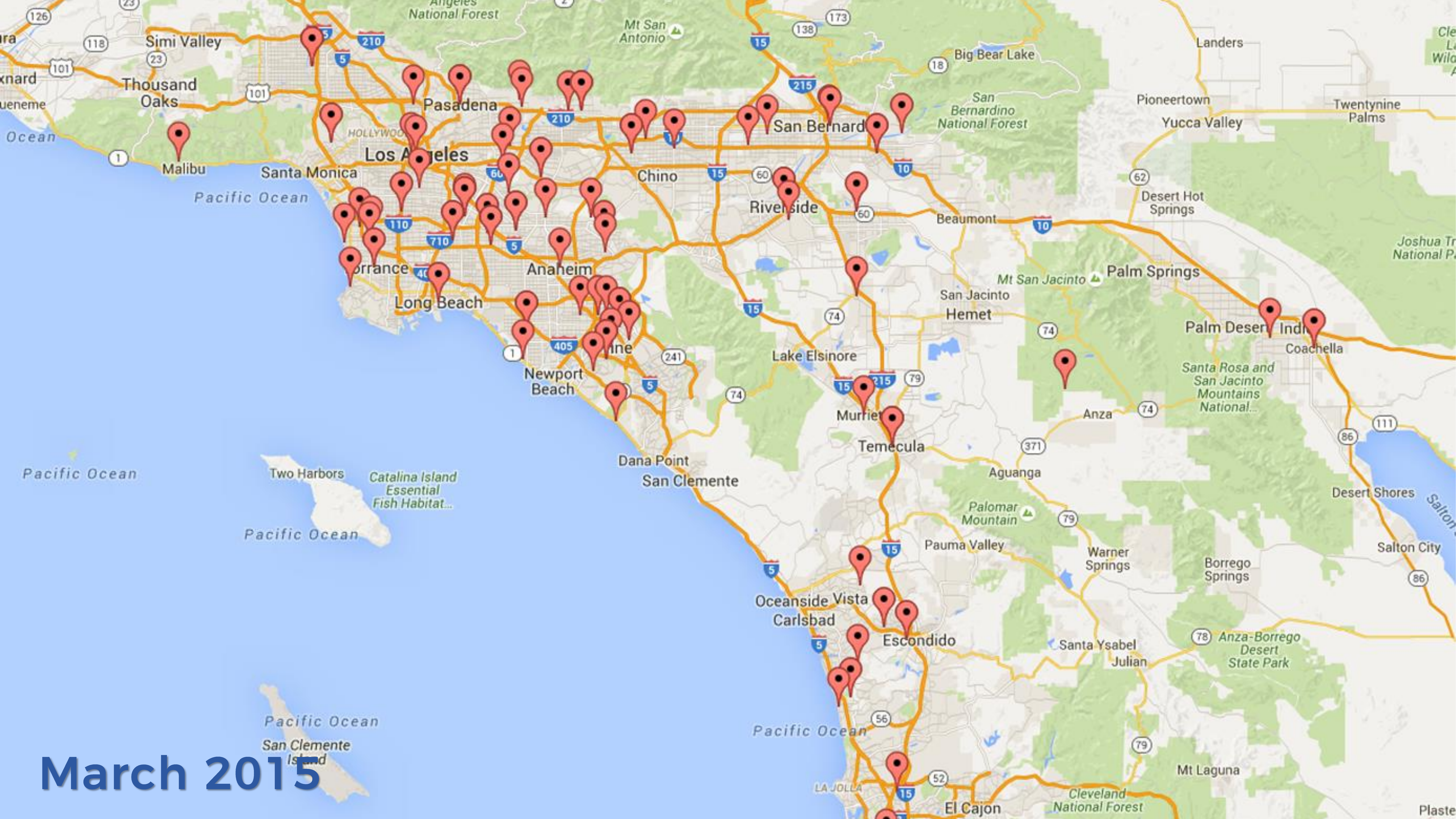
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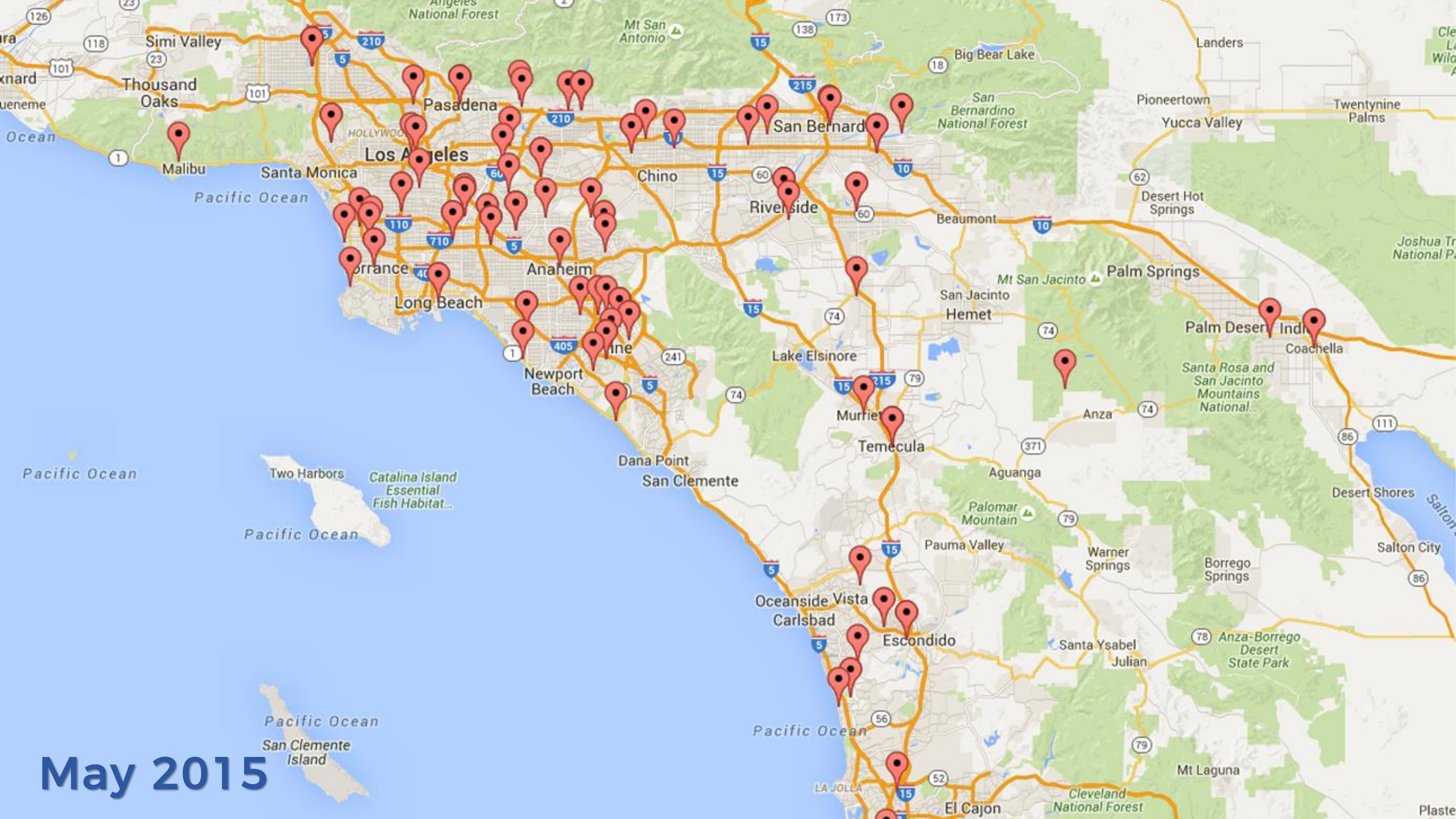
Anza-Borrego Desert State Park
San Clemente Island
LA JOLLA
Mt Laguna
El Cajon
Cleveland National Forest

March 2015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Cleveland National Forest
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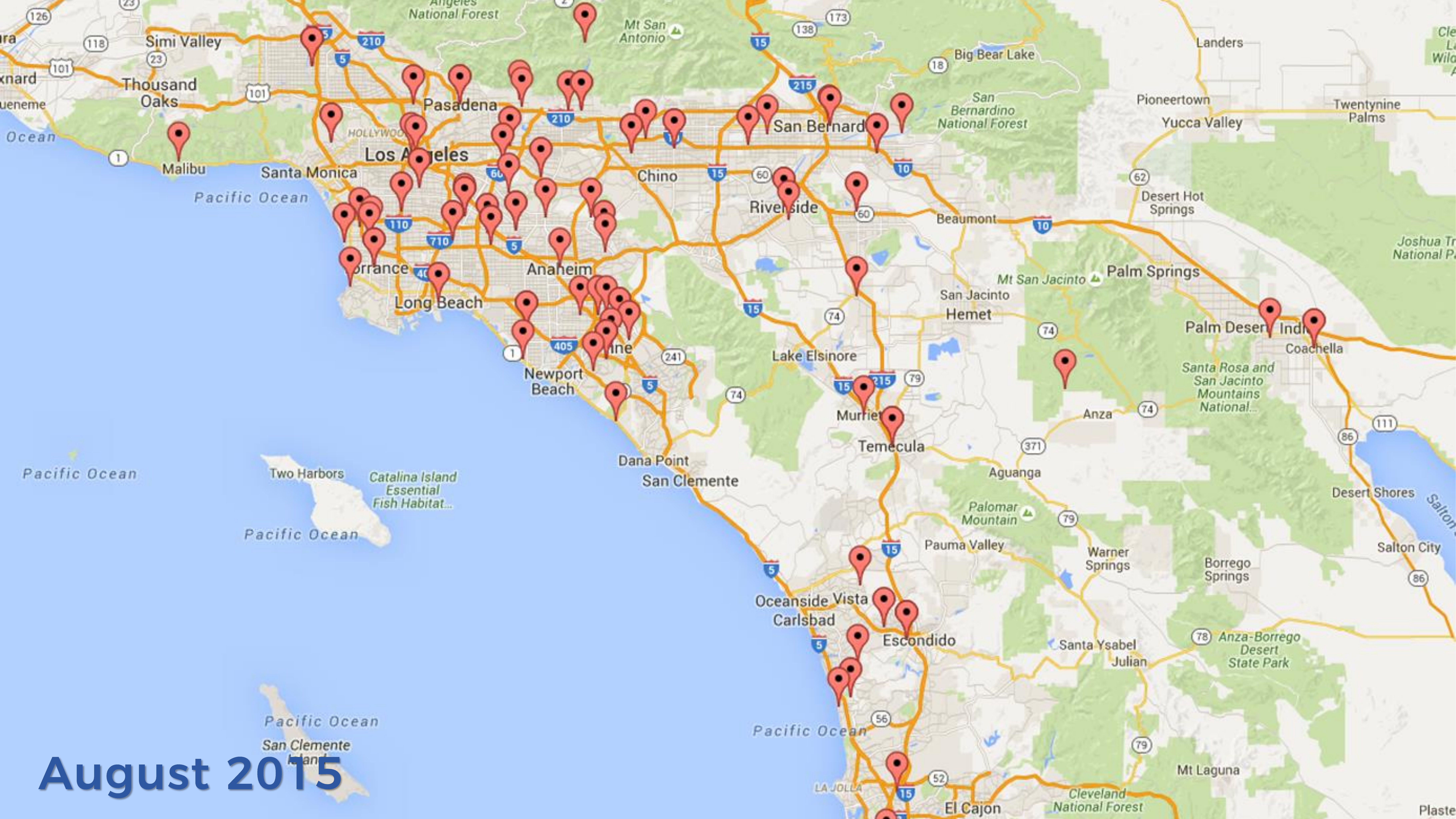
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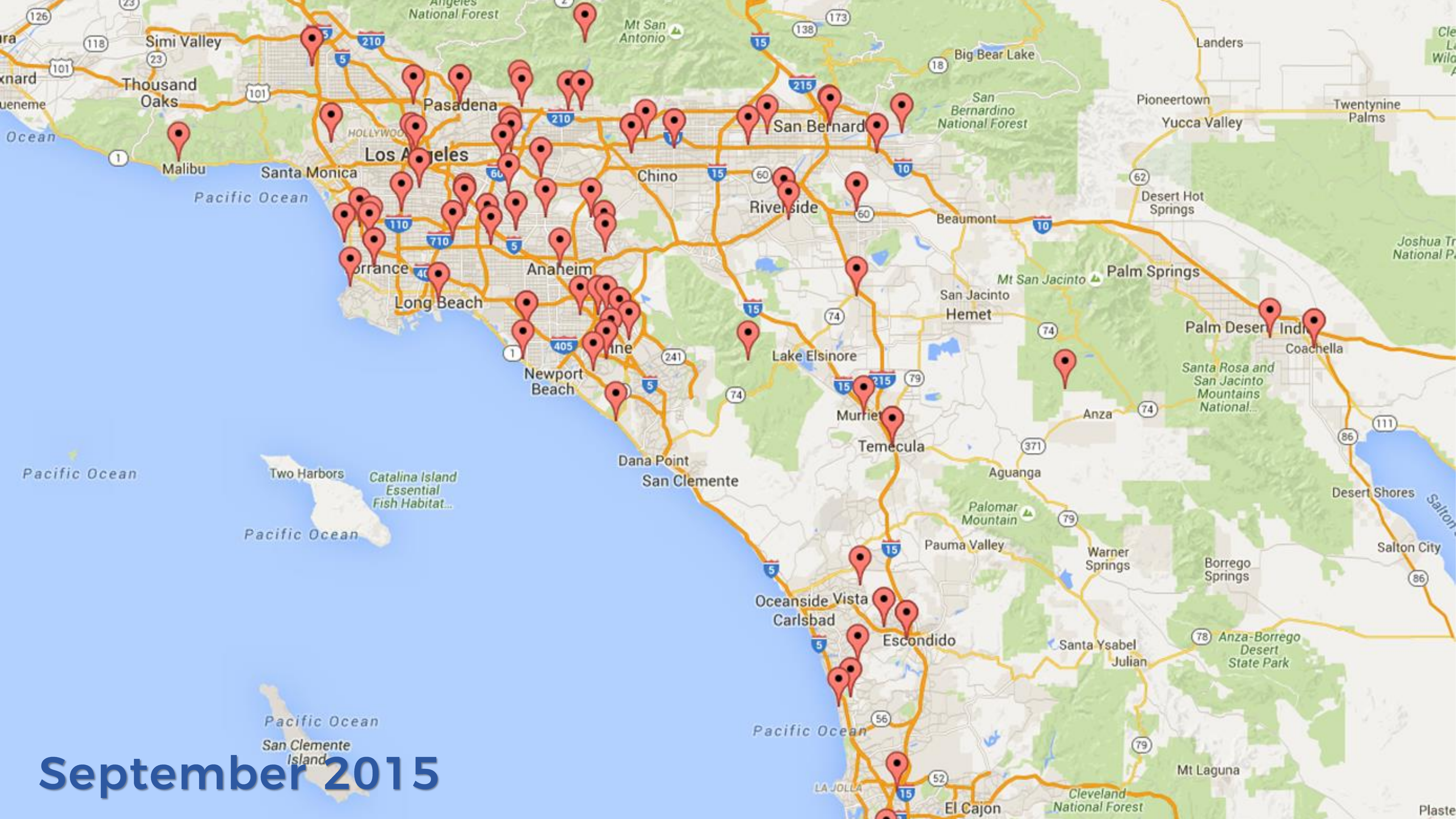
La Jolla
El Cajon
Cleveland National Forest

August 2015



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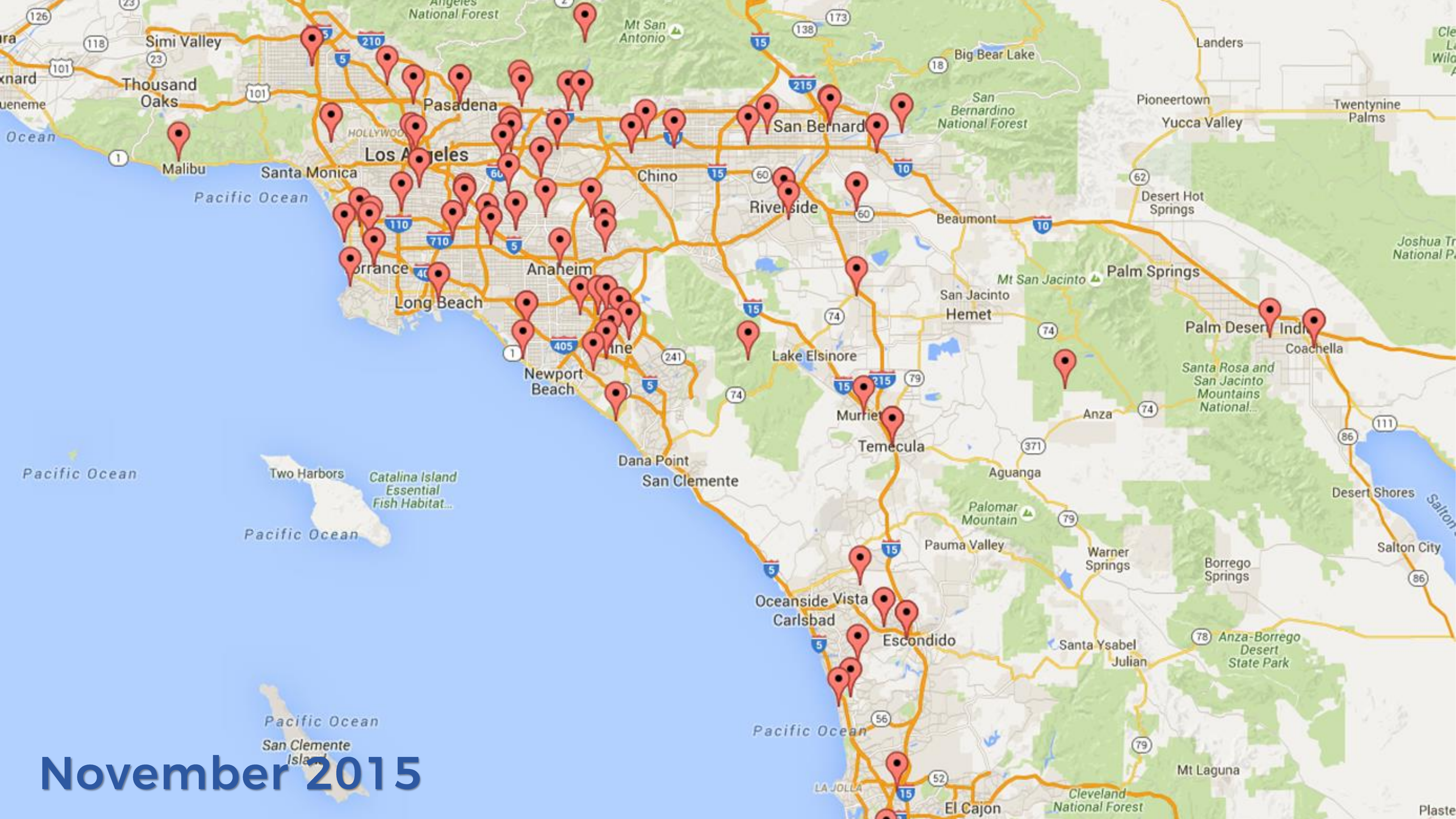

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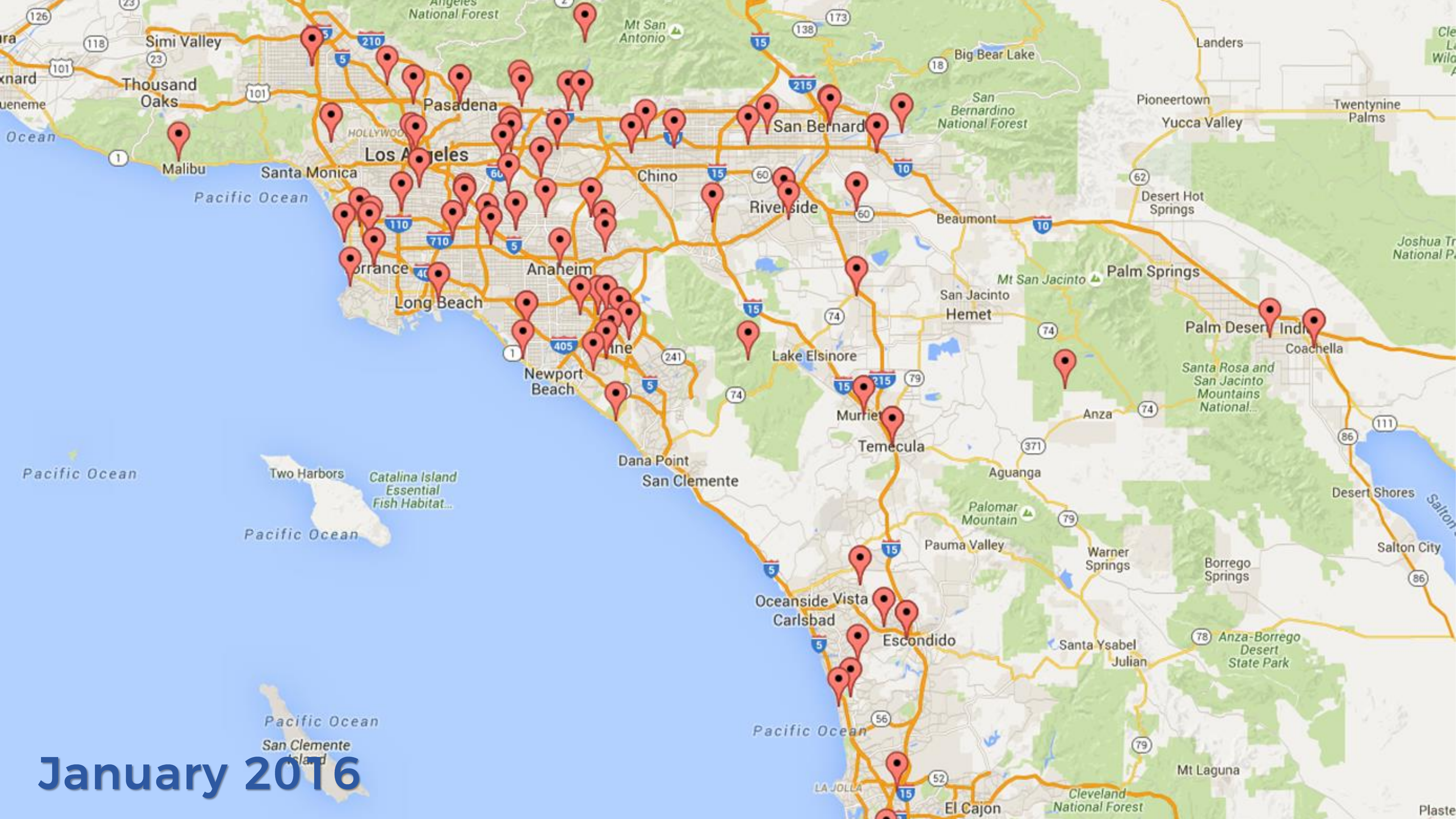

Angeles National Forest
Mt San Antonio
Simi Valley
Thousand Oaks
Oxnard
Hueneme
Ocean
Malibu
Santa Monica
Pacific Ocean
Pasadena
Hollywood
Los Angeles
Torrance
Long Beach
Anaheim
Irvine
Newport Beach
Chino
Riverside
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Pacific Ocean
San Clemente Island
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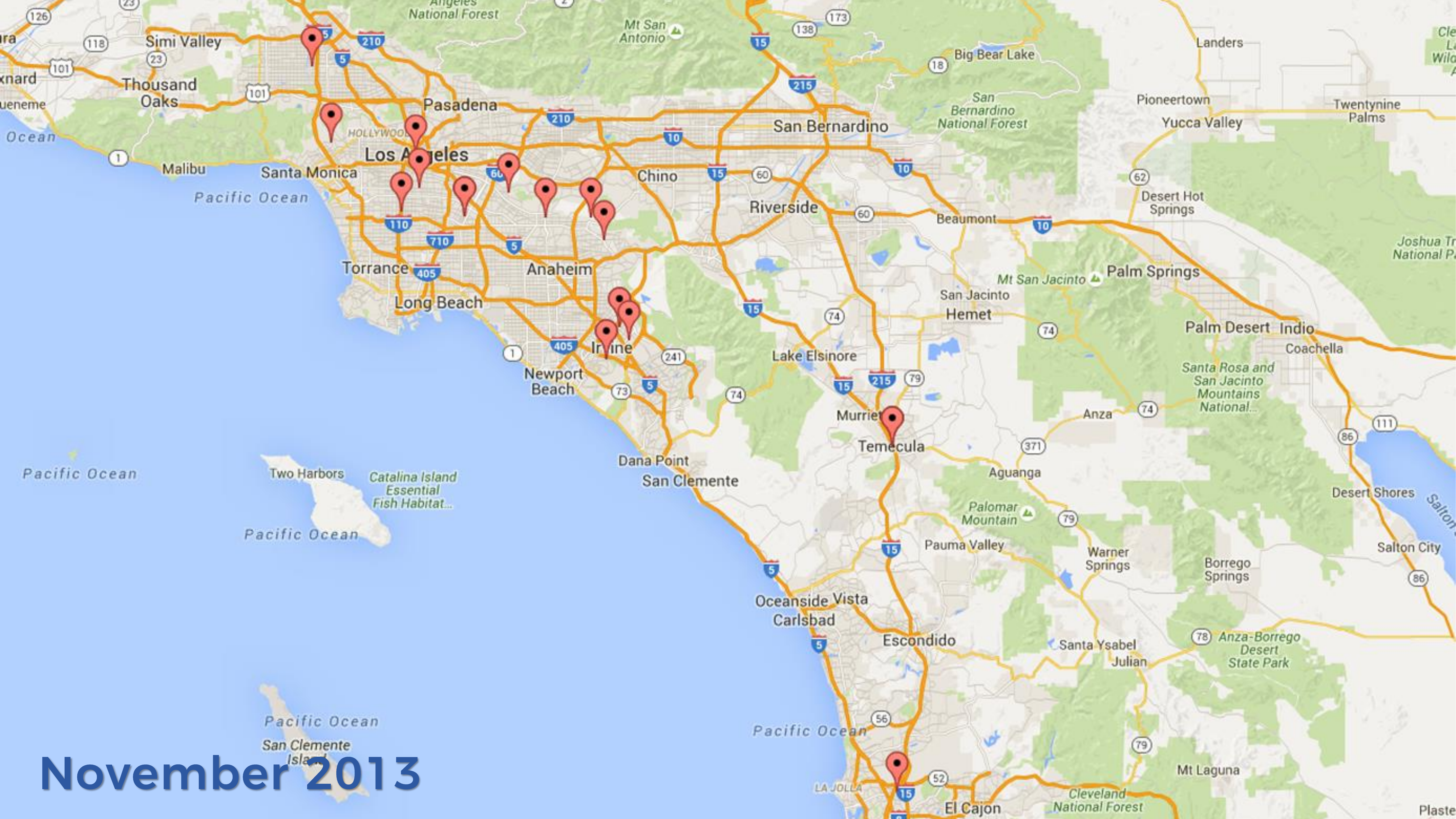
El Cajon
Cleveland National Forest
January 2016

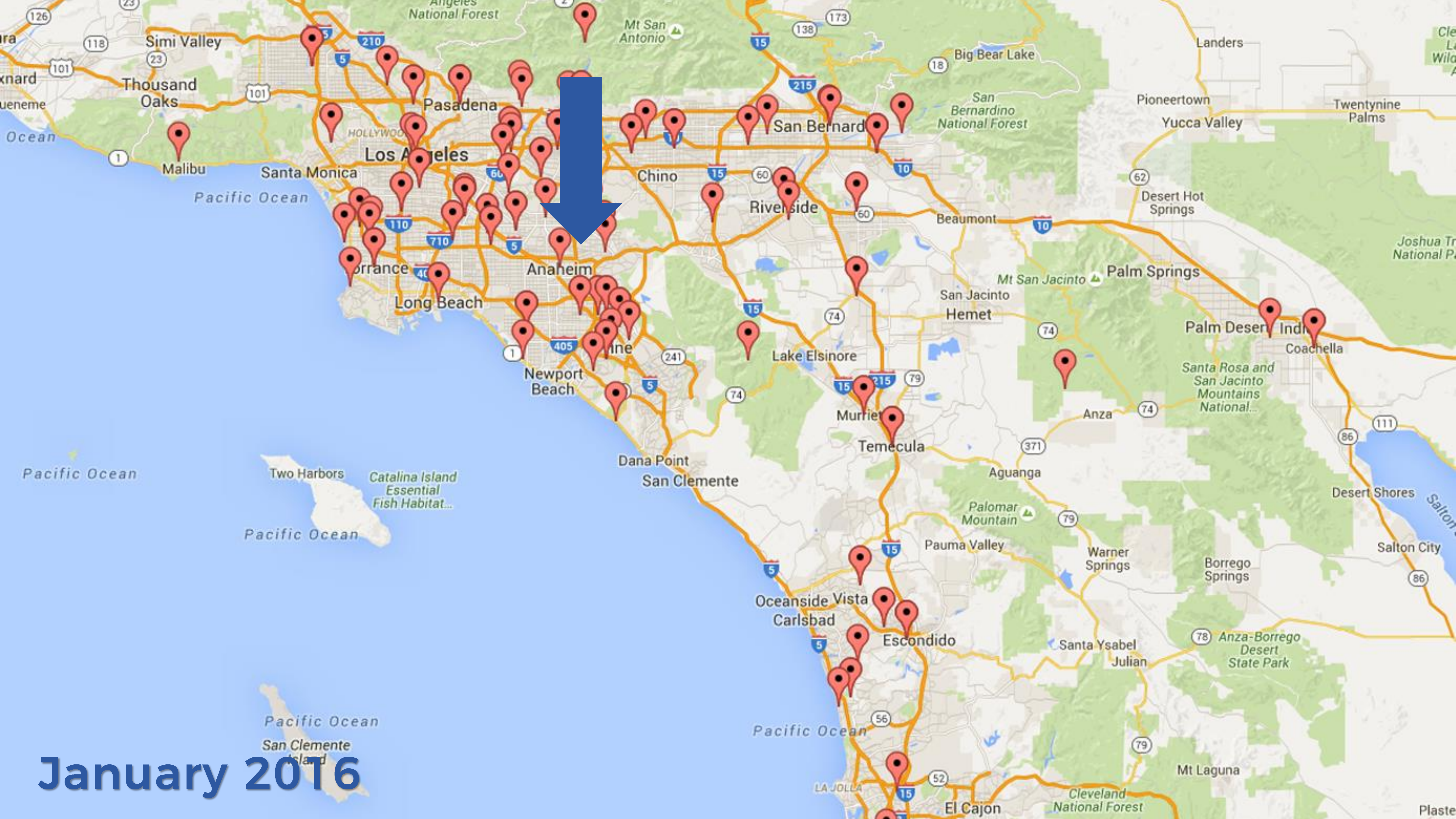


November 2013

Spies

Analysts

Model

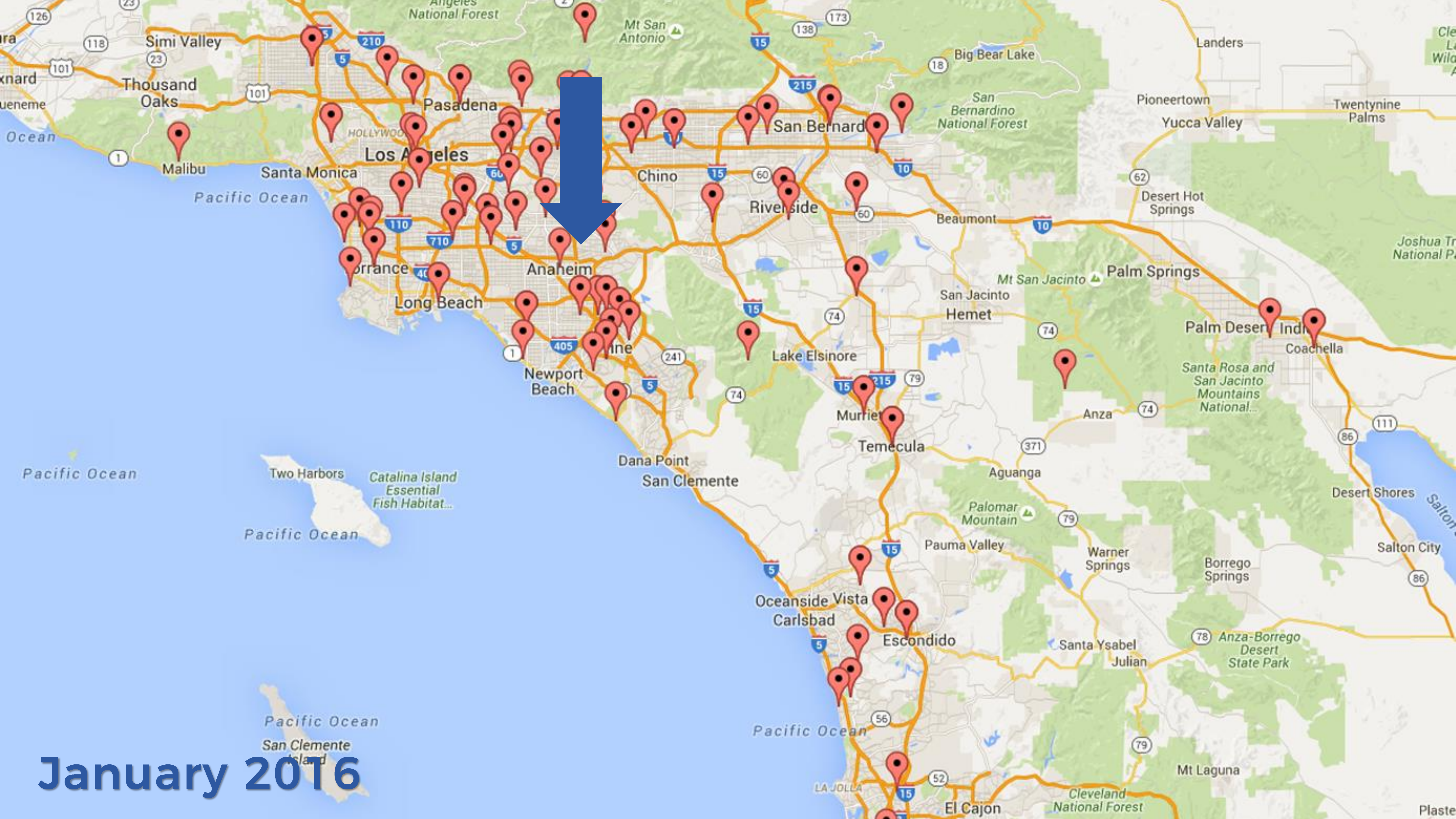


January 2016

Spies

Analysts

Model

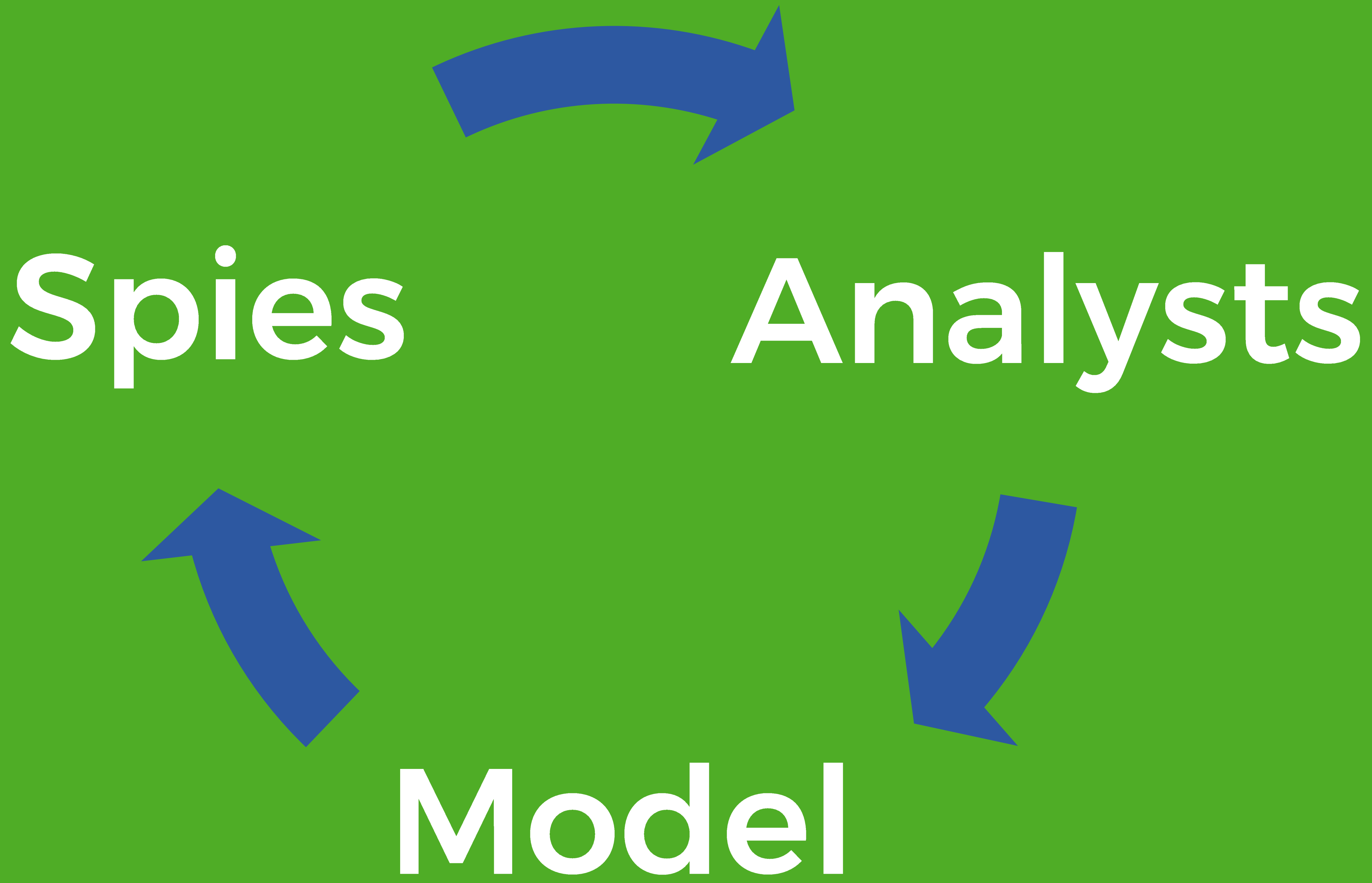


January 2016

All models are wrong, but some are useful.

GEORGE E. P. BOX

Lay's
Classic
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
BRAND
The ORIGINAL
CORN CHIPS
4
4
2
4
2
4
Classic Mix
20 Singles
LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.


Spies
Analysts
Model

THINKING TIME

Robert Kaplinsky
@robertkaplinsky

Hey #MTBoS, can you do me a favor and complete this 3 question anonymous survey about your favorite chips? I need data for a presentation. Please RT.
goo.gl/forms/etPtujlI… #iteachmath

Favorite Chips
Please complete this anonymous survey. I'll be using this data in a presentation.
docs.google.com

8:05 PM - 4 Feb 2018

63 Retweets **45** Likes

18 63 45

Favorite Chips (Responses)

File Edit View Insert Format Data Tools Form Add-ons Help

Comments Share

100% $ % .0 .00 123 Arial 10

fx Timestamp

	A	B	C	D	E	F	G	H
1	Timestamp	Lays (Classic)	Doritos (Nacho Cheese)	Doritos (Cool Ranch)	Cheetos (Crunchy)	Sun Chips (Original)	Fritos (Original)	Time Zone
2	2/4/2018 20:06:53	6	5	4	2	3	1	Central Time Zone
3	2/4/2018 20:06:55	1	5	6	3	2	4	Eastern Time Zone
4	2/4/2018 20:06:56	5	2	1	3	6	4	Central Time Zone
5	2/4/2018 20:06:57	2	1	6	3	5	4	Pacific Time Zone
6	2/4/2018 20:07:36	4	1	2	3	5	6	Pacific Time Zone
7	2/4/2018 20:08:02	5	1	6	4	2	3	Pacific Time Zone
8	2/4/2018 20:08:05	6	2	4	3	5	1	Pacific Time Zone
9	2/4/2018 20:08:07	4	2	1	5	3	6	Pacific Time Zone
10	2/4/2018 20:08:29	5	3	4	1	6	2	Central Time Zone
11	2/4/2018 20:08:56	4	5	6	1	2	3	Central Time Zone
12	2/4/2018 20:09:54	5	6	5	6	5	4	Pacific Time Zone
13	2/4/2018 20:10:01	4	2	3	1	5	6	Pacific Time Zone
14	2/4/2018 20:10:04	6	2	3	1	5	4	Central Time Zone
15	2/4/2018 20:10:04	3	5	6	1	4	2	Central Time Zone
16	2/4/2018 20:10:05	4	2	6	1	3	5	Eastern Time Zone
17	2/4/2018 20:10:06	3	2	6	5	1	2	Pacific Time Zone
18	2/4/2018 20:10:10	4	2	6	3	5	1	Mountain Time Zone
19	2/4/2018 20:10:12	3	1	5	6	2	4	Eastern Time Zone
20	2/4/2018 20:10:26	5	3	6	2	4	1	Pacific Time Zone

Sheet3

Explore

THINKING TIME

- The available data includes:
  - Lays, Nacho Cheese Doritos, Cool Ranch Doritos, Cheetos, Sun Chips, and Fritos ranked from 1 to 6
  - Geographic region: West, Central, or Eastern

ANALYSTS' JOB FOR THE TOP 1

1. Count all the first place votes for each chip type.
2. Divide the total first place votes for each chip type by the total number of votes.
3. Multiply that fraction by 20 to find how many bags there would be in a twenty pack, rounding as necessary.

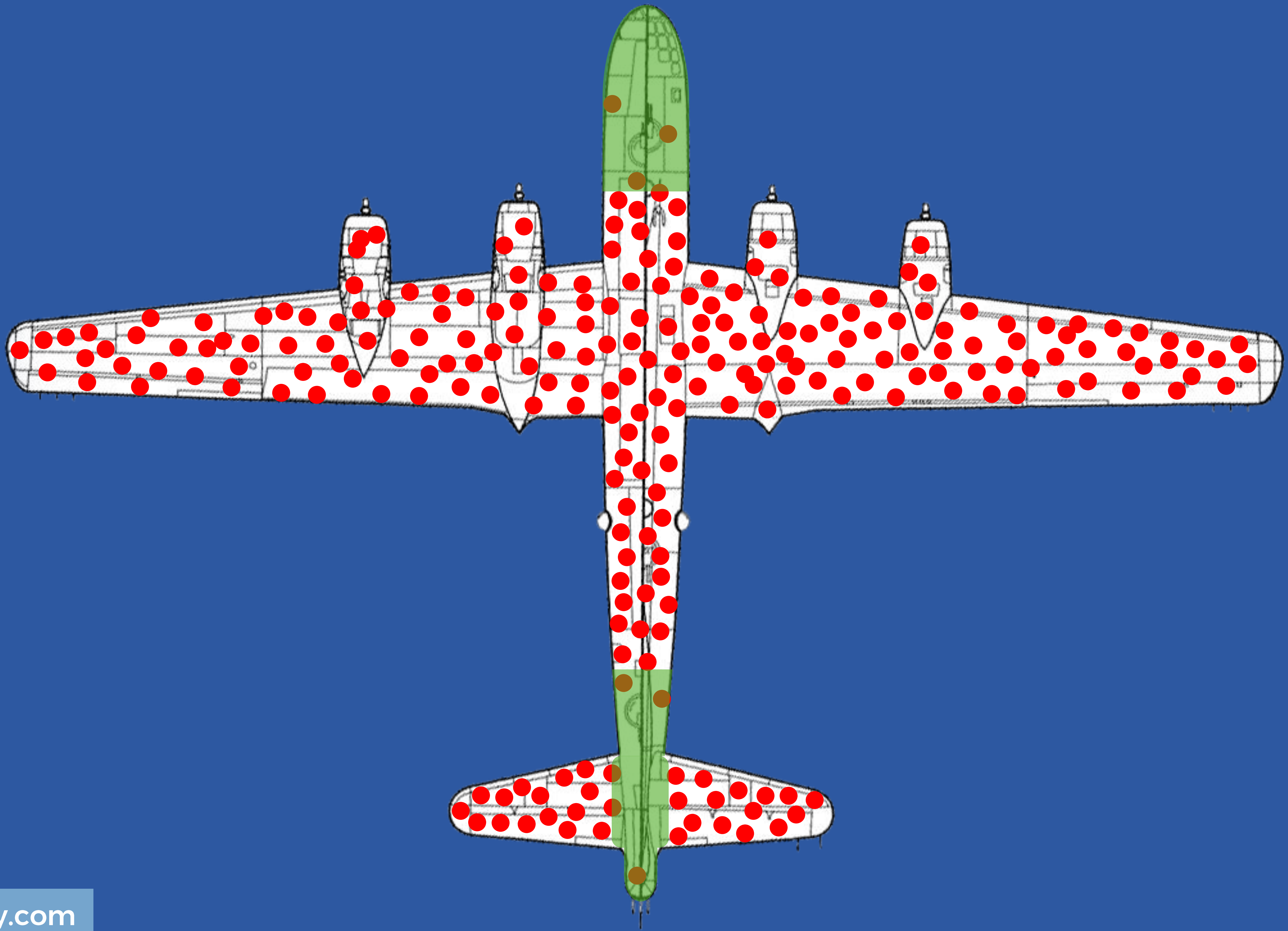
ANALYSTS' EXAMPLE

CHIP BAG RESULTS

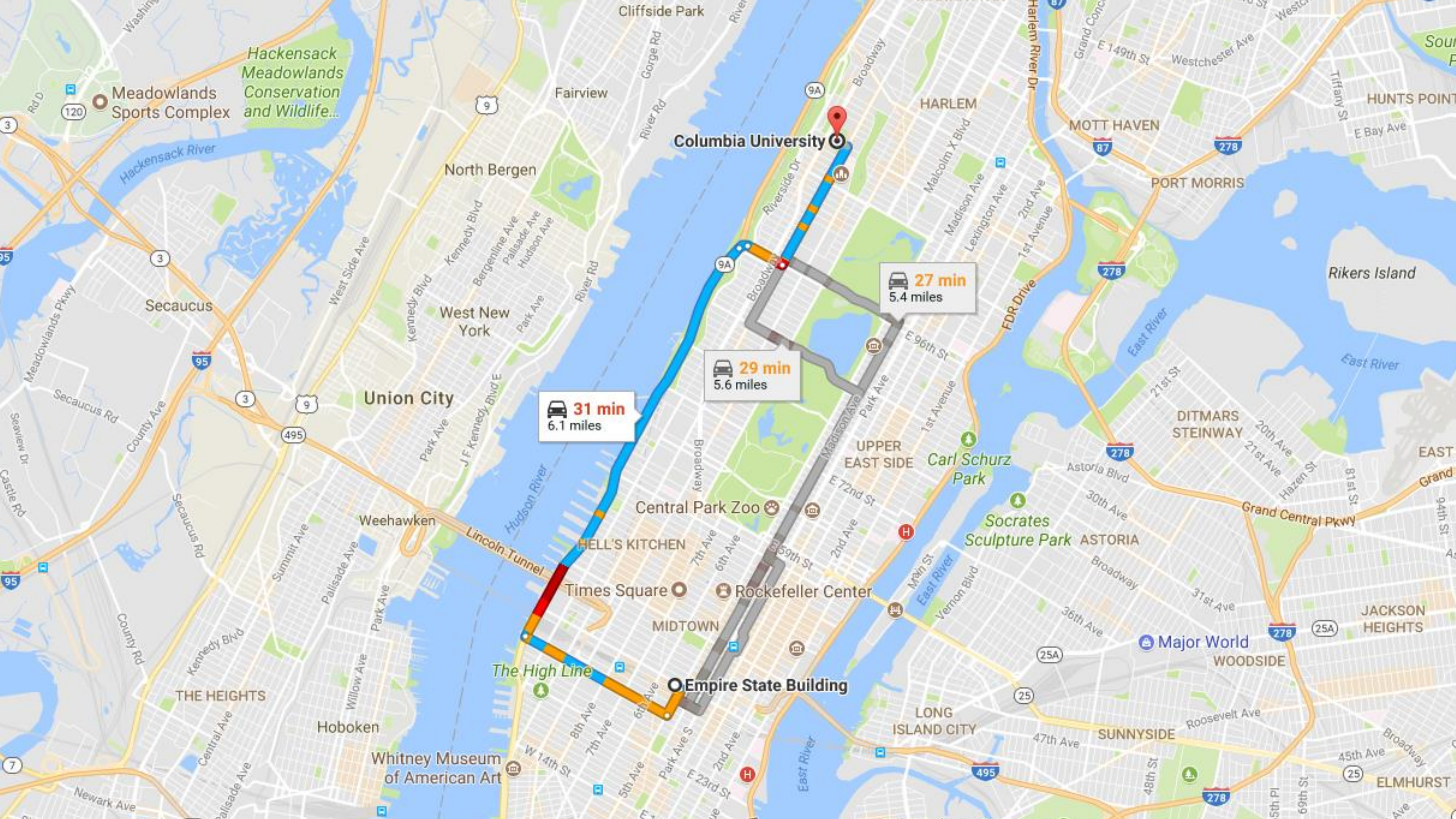
MATH MODELING

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [ ] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW IS MATH MODELING USED IN REAL LIFE?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?


224612



- ~~How do we protect our planes?~~
- ~~Which parts of the plane are being hit by the most bullets?~~
- Which parts of the plane are the most critical to protect?


Columbia University
Empire State Building
31 min
6.1 miles
29 min
5.6 miles
27 min
5.4 miles
HARLEM
UPPER EAST SIDE
HELL'S KITCHEN
MIDTOWN
Times Square
Rockefeller Center
Central Park Zoo
The High Line
Whitney Museum of American Art
Hoboken
Union City
West New York
Weehawken
North Bergen
Fairview
Cliffside Park
Secaucus
Meadowlands Sports Complex
Hackensack Meadowlands Conservation and Wildlife...
Hackensack River
Hudson River
Lincoln Tunnel
East River
Rikers Island
MOTT HAVEN
HUNTS POINT
PORT MORRIS
DITMARS STEINWAY
ASTORIA
Carl Schurz Park
Socrates Sculpture Park
LONG ISLAND CITY
SUNNYSIDE
WOODSIDE
JACKSON HEIGHTS
ELMHURST
Major World
THE HEIGHTS
Grand Central Pkwy
FDR Drive

- ~~How do we find the fastest route for each customer?~~
- How do we find the fastest route for each customer without impacting our other customers?

Lay's
Classic
Doritos
NACHO CHEESE
Doritos
COOL RANCH
Cheetos
Crunchy
Sun Chips
ORIGINAL
Fritos
BRAND
The ORIGINAL
CORN CHIPS
4
4
2
4
2
4
Classic Mix
20
Singles
4 LAY'S® Classic Potato Chips, 4 DORITOS® Nacho Cheese Flavored Tortilla Chips, 2 DORITOS® COOL RANCH® Flavored Tortilla Chips, 4 CHEETOS® Crunchy Cheese Flavored Snacks, 2 SUNCHIPS® Original Multigrain Snacks, 4 FRITOS® Original Corn Chips (All 1 OZ. Each)
20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g
⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

- ~~How many of each flavor should we put in a package?~~
- ~~How many of each flavor should we put in a package for each region?~~
- How can we determine if the extra cost of creating different packages will make us more money?

Apply mathematics to problems arising in everyday life, society, and the workplace.

TEKS PROCESS STANDARDS

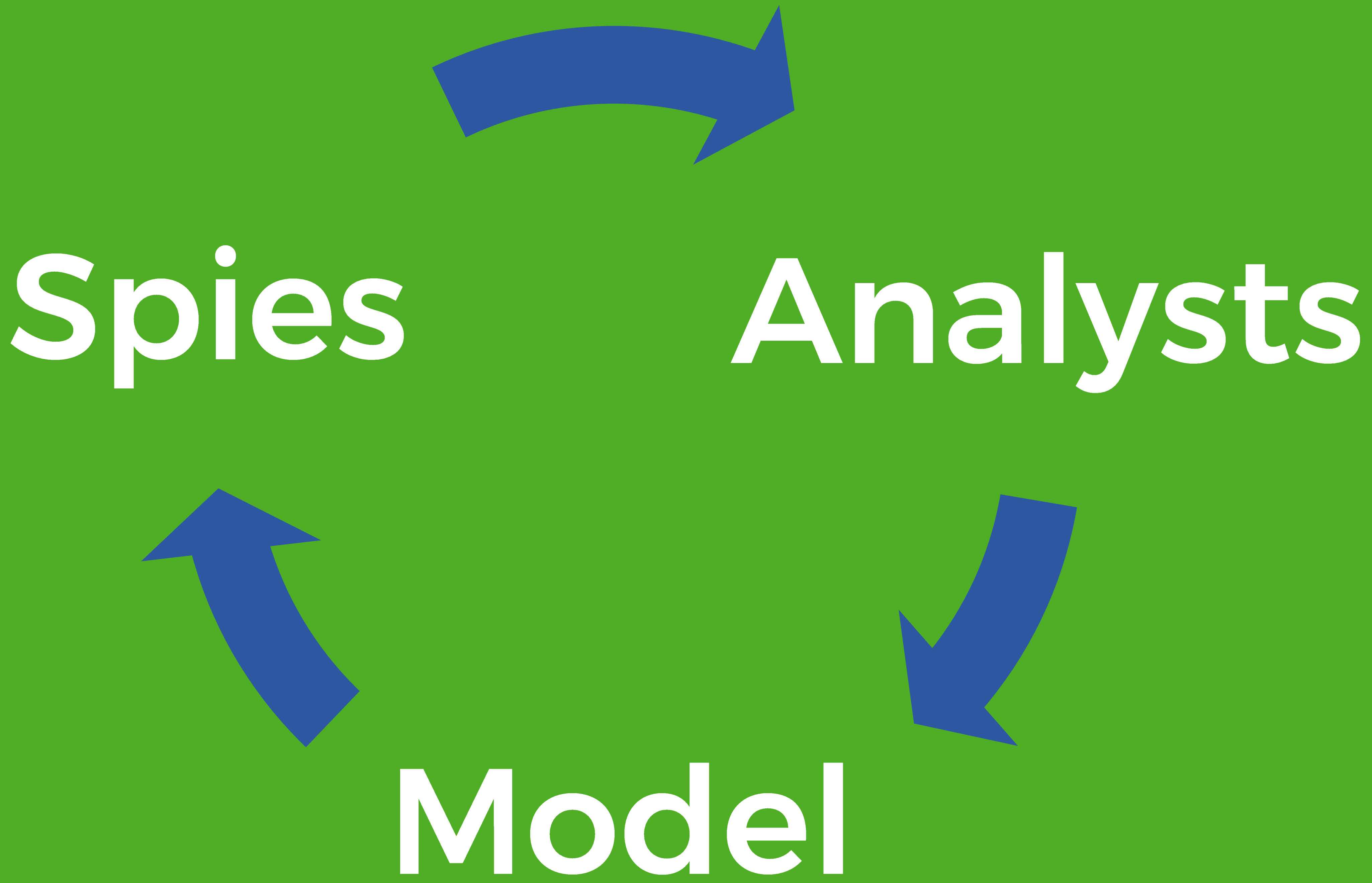
Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.

TEKS PROCESS STANDARDS

MATH MODELING

- [x] HOW DO WE MAKE SENSE OF MATH MODELING?
- [x] IS IT JUST ANSWERING QUESTIONS?
- [ ] HOW IS MATH MODELING USED IN REAL LIFE?
- [ ] HOW DO WE HELP OUR STUDENTS IMPROVE?


TARGET
TARGET PARKING


Spies
Analysts
Model

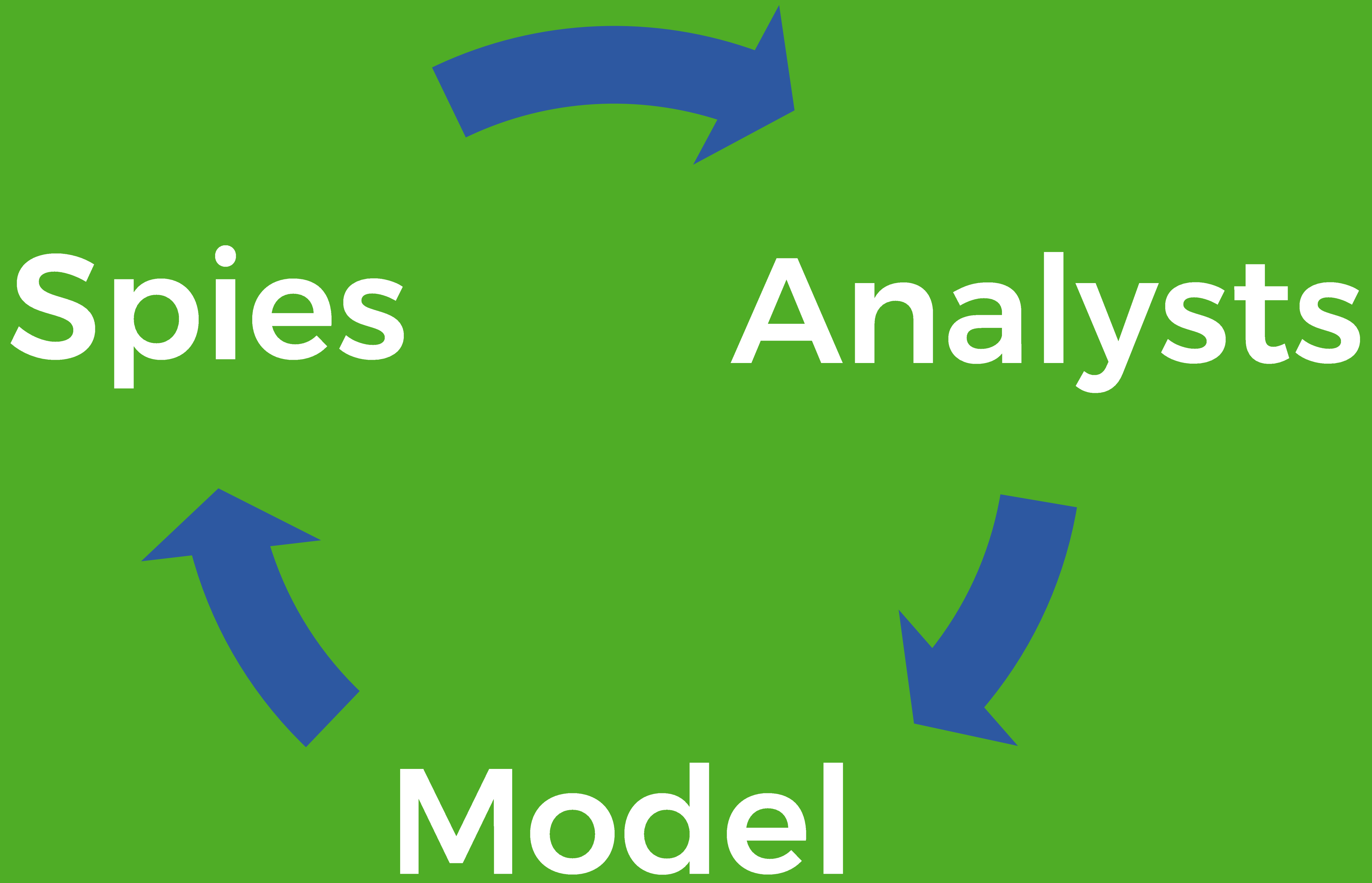
THINKING TIME

They used 25 products for a pregnancy prediction' score including:

- unscented lotion
- mineral supplements
- cotton balls

Source: New York Times


UNITED
A319
4047
B G→
←G A

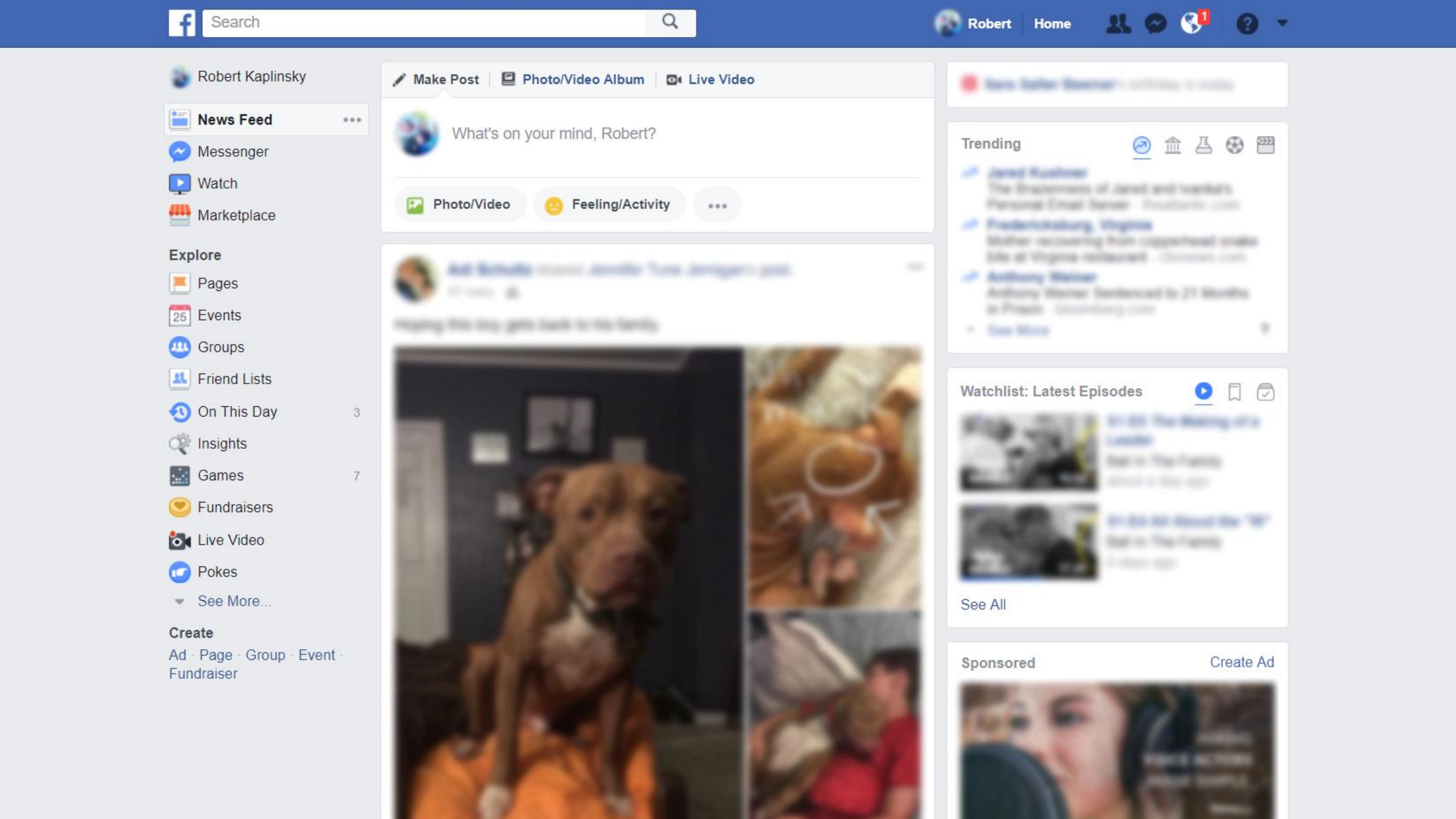

Spies
Analysts
Model

THINKING TIME

Priority is determined by:

- passenger’s fare class
- itinerary
- frequent flyer program membership
- check-in time

Source: United Airlines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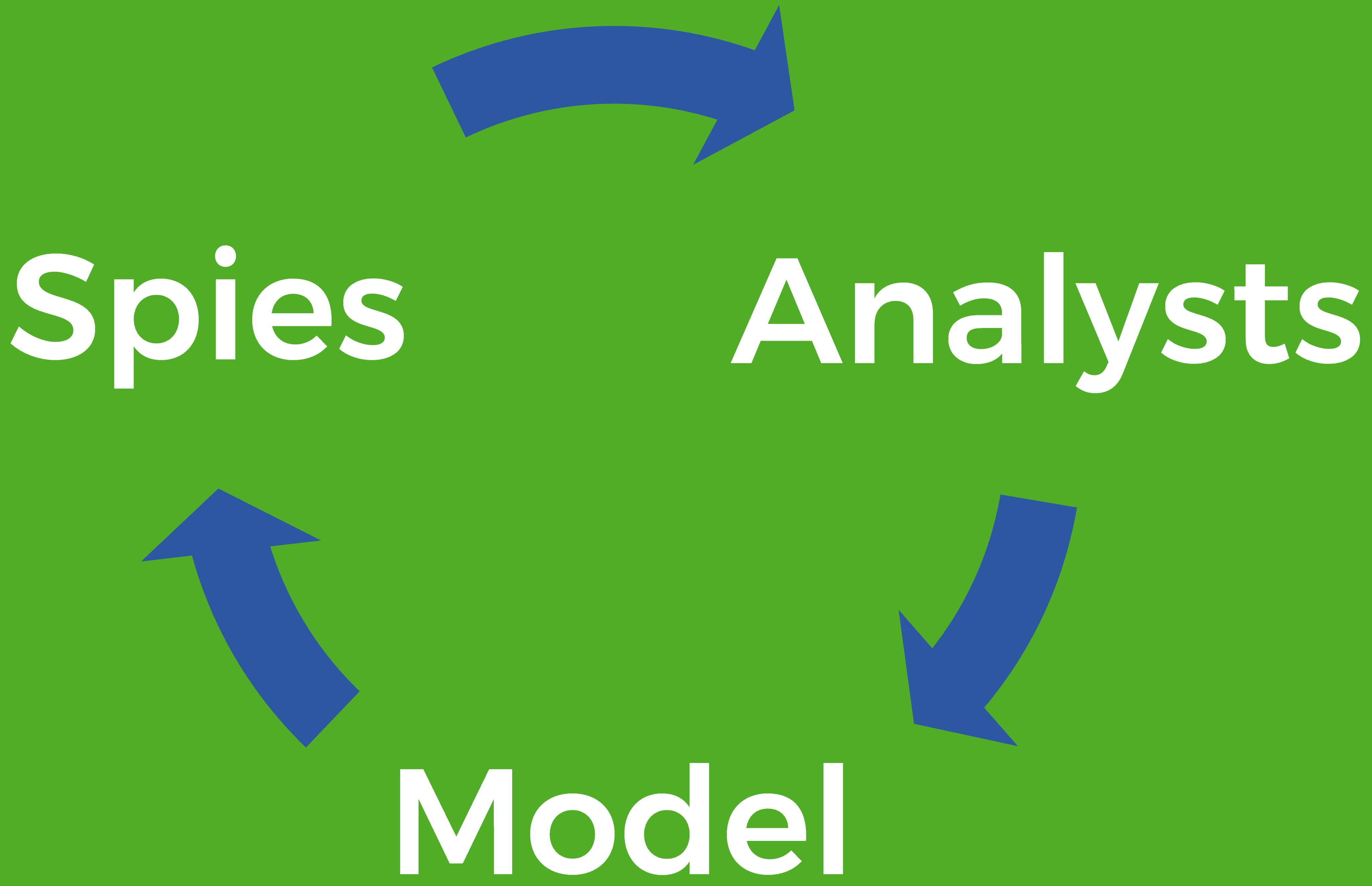
Robert
Home
Robert Kaplinsky
News Feed
Messenger
Watch
Marketplace
Explore
Pages
Events
Groups
Friend Lists
On This Day 3
Insights
Games 7
Fundraisers
Live Video
Pokes
See More...
Create
Ad · Page · Group · Event · Fundraiser
Make Post
Photo/Video Album
Live Video
What's on your mind, Robert?
Photo/Video
Feeling/Activity
Trending
Watchlist: Latest Episodes
See All
Sponsored
Create Ad


Spies
Analysts
Model

THINKING TIME

The stories that show in your News Feed are influenced by:

- friends you interact with the most
- the number of comments and likes a post receives
- what kind of story it is (ex: photo, video, status update)

Source: Facebook

MORE EXAMPLES

- How does US News and World Reports rank colleges?
- How does Google know which results to show?
- How do sports teams know who to draft?
- How does Amazon know what products to recommend?
- How does Zillow estimate home prices?
- How does Pandora know what music to play?
- How does eHarmony know which people to show you?
- How do they figure out who should speak at a conference?

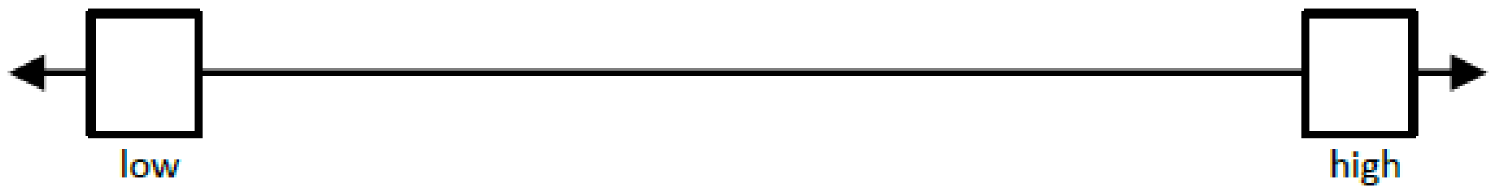
MATH MODELING

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW IS MATH MODELING USED IN REAL LIFE?
- ☐ HOW DO WE HELP OUR STUDENTS IMPROVE?

Name: ______________________ Period: __________ Date: ______________________

What problem are you trying to figure out?

What estimates do you have?



Place your estimate on the number line.

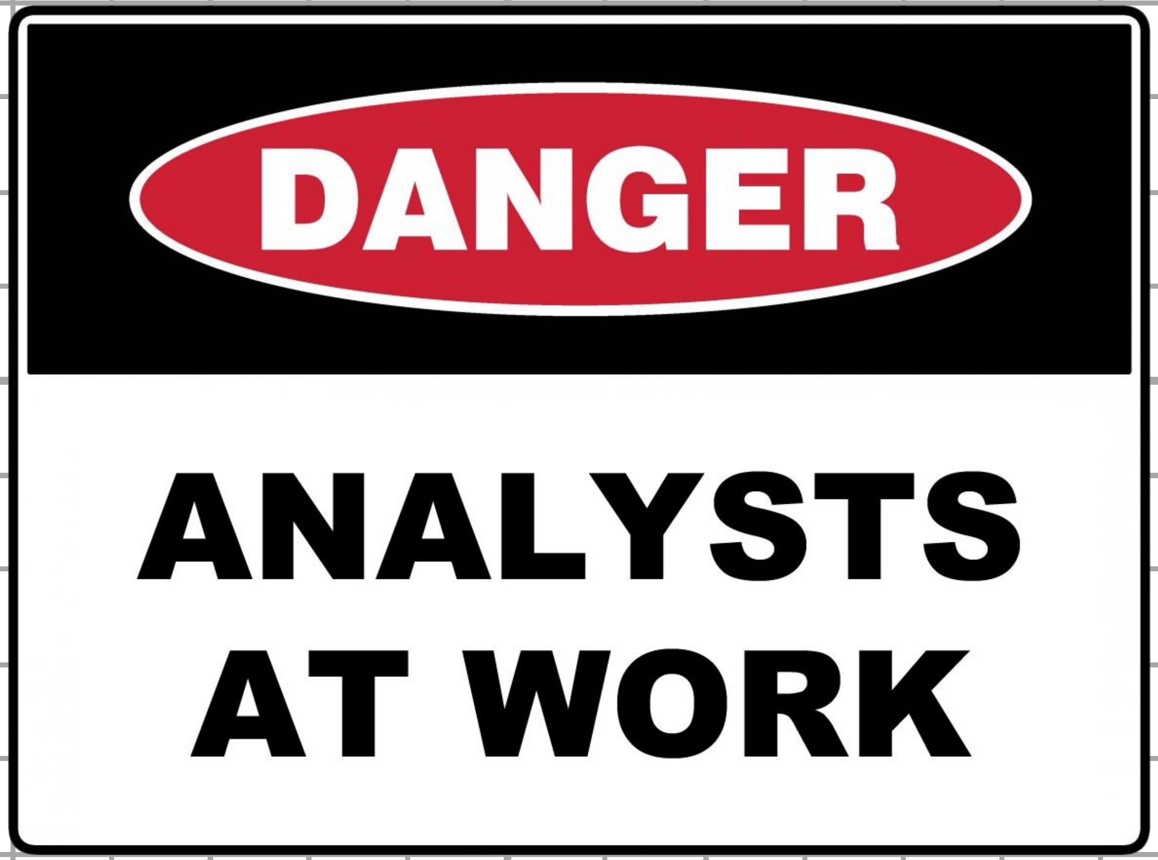
What info do you already know about the problem?

What info do you need about the problem?

TOP SECRET! SPIES ONLY

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

Your work



MODELING EXAMPLES

- ❑ MIDDLE SCHOOL
- ❑ HIGH SCHOOL


IVE
FOX NEWS
Junction

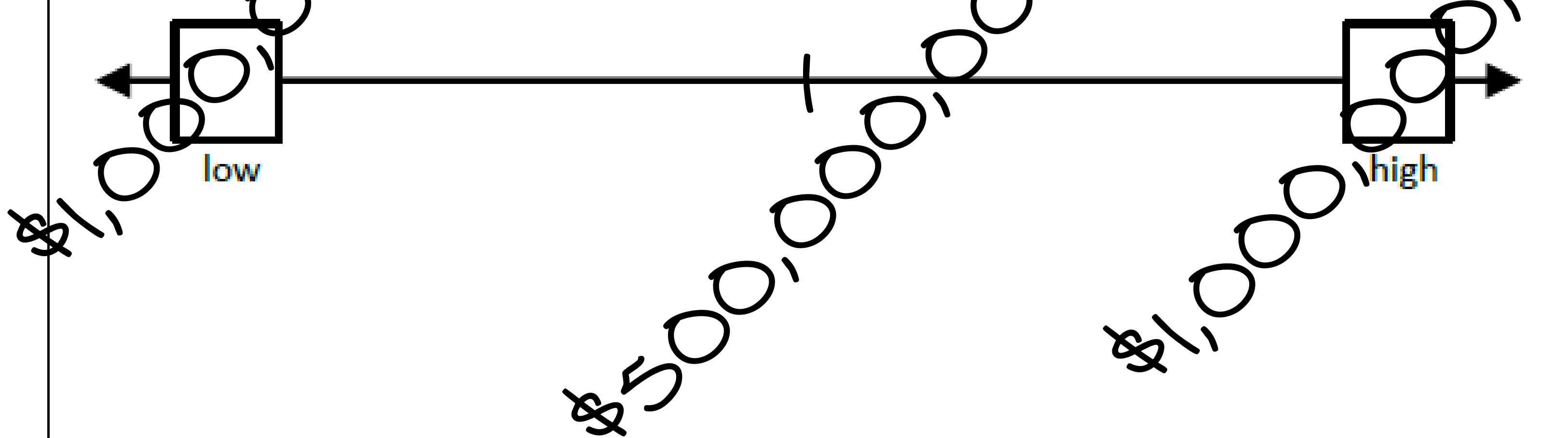
Spies

Analysts

Model

THINKING TIME

Name: ______________________ Period: __________ Date: ______________

What problem are you trying to figure out?	What estimates do you have?
How much money was that?	 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• There is a lot of money. • It is in a pile. • It is in bundles.	• Is it all the same denomination? • ~~How much does one bill weigh?~~ • ~~How much does all the money weigh?~~

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

Name: ______________________ Period: __________ Date: ______________

What problem are you trying to figure out?	What estimates do you have?
How much money was that?	low: $1,000,000 $500,000,000 high: $1,000,000,000 Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• There is a lot of money. • It is in a pile. • It is in bundles.	• Is it all the same denomination? • How many rows and columns are there? • How many bills are in one stack?

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


PGR
SIEDO

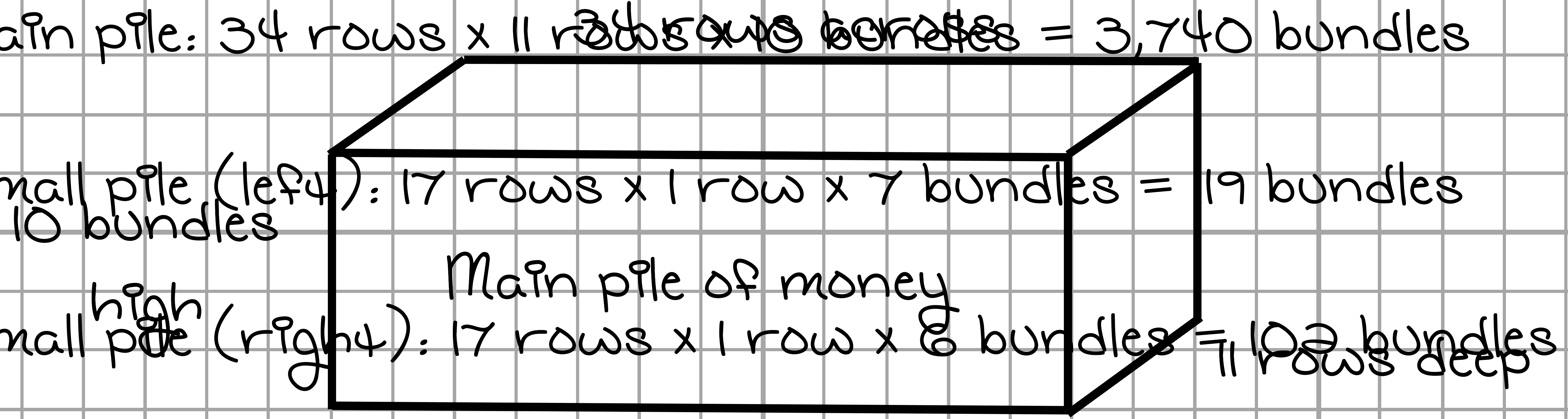

PGR
SIEDO
PGR
SIEDO

Your work

Main pile: 34 rows x 11 rows x 10 bundles = 3,740 bundles

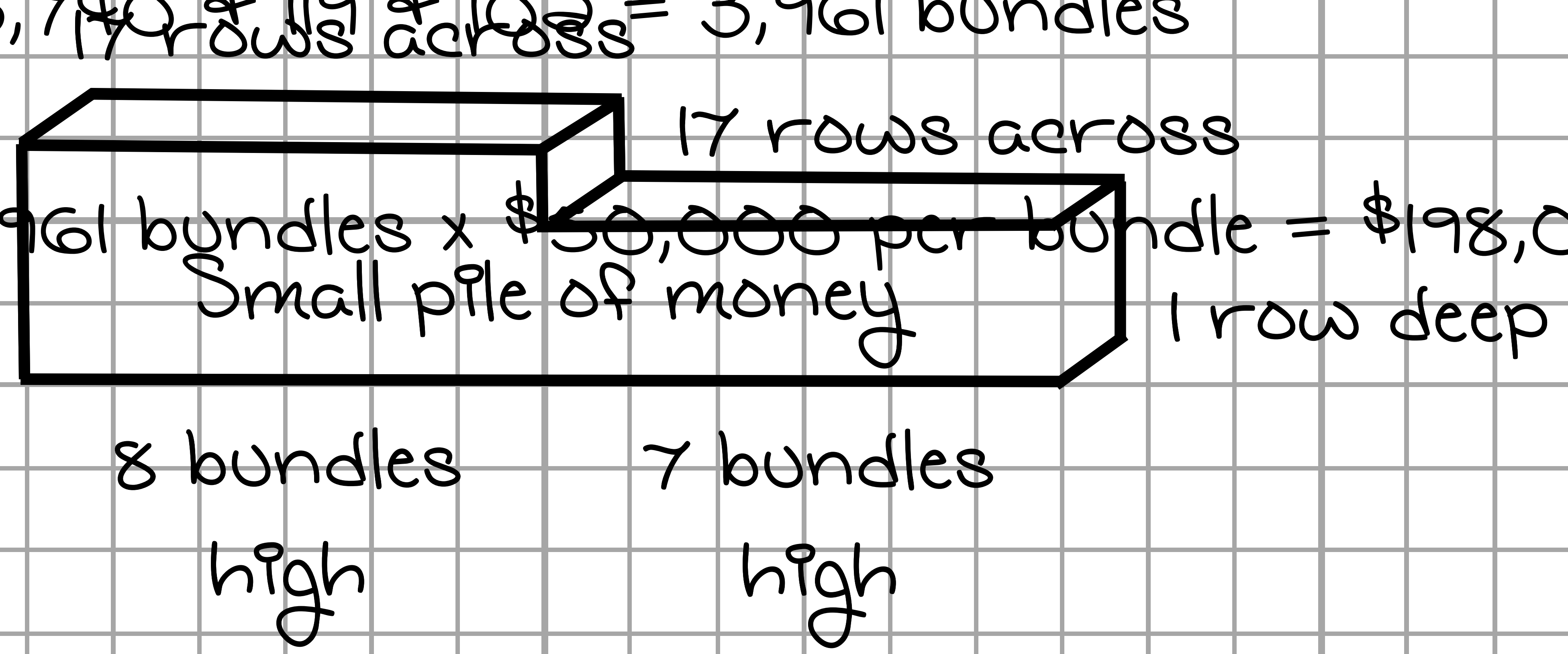
Small pile (left): 17 rows x 1 row x 7 bundles = 119 bundles

Small pile (right): 17 rows x 1 row x 6 bundles = 102 bundles



Total bundles: 3,740 + 119 + 102 = 3,961 bundles

Total money: 3,961 bundles x $50,000 per bundle = $198,050,000



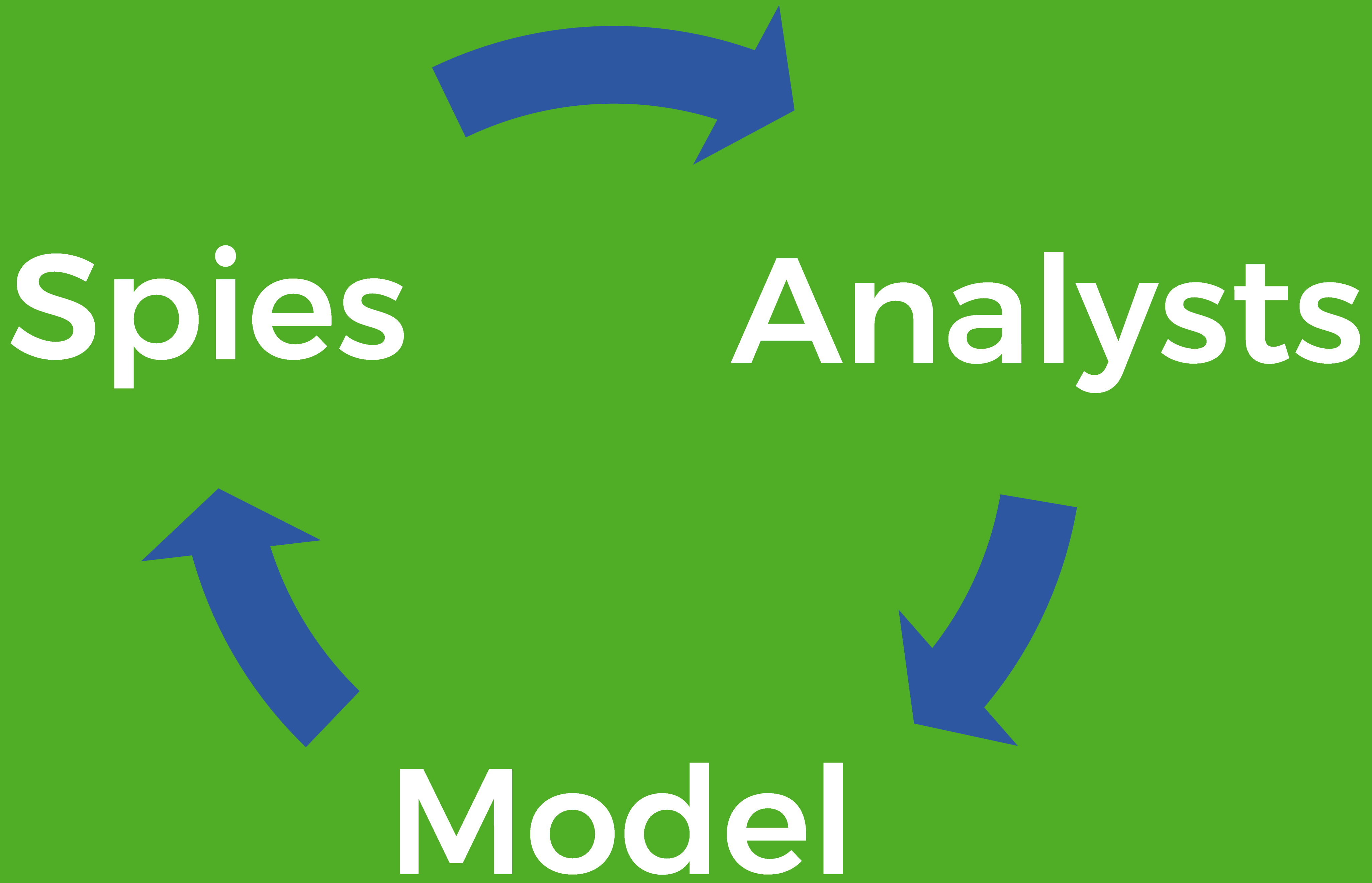

FOX

MODELING EXAMPLES

☑ MIDDLE SCHOOL

☐ HIGH SCHOOL


NON-STAGGERED
STAGGERED


Spies
Analysts
Model

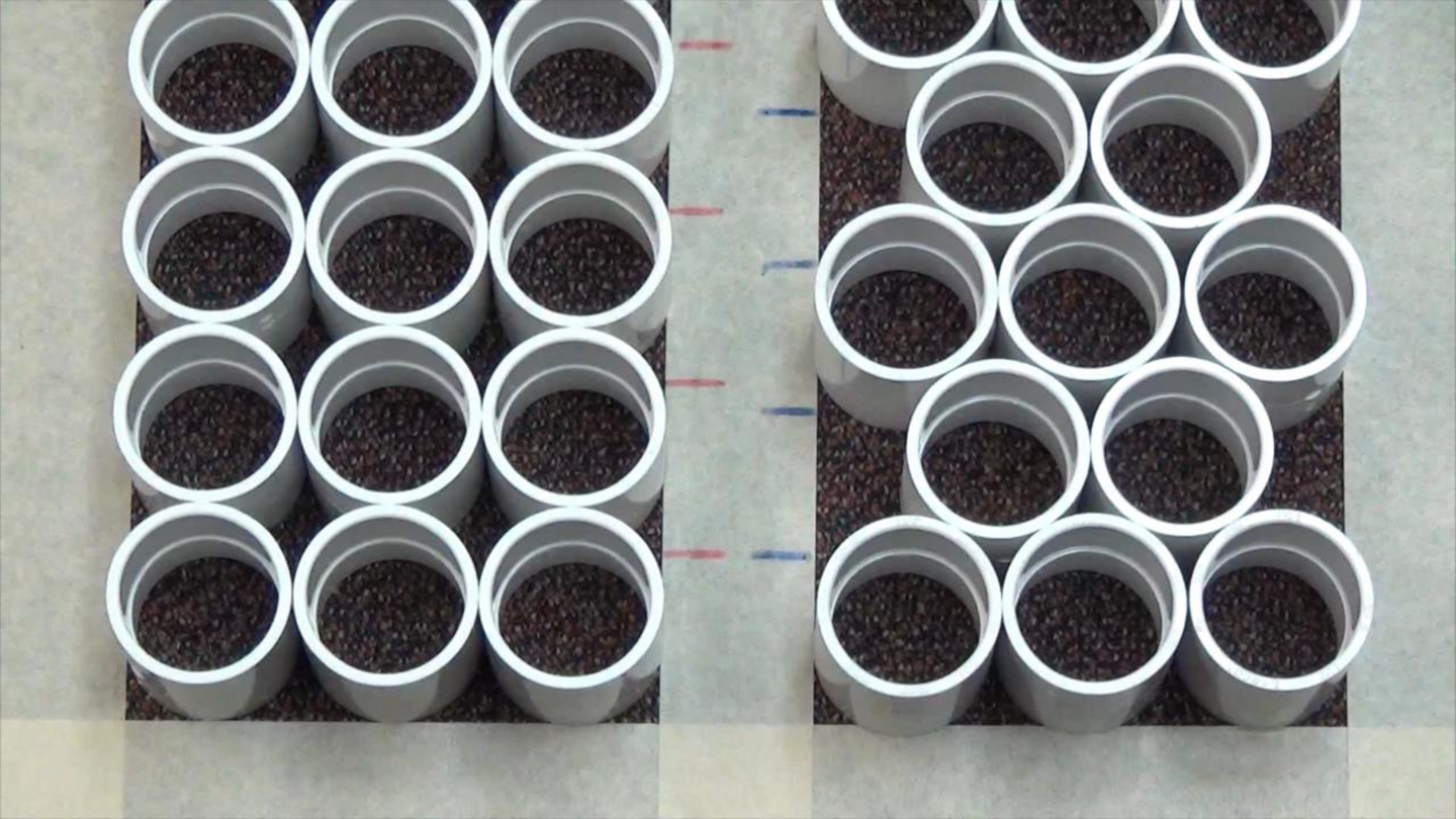
THINKING TIME

Name: ______________________ Period: __________ Date: ______________________

What problem are you trying to figure out?	What estimates do you have?
How much shorter are 20 layers of non-staggered pipes?	low: 3 8 high: 20 (in inches) Place your estimate on the number line.
What info do you already know about the problem?	**What info do you need about the problem?**
• One pile of pipes is staggered. • One pile of pipes is not staggered. • We have to compare 20 layers of each.	• What are the dimensions of a pipe? • What units are we using to measure?

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

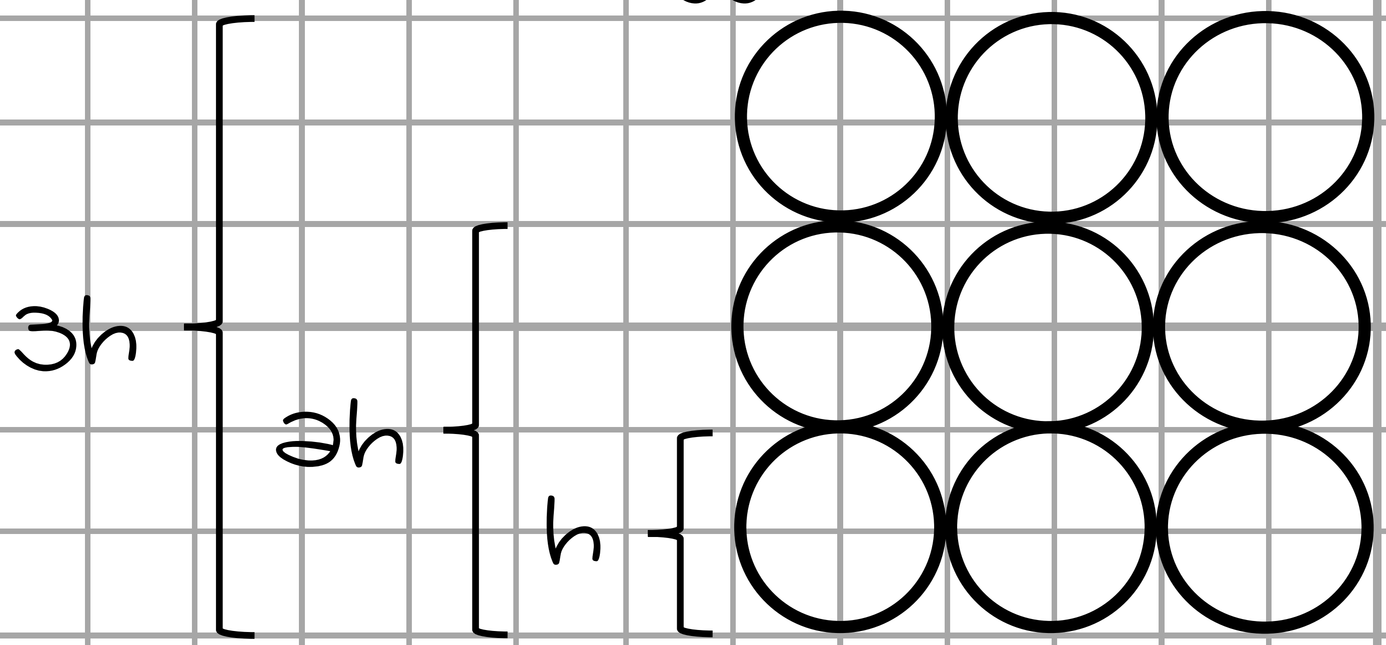

6
7



THINKING TIME

Your work

Non-staggered pipes



1 pipe = h cm

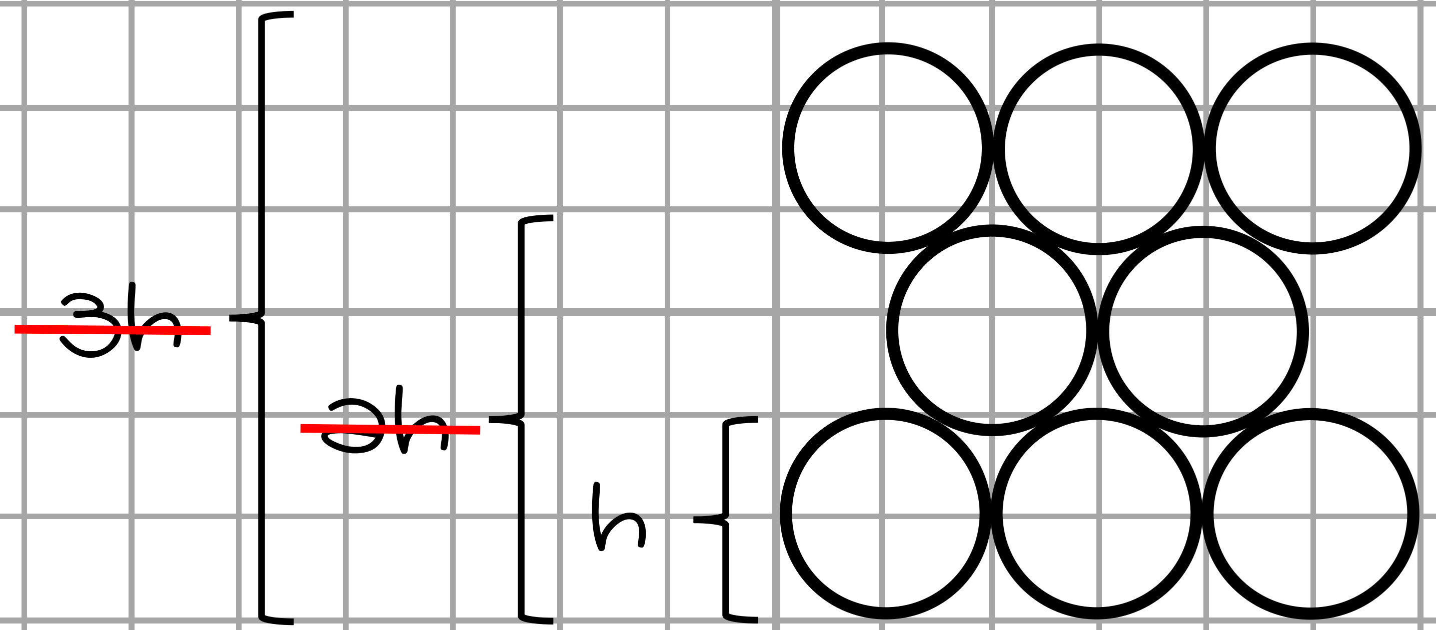
2 pipes = 2h cm

3 pipes = 3h cm

⋮

20 pipes = 20h cm

Staggered pipes



1 pipe = h cm

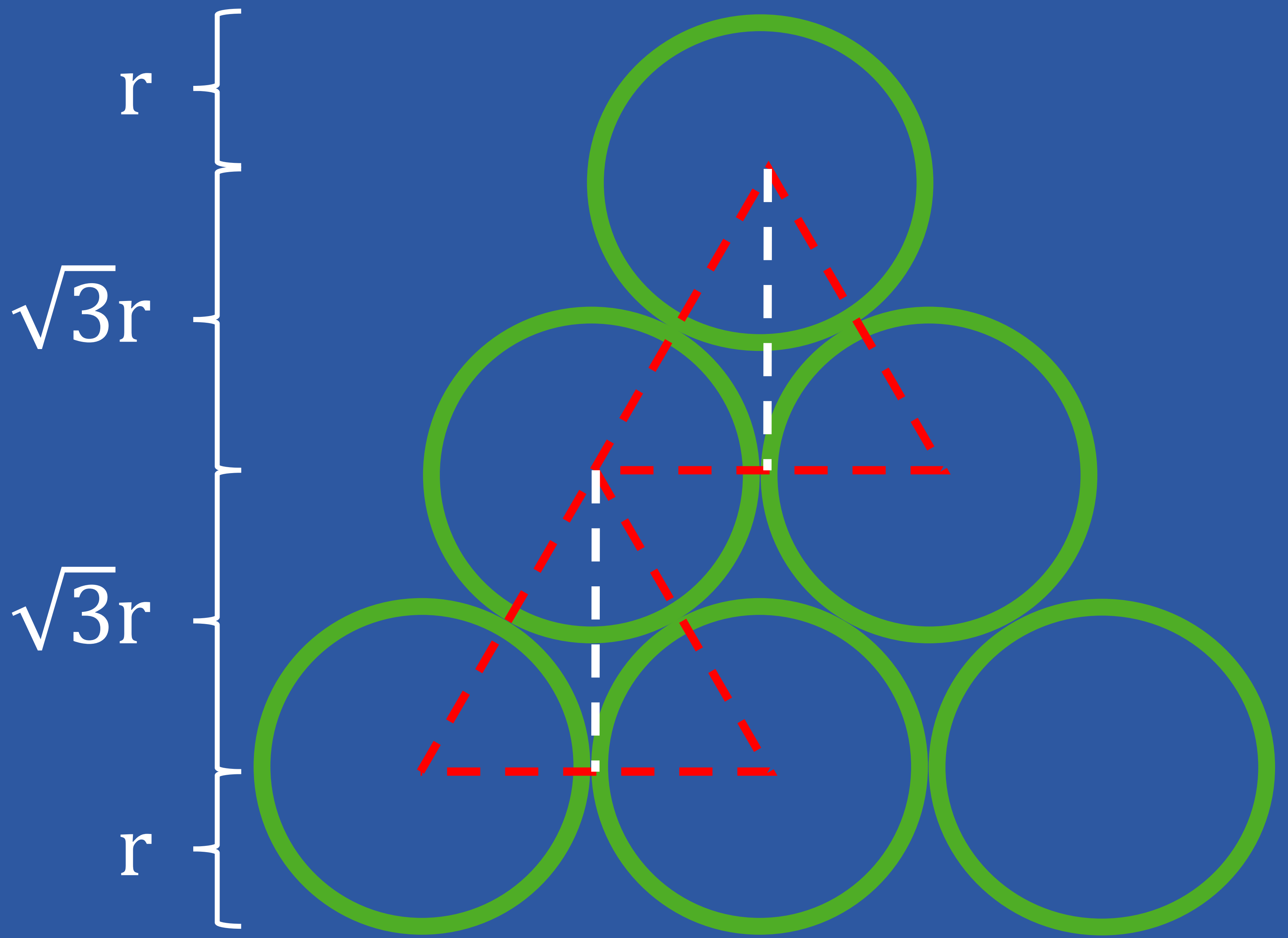
2 pipes = ?? cm

3 pipes = ?? cm

⋮

20 pipes = ?? cm

STAGGERED PIPES



MODELING EXAMPLES

☑ MIDDLE SCHOOL

☑ HIGH SCHOOL

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MATH MODELING

- ☑ HOW DO WE MAKE SENSE OF MATH MODELING?
- ☑ IS IT JUST ANSWERING QUESTIONS?
- ☑ HOW IS MATH MODELING USED IN REAL LIFE?
- ☑ HOW DO WE HELP OUR STUDENTS IMPROVE?

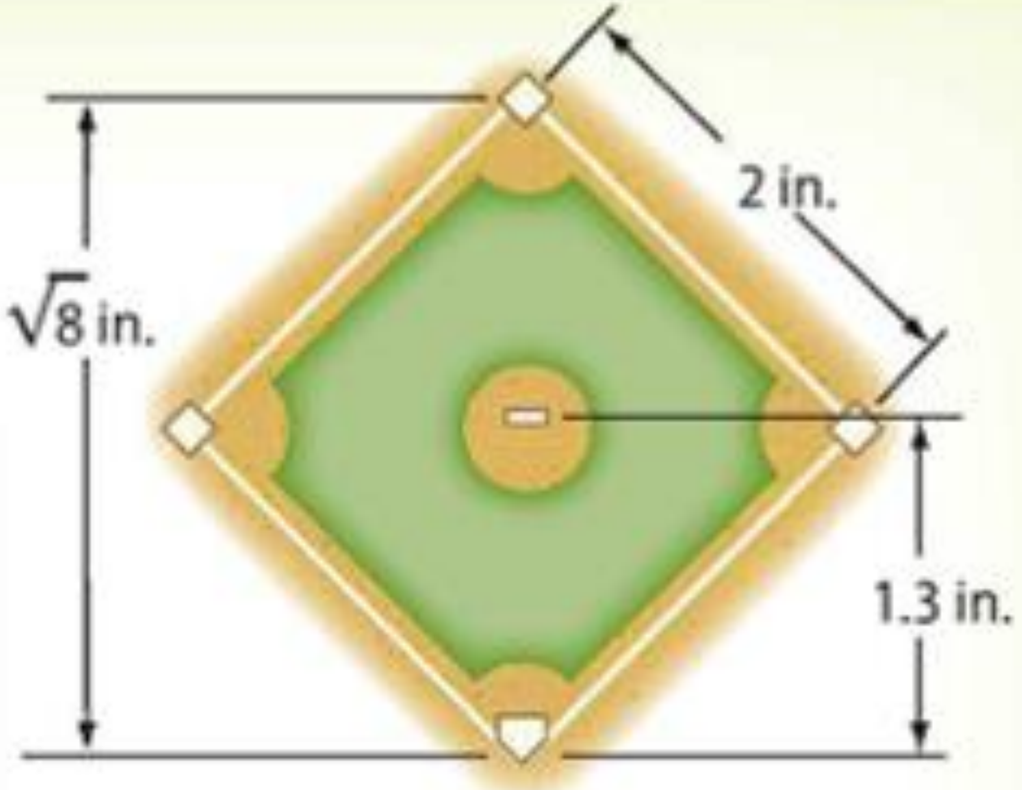
Real-World Link

Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



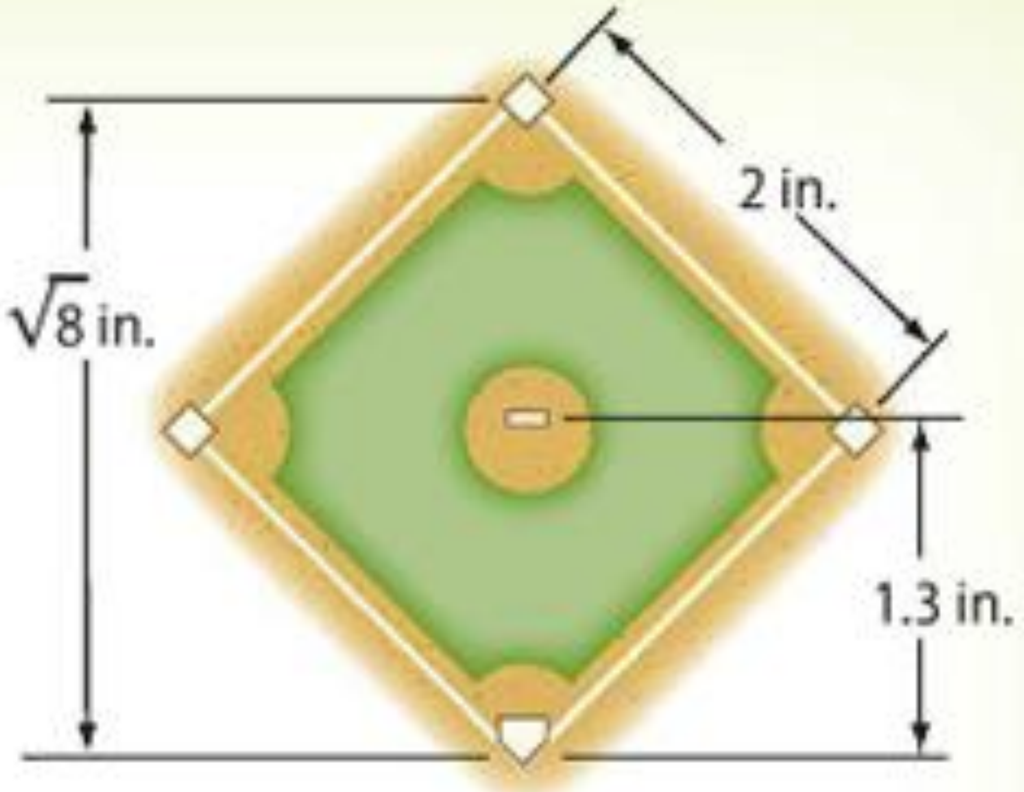
1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

CCSS Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6


NETFLIX
2009
DATE: 09·21·09
PAY TO THE ORDER OF: BellKor's Pragmatic Chaos
$ 1,000,000 00
AMOUNT: ONE MILLION 00/100
FOR: The Netflix Prize
Reed Hastings

DISCUSSION TIME

- Why should we reconsider using word problems?
- What should we be doing instead of word problems?

GOALS

- CORRECT ANSWERS + UNDERSTANDING
- MAKE OUR LESSONS UNFORGETTABLE
- RECONSIDER USING WORD PROBLEMS
- MAKE MATH CHALLENGING + ACCESSIBLE

Student Name	ID Number	Perf. Level	Scaled Score	Mathematics Clusters (Clusters where the percent correct is shown in bold represent proficiency for that cluster.)											
				Rational numbers		Exponents, powers, and roots		Quantitative relationships and evaluating expressions		Multi-step problems, graphing, and functions		Measurement and geometry		Statistics, data analysis, and probability	
				Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct	Number Correct	Percent Correct
[illegible]	[illegible]	ADV	476	13	93%	8	100%	8	80%	14	93%	12	92%	5	100%
[illegible]	[illegible]	ADV	464	13	93%	7	88%	8	80%	15	100%	11	85%	5	100%
[illegible]	[illegible]	ADV	453	10	71%	8	100%	10	100%	14	93%	11	85%	5	100%
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[illegible]	[illegible]	PRO	408	11	79%	6	75%	9	90%	11	73%	10	77%	5	100%
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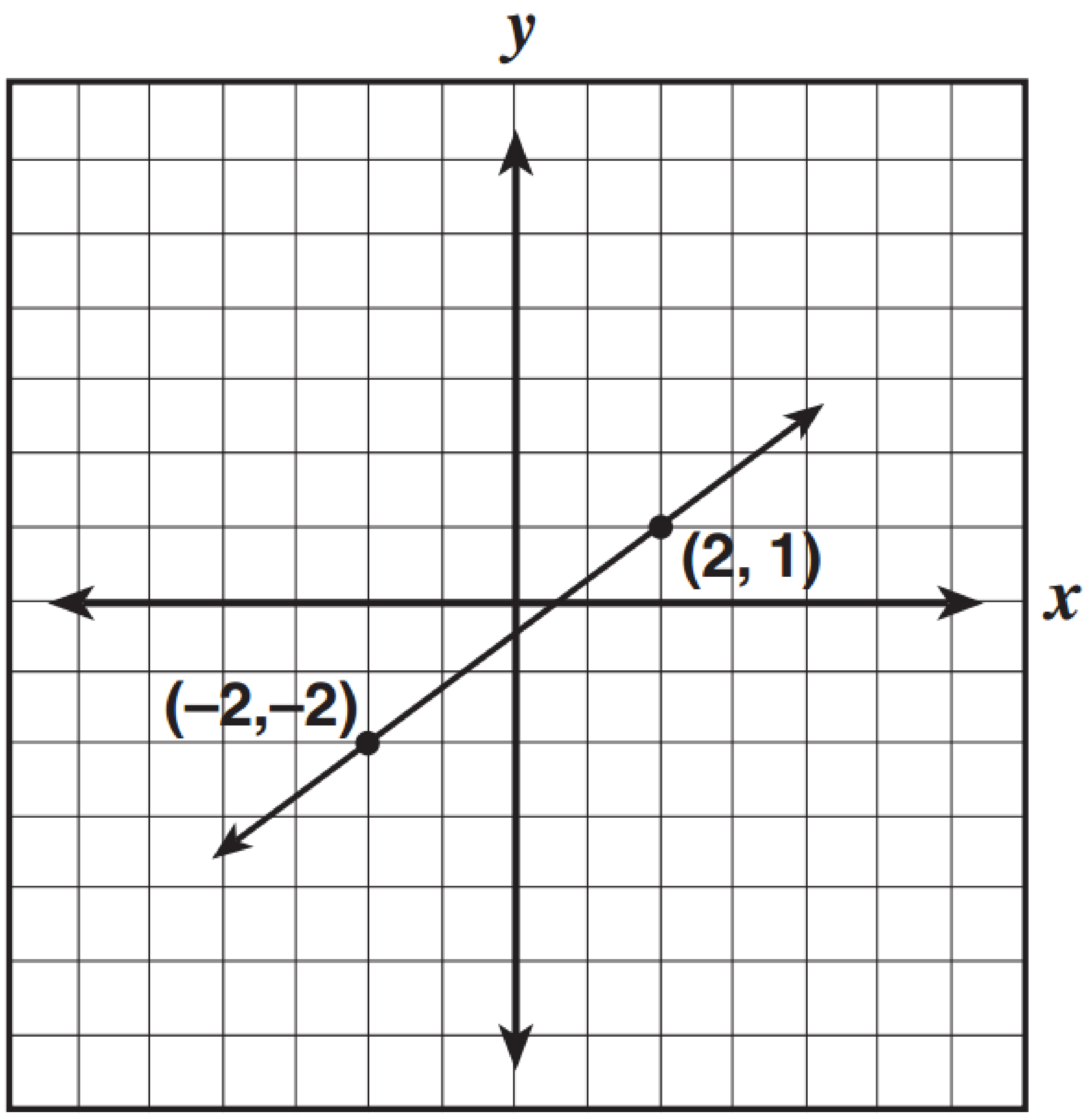
[illegible]	[illegible]	PRO	396	12	86%	8	100%	6	60%	9	60%	11	85%	4	80%

52 What is the slope of this line?



A $\frac{1}{2}$

B $\frac{3}{4}$

C 1

D $\frac{4}{3}$

Source: California Released Test Questions (7th Grade Math)


X-RAY
VISION

Mathematics Clusters

(Clusters where the percent correct is shown in bold represent proficiency for that cluster.)

Student Name	ID Number	Perf. Level	Scaled Score	Rational numbers: Number Correct	Rational numbers: Percent Correct	Exponents, powers, and roots: Number Correct	Exponents, powers, and roots: Percent Correct	Quantitative relationships and evaluating expressions: Number Correct	Quantitative relationships and evaluating expressions: Percent Correct	Multi-step problems, graphing, and functions: Number Correct	Multi-step problems, graphing, and functions: Percent Correct	Measurement and geometry: Number Correct	Measurement and geometry: Percent Correct	Statistics, data analysis, and probability: Number Correct	Statistics, data analysis, and probability: Percent Correct
[illegible]	[illegible]	ADV	476	13	93%	8	100%	8	80%	14	93%	12	92%	5	100%
[illegible]	[illegible]	ADV	464	13	93%	7	88%	8	80%	15	100%	11	85%	5	100%
[illegible]	[illegible]	ADV	453	10	71%	8	100%	10	100%	14	93%	11	85%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	100%	[illegible]	[illegible]	[illegible]	[illegible]	11	85%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	4	80%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9	69%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	77%	5	100%
[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	85%	5	100%
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[illegible]	[illegible]	ADV	[illegible]	[illegible]	[illegible]	5	63%	[illegible]	[illegible]	[illegible]	93%	10	77%	5	100%
[illegible]	[illegible]	ADV	[illegible]	[illegible]	[illegible]	6	75%	6	[illegible]	[illegible]	93%	10	77%	5	100%
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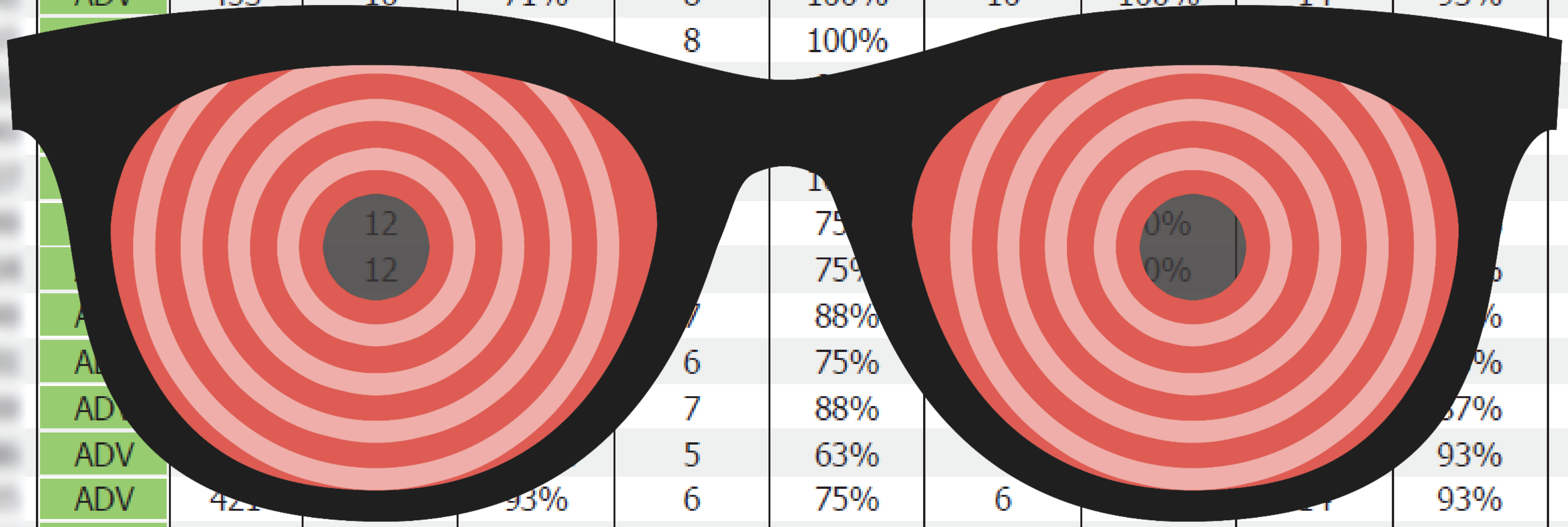


X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☐ WHY ARE THEY DIFFERENT?
- ☐ HOW DO YOU IMPLEMENT THEM?
- ☐ HOW DO YOU CREATE YOUR OWN?

PROBLEM ONE

Solve for x.

$$21 + x = 70$$

PROBLEM TWO

Using the digits 1 to 9, at most one time each, create two equations: one where x has a positive value and one where x has a negative value.

$$\square\square + x = \square\square$$

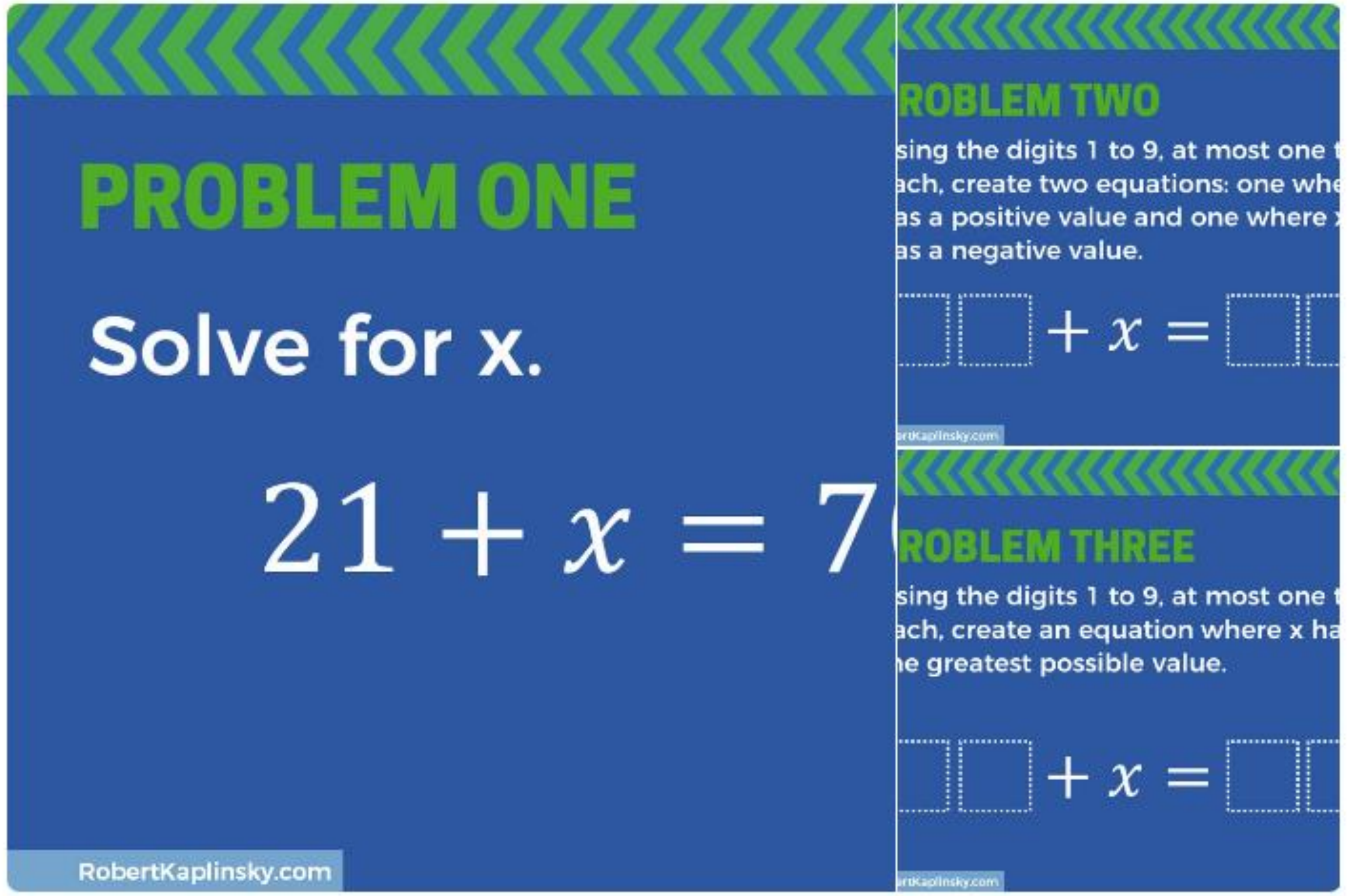
PROBLEM THREE

Using the digits 1 to 9, at most one time each, create an equation where x has the greatest possible value.

$$\square\square + x = \square\square$$

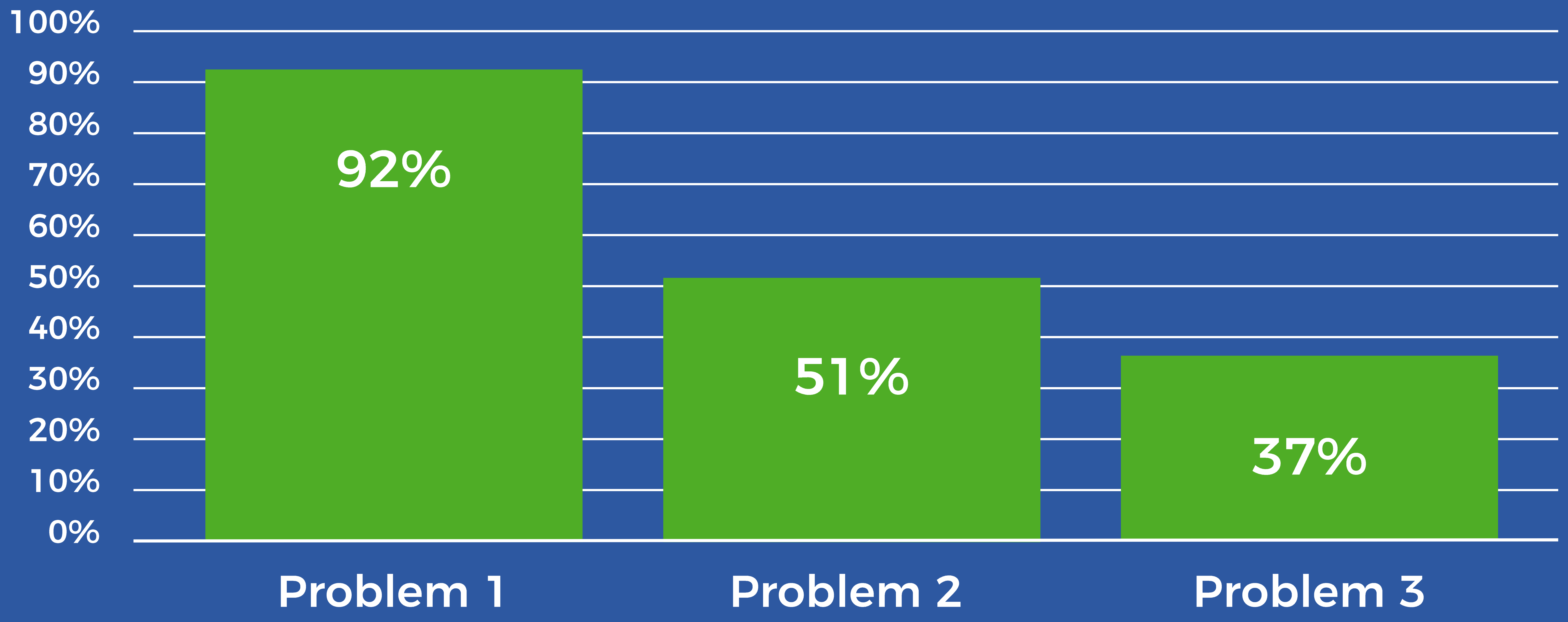
Robert Kaplinsky
@robertkaplinsky

MS & HS #MTBoS Ts, please ask your Ss these 3 ?s and put the % who answered correctly here: docs.google.com/forms/d/e/1FAI …. Answers at top of form.



RETWEETS 36 LIKES 54

PROBLEM RESULTS



Depth of Knowledge Matrix - Secondary Math

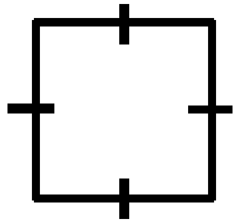
Topic	Dividing Fractions	Solving Two-Step Equations	Exponents	Solving Equations with Variables on Both Sides
CCSS Standard(s)	• 6.NS.1	• 7.EE.4a	• 8.EE.1	• 8.EE.8 • A-REI.3
DOK 1 Example	Evaluate. $\frac{4}{9} \div \frac{2}{5}$	Solve for x. $2x + 3 = 9$	Evaluate. 3^4	Solve for x. $3x + 2 = -2x + 4$
DOK 2 Example	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two different pairs of fractions that have a quotient of 2/3. $\frac{\square}{\square} \div \frac{\square}{\square} = \frac{2}{3}$	Use the digits 1 to 9, at most one time each, to create two equations: one where x has a positive value and one where x has a negative value. $\square x + \square = \square$	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two true number sentences. $\square^{\square} = 64$	Use the digits 1 to 9, at most <u>two</u> times each, to fill in the boxes to make an equation with no solutions. $\square x + \square = \square x + \square$
DOK 3 Example	Use the digits 1 to 9, at most one time each, to fill in the boxes to make two fractions that have a quotient that is as close to 4/11 as possible. $\frac{\square}{\square} \div \frac{\square}{\square}$	Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value. $\square x + \square = \square$	Use the digits 1 to 9, at most one time each, to fill in the boxes to make a result that has the greatest value possible. $\square^{\square} = \square\square\square$	Use the digits 1 to 9, at most one time each, to fill in the boxes so that the solution is closest to zero. $\square x + \square = \square x + \square$

Robert Kaplinsky

More free DOK 2 & 3 problems available at openmiddle.com

Version 1.5

Depth of Knowledge Matrix - Secondary Math

Topic	Geometric Proofs	Complex Numbers	Trigonometric Functions	Definite Integral
CCSS Standard(s)	• G-CO.11	• N-CN.2	• F-TF.3	• N/A
DOK 1 Example	Add one geometric marking to demonstrate the quadrilateral is a square. 	Multiply the binomials. $(3+4i)(2+3i)$	Evaluate. $\sin\frac{\pi}{3}$	Solve. $\int_{2}^{6} x^{3}\,dx$
DOK 2 Example	Use exactly 5 geometric markings to show that a quadrilateral is a square.	Use the integers -9 to 9, at most one time each, to fill in the boxes twice: once to make a positive real number product and once to make a negative real number product. $(\square+\square i)(\square+\square i)$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make two true number sentences. $\sin\frac{\square\pi}{\square}=0$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make a positive and a negative solution. $\int_{\square}^{\square} x^{\square}\,dx$
DOK 3 Example	What is the least number of geometric markings needed to demonstrate that a quadrilateral is a square?	Use the integers -9 to 9, at most one time each, to fill in the boxes and make a real number product with the greatest value. $(\square+\square i)(\square+\square i)$	Use the digits 1 to 9, at most one time each, so that the function has the greatest possible value. $\sin\frac{\square\pi}{\square}=\frac{\sqrt{\square}}{\square}$	Use the digits 1 to 9, at most one time each, to fill in the boxes and make a solution that is as close to 100 as possible. $\int_{\square}^{\square} x^{\square}\,dx$

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Version 1.5

DOK ONE

6. $9 + a = 46$

DOK TWO

11. Anton walked 8.9 miles of his 13.5-mile goal for this week. Use the equation $m + 8.9 = 13.5$ to find which path Anton should walk so that he meets his goal for the week.

Path Lengths	
Meadow Path	3.2 miles
Circle Path	4.2 miles
Oak Tree Path	4.6 miles

DOK THREE

14. Reasoning Kyle bought a movie ticket for $8.45 and a drink for $1.80. He had just enough money remaining to buy a large popcorn. How much money did Kyle start with? Write an equation to show your reasoning. MP.2

Cost of Popcorn	
Small	$2.85
Medium	$3.75
Large	$4.75
Extra Large	$4.85

X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☑ WHY ARE THEY DIFFERENT?
- ☐ HOW DO YOU IMPLEMENT THEM?
- ☐ HOW DO YOU CREATE YOUR OWN?

IMPLEMENTATION

- Open Middle Worksheet

First attempt: Points: ____/2 attempt ____/2 explanation

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

Name: ______________________________ Period: ________ Date: ______________

First attempt: Points: ____/2 attempt ____/2 explanation

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

Second attempt: Points: ____/2 attempt ____/2 explanation

IMPLEMENTATION

- Open Middle Worksheet
- Classwork
  - Single problem for entire class
  - Extensions menu

QUESTION #1

Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value.

$$\square\square + x = \square\square$$

4 points

QUESTION #2

Solve for x.

$$3x + 7 = 19$$

1 point

QUESTION #3

Use the digits 1 to 9, at most one time each, to create two equations: one where x has a positive value and one where x has a negative value.

$$\square\square + x = \square\square$$

2 points

QUESTION #4

Use the digits 1 to 9, at most one time each, to make each equation true.

$$\square + a = \square$$

SOLVING EQUATIONS EXTENSION MENU

You must earn **at least 12 points** by doing the problems of your choice. Circle the questions you

QUESTION #5

Use the digits 1 to 9, at most one time each, to create an equation where x has the greatest possible value.

IMPLEMENTATION

- Open Middle Worksheet
- Classwork
  - Single problem for entire class
  - Extensions menu
- Homework
- Assessments

X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☑ WHY ARE THEY DIFFERENT?
- ☑ HOW DO YOU IMPLEMENT THEM?
- ☐ HOW DO YOU CREATE YOUR OWN?

STEP ONE

- Find a One-Operation Problem
  - Addition
  - Subtraction
  - Multiplying
  - Dividing
  - Exponents (including square root)
  - Trigonometric functions

ADDING 2-DIGIT NUMBERS

Solve.

$$41 + 36 =$$

MULTIPLYING FRACTIONS

Solve.

$$\frac{3}{7} \times \frac{2}{9} =$$

THINKING TIME

STEP TWO

- Go from DOK 1 to DOK 2
  - Strategically remove some information from the problem to prevent immediate calculation
  - Increase the quantity of solutions needed to increase the need to look for patterns

ADDING 2-DIGIT NUMBERS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two different pairs of two-digit numbers that have a sum of 71.

$$\boxed{}\,\boxed{} + \boxed{}\,\boxed{} = 71$$

MULTIPLYING FRACTIONS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two different pairs of fractions that have a product of 2/3.

$$\frac{\square}{\square} \times \frac{\square}{\square} = \frac{2}{3}$$

THINKING TIME

- Go from DOK 1 to DOK 2
  - Strategically remove some information from the problem to prevent immediate calculation
  - Increase the quantity of solutions needed to increase the need to look for patterns

STEP THREE

- Go from DOK 2 to DOK 3
  - Introduce the need to optimize the solution by making the greatest or least product / sum / difference / quotient / answer.
  - Another optimization option is make the answer closest to a specific value.

ADDING 2-DIGIT NUMBERS

Using the digits 1 to 9, at most one time each, fill in the boxes to make the smallest sum.

$\boxed{1}\ \boxed{2/3/8} + \boxed{2/3}\ \boxed{4/5} = \boxed{3/4}\ \boxed{0/7/9}$

MULTIPLYING FRACTIONS

Using the digits 1 to 9, at most one time each, fill in the boxes to make two fractions that have a product that is as close to 4/11 as possible.

$$\frac{\square}{\square} \times \frac{\square}{\square}$$

THINKING TIME

- Go from DOK 2 to DOK 3
  - Introduce the need to optimize the solution by making the greatest or least product / sum / difference / quotient / answer.
  - Another optimization option is make the answer closest to a specific value.

3 Steps to Increase Math DOK Levels

Step 1: Find a One-Operation Problem

- Procedural problems with one operation are easiest to modify.
- Other problems may also be modified but may not be as easy.

Adding 2-Digit Numbers
Solve.

41 + 36 = ___

Multiplying Fractions
Solve.

$$\frac{3}{7} \times \frac{2}{9} = \_\_\_$$

Trigonometry
Solve.

$$\sin \frac{\pi}{3} = \_\_\_$$

Step 2: Go from DOK 1 to DOK 2

- Strategically remove some information from the problem to prevent immediate calculation
- Increase the quantity of solutions needed to increase the need to look for patterns

Adding 2-Digit Numbers
Using the digits 1 to 9, at most one time each, fill in the boxes

Multiplying Fractions
Using the digits 1 to 9, at most one time each, fill in the boxes

Trigonometry
Using the digits 1 to 9, at most one time each, fill in the boxes

X-RAY VISION PROBLEMS

- ☑ WHY DO WE NEED THEM?
- ☑ WHY ARE THEY DIFFERENT?
- ☑ HOW DO YOU IMPLEMENT THEM?
- ☑ HOW DO YOU CREATE YOUR OWN?

Open Middle @openmiddle · Jan 11

Open Middle
@openmiddle

Hey @openmiddle fans, we want to hear from you. Why do you use our problems with your students? Share your success stories or lessons learned.

RETWEETS 7 LIKES 6

2:10 PM - 11 Jan 2017

8 7 6

1 2

DISCUSSION TIME

- How can x-ray vision problems like the kinds on Open Middle spot misconceptions that may often go unnoticed?
- How do Open Middle problems make mathematics accessible yet appropriately challenging for every student?

GOALS

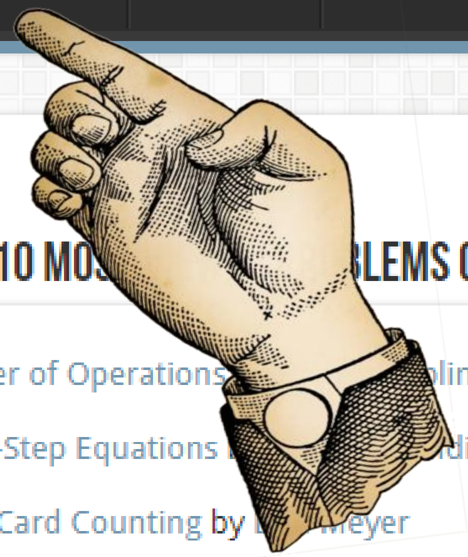
- ☑ CORRECT ANSWERS + UNDERSTANDING
- ☑ MAKE OUR LESSONS UNFORGETTABLE
- ☑ RECONSIDER USING WORD PROBLEMS
- ☑ MAKE MATH CHALLENGING + ACCESSIBLE

PROBLEM 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

Open Middle™

Challenging math problems worth solving



THE TOP 10 MO… LEMS OF 2017

1. Order of Operations … linsky with answer from Michael Fenton and his students
2. Two-Step Equations … divil, Daniel Luevanos, and Robert Kaplinsky
3. Dot Card Counting by … eyer
4. Two-Step Equations 3 by Erick Lee 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. Rational and Irrational Numbers by Bryan Anderson
9. Converting Between Fractions and Decimals by Robert Kaplinsky
10. Interpretting Percentages by Robert Kaplinsky

WHAT ARE PEOPLE SAYING ABOUT OPEN MIDDLE?

Brian Marks
@Yummymath

Have you checked out openmiddle.com @openmiddle Should be on your short list of math ed resources #MTBoS #mathchat #maths #elemchat

Search

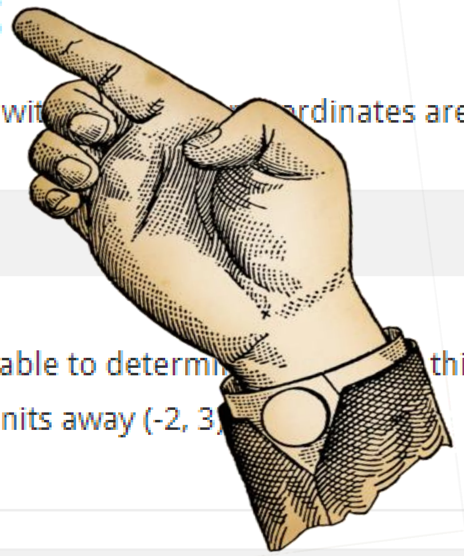
OPEN MIDDLE WORKSHEET

- English (student version)
- English (document camera version)
- Spanish (student version)
- Spanish (document camera version)

BROWSE BY COMMON CORE STATE STANDARDS

- Kindergarten (12)
  - Counting & Cardinality (3)
  - Geometry (3)
  - Number & Operations in Base Ten (1)
  - Operations & Algebraic Thinking (5)
- Grade 1 (17)
  - Geometry (3)
  - Measurement & Data (4)
  - Number & Operations in Base Ten (3)
  - Operations & Algebraic Thinking (7)

EQUIDISTANT POINTS



Directions: How many points wit[...]rdinates are 5 units away from (-2, 3)?

Hint

Which methods are available to determi[...] 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

Search

OPEN MIDDLE WORKSHEET

English (student version)
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  - Operations & Algebraic Thinking (7)

Home

Math resources that create problem solvers, not robots.

Download my favorite lessons for elementary, middle, and high school.

GET FREE LESSONS TAKE MY WORKSHOP

What happens next?

1

Keep coming back for more free lessons and resources.

2

Learn implementation tips from my blog and weekly emails.

3

Take my online workshop for more implementation support.

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 ...

Get My Emails

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

First Name

Last Name

Email address

Zip Code (optional)

Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

Resources

Depth of Knowledge

- Open Middle
- Open Middle Worksheet – English (student version)
- Open Middle Worksheet – English (document camera version)
- Open Middle Worksheet – Spanish (student version)
- Open Middle Worksheet – Spanish (document camera version)
- Robert's blog posts on Depth of Knowledge
- Tool to Distinguish Between Depth of Knowledge Levels

Problem-Based Lesson Tools

- Problem-Based Lesson Search Engine
- Problem Solving Framework v8.1
- Robert's blog posts on Problem-Based Learning

Problem-Based Lesson Sources

- 101 Questions
- Andrew Gael
- Andrew Stadel
- Catherine Castillo
- Christina Tondevold
- Dan Meyer
- Dane Ehlert
- Emergent Math's Problem Based Curriculum Maps

Robert Kaplinsky's Problem-Based Lessons

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

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

Sheet1

Scary & Dangerous

THE FOUR STEPS TO CREATE A CLASSROOM WHERE STUDENTS ARE EXCITED TO LEARN MATHEMATICS

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