

# Getting Struggling Math Learners to Mathematize Their World and Engage Them in Meaningful Procedures

**AOGPE  
2017**

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# **Common refrains about teaching children with dyslexia**

**“You know, the good news is that children with dyslexia are good at math.”**

**-and-**

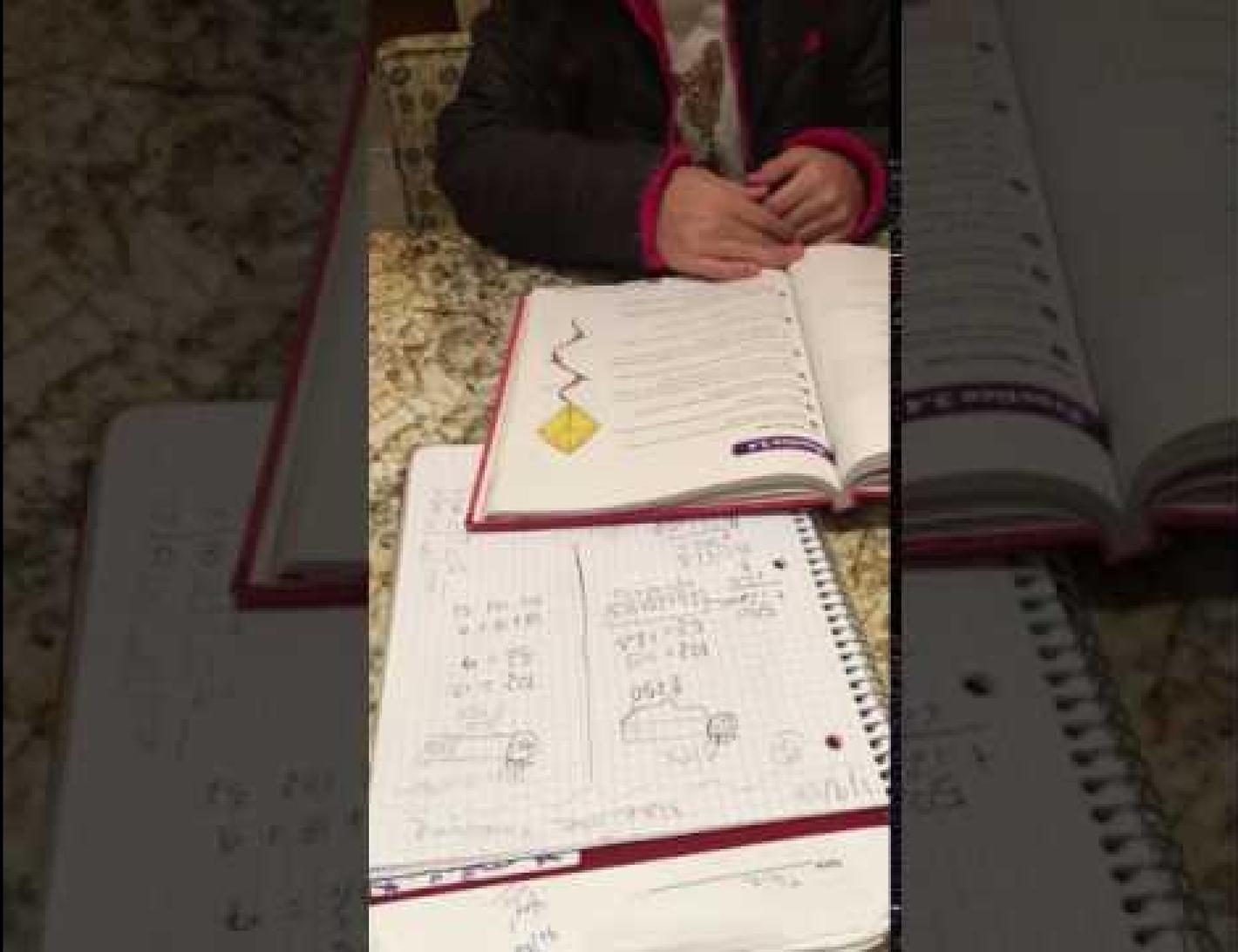
**“What works in teaching reading will work in teaching math.”**

**-and-**

**“Math is just another symbolic language.”**

- **Underlying cognitive deficits can affect math learning**
- **Math instruction is often approached like reading instruction**
  - **Approaches that emphasize memorization exacerbate the deficits**

**Memorization Leads to  
Misconceptions**



**Students who struggle in math  
often associate success with  
speed, memorization, and getting  
the right answers**

# Effective teaching in reading and math is:

**Intentional**

**Engaging**

**Multisensory**

**Student-centered**

**Known to Unknown**

**Concrete  $\Leftrightarrow$  Abstract**

**Math learning is  
fundamentally different  
from learning to read**

# Foundations

Reading Instruction:

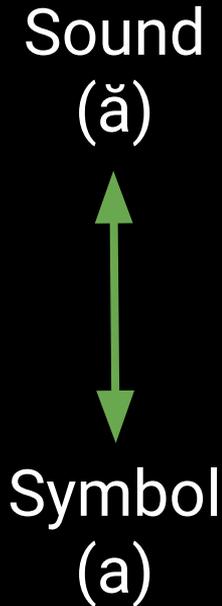
**Sound/Symbol  
Relationships**

Math Instruction:

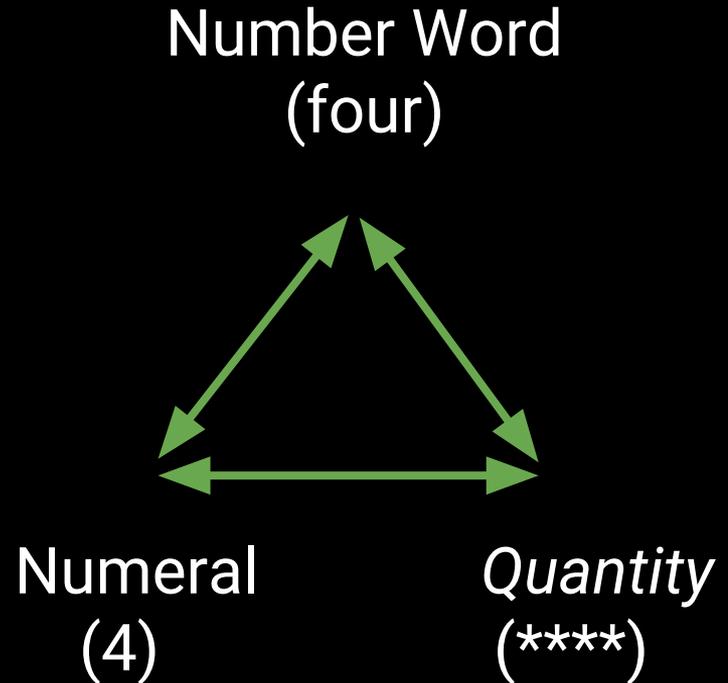
**Number  
Relationships**

# Letters vs Numbers

## Aspects of Letters



## Aspects of Numbers



# Critical Difference

Letters have no  
intrinsic meaning

A

Numbers DO have  
meaning (quantity)

4

(\*\*\*\*)

**“When you have mastered numbers,  
you will in fact no longer be reading  
numbers, any more than you read  
words when reading books.  
You will be reading meanings.”**

**-W.E.B. Du Bois**

# Man Memorizes French Dictionary to Win French Scrabble Tournament, Does Not Speak French

5k  
SHARES



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# Inchworms and Grasshoppers

TASK	INCHWORM	GRASSHOPPER
Analyzing and identifying problems		

# Inchworms and Grasshoppers

TASK	INCHWORM
Analyzing and identifying problems	<ul style="list-style-type: none"><li>• Focuses on the parts and details</li><li>• Looks at numbers and facts to arbitrarily select a formula</li></ul>
Solving the problem	<ul style="list-style-type: none"><li>• Formulaic/procedural</li><li>• One method</li><li>• Forward moving in ordered steps</li><li>• Uses exact numbers</li><li>• Paper/Pen - documenting steps</li></ul>
Checking and evaluating	<ul style="list-style-type: none"><li>• Unlikely to check or evaluate their answers or checks using the same procedure as before</li></ul>

**OUR  
PEOPLE!**

**“In mathematics ... we find two tendencies present. On the one hand, the tendency towards abstraction seeks to crystallise the logical relations inherent in the maze of materials ... being studied, and to correlate the material in a systematic and orderly manner. On the other hand, the tendency towards intuitive understanding fosters a more immediate grasp of the objects one studies, a live rapport with them, so to speak, which stresses the concrete meaning of their relations.” - David Hilbert**



**KID SNIPPETS:**  
**MATH CLASS**

"I'm terrible at math"

"I just don't have a  
math mind."

THE GOAL FOR OUR MATH STUDENTS SHOULD NOT BE

"I can't remember how  
my teacher taught me"

TO MEMORIZE FACTS AND PROCEDURES AS SKILLS

ISOLATED FROM MEANING

THINKING

IS THE

GOAL

"I wasn't taught how to  
do that."

"I'll never understand  
this"

**There is not one best process to solve every problem**



# How many people have to exit the plane before us?

		EXIT EXIT																											
	F	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	D	E	F
	F	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	D	E	F
	D	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	D	E	F
	E	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	D	E	F
	C	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	C	B	A
	B	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	C	B	A
	A	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	C	B	A

**How many people have to exit the plane before us?**

**800!**

**That does not make sense. Look...**

**300?**

**Hun... do the math. We are in row 23, which means there are 22 rows in front of us. Each row has 6 people. So  $6 \times 22...$**

**100!**

**6 times 22, 2 times 6 is 12, carry the one. Then 6 times 2 is 12 again but add one so... 132. How didn't you get that?**

**Oh.. haha, I'm tired.**

“Intuitive experiences must be acquired by the student through his/her own activities—they cannot be learned through verbal instruction.”

Erich Wittmann

Wittmann, Erich. 1981. "The Complementary Roles of Intuitive and Reflective Thinking in Mathematics Teaching." *Educational Studies in Mathematics* 12 (3): 389-397.

@tracyzager









important to animals and you!  
 Visit the "Attractions" page on the Columbus Zoo's free App to follow the Scavenger Hunt

# SCAVENGER HUNT



**B**

**A**



Frog Parking Lot

South Exit

34th Street

Tiger Parking Lot

Bicycle Racks

Taxi Stop

Main Entrance Exit

Zookeeper Drive

Main Path

Main Path

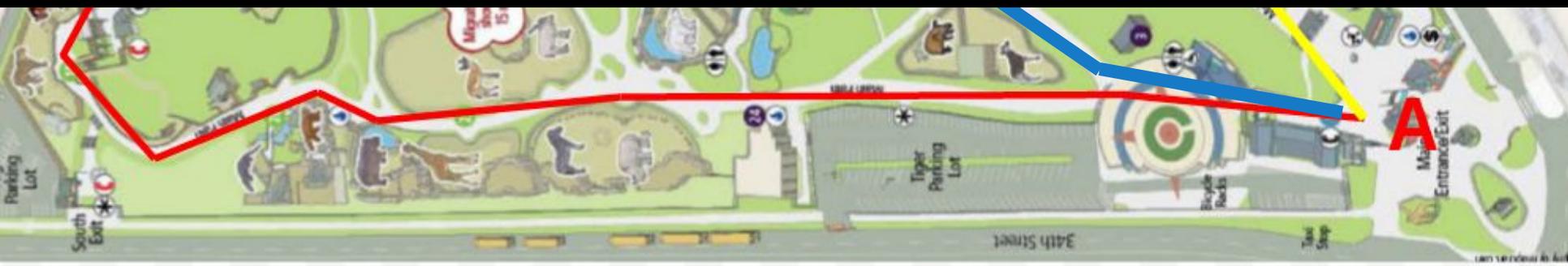
Main Path

Main Path

Main Path



**“NOT ALL WHO WANDER ARE LOST”**  
**-J. R. R. Tolkien**



Edit

# Directions

Route Overview  
2.5 minutes with no confusion on route  
You are on the *fastest* route

Destination: Long Division

1 Divide

2 Multiply

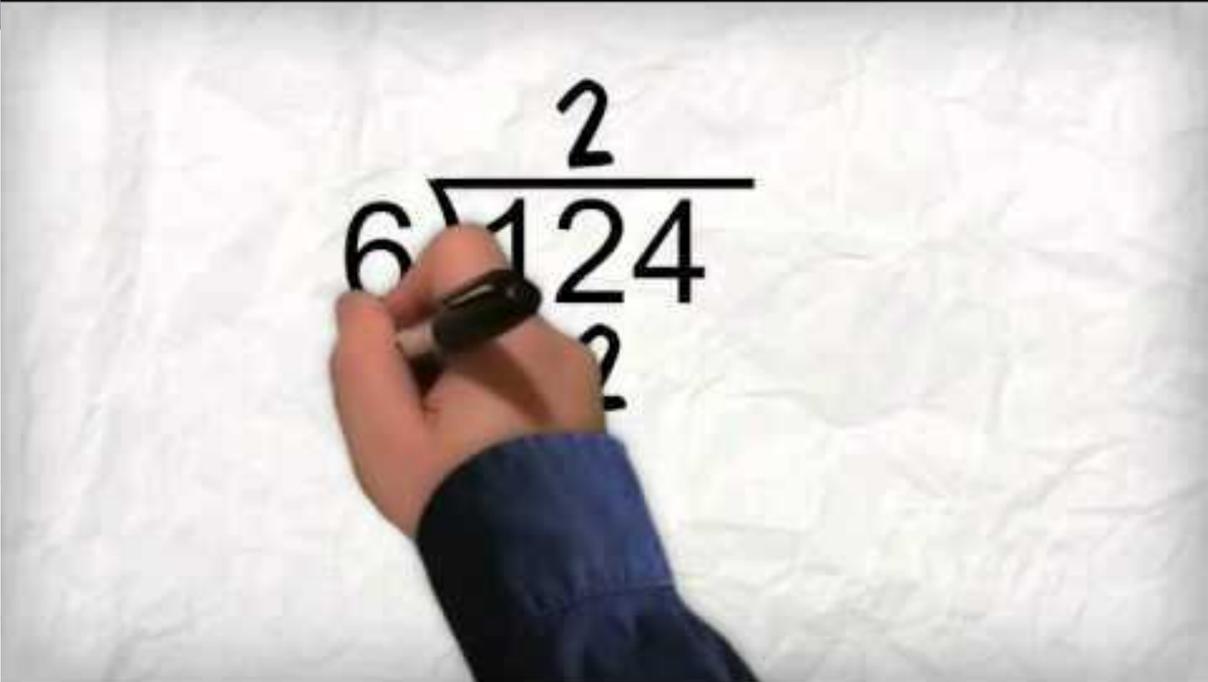
3 Subtract

4 Check and Bring down



Search

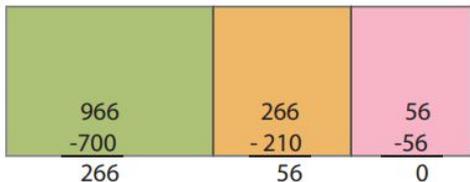
Directions



# Context matters!

Method A:

$$100 + 30 + 8 = 138$$



$$\begin{array}{r} 8 \\ 30 \\ 100 \\ \hline 138 \end{array}$$
$$\begin{array}{r} 7 \overline{)966} \\ -700 \\ \hline 266 \\ -210 \\ \hline 56 \\ -56 \\ \hline 0 \end{array}$$

Area/array drawing for  $966 \div 7$

? hundreds + ? tens + ? ones



$$\begin{array}{r} ??? \\ 7 \overline{)966} \end{array}$$

$$\begin{array}{r} 6 \overline{)875} \\ -600 \\ \hline 275 \\ -60 \\ \hline 215 \\ -120 \\ \hline 95 \\ -60 \\ \hline 35 \\ -30 \\ \hline 5 \end{array}$$

$100 \times 6$   
 $10 \times 6$   
 $20 \times 6$   
 $10 \times 6$   
 $5 \times 6$

5    145 R5

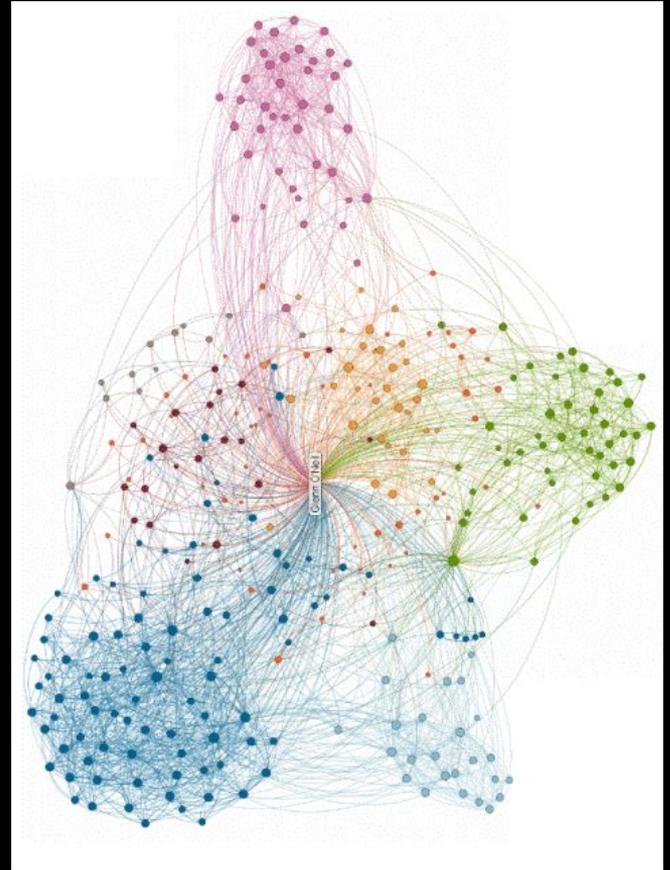
$$\begin{array}{r} 138 \\ 7 \overline{)966} \\ -7 \\ \hline 26 \\ -21 \\ \hline 56 \\ -56 \\ \hline 0 \end{array}$$

I can't tell them how to see/do the process if they aren't **ready** yet.

# Construct a Map

Support students in:

- **Surveying the landscape**
- **Identifying landmarks**
- **Navigating the map**
- **Exploring multiple paths**
- **Making connections**



**What is the role of  
direct instruction  
in the math classroom?**

**Inefficient  
Thinkers**

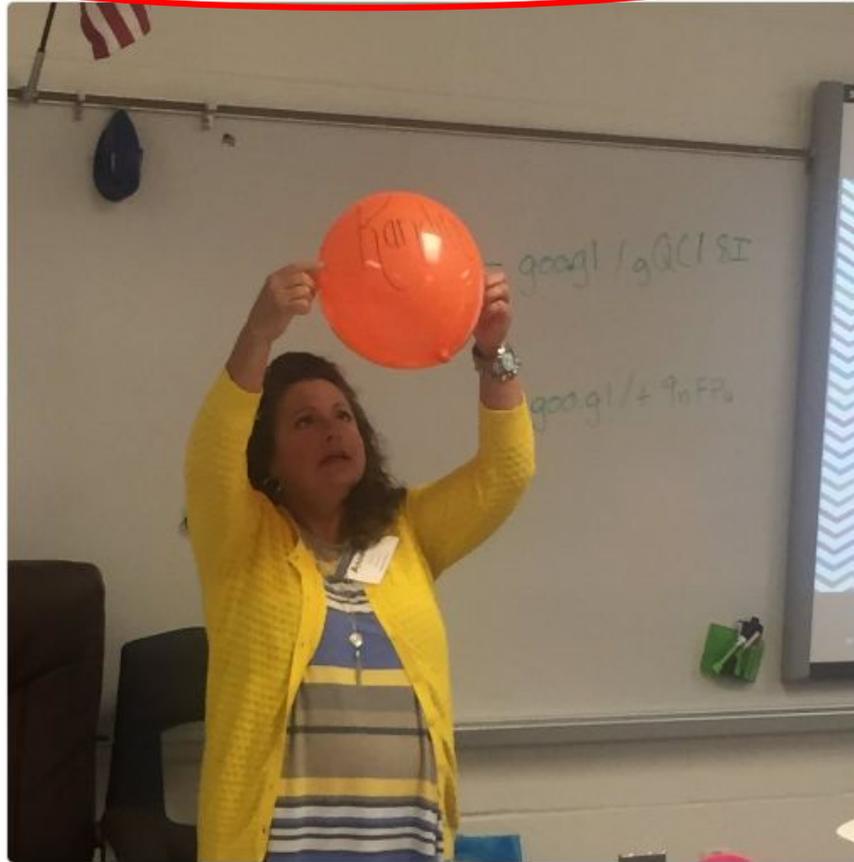
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**Efficient  
Thinkers**

Math facts on balloons are much more engaging than math facts on worksheets! #iChampion



4 6

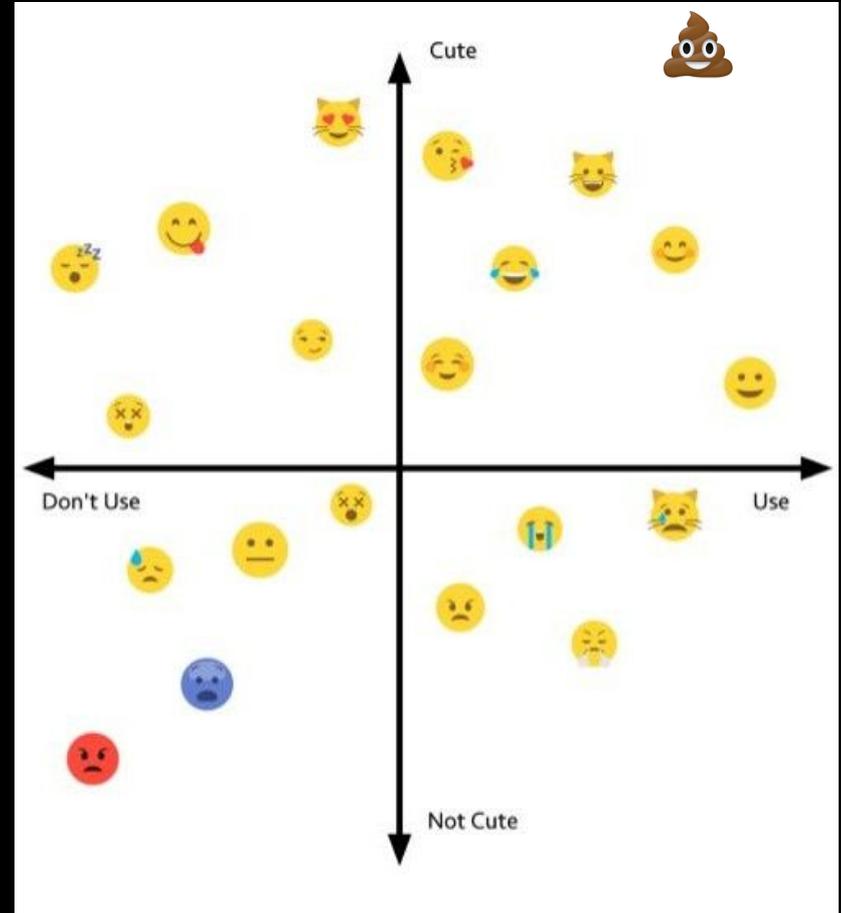
Use entry points **ALL**  
students are able to access







# Where's the poop emoji?



**“If it matters to students, it  
HAS to matter to us.”**

**-Graham Fletcher**

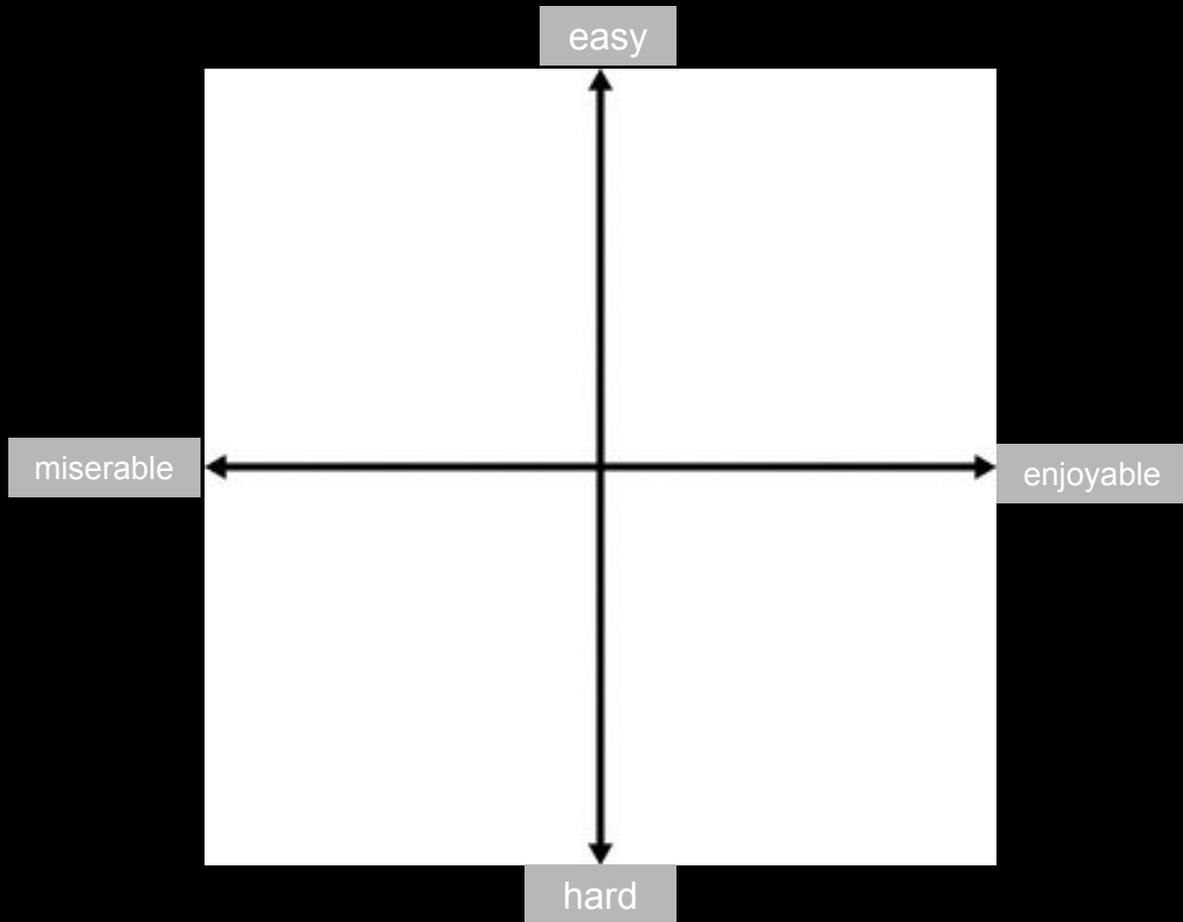
Math

Science

Language

History

Gym



Easy

Keyboarding

Gym

History

Math

Miserable

Enjoyable

English

Science

Difficult

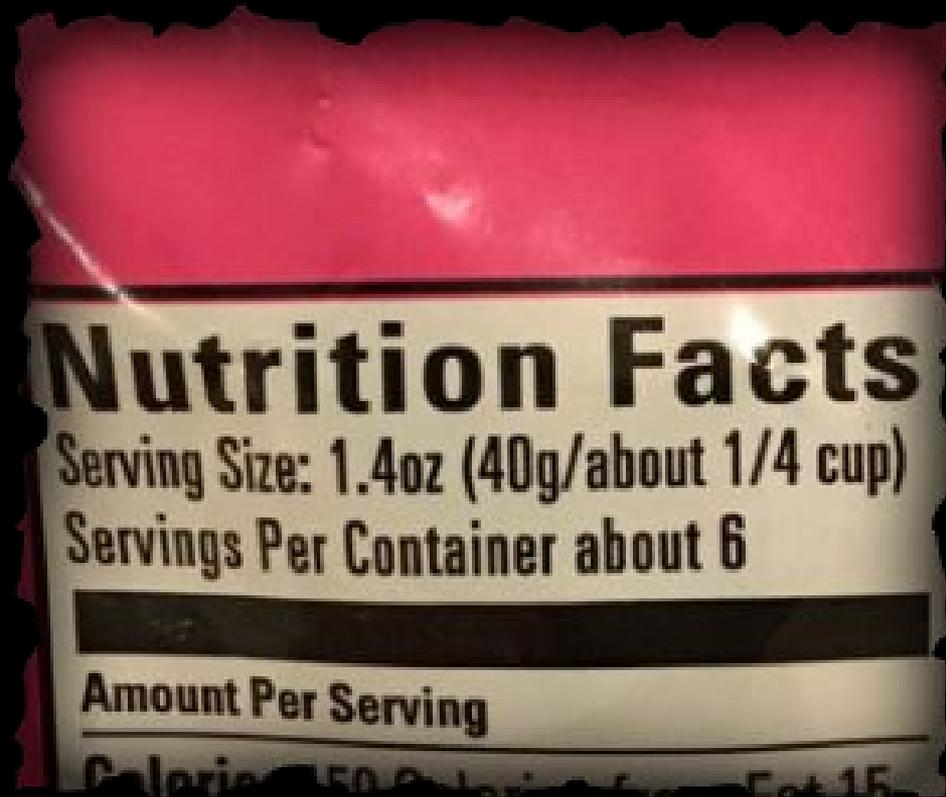
# “Real world” $\neq$ Context



**Nathan Kraft** @nathankraft1 · 46s

Dumbest textbook question of the day: 50 of the 1,500 possibly active volcanoes on Earth erupt every year. What is the GCF of 50 and 1,500?

# Wanna make kids mad?



## Nutrition Facts

Serving Size: 1.4oz (40g/about 1/4 cup)

Servings Per Container about 6

Amount Per Serving

Calories 150 Fat 15





37



NEW

RESEALABLE!

FRESH  
PACK

Fave REDS

Starburst

FRUIT CHEWS

minis

unwrapped!

NET WT. 8 OZ.





149



**BUT I WANTED 180!**

**Nutrition Facts**

Serving Size: 1.4oz (40g/about 1/4 cup)

Servings Per Container about 6

Amount Per Serving

Calories 150 Calories from Fat 15



**It's like taking candy from a baby**



**Links between school mathematics and  
the real world will not be demonstrated  
by perfectly-phrased questions  
involving buses and cans of paint.**

**-Jo Boaler**



**O.M.G.**

**SHARKS**

# Here's how the lesson could have gone...

**Here are a list of sharks to contrast and compare.**

**Here are the factors that matter.**

**Here is the way Discovery Channel weighed and rated sharks.**

**Research, plug in the information, and spit out a value..**

**..We can rank them**

# Instead, we had a math fight...



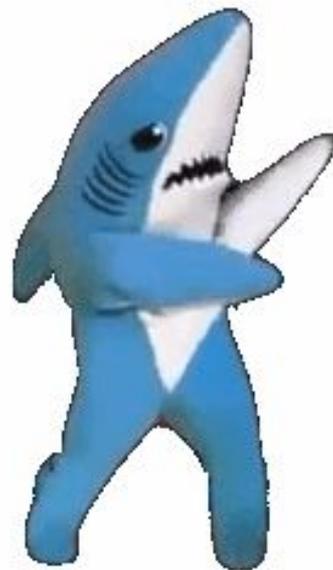
# Students generated questions...

- How many types of sharks are there?
- Which sharks have the most attacks?
- Which shark is the deadliest?
- What is considered deadly?
- What sharks have the strongest bite?
- Are the sharks considered only relevant to the US?
- What makes a shark deadly?
- Is the great white the shark that kills the most people?
- Is a bear more deadly than a shark?

# ...and important factors

- Proximity to humans
- Bite force
- Size of bite
- Size of shark
- Speed of shark
- Number of attacks
- Deaths by attack
- Location (where the shark most frequents)
- Number of teeth
- Size of teeth
- Species population size

**O.M.G.**



**RESEARCH**

# Formula Developed by Students:

**df**  
deadly factor

**\* 1.25**  
↓

**\* 1.25**  
↓

$$[(\text{deadly attacks} \div \text{total attacks}) * 100] + (\text{Bite Force} \div \text{Size} * 100) + \text{Location Factor} + \text{Speed of Shark}$$

# SO WHAT HA

## STUDENT LIST

## DISCOVERY CHANNEL

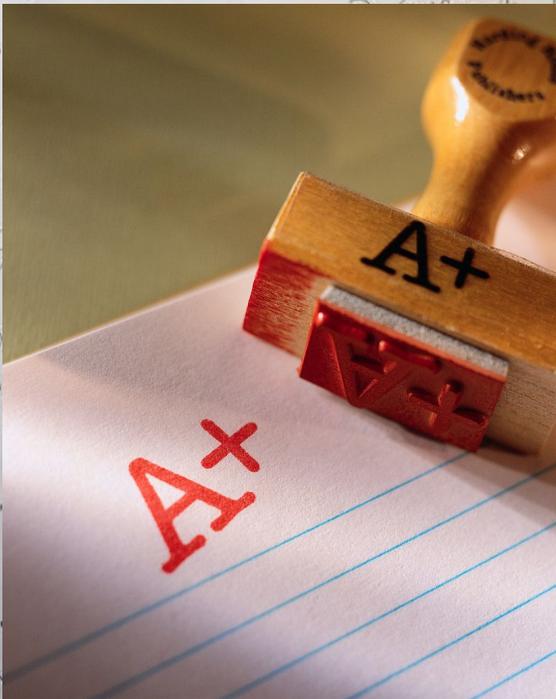
1 Bull	1 Bull
2. Great White	2 Great white
3. Cookie Cutter	3. Tiger shark
4. Tiger Shark	4 Blue shark
5. Mako shark	5 Mako shark
6. White tip	6 White tip
7. Goblin shark	7. Sand tiger
8. silky	8. Hammer head
9. Hammerhead	9. Reef shark
10. Black tip	10. Black tip



HATERS GONNA HATE

- |                  |                |
|------------------|----------------|
| 1 Bull           | 1 Bull         |
| 2. Great White   | 2 Great white  |
| 3. Cookie Cutter | 3. Tiger shark |
| 4. Tiger Shark   | 4 Blue shark   |
| 5. Mako shark    | 5 Mako shark   |
| 6. White tip     | 6 White tip    |
| 7. Goblin shark  | 7. Sand tiger  |
| 8. silky         | 8. Hammer head |
| 9. Hammerhead    | 9. Reef shark  |
| 10. Black tip    | 10. Black tip  |

- 1 Bull
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



- 1 Bull
- 2. ... white
- 3. ... shark
- 4. ... shark
- 5. ... shark
- 6. ... tip
- 7. ... Tiger
- 8. ... er head
- 9. ... shark
- 10. ... 10. Black Tip

# OUR LIST

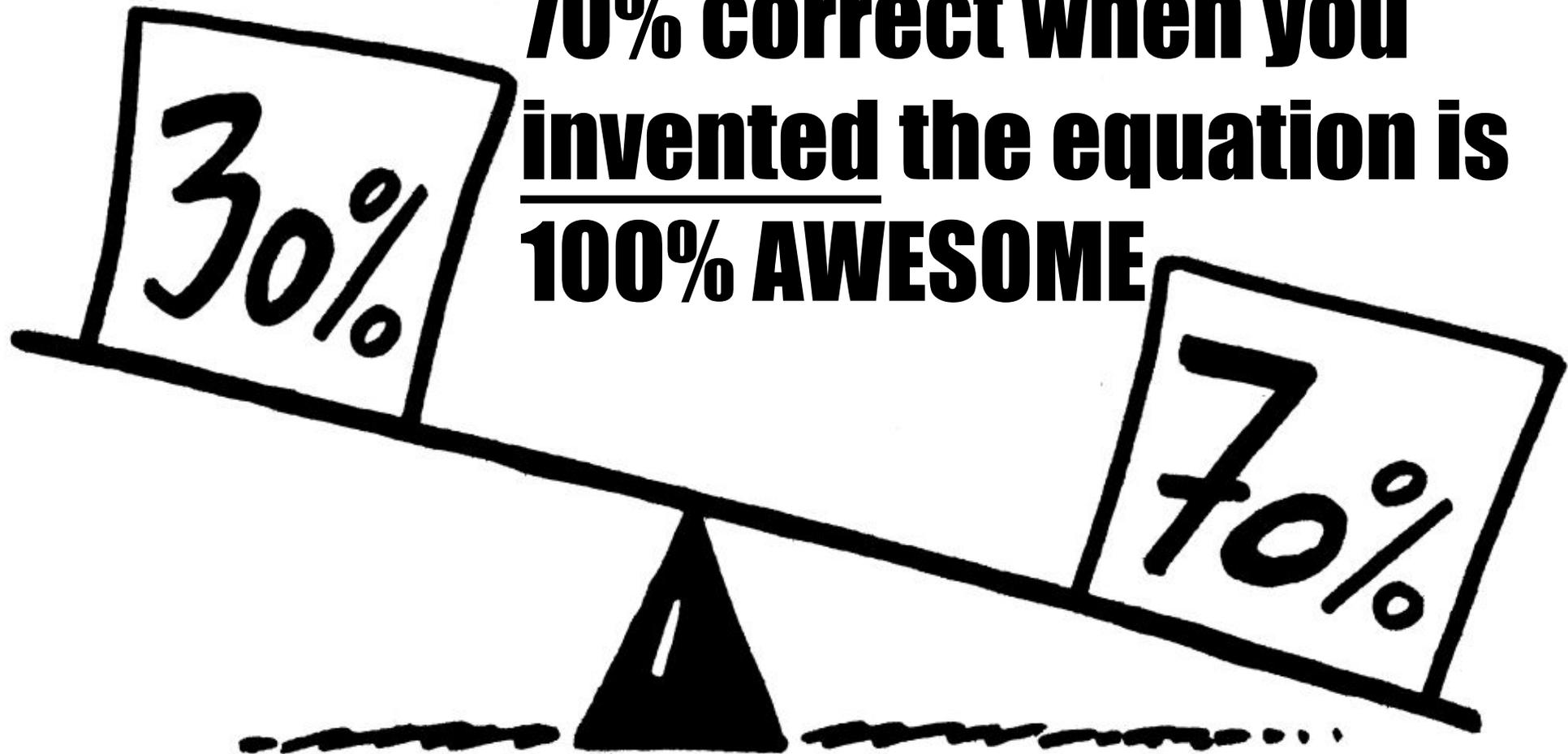
# DISCOVERY CHANNEL

- 1 Bull
2. Great White
3. Cookie Cutter
- 4.
- 5.
- 6.
- 7.
- 8.
9. Hammerhead
10. Black tip

- 1 Bull
- 2 Great white
3. Tiger shark
- 4 Blue shark
- rk
- D
- er
- head
9. Reef shark
10. Black tip



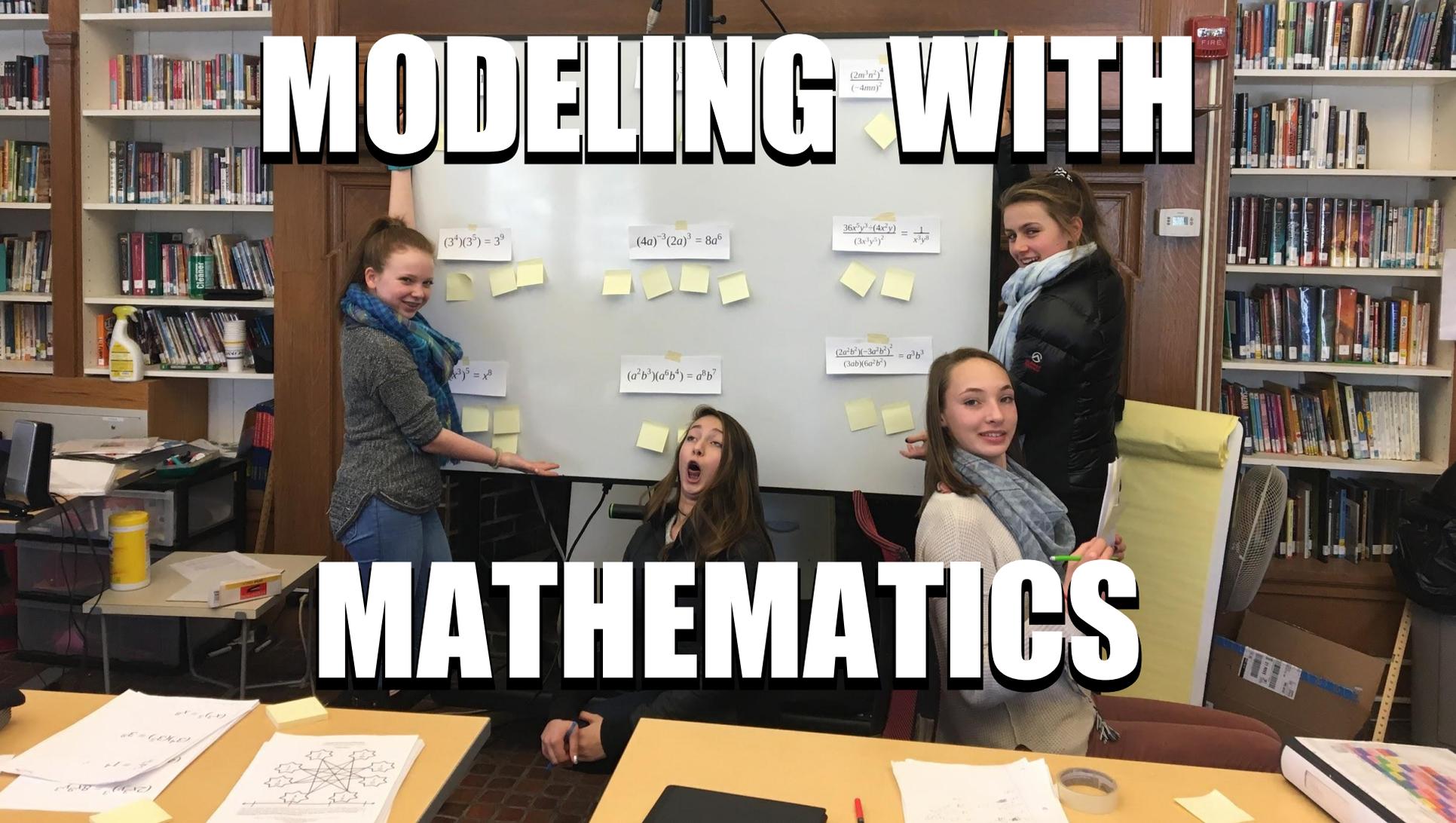
**70% correct when you  
invented the equation is  
100% AWESOME**





# MODELING WITH

# MATHEMATICS

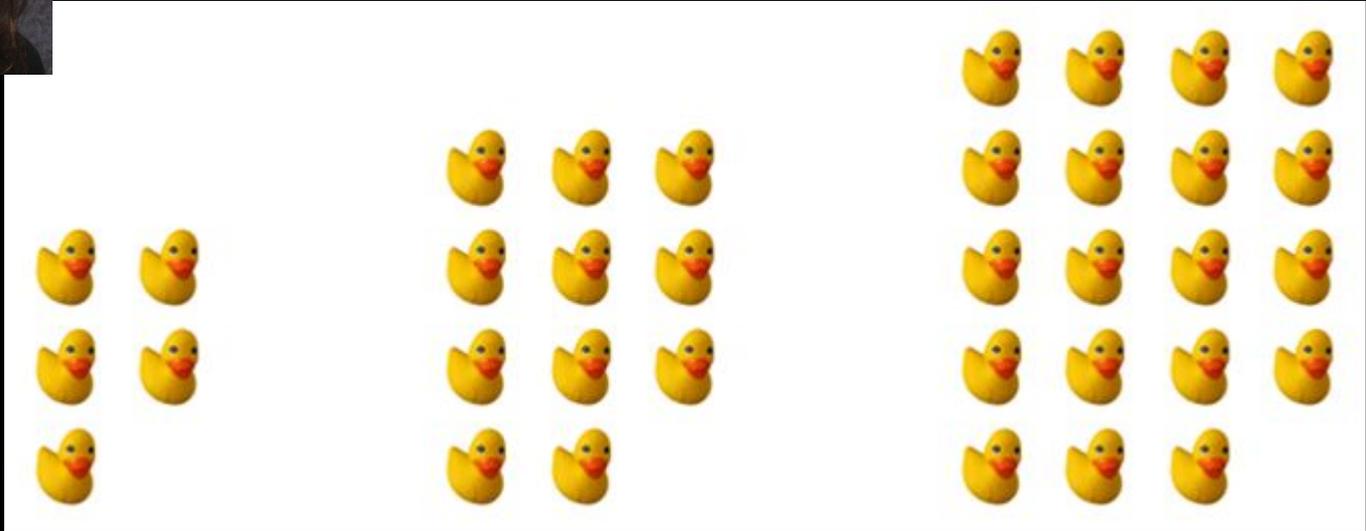


**Give students'  
strategies a voice no  
matter how inefficient  
they might be**



# VISUAL PATTERNS

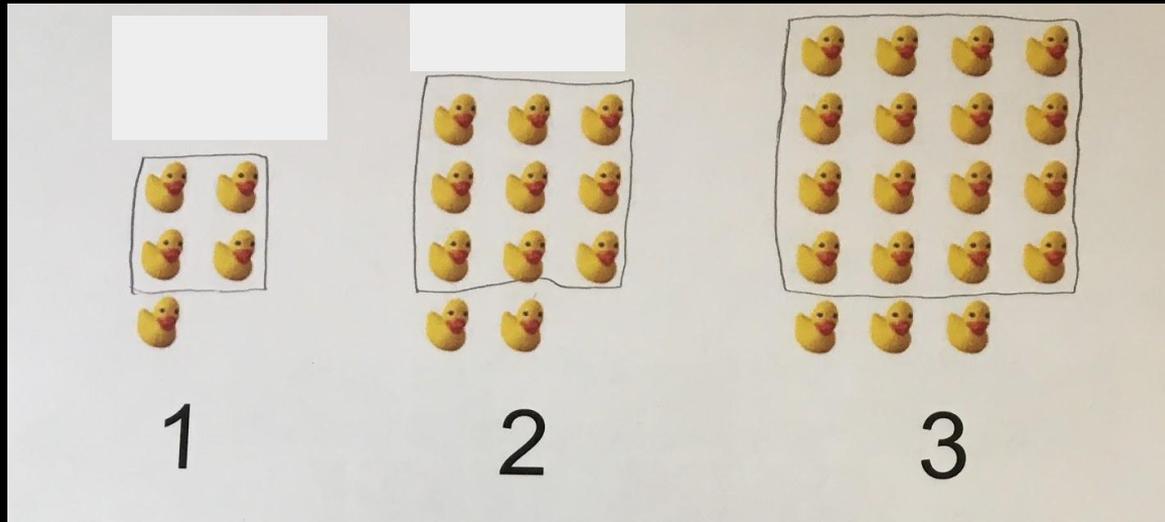
<http://www.visualpatterns.org/>



Pattern #147

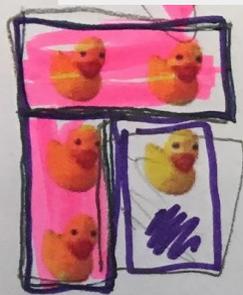
# How my students saw it

<http://www.visualpatterns.org/>

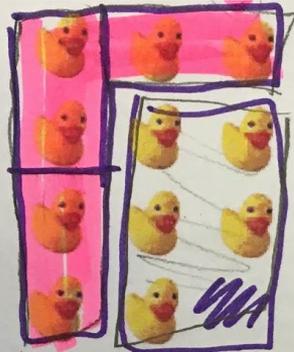


# How my students saw it

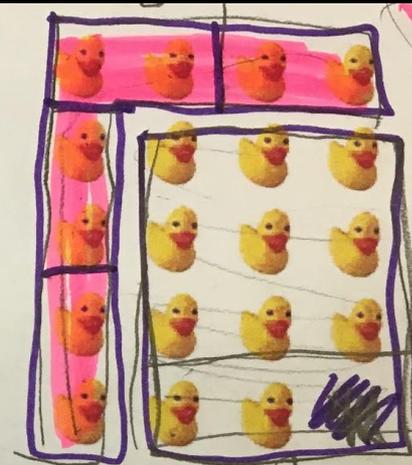
<http://www.visualpatterns.org/>



1



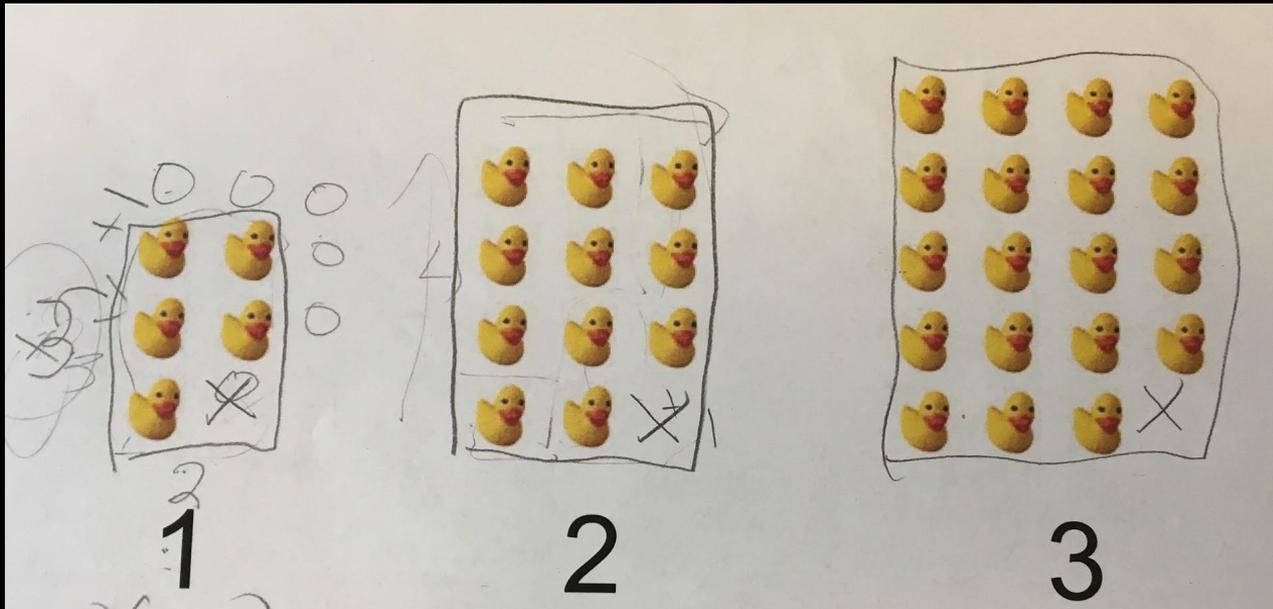
2



3

# How my students saw it

<http://www.visualpatterns.org/>

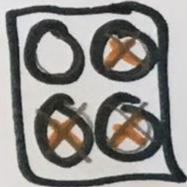


**Not every student is ready to  
make a claim**

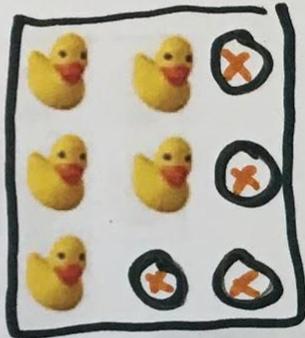


# How my students saw it

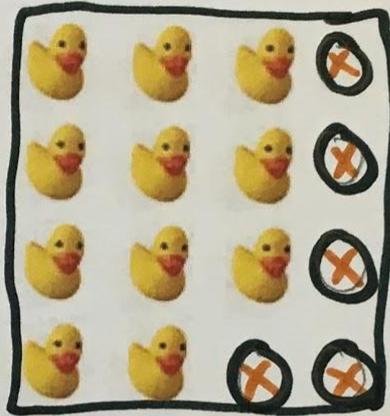
<http://www.visualpatterns.org/>



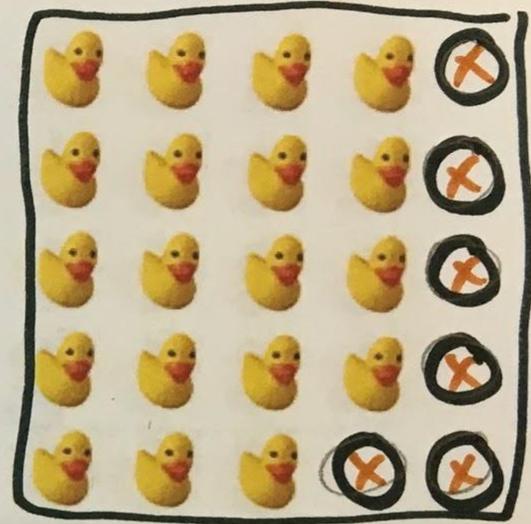
0



1



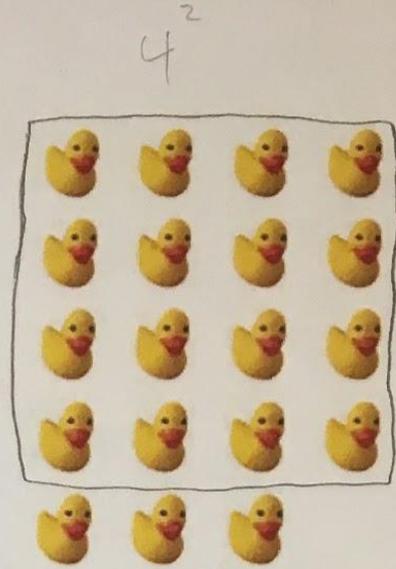
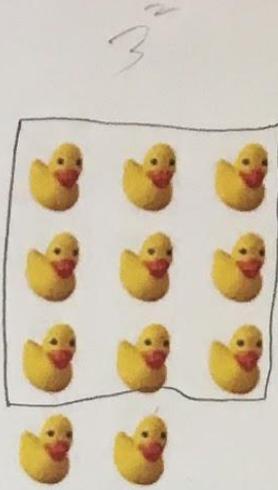
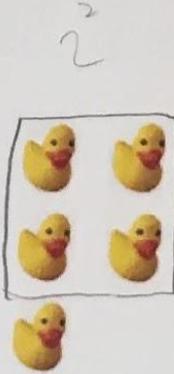
2



3

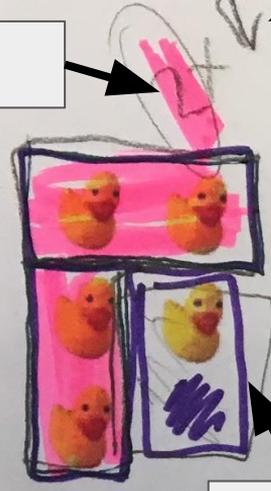
**Concrete**  **Abstract**

**Student thinking guides process**



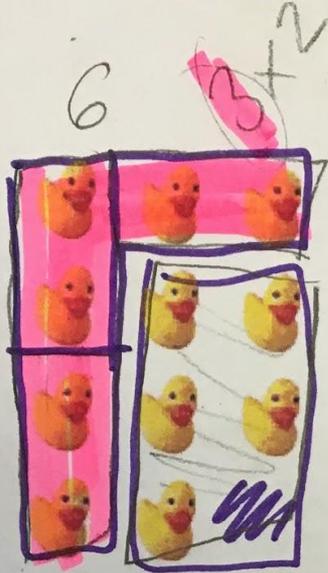
$(x+1)$

$*2$

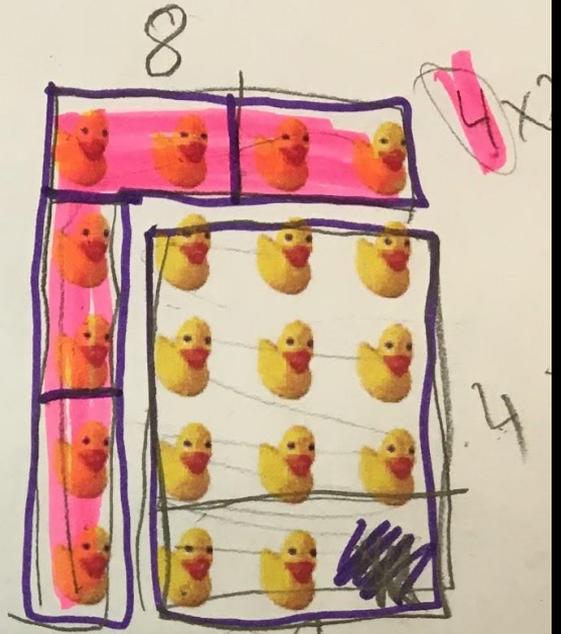


1

$x(x+1)-1$

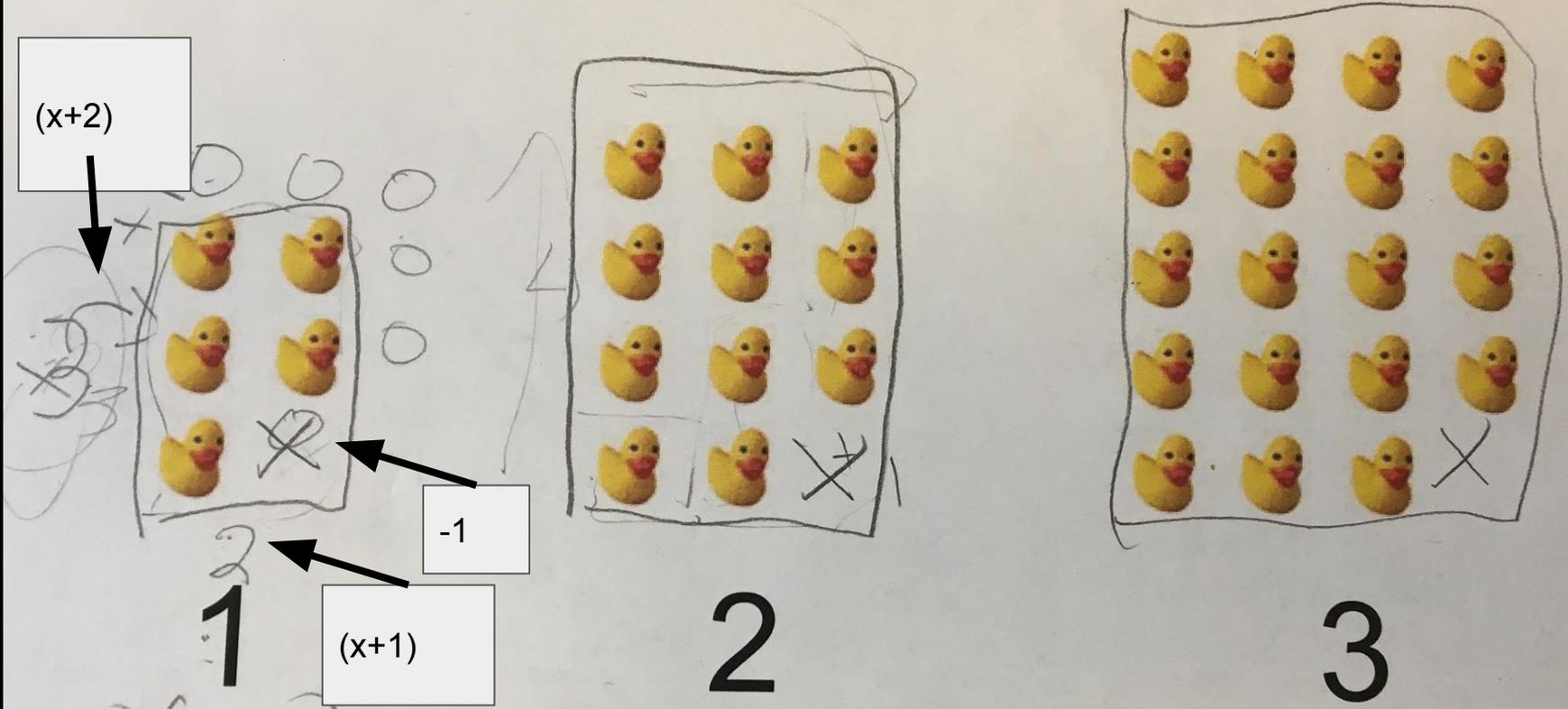


2



3

Total =  $2(x+1) + x(x+1)-1$



Total =  $(x+2)(x+1) - 1$

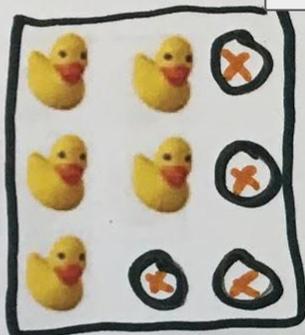
$$2^2 - 3$$



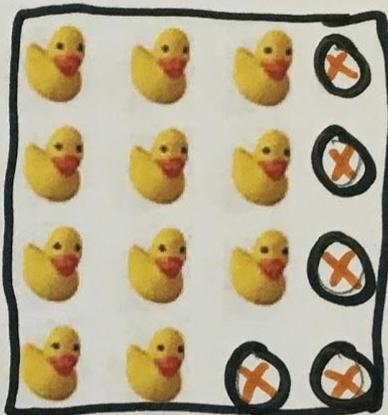
$$(x+2)$$

$$3^2 - 4$$

$$x+3$$



$$4^2 - 5$$



$$5^2 - 6$$



0

1

2

3

$$\text{Total} = (x+2)(x+2) - (x+3)$$

**“Children with dyslexia tend to look at the world differently. Isn’t the world lucky they do?”**



**Cathy Marks Krpan**

@CathyMarksKrpan

Following



We can only assess what we see & hear. If we want to gain insight into S thinking in math, they need to be talking & we need to be listening

RETWEETS

33

LIKES

41



3:07 PM - 24 Apr 2017

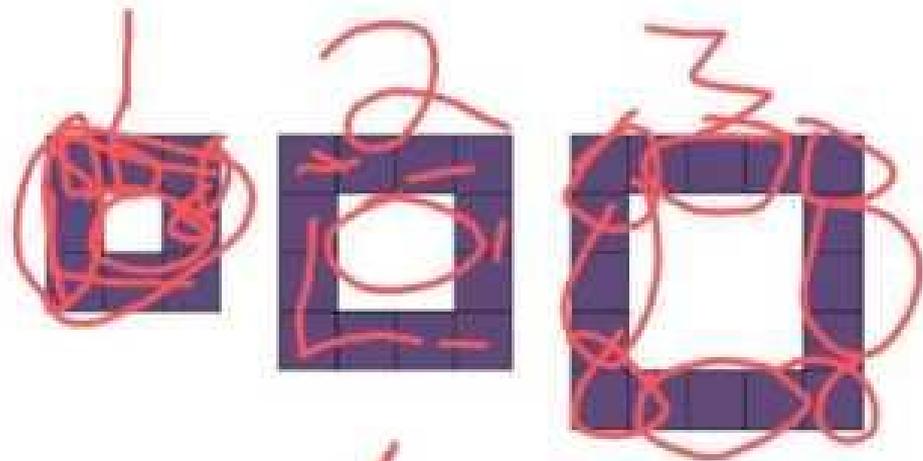


33



41

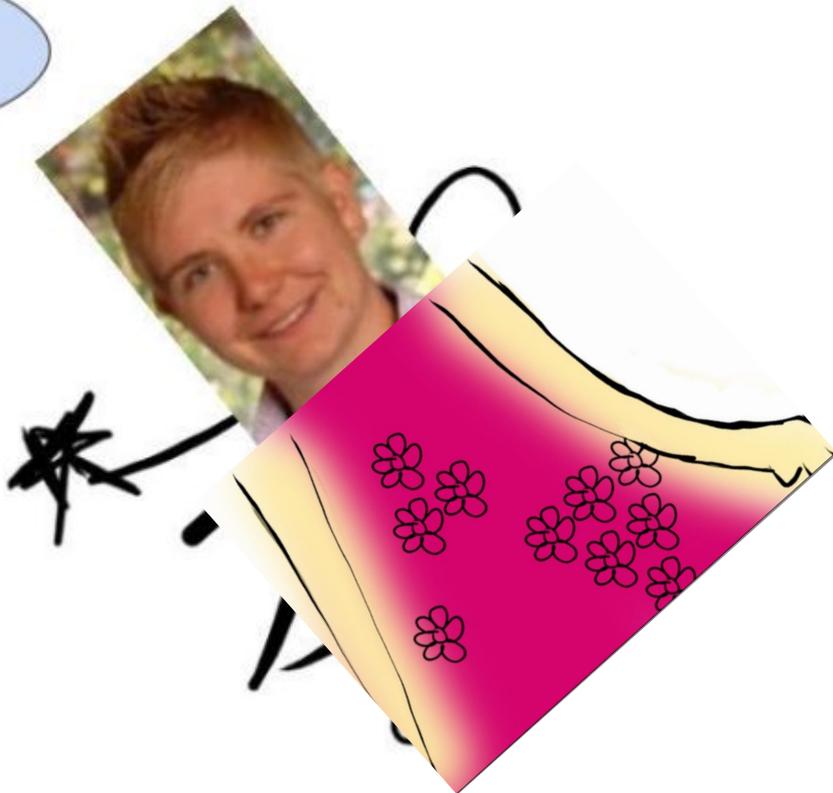
FIND AN ALGEBRAIC RULE FOR THE FOLLOWING PATTERN. JUSTIFY/PROVE IT!

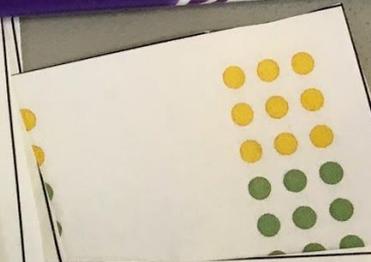
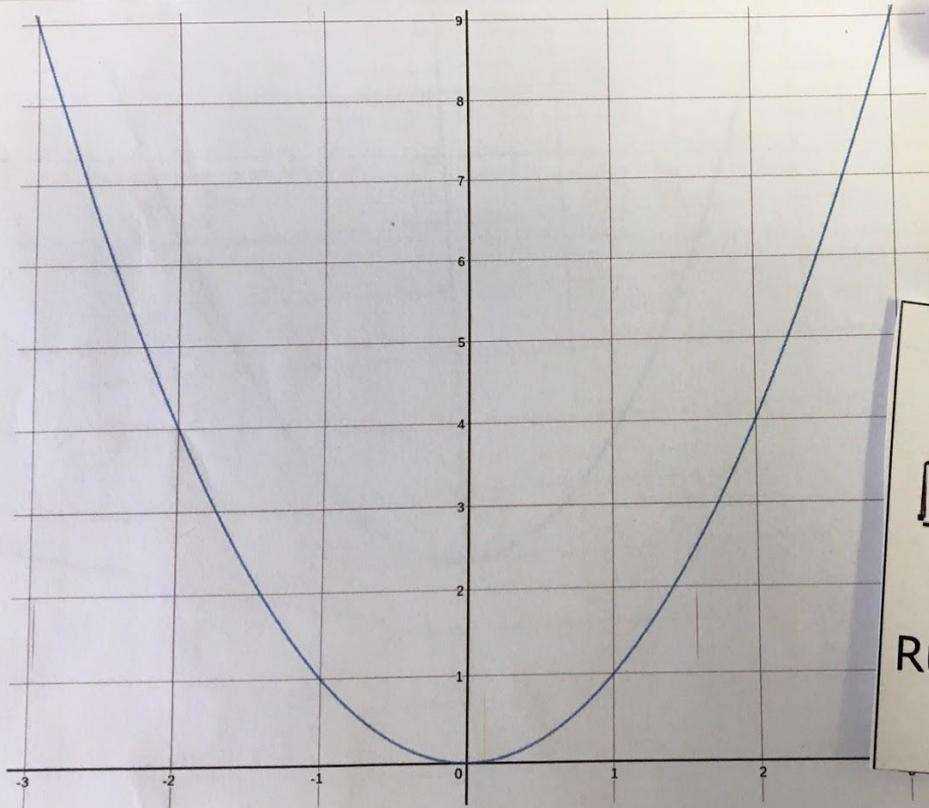


$$4x + 4$$

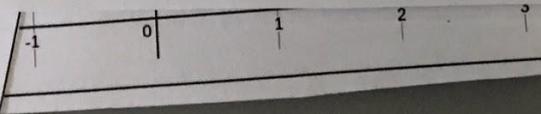
$$(x+2)^2 - x^2$$

there are visual  
patterns every where,  
even that dress you're  
wearing has a pattern





Rule:  $x^2$



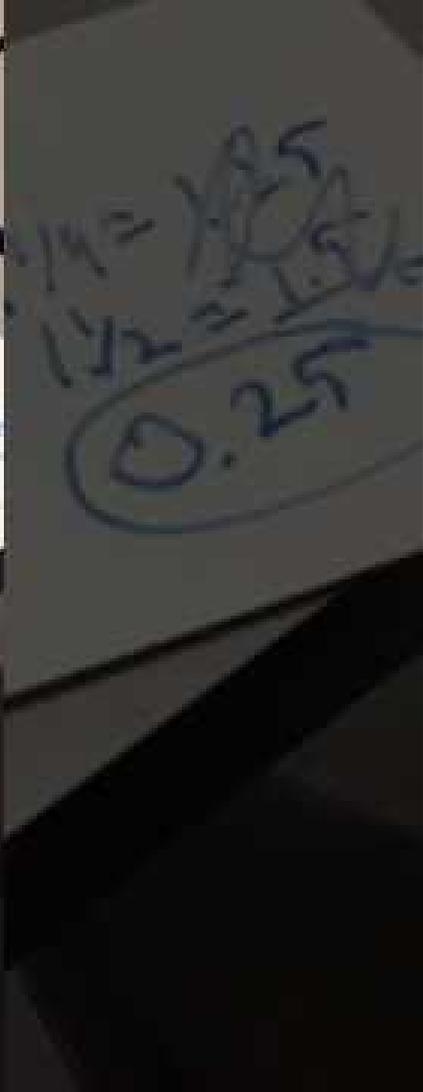
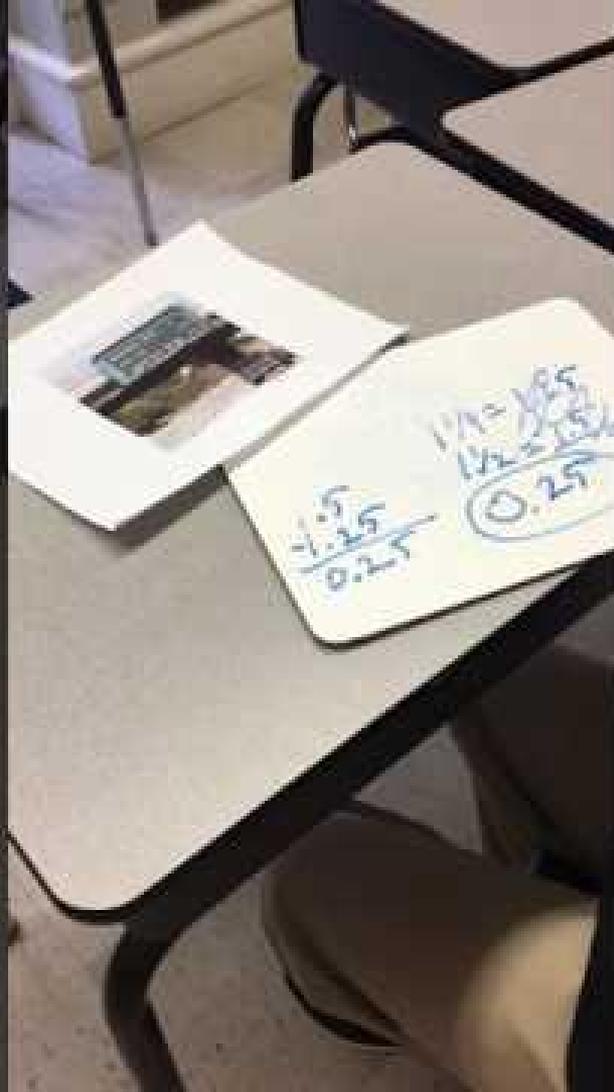
-9

**“If a child can’t learn the way  
we teach, maybe we should  
teach the way they learn.”**

**– IGNACIO ESTRADA**

## ABOUT YOU AND MATH

Statement	Agree (always), Disagree (never), Sometimes	Reasoning
If I can do math problems fast, it means I am good at math	Sometimes	fast is great but you might not always get it right
Getting a problem wrong means you are bad at math	Never	you learn more when you get things wrong
A person is either good or bad at math	<del>Never</del> Sometimes	you might be better at other things in math
Drawing a picture or seeing visuals helps when doing math	Sometimes	depends on Problem
There is only one way to do math problems	No	





**NAILED IT**

**It's not about having time.  
It's about **MAKING** time**

**#Priority**

# Getting Struggling Math Learners to Mathematize Their World and Engage Them in Meaningful Procedures

Resources can be found at:

<http://msmaths.weebly.com/AOGPE2017.html>

Jen McAleer

 @jennifuhs4

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**AOGPE 2017**

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