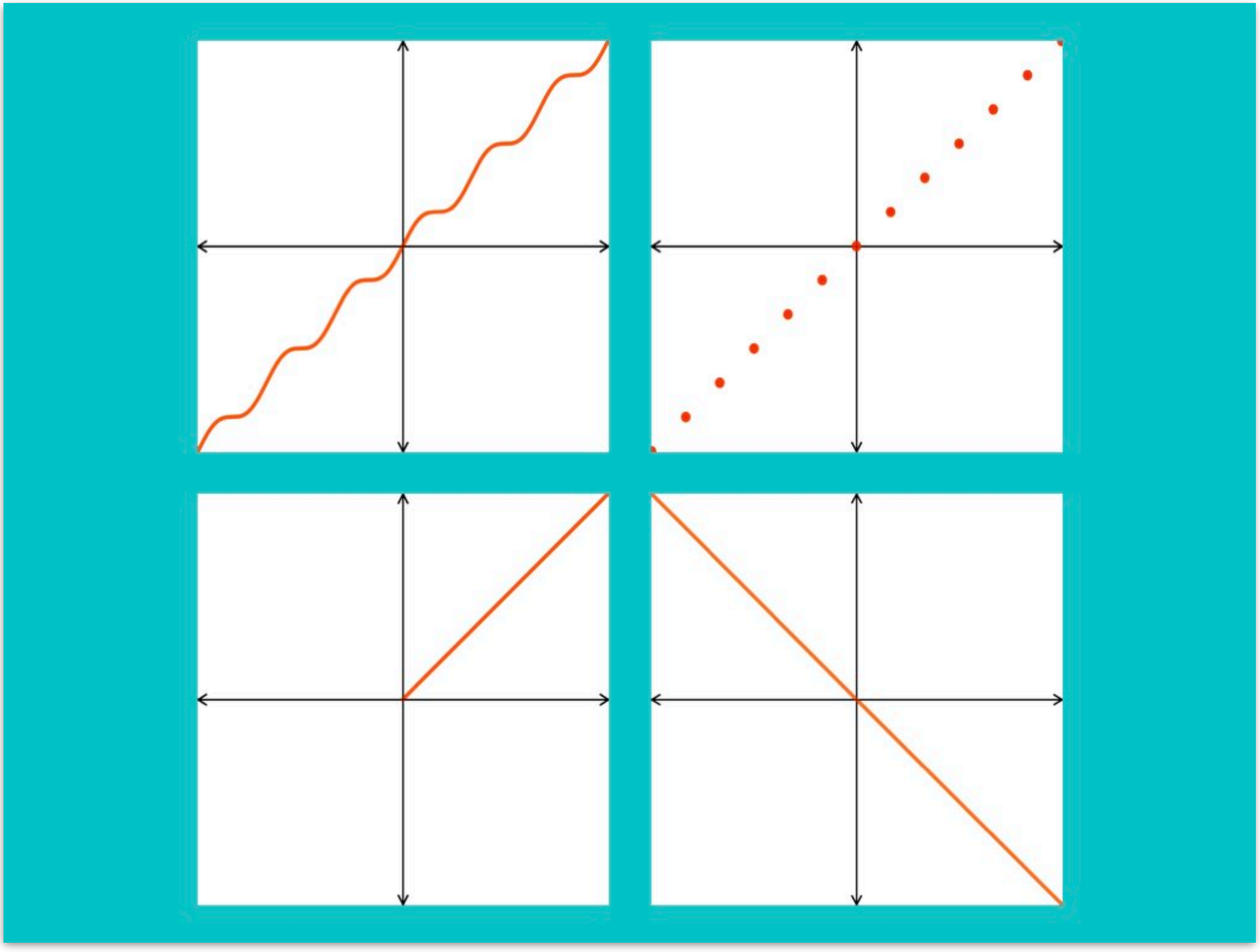
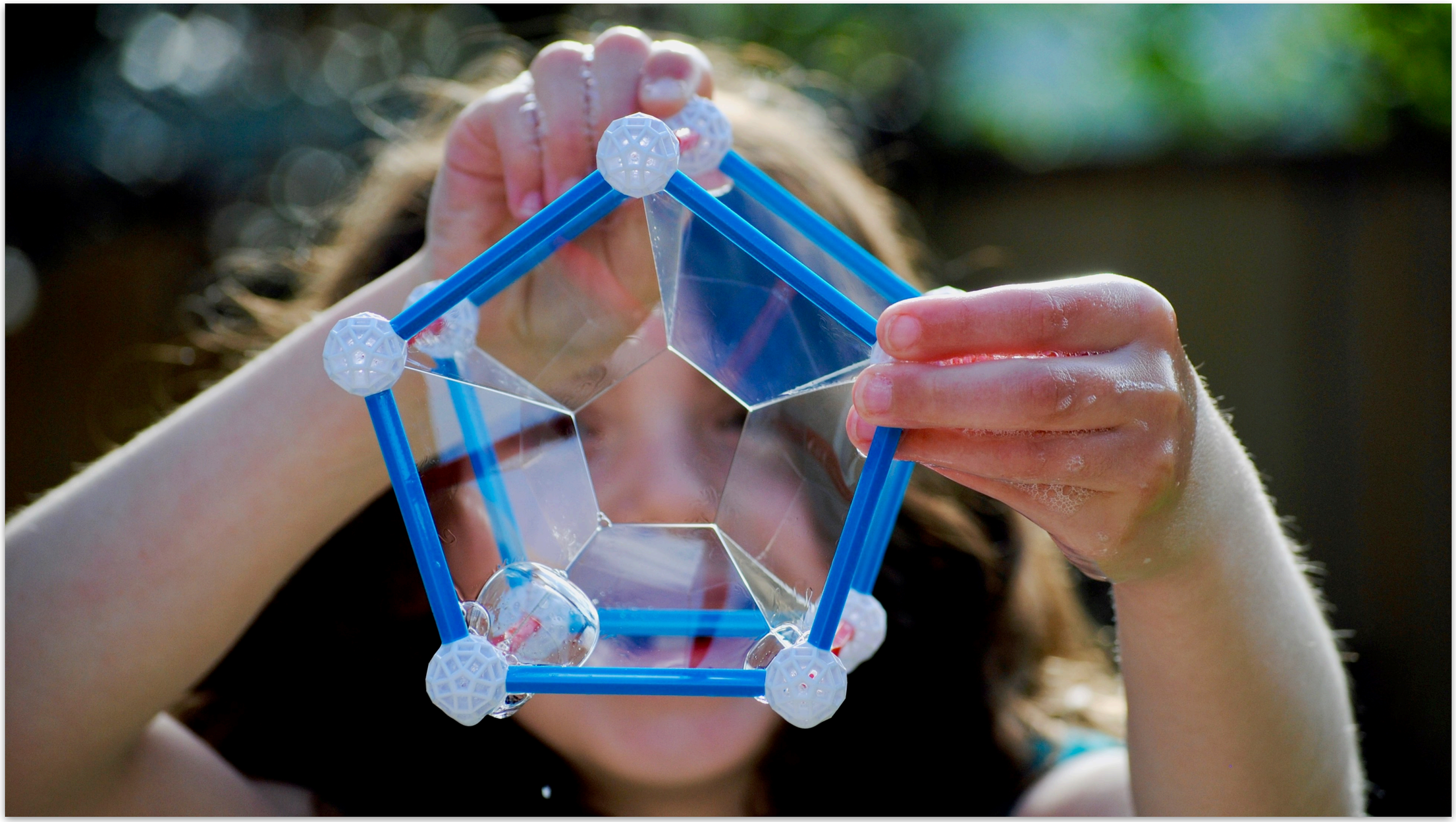


Linear Relations Across the Grades

BCAMT Fall Conference • October 2019

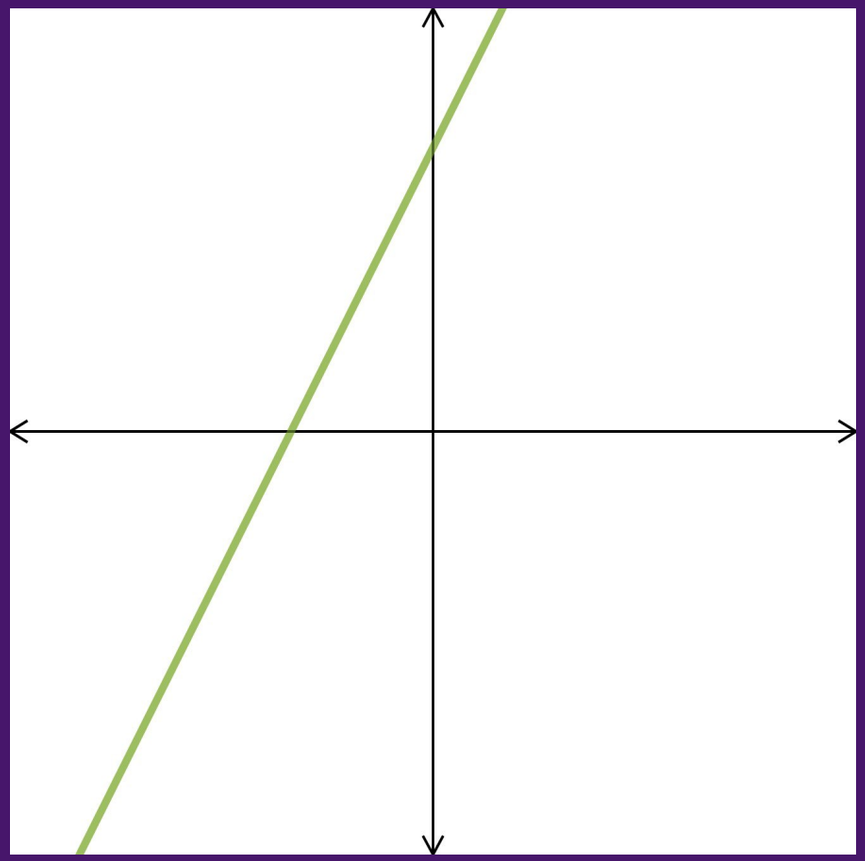


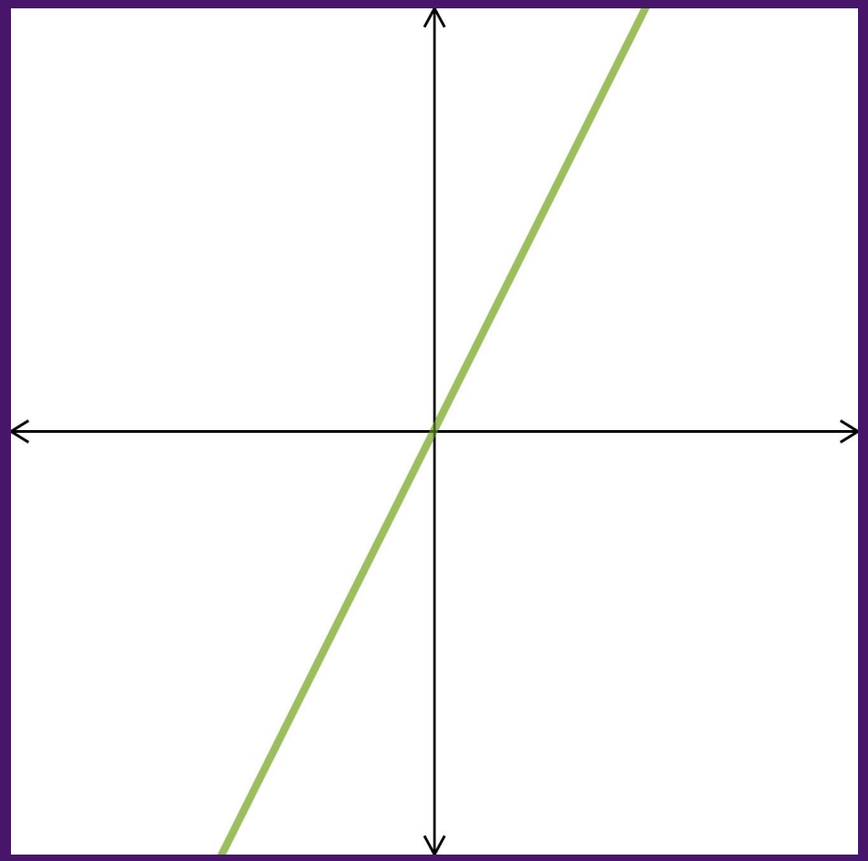
Chris Hunter • K-12 Numeracy Helping Teacher

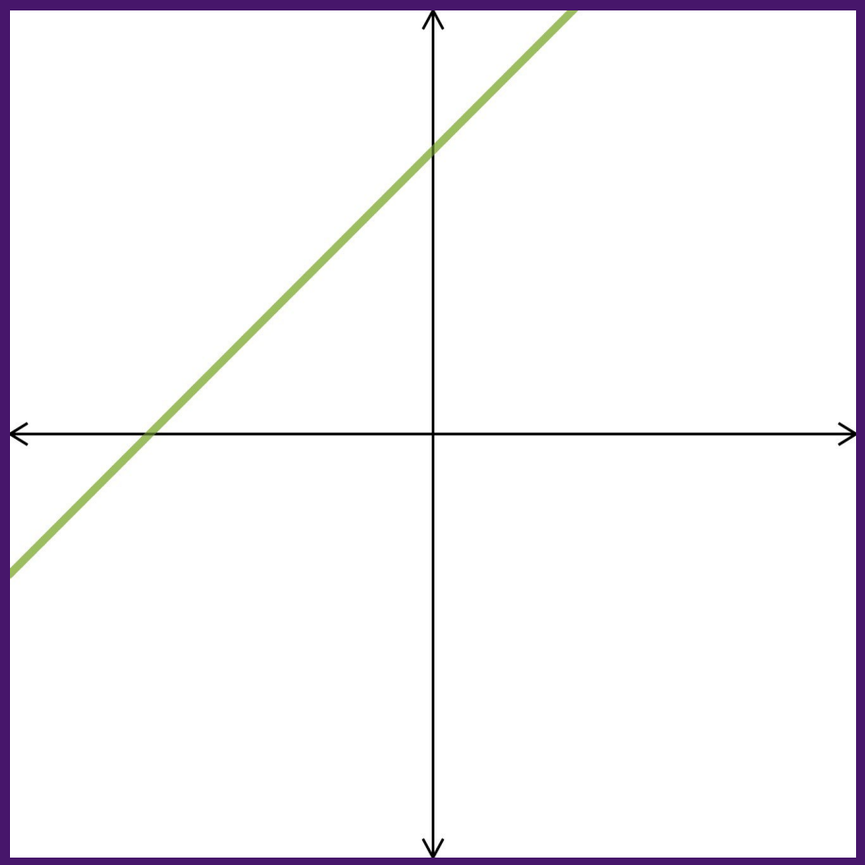
hunter_c@surreyschools.ca

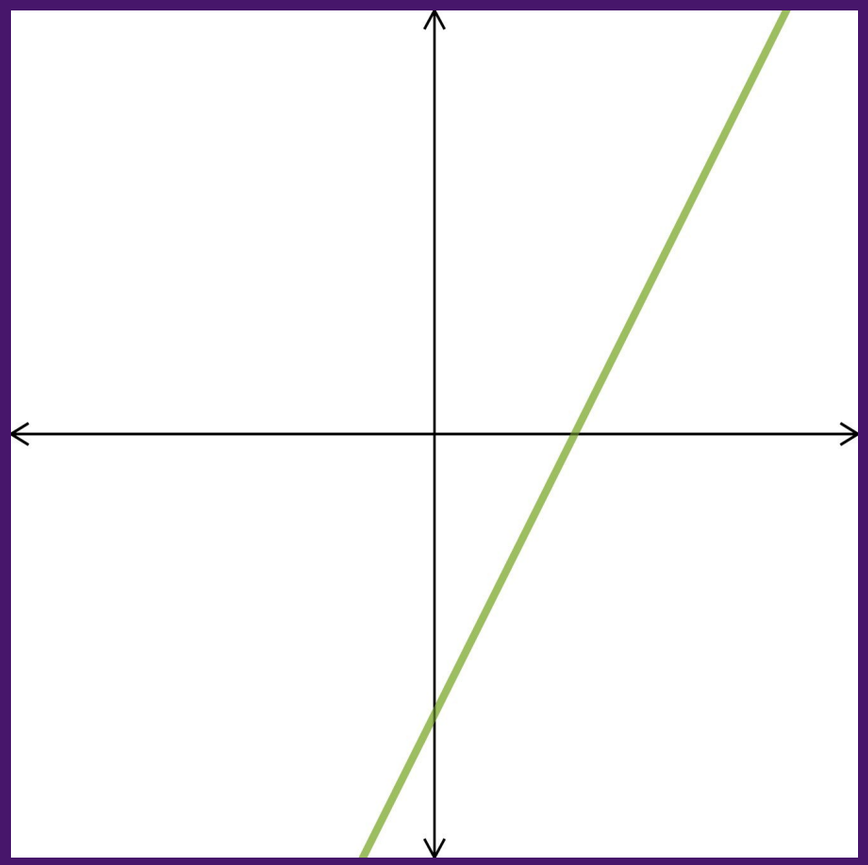
@ChrisHunter36

reflectionsinthewhy.wordpress.com/bcamt2019









WHICH ONE DOESN'T BELONG?

NUMBERS

Find a reason why each one does not belong.

9	16
25	43

3	27
123	31

17	26
44	65

Open Middle

Using the digits 1 to 9 at most one time each, fill in the boxes to make the slope of the line that passes through the points as small as possible.

A(□, □)

B(□, □)

Open Middle®

Math problems that replace worksheets

SEARCH RESULTS FOR: LINEAR RELATIONS

Non-Linear Correlations

November 19, 2015 0

Directions: Using the integers 0-9 (without repeating any number), create a set of points that have the following characteristics: Non-linear Positive Correlation (__,__) (__,__) (__,__) (__,__) (__,__) Non-linear Negative Correlation (__,__) (__,__) (__,__) (__,__) (__,__) No Correlation (__,__) (__,__) (__,__) (__,__) (__,__) Source: Bryan Anderson

Read More »

Linear Function from Table of Values

February 23, 2015 4

Directions: Using the digits 1 to 9 at most one time each, fill in the boxes to create a table of values that represent a linear function. Source: Robert Kaplinsky

Read More »

System of Equations – Table of Value and Slope Intercept Form

November 15, 2015 1

Search

OPEN MIDDLE WORKSHEET

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

BROWSE BY COMMON CORE STATE STANDARDS

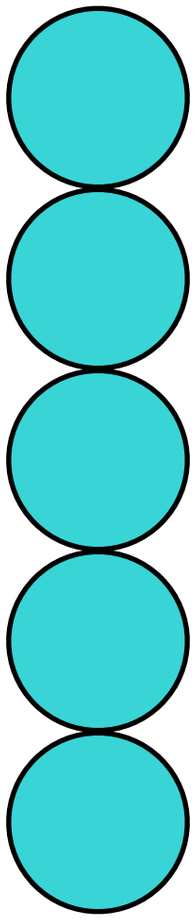
Kindergarten (13)
- Counting & Cardinality (3)
- Geometry (3)
- Number & Operations in Base Ten (1)
- Operations & Algebraic Thinking (6)

Grade 1 (18)
- Geometry (3)

WANTED

Linear Relation…
… positive y-intercept
… never passes through QIII
… positive x-intercept
… perpendicular to $y = \frac{1}{2}x + 3$
… decreases from left to right
… slope = -2
… x-intercept = 4
… has the same y-intercept as $8x - 3y + 24 = 0$
… passes through (1, 6)

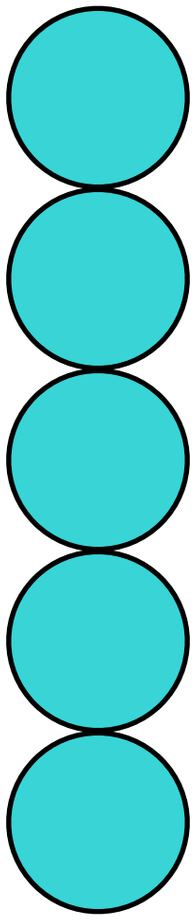
Visual Patterns



What comes *next*?

Michael Fenton • @mjfenton

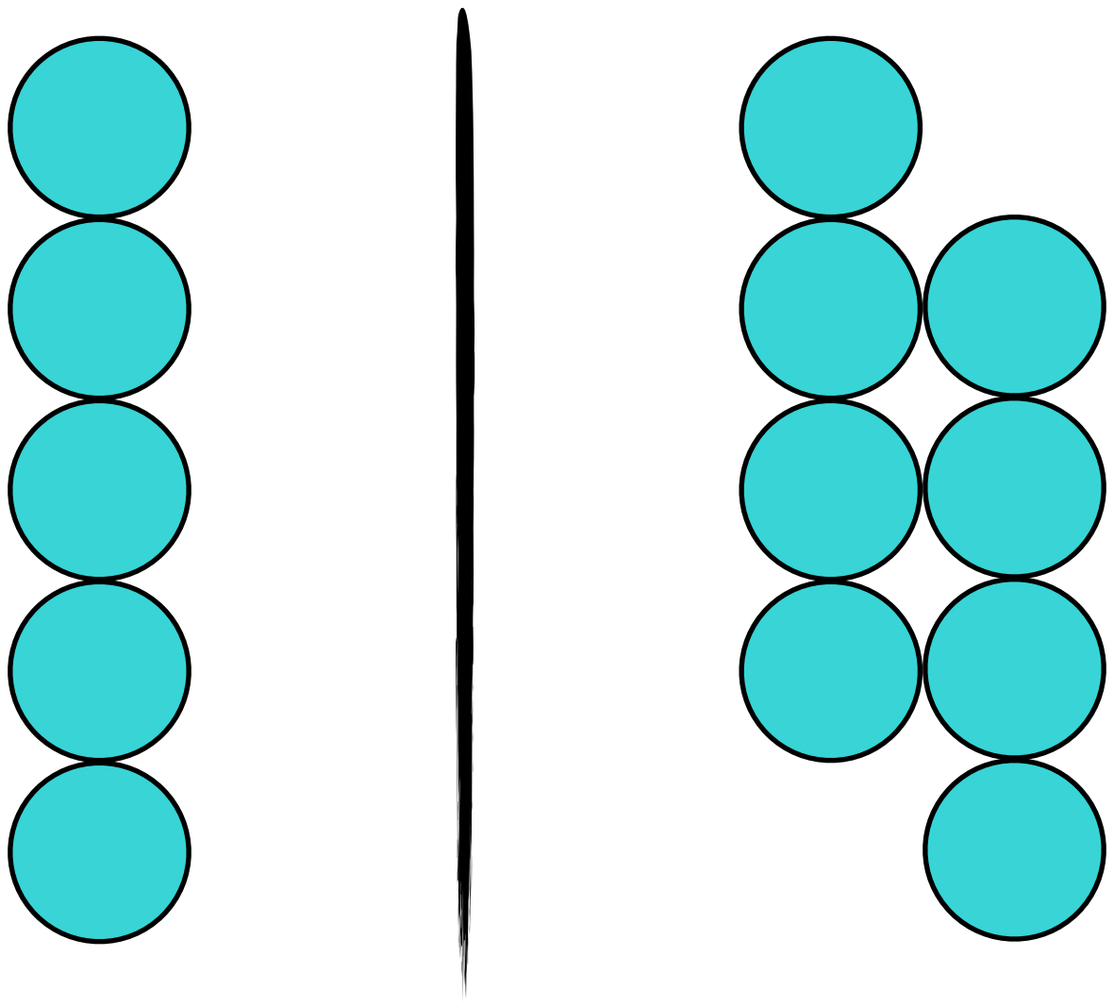
Visual Patterns



What else?

Michael Fenton • @mjfenton

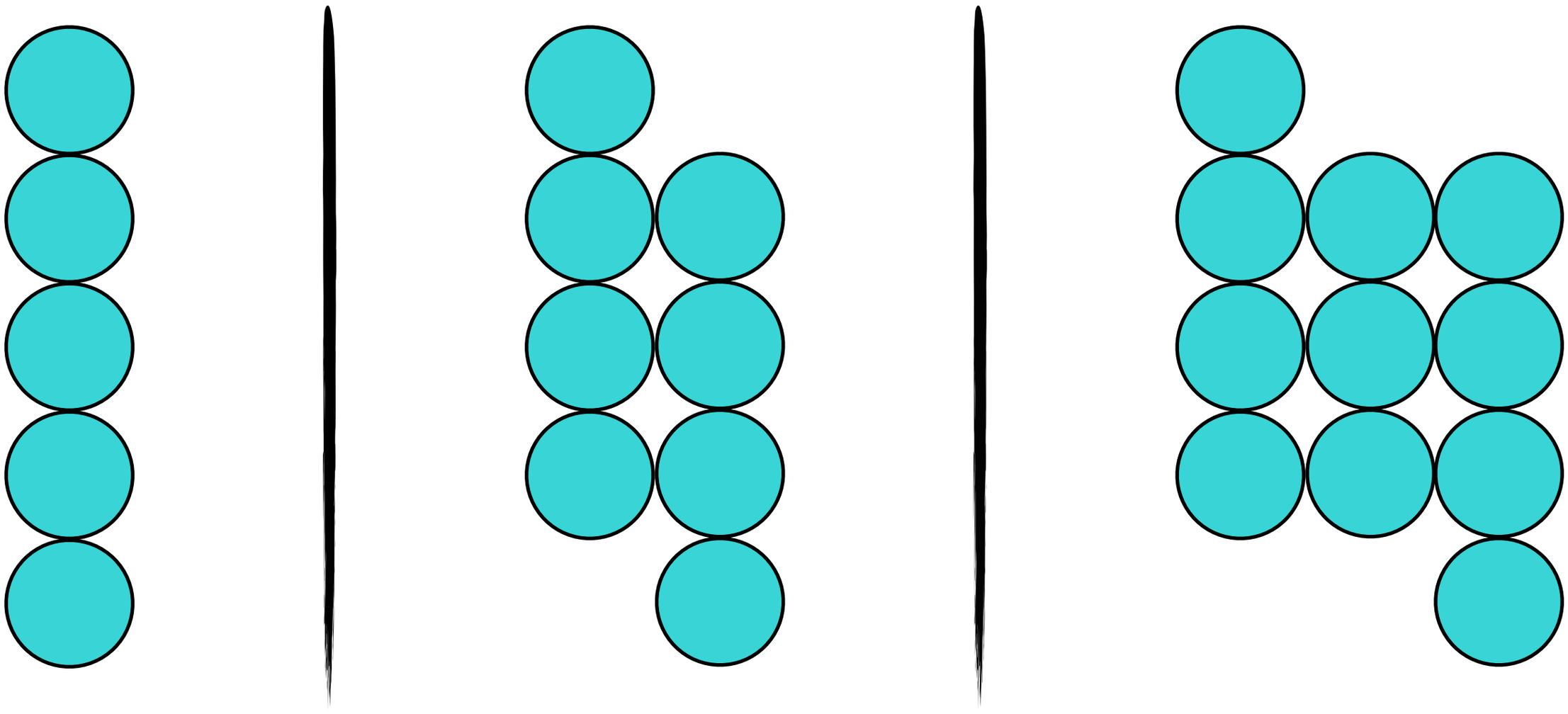
Visual Patterns



What comes *next*?

Michael Fenton • @mjfenton

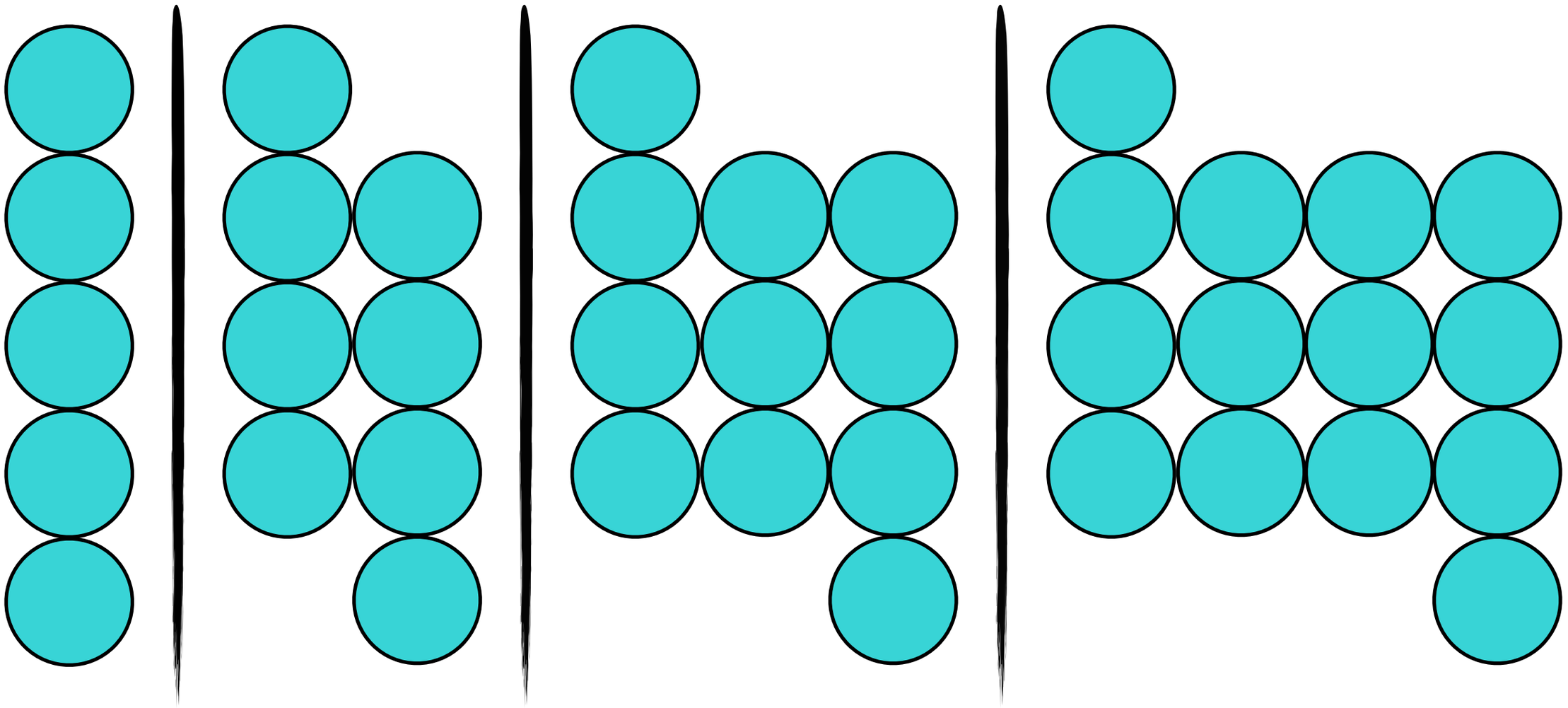
Visual Patterns



What comes *next*?

Michael Fenton • @mjfenton

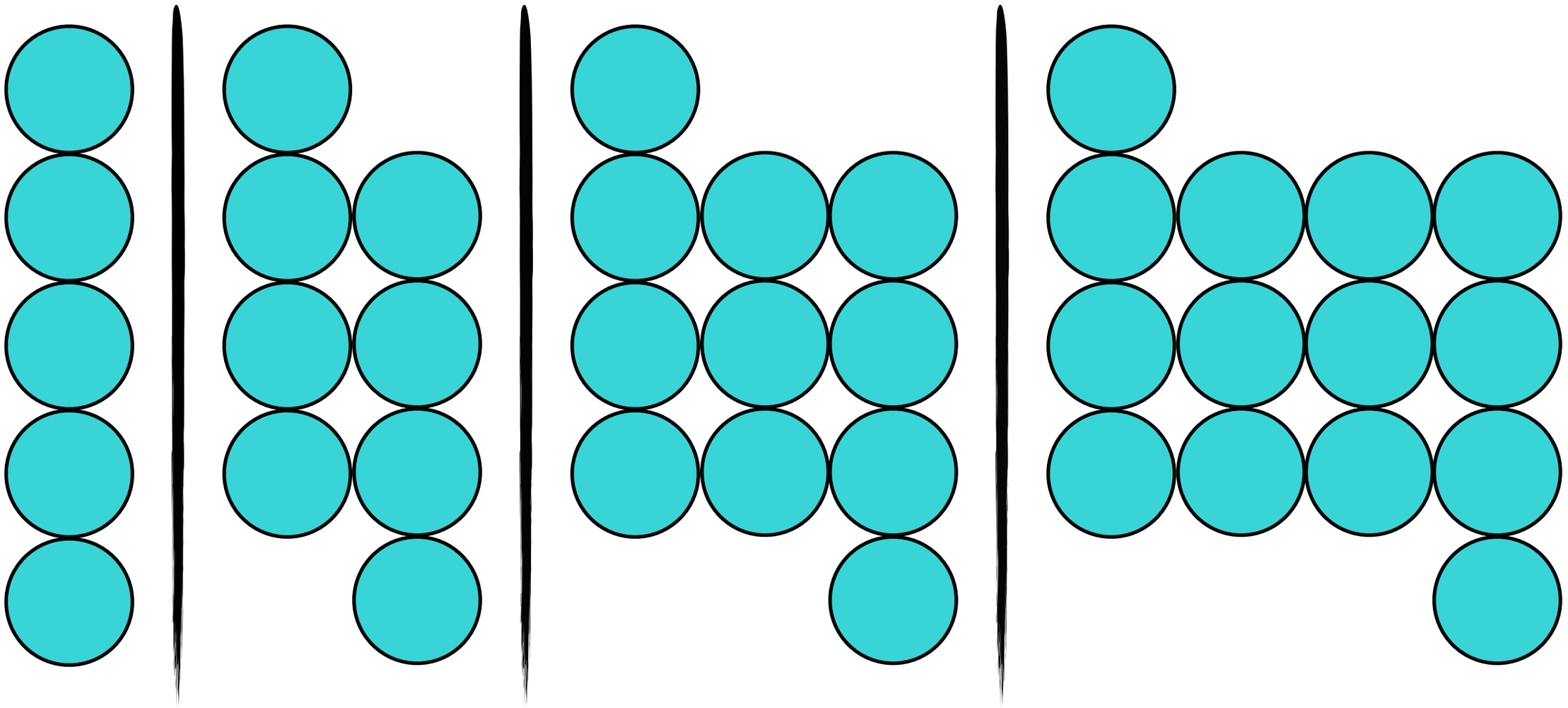
Visual Patterns



What comes *next*?

Michael Fenton • @mjfenton

Visual Patterns



How many in Figure 10?

Michael Fenton • @mjfenton

Visual Patterns

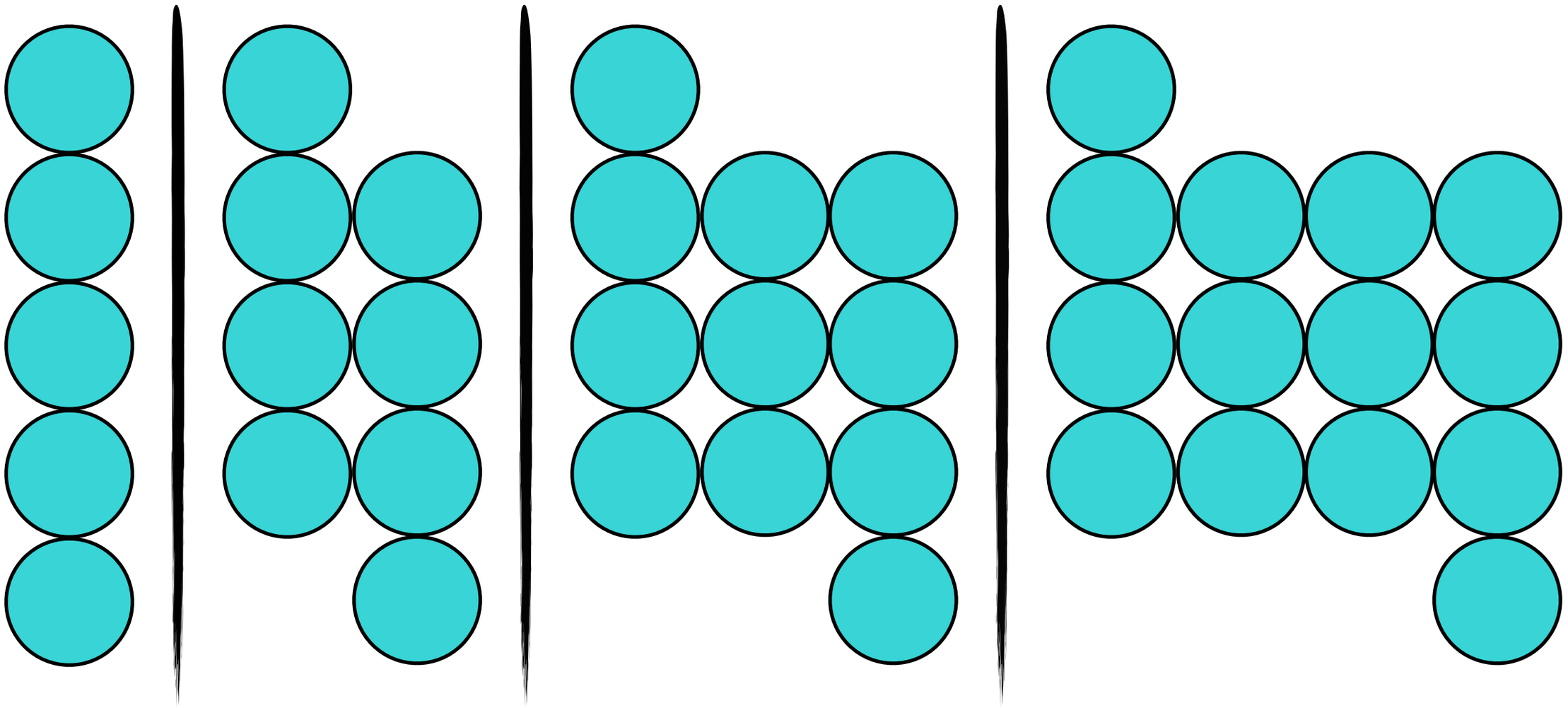


Figure *n*?

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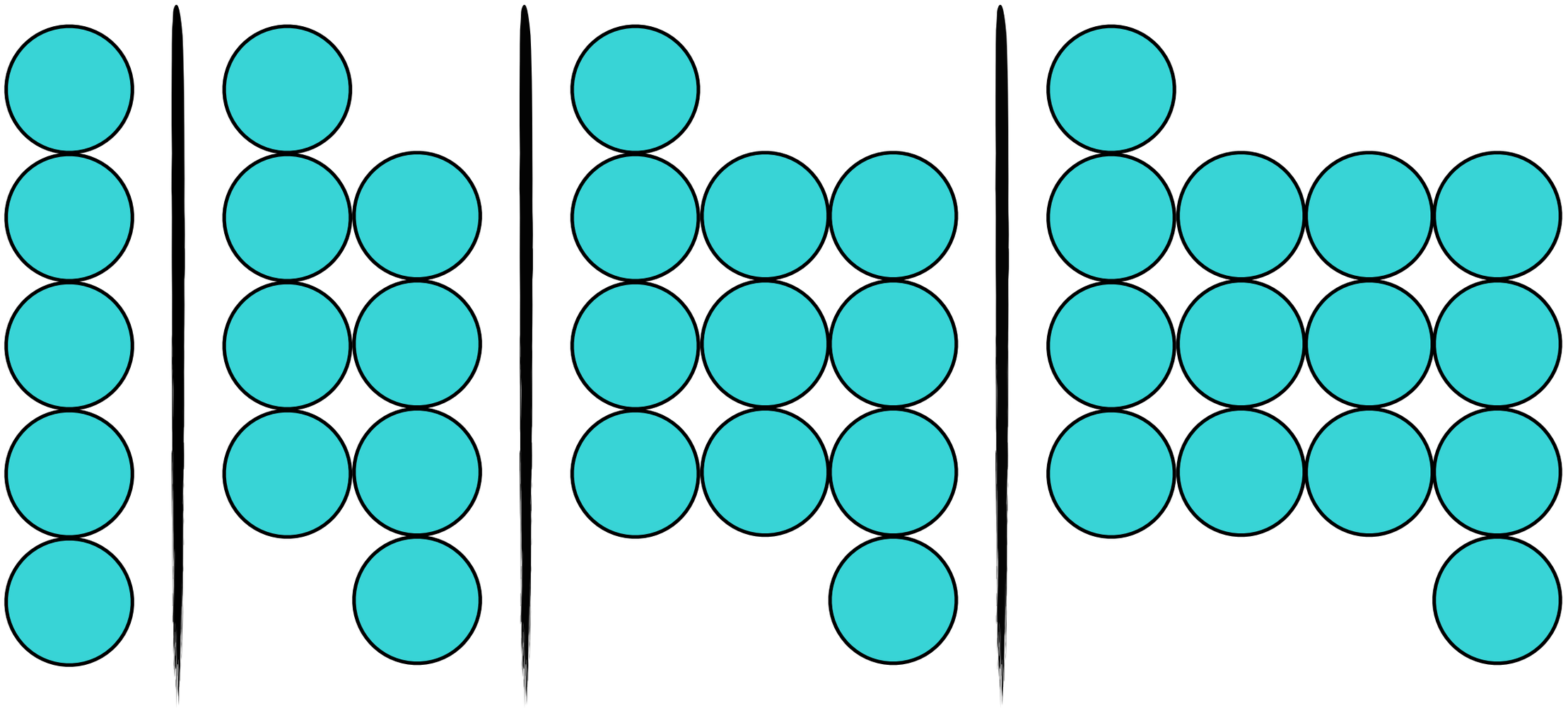
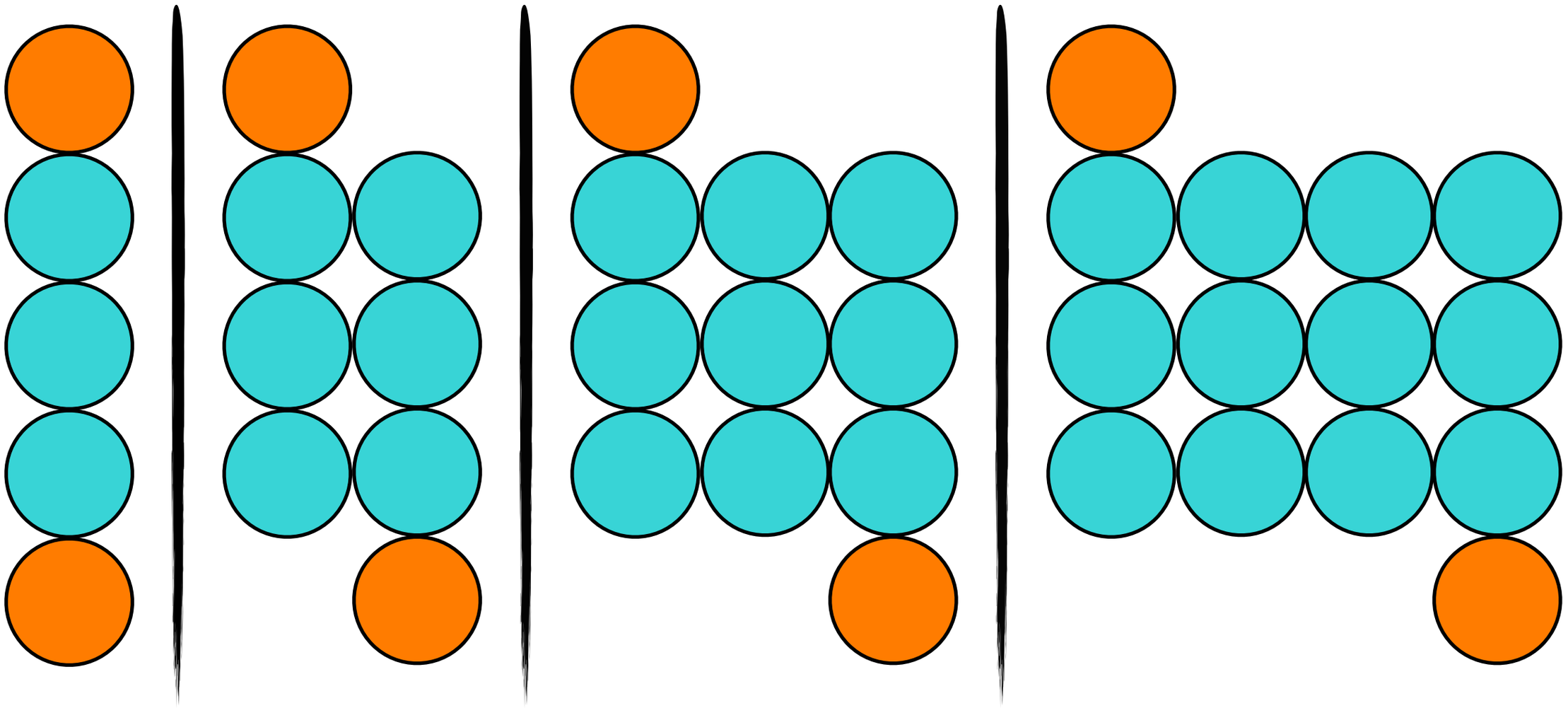
Visual Patterns



How do you see it?

Michael Fenton • @mjfenton

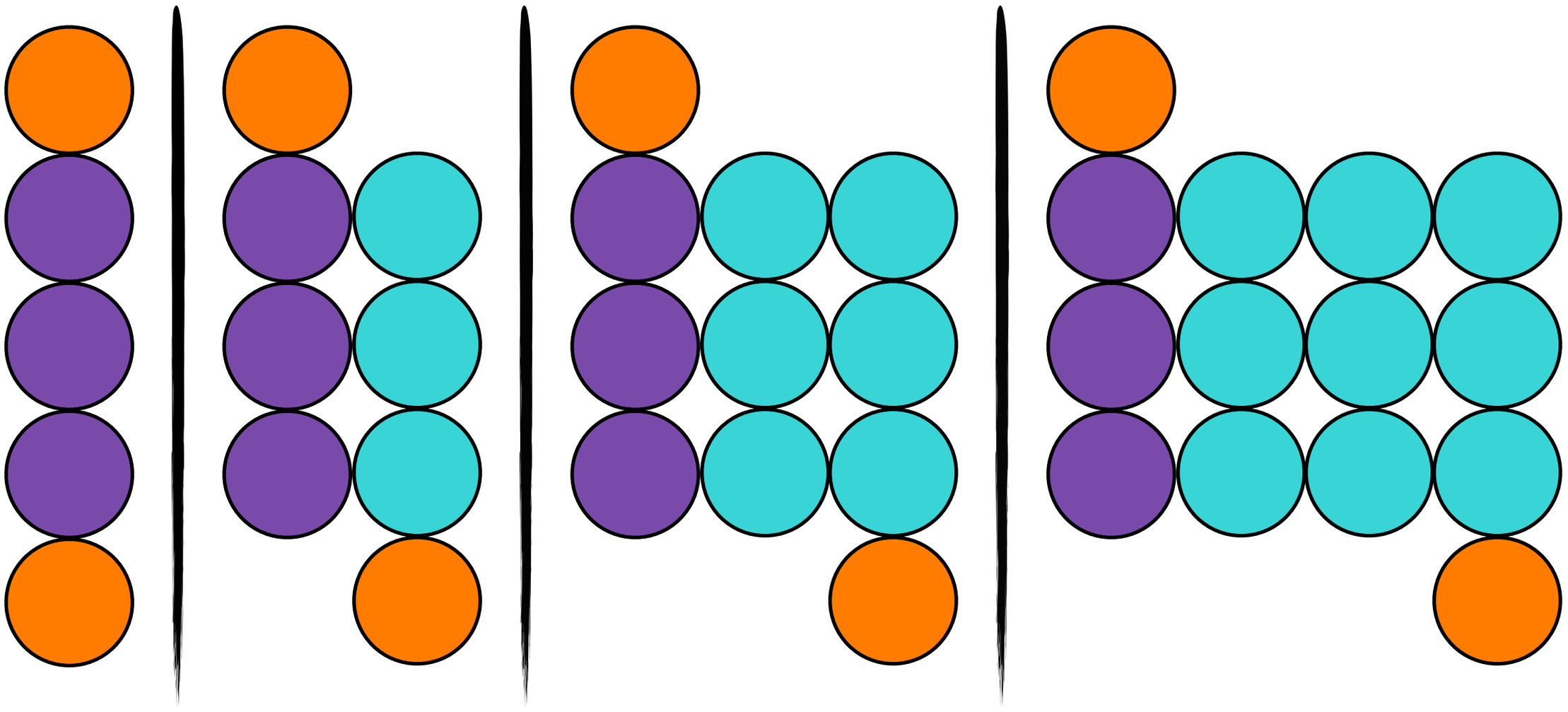
Visual Patterns



$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

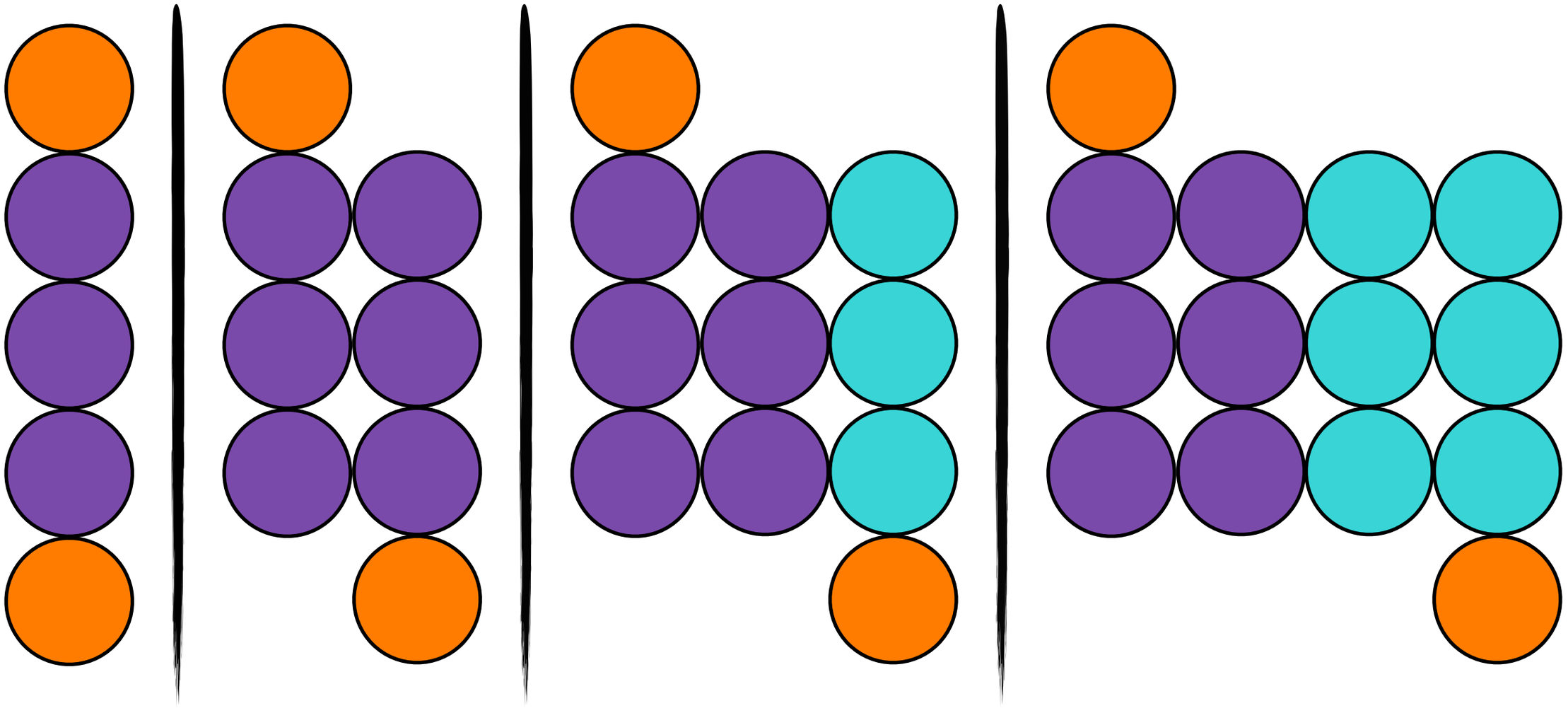


n groups of 3

$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

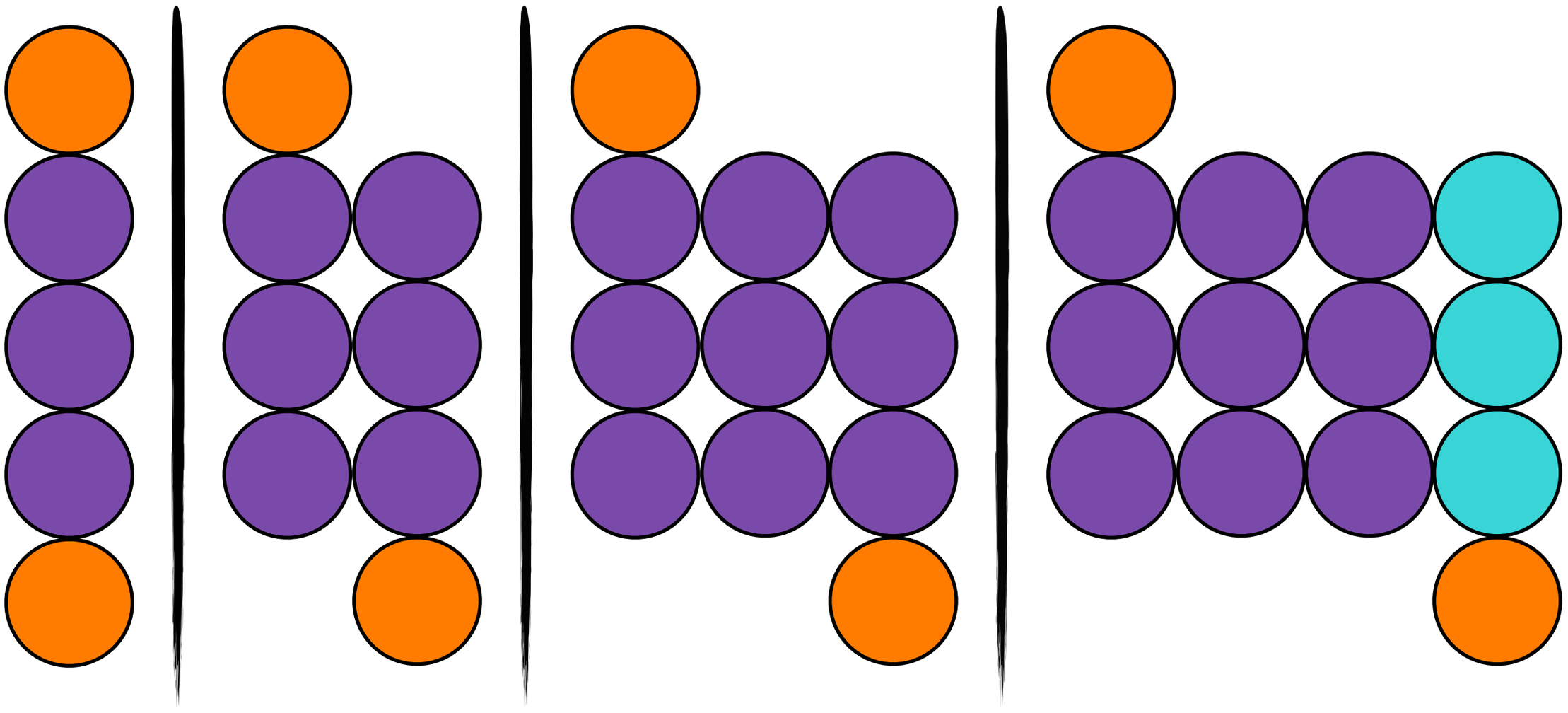


n groups of 3

$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

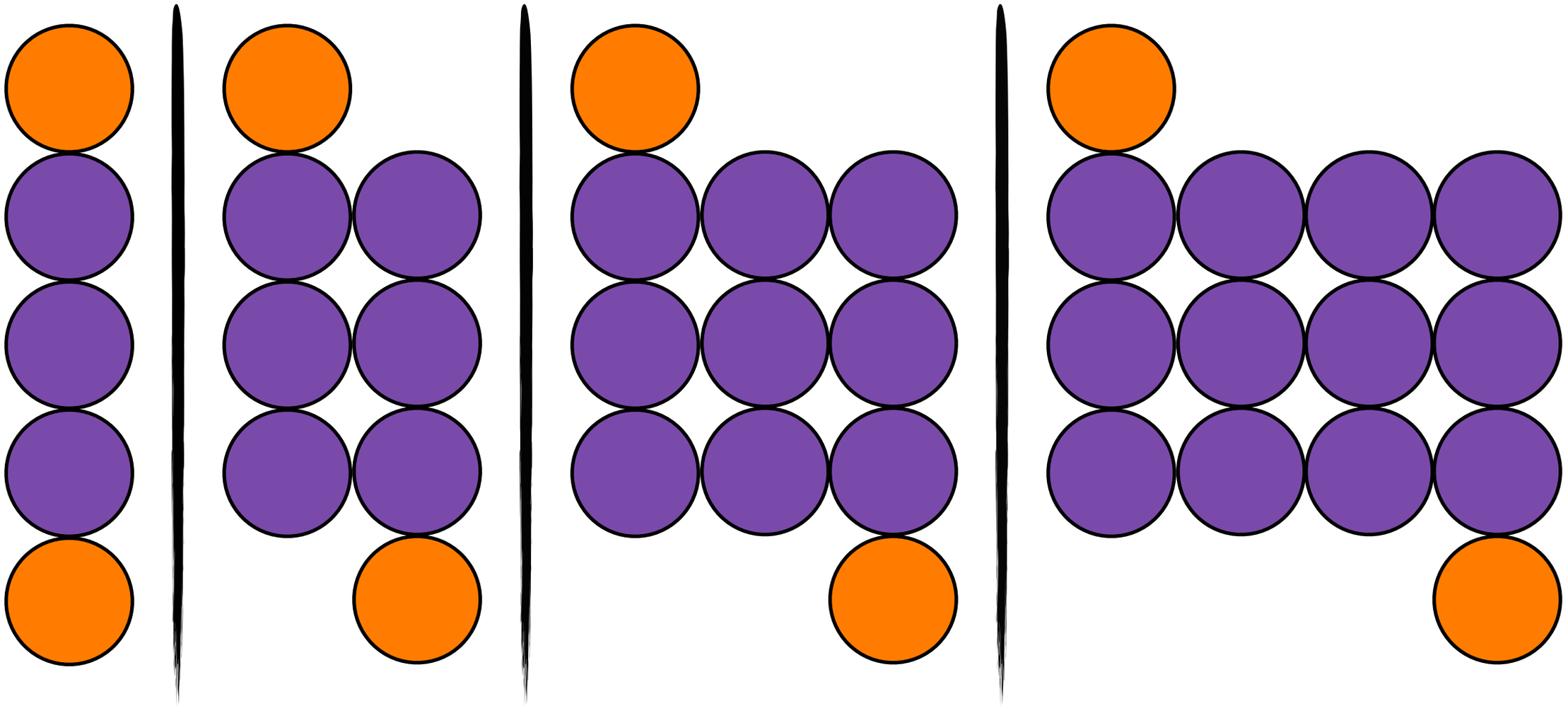


n groups of 3

$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

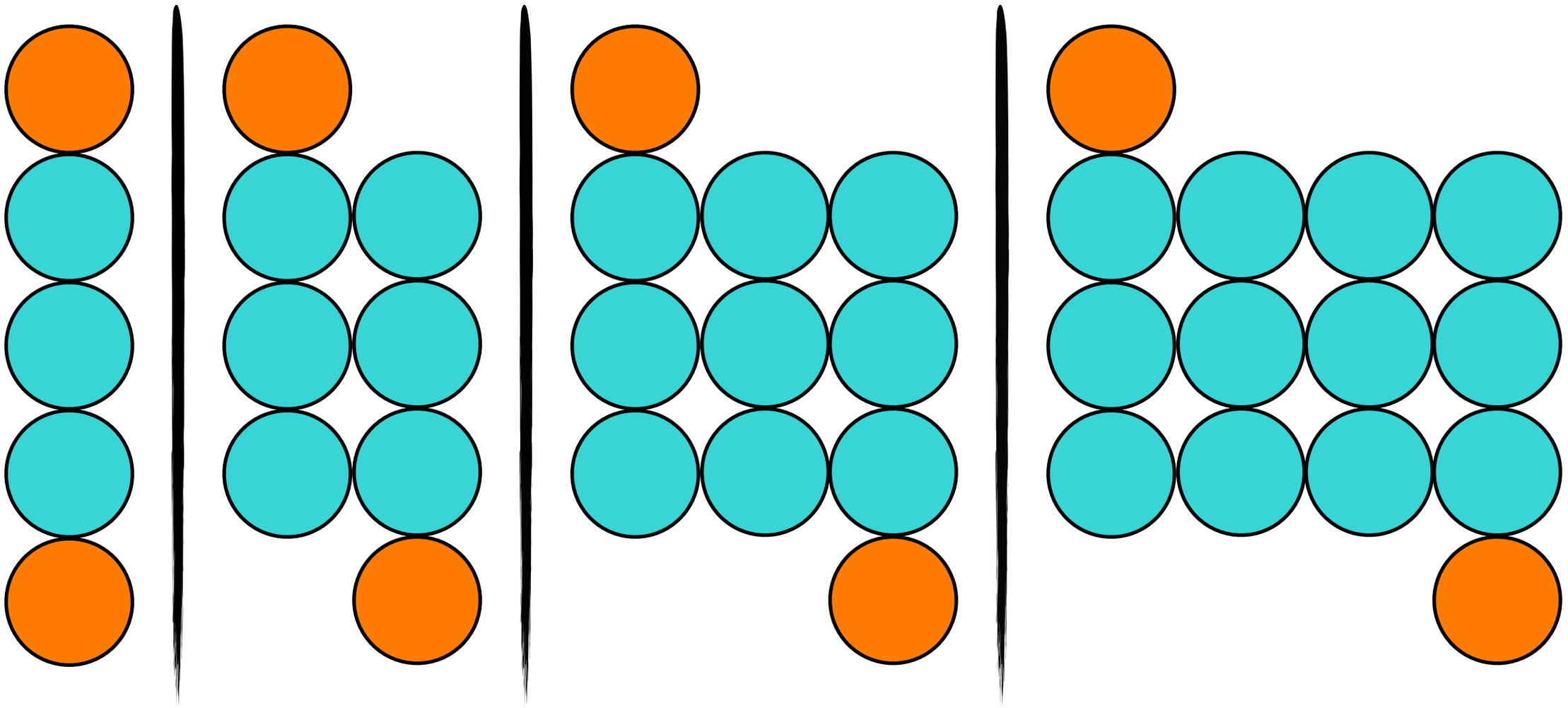


n groups of 3

$3n + 2$

Michael Fenton • @mjfenton

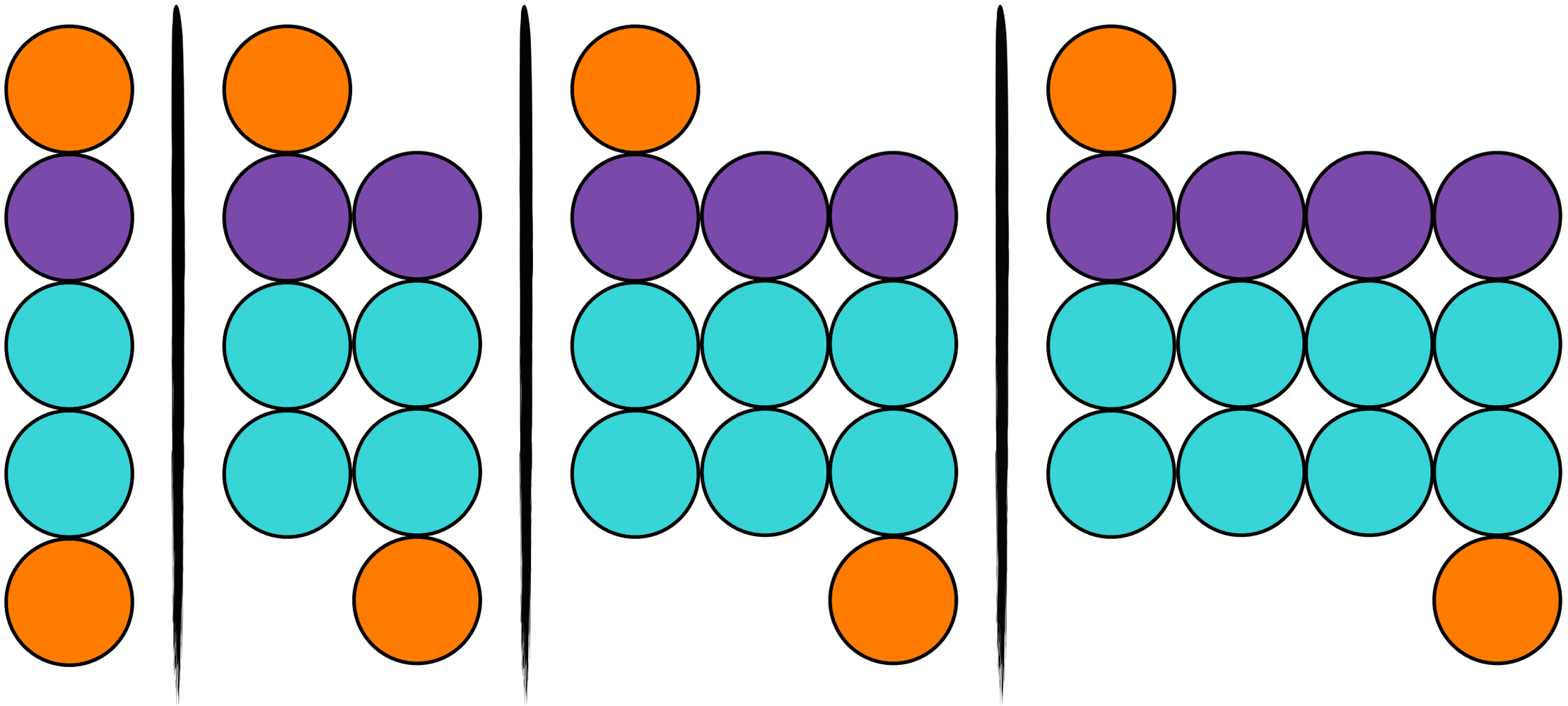
Visual Patterns



$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

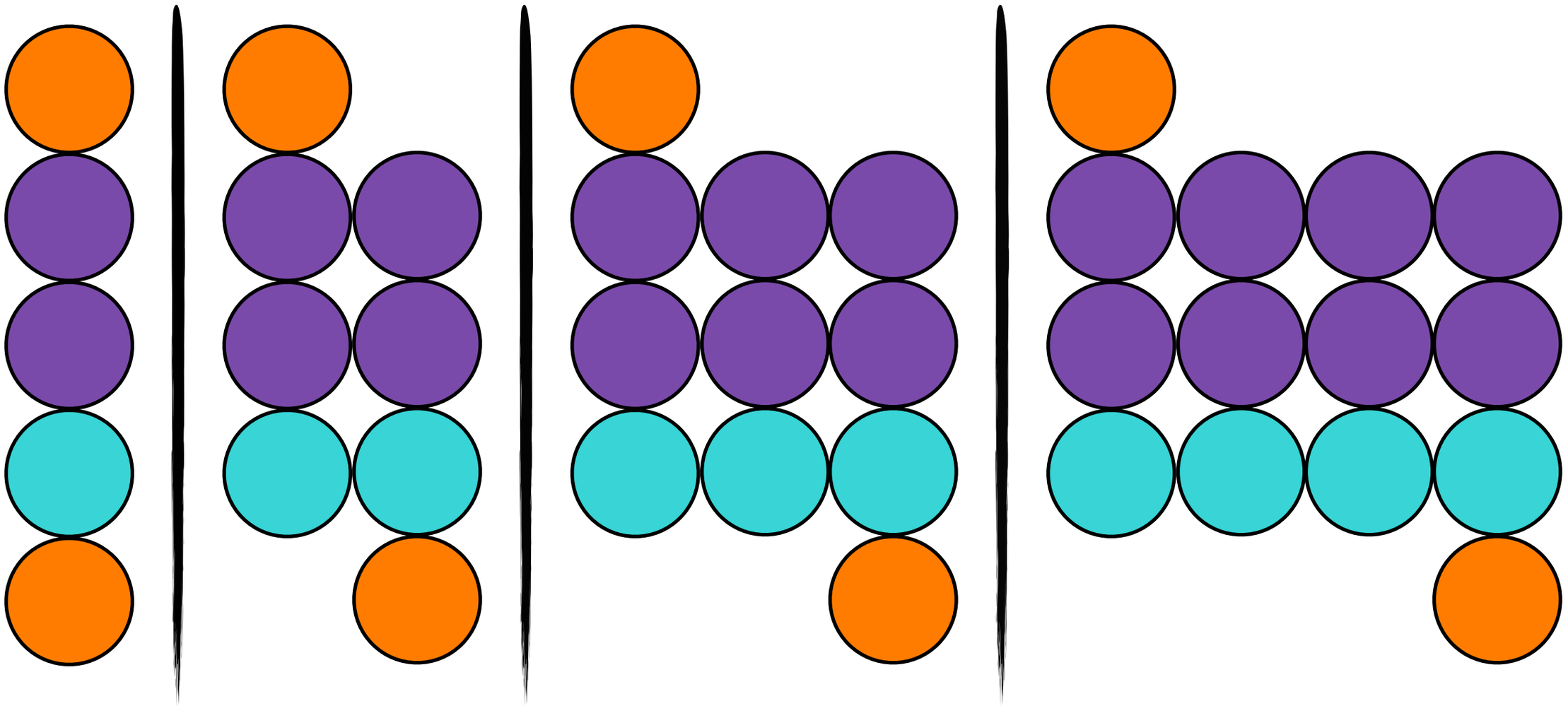


3 groups of n

$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

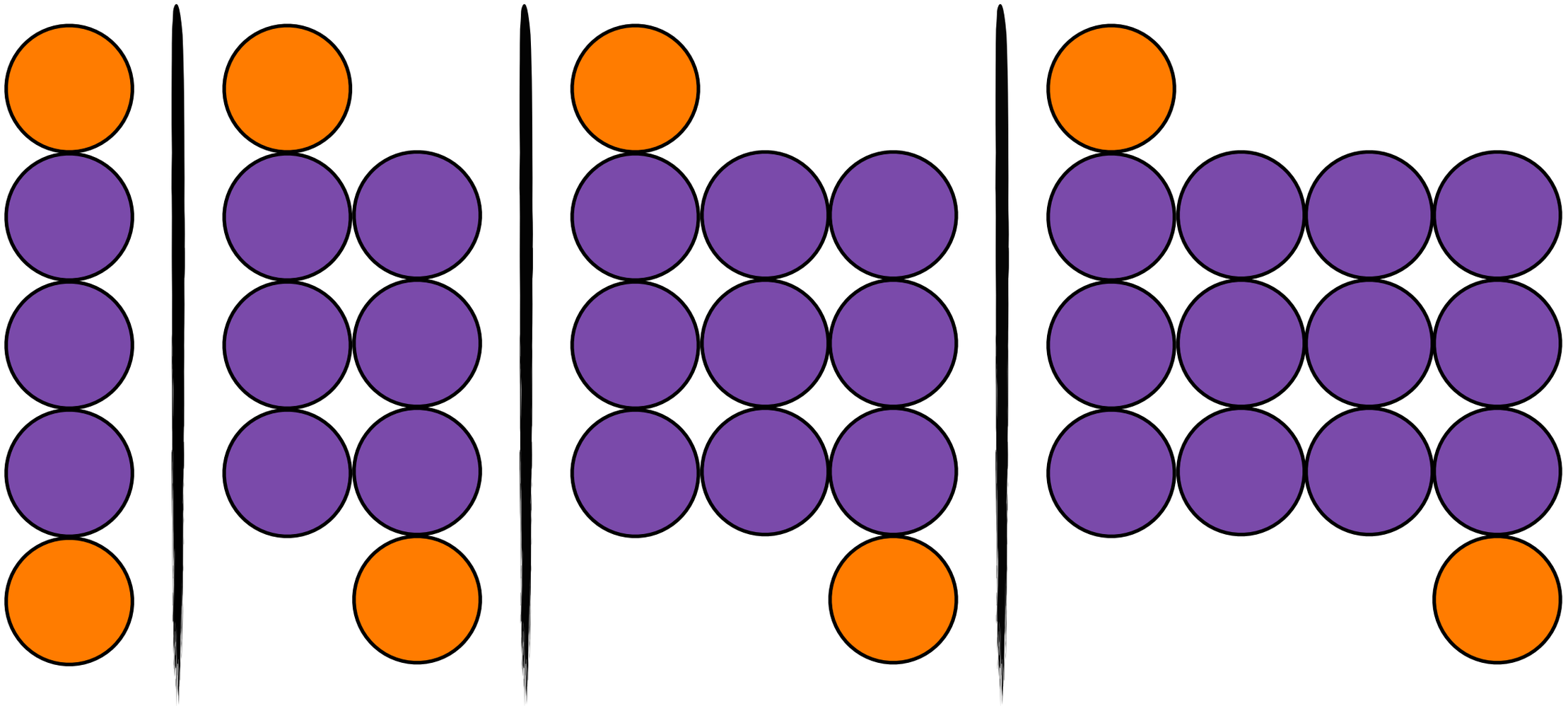


3 groups of n

$3n + 2$

Michael Fenton • @mjfenton

Visual Patterns

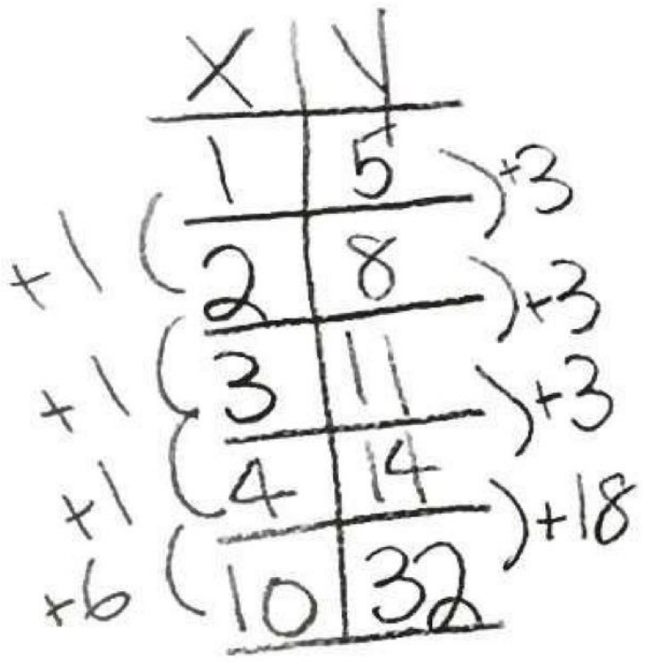


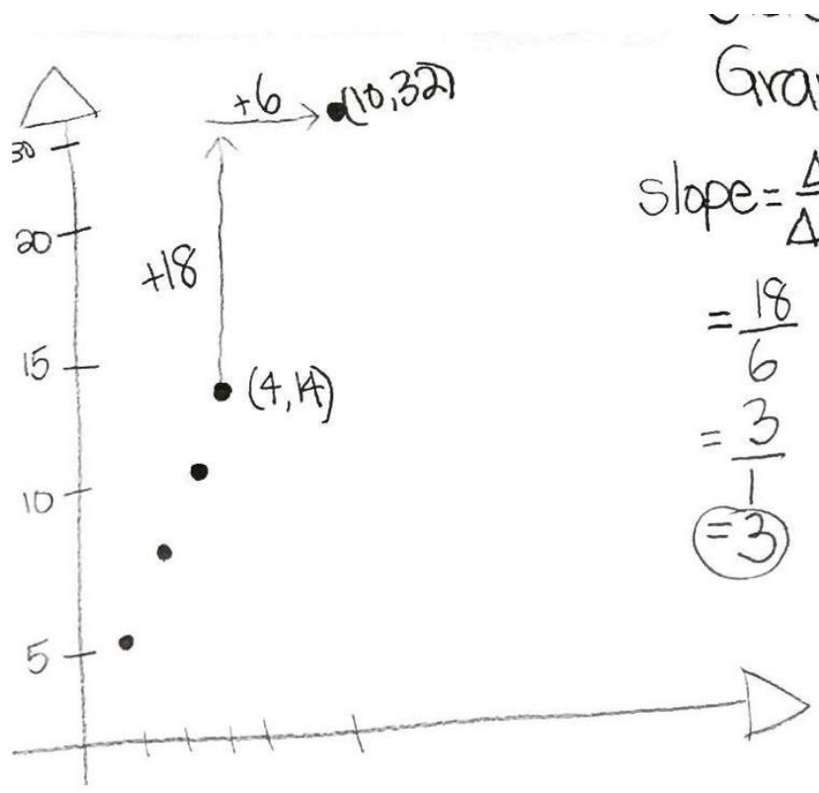
3 groups of n

$3n + 2$

Michael Fenton • @mjfenton

<u>Visual</u> Patterns

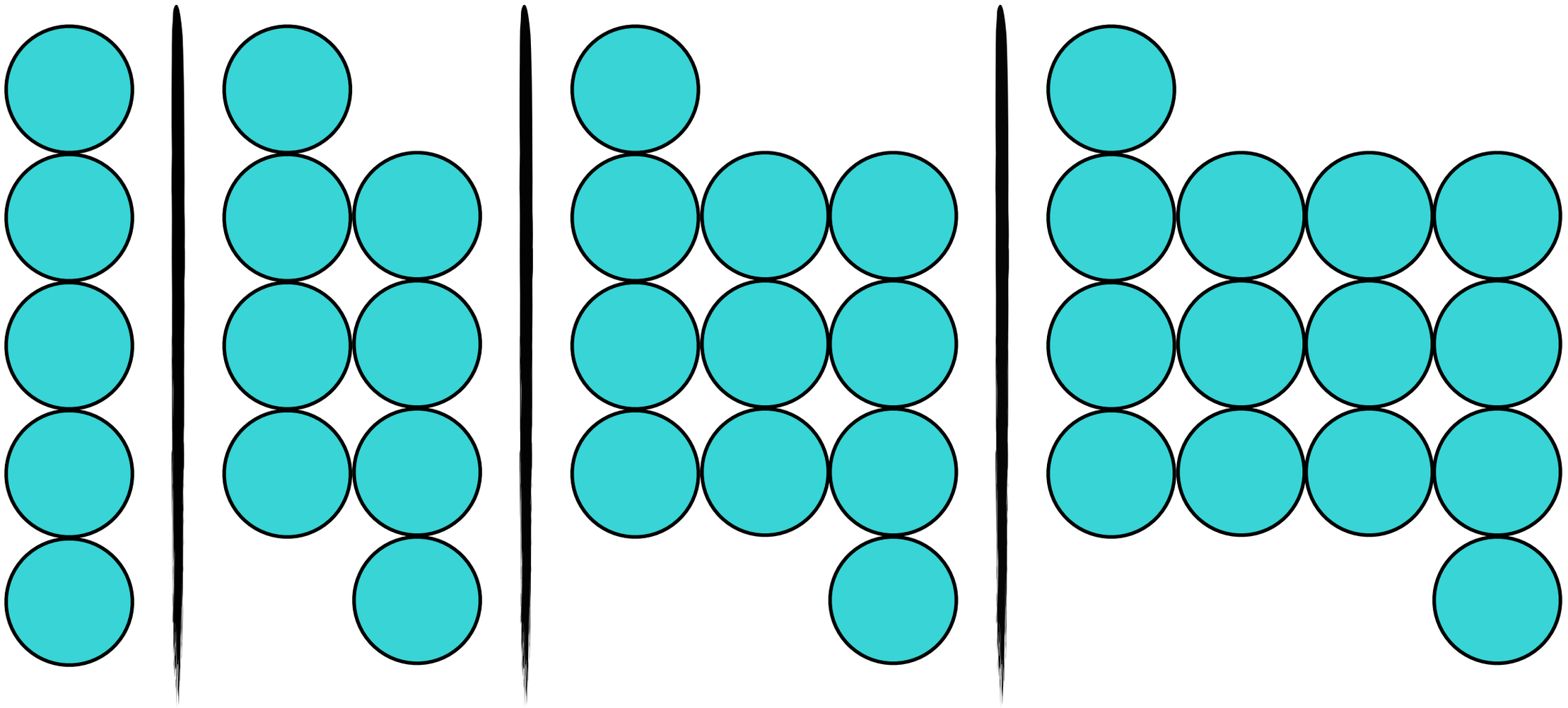




$$3n + 2$$

Michael Fenton • @mjfenton

Visual Patterns



In what figure will the number of circles exceed 100?

Michael Fenton • @mjfenton

Visual Patterns

- What comes *next*?
- *What else* could come next?
- What comes *before*?
- What comes *between*?
- What comes *way down the line*?

What comes *next*?

What else could come next?

@WOMIworldwide

#sidewalkmath

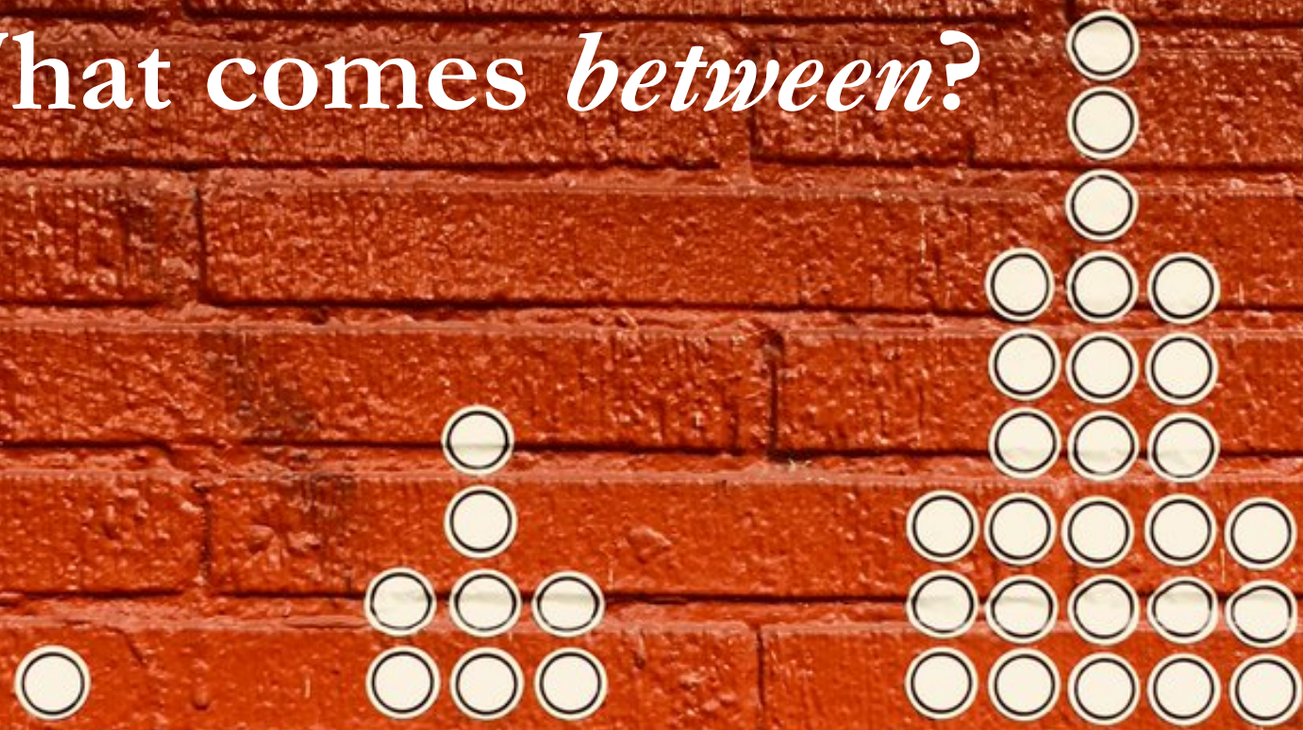
What comes *before*?

Brian Palacios • @_b_p
#sidewalkmath

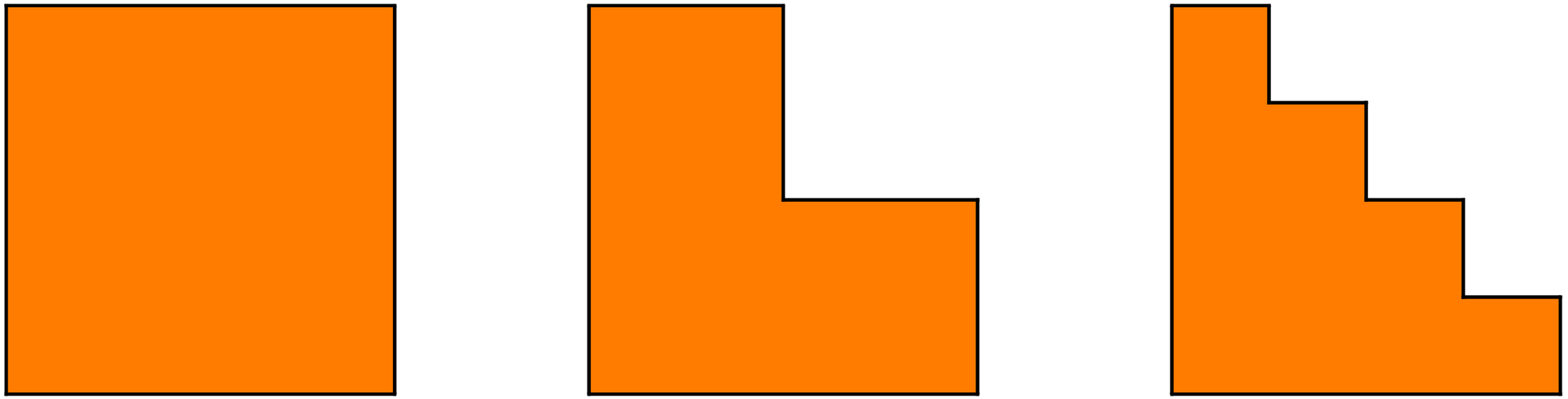
What comes *between*?

how many in figure 43?

What comes *between*?



how many in figure 43?

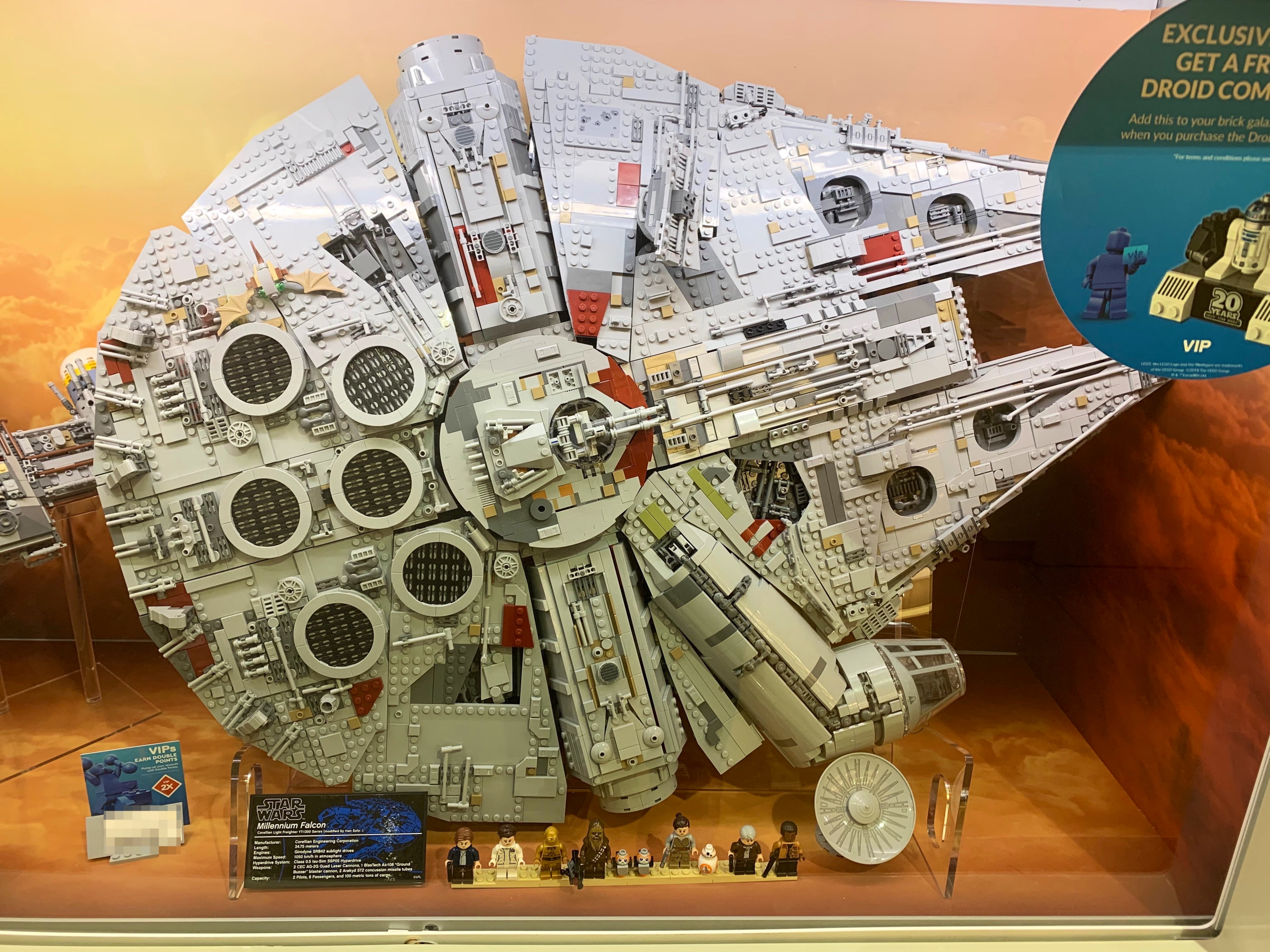


What comes *way down the line*?

Michael Fenton • @mjfenton

Visual Patterns

Click on a pattern to see a larger image and the answer to step 43. **What is the equation?**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DROID COM
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20
YEARS
VIPs
EARN DOUBLE
POINTS
Pump up your rewards
with Double Points.
VIP
2x
STAR
WARS
Millennium Falcon
Corellian Light Freighter YT-1300 Series (modified by Han Solo)
Manufacturer: Corellian Engineering Corporation
Length: 34.75 meters
Engines: Girodyne SRB42 sublight drives
Maximum Speed: 1050 km/h in atmosphere
Hyperdrive System: Class 0.5 Isu-Sim SSP05 Hyperdrive
Weapons: 2 CEC AG-2G Quad Laser Cannons, 1 BlasTech Ax-108 "Ground Buzzer" blaster cannon, 2 Arakyd ST2 concussion missile tubes
Capacity: 2 Pilots, 6 Passengers, and 100 metric tons of cargo.
CLFL

3-Act Math Tasks

- What do you *notice*?
- What do you *wonder*?
- Write down an estimate that is:
  - too low
  - too high
  - just right
- What information would be helpful to have here?


LEGO
STAR WARS
ULTIMATE COLLECTOR SERIES
16+
75192
Millennium Falcon™
7541 PCS/PZS

7541 pieces

1329 pieces

$179.99

How confident are you?

7514 pieces

?

1329 pieces

$179.99

4016 pieces

?

193 pieces

?

How confident are you now?

4016 pieces
$599.99

193 pieces
$24.99

How confident are you now?

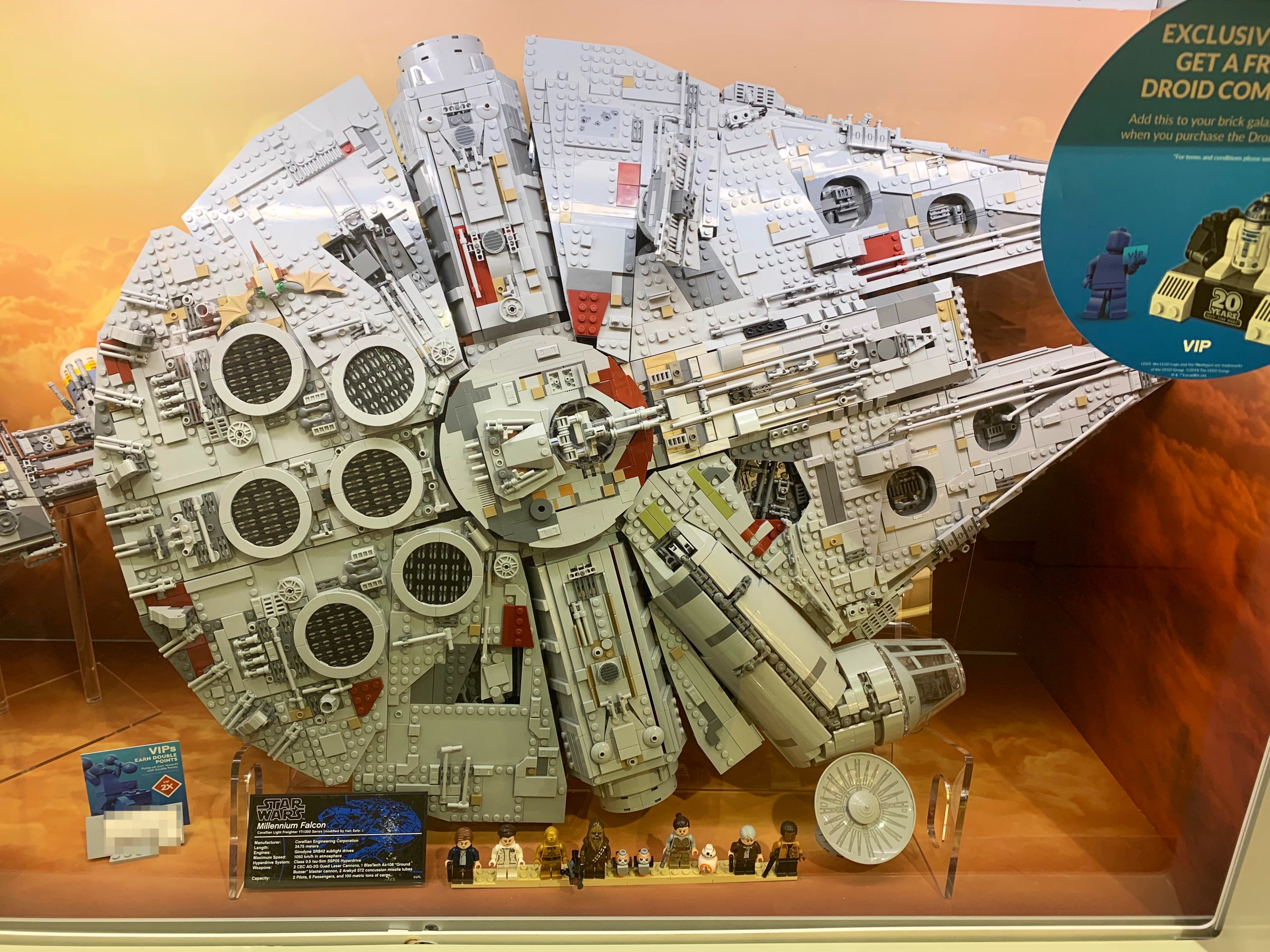
How confident are you now?

1106 pieces

$129.99

717 pieces

$99.99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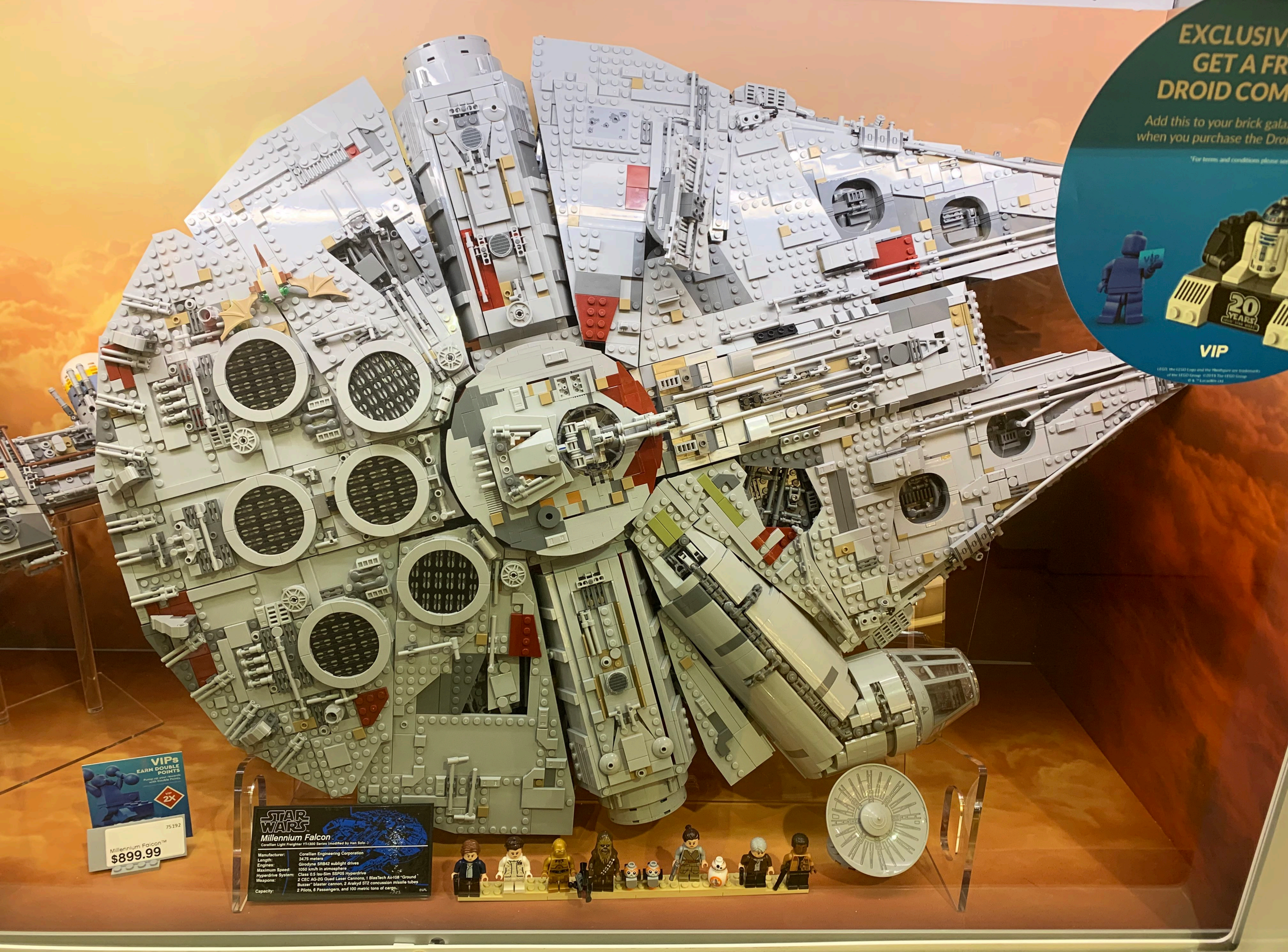
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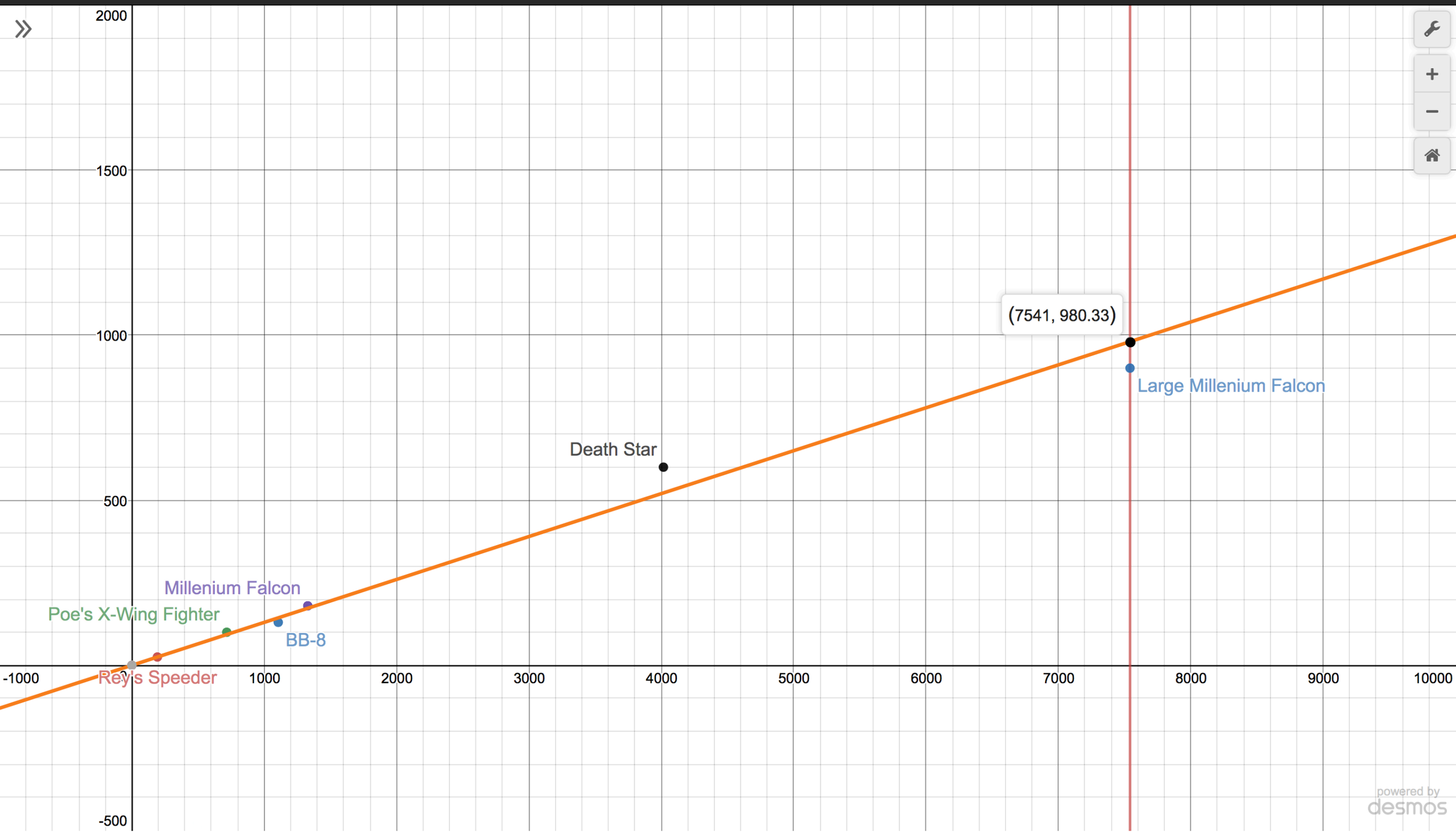
Corellian Light Freighter YT-1300 Ser
Manufacturer:
Length:
Engines:
Maximum Speed:
Hyperdrive System:
Weapons:
Capacity:
Corellian En
34.75 meters
Girodyne SR
1050 km/h in
Class 0.5 Isu
2 CEC AG-2G
Buzzer" blast
2 Pilots, 6 Pa

desmos.com

Star Wars LEGO | Save | desmos | Chris



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LEGO Prices

Teacher Guide

by Desmos | 30-45 minutes | Application

Mobile | Tablet | Laptop | Screen Reader Friendly

In this activity, students use sliders to explore the relationship between price and number of pieces for various Star Wars LEGO sets and to make several predictions based on that model. Students will also interpret the parameters of their equation in context.

Image Credit
Screen 7: The LEGO Group

French translation courtesy of Maryse LeBouthillier: https://teacher.desmos.com/activitybuilder/custom/58ebe320b52e4e08377eae3f

As seen in:

Linear Bundle
7 Activities

Classes

Create Class Code

Sign in to see your classes and create new ones.

Screens

Student Preview

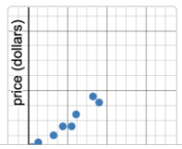
1 Make a Prediction

Mackenzie built the small LEGO set. It cost $5.49.

2 Sketch the Relationship

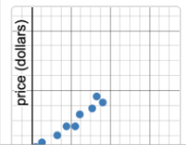
One way to make a more accurate prediction is to

3 Build a Model



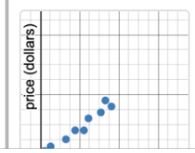
The blue points represent price and number of pieces for several LEGO

4 Use your Model



The model you built on Screen 3 is shown in red.

5 Interpret the Slope



The equation of your model is $y = kx$.

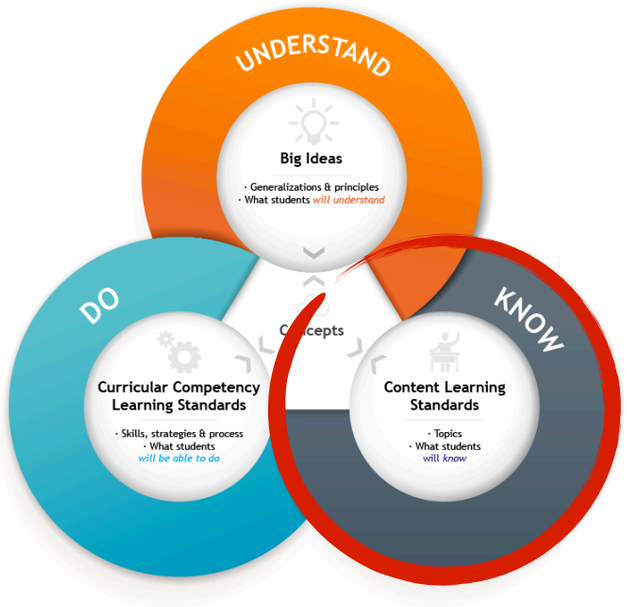
Kyle Pearce • @MathletePearce

Kyle Pearce • @MathletePearce

Kyle Pearce • @MathletePearce

Kyle Pearce • @MathletePearce


UNDERSTAND
Big Ideas
· Generalizations & principles
· What students will understand
DO
Curricular Competency Learning Standards
· Skills, strategies & process
· What students will be able to do
Concepts
KNOW
Content Learning Standards
· Topics
· What students will know

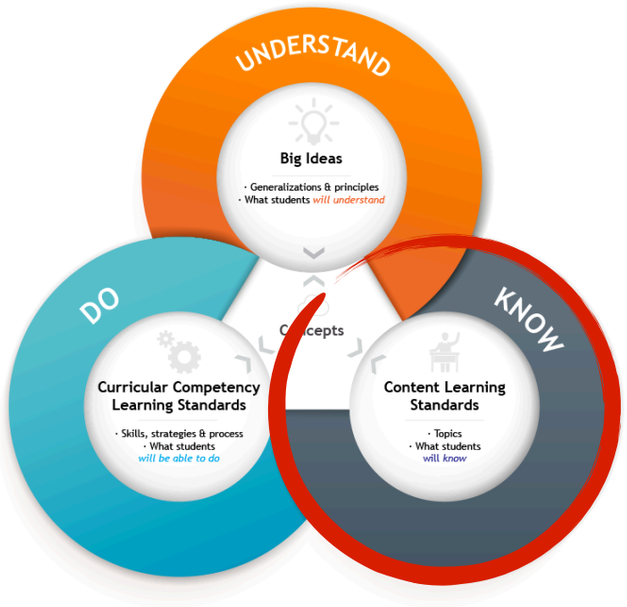


Big Idea(s)

Competencies

Content

linear equations: slopes and equations of lines



Big Idea(s)

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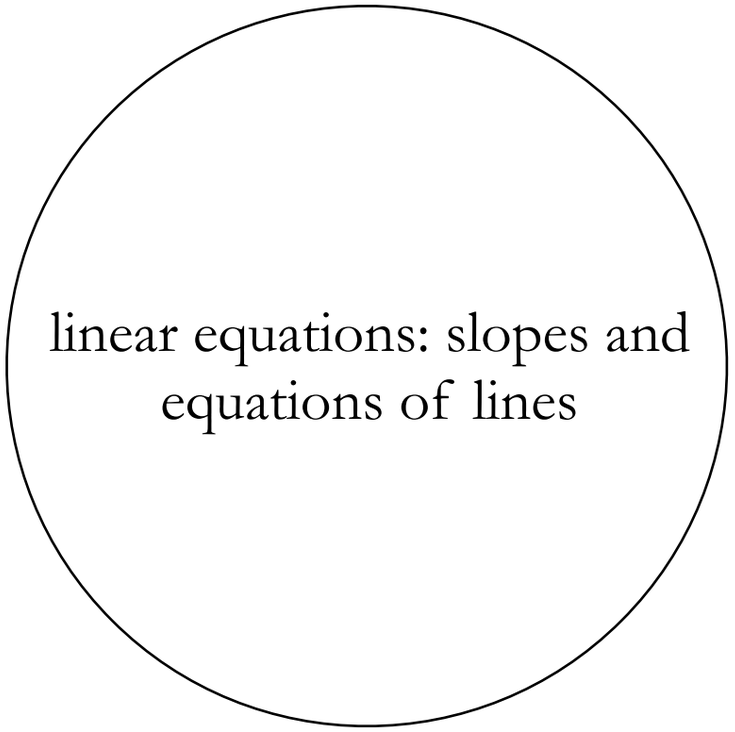
linear equations: slopes and equations of lines

Foundations & Pre-calculus 10



Math 9

two-variable continuous linear relations; includes rational coordinates

Foundations & Pre-calculus 10

linear equations: slopes and equations of lines

Math 8

discrete linear relations (extended to larger numbers, limited to integers)

Math 9

two-variable continuous linear relations; includes rational coordinates

Foundations & Pre-calculus 10

linear equations: slopes and equations of lines

Math 7

discrete linear relations, using expressions, tables, and graphs (four quadrants; limited to integral coordinates)

Math 8

discrete linear relations (extended to larger numbers, limited to integers)

Math 9

two-variable continuous linear relations; includes rational coordinates

Math 6

increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships (limited to discrete points in the first quadrant)

Math 7

discrete linear relations, using expressions, tables, and graphs (four quadrants; limited to integral coordinates)

Math 8

discrete linear relations (extended to larger numbers, limited to integers)

Big Idea(s)

Constant rate of change is an essential attribute of linear relations and has meaning in different representations and contexts.

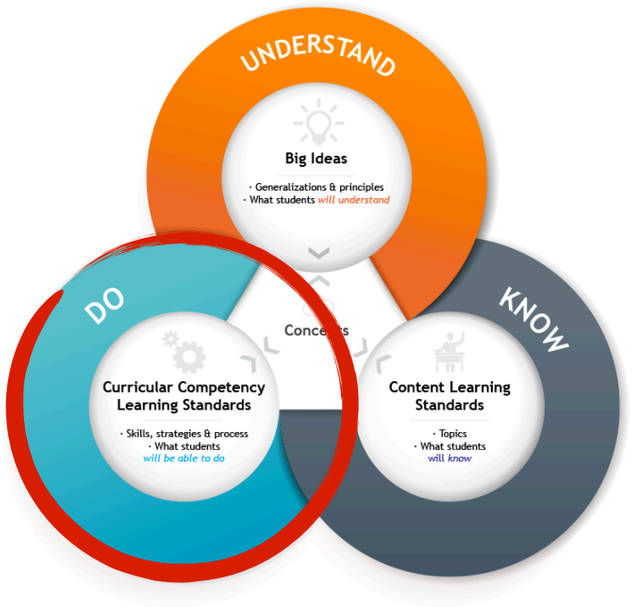
Competencies

Content

linear equations: slopes and equations of lines

Big Ideas: Essential Qs

- What are important features of lines?
- How do these appear in tables, graphs, and equations?
- Which representation should I use?
- How can I make predictions?



Big Idea(s)

Constant rate of change is an essential attribute of linear relations and has meaning in different representations and contexts.

Competencies

?

Content

linear equations: slopes and equations of lines

Curricular Competency Connections

BRITISH COLUMBIA
Ministry of Education

Area of Learning: MATHEMATICS **Grade 5**

BIG IDEAS

Numbers describe quantities that can be represented by equivalent fractions.	Computational **fluency** and flexibility with numbers extend to operations with larger (multi-digit) numbers.	Identified regularities in number **patterns** can be expressed in tables.	Closed shapes have **area and perimeter** that can be described, measured, and compared.	**Data** represented in graphs can be used to show many-to-one correspondence.

Learning Standards

Curricular Competencies	Content
Students are expected to do the following: **Reasoning and analyzing** • Use reasoning to explore and make connections • **Estimate reasonably** • Develop **mental math strategies** and abilities to make sense of quantities • Use **technology** to explore mathematics • **Model** mathematics in contextualized experiences **Understanding and solving** • Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving • Visualize to explore mathematical concepts • Develop and use **multiple strategies** to engage in problem solving • Engage in problem-solving experiences that are **connected** to place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures **Communicating and representing** • **Communicate** mathematical thinking in many ways • Use mathematical vocabulary and language to contribute to mathematical discussions • **Explain and justify** mathematical ideas and decisions • Represent mathematical ideas in **concrete, pictorial, and symbolic forms**	*Students are expected to know the following:* • **number concepts** to 1 000 000 • decimals to thousandths • equivalent fractions • whole-number, fraction, and decimal **benchmarks** • addition and subtraction of **whole numbers** to 1 000 000 • **multiplication and division** to three digits, including division with remainders • addition and subtraction of **decimals** to thousandths • **addition and subtraction facts to 20** (extending computational fluency) • multiplication and division **facts to 100** (emerging computational fluency) • rules for increasing and decreasing patterns with words, numbers, symbols, and variables • **one-step equations** with variables • area measurement of squares and rectangles • relationships between **area and perimeter** • duration, using measurement of **time** • **classification** of prisms and pyramids • single **transformations** • one-to-one correspondence and **many-to-one**
Connecting and reflecting • **Reflect** on mathematical thinking • Connect mathematical concepts to each other and to **other areas and personal interests** • **Incorporate** First Peoples worldviews and perspectives to **make connections** to mathematical concepts	**correspondence**, using double bar graphs • **probability experiments**, single events or outcomes • **financial literacy** — monetary calculations, including making change with amounts to 1000 dollars and developing simple financial plans

Curricular Competencies

Students are expected to do the following:

Reasoning and analyzing

- Use reasoning to explore and make connections
- **Estimate reasonably**
- Develop **mental math strategies** and abilities to make sense of quantities
- Use **technology** to explore mathematics
- **Model** mathematics in contextualized experiences

Understanding and solving

- Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving
- Visualize to explore mathematical concepts
- Develop and use **multiple strategies** to engage in problem solving
- Engage in problem-solving experiences that are **connected** to place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures

Communicating and representing

- **Communicate** mathematical thinking in many ways
- Use mathematical vocabulary and language to contribute to mathematical discussions
- **Explain and justify** mathematical ideas and decisions
- Represent mathematical ideas in **concrete, pictorial, and symbolic forms**

Connecting and reflecting

- **Reflect** on mathematical thinking
- Connect mathematical concepts to each other and to **other areas and personal interests**
- **Incorporate** First Peoples worldviews and perspectives to **make connections** to mathematical concepts

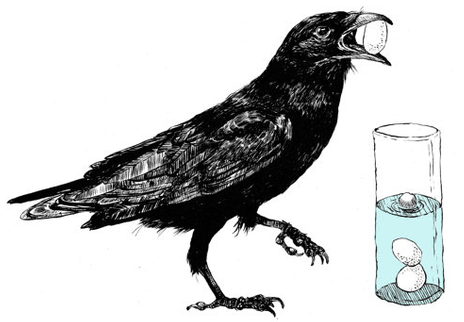
THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

UNIVERSITY OF CAMBRIDGE

Experiment 1
Sand vs. Water

Red-Blue – First trial

The Crow and The Pitcher



CORVUS MONODULOIDES
figure 1.

Once upon a time, there was a thirsty crow.

She came upon a pitcher that had some water in it, but when she put her beak into the pitcher she found she could not reach the water.

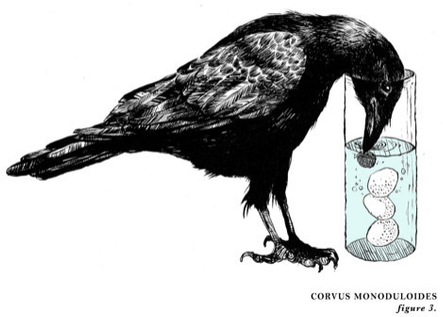
Then, she had an idea.

CORVUS MONODULOIDES
figure 2.

She looked around, found a pebble, and dropped it into the pitcher.

The water rose a little bit.

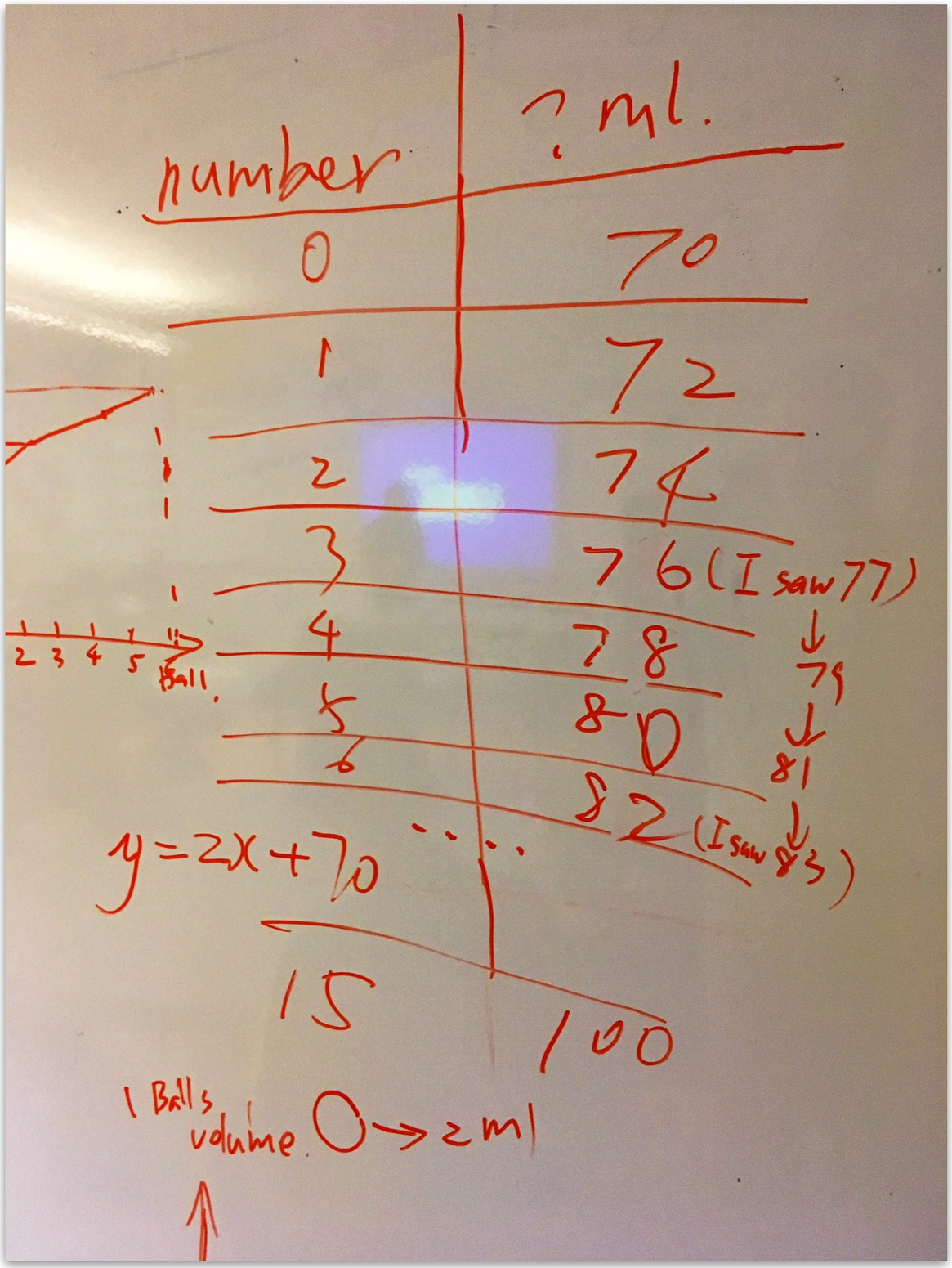
The crow was encouraged and continued to drop pebbles into the pitcher, one at a time, until the water rose up high enough for the crow to reach it with her beak.

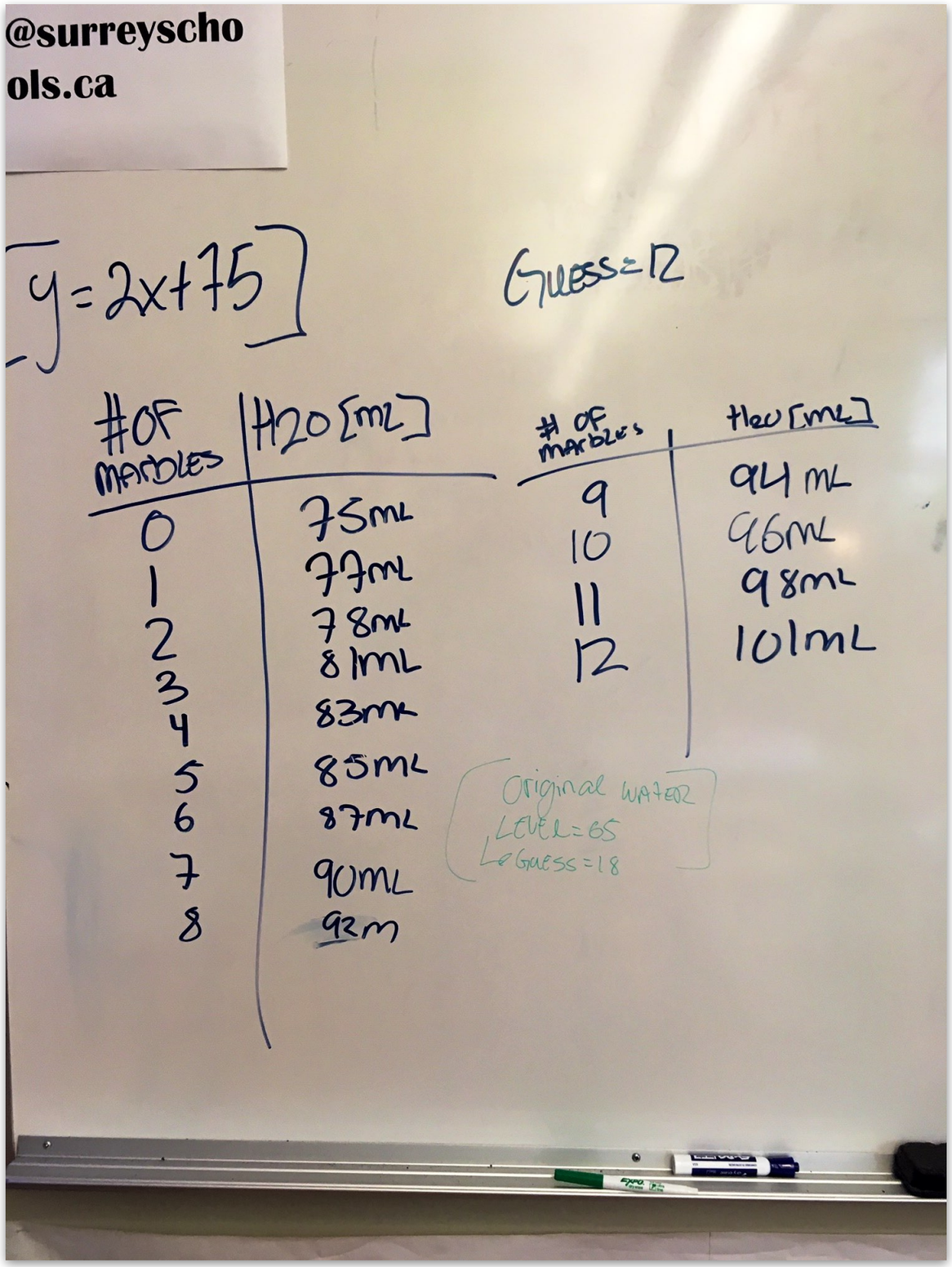


CORVUS MONODULOIDES
figure 3.

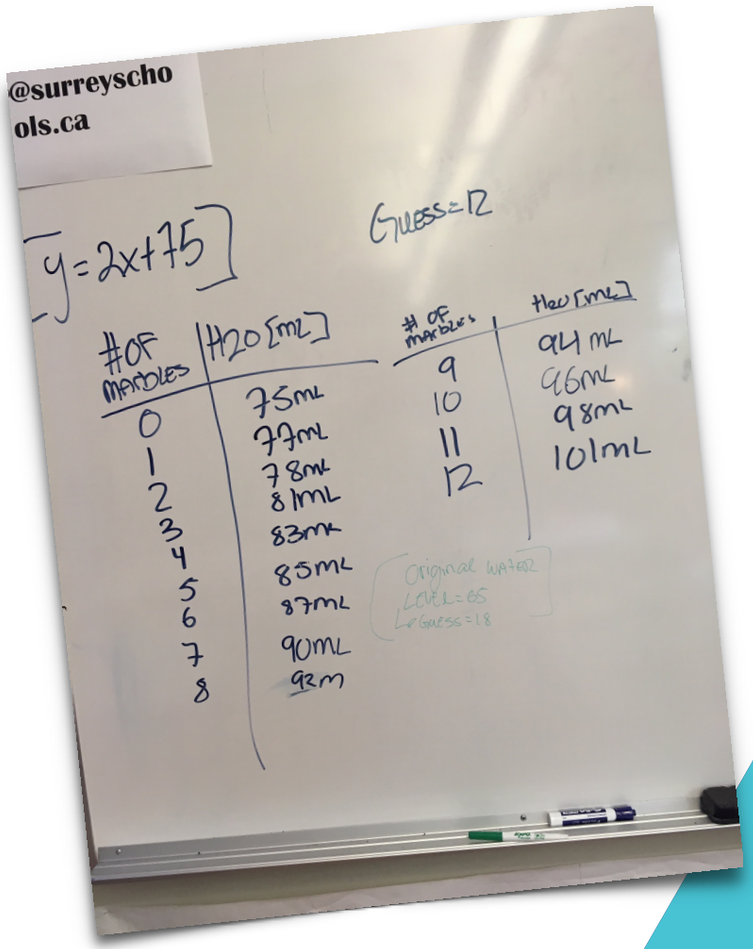
The crow drank and was satisfied!

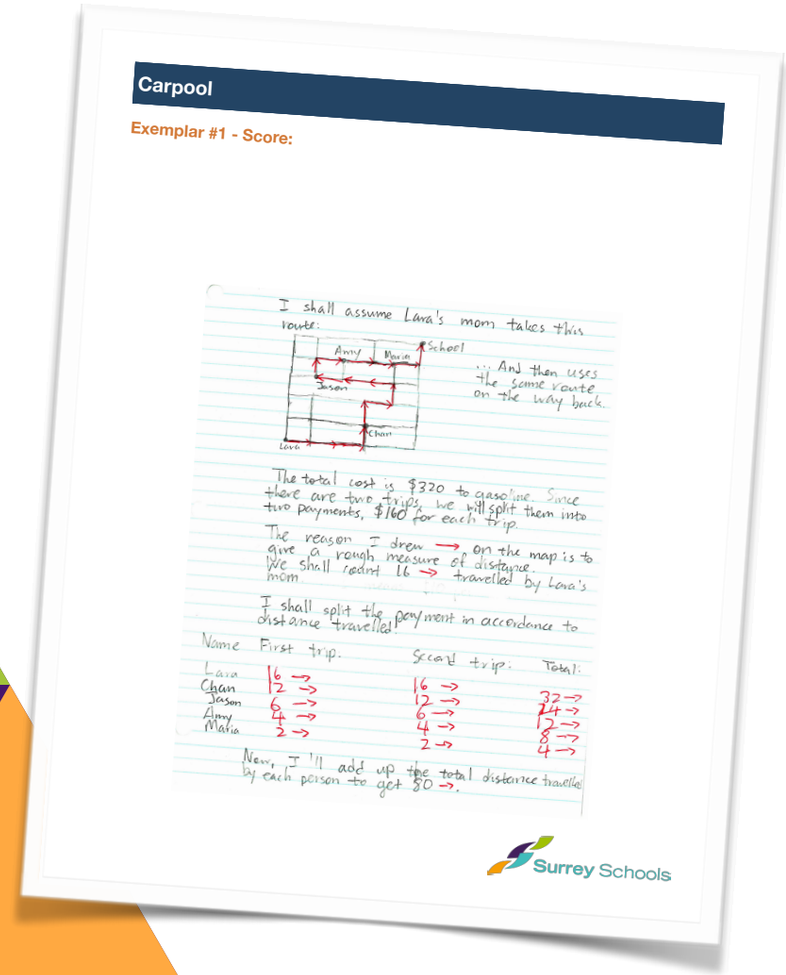
Moral: “Little by little does the trick.”


number
? ml.
0
70
1
72
2
74
3
76 (I saw 77)
4
78
5
80
6
82 (I saw 83)
y = 2x + 70
15
100
1 Balls volume. 0 → 2 ml
1 2 3 4 5 Ball.
↓ 79
↓ 81
↓ 83


@surreyschools.ca
y = 2x + 75
Guess = 12
# OF MARBLES
H2O [ml]
0 — 75ml
1 — 77ml
2 — 78ml
3 — 81ml
4 — 83ml
5 — 85ml
6 — 87ml
7 — 90ml
8 — 92ml
OF MARBLES
How [ml]
9 — 94 ml
10 — 96ml
11 — 98ml
12 — 101ml
Original WATER LEVEL = 65
1e Guess = 18

What counts?





Conversations

EVIDENCE OF STUDENT LEARNING

Observations

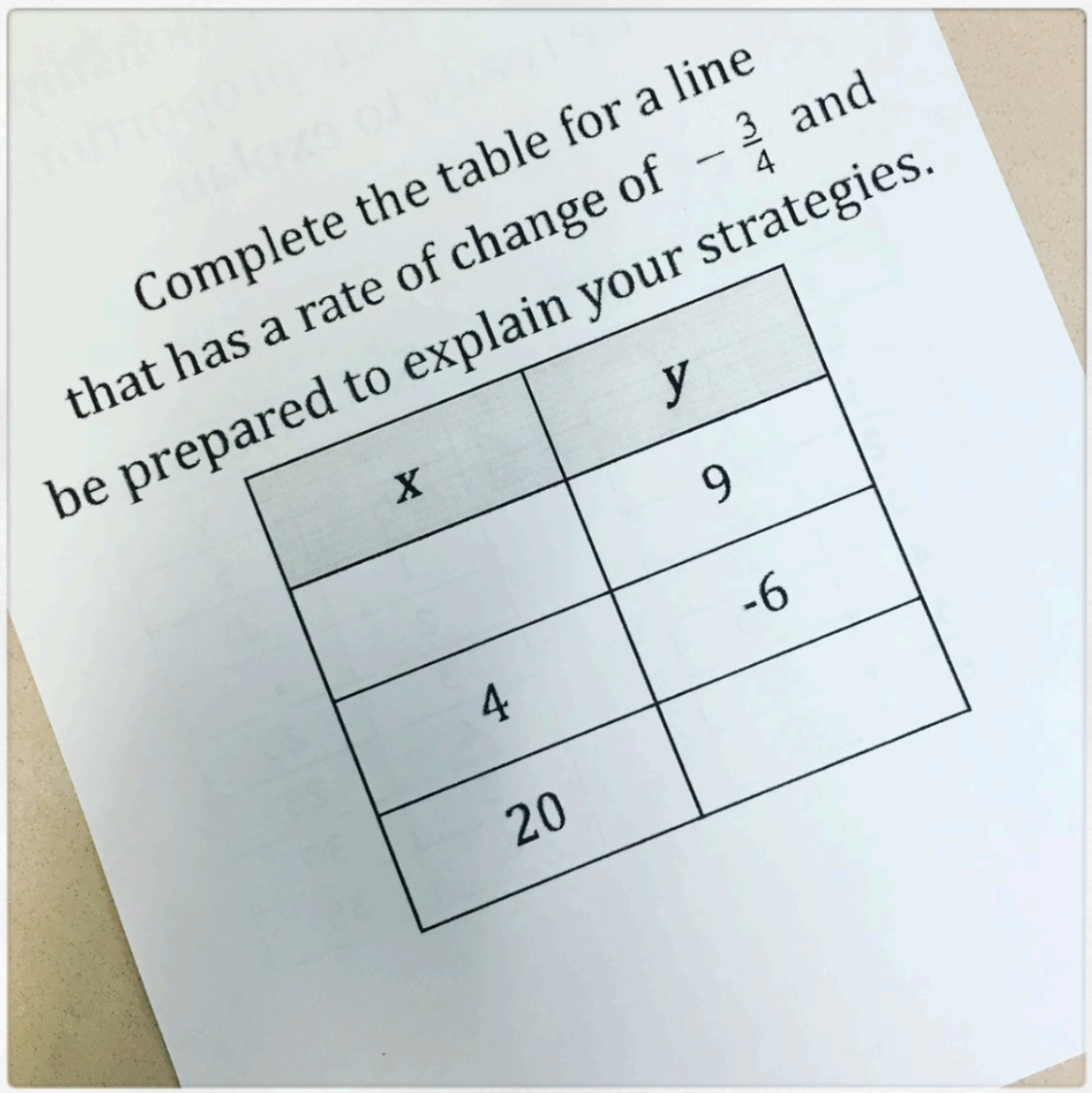
Products

(triangulation)

Cathy Yenca
@mathycathy

Following

I don't remember who shared this, but thank you! Made one large paper copy for each group, asked them to collaborate. So many rich conversations! #iteachmath #MTBoS

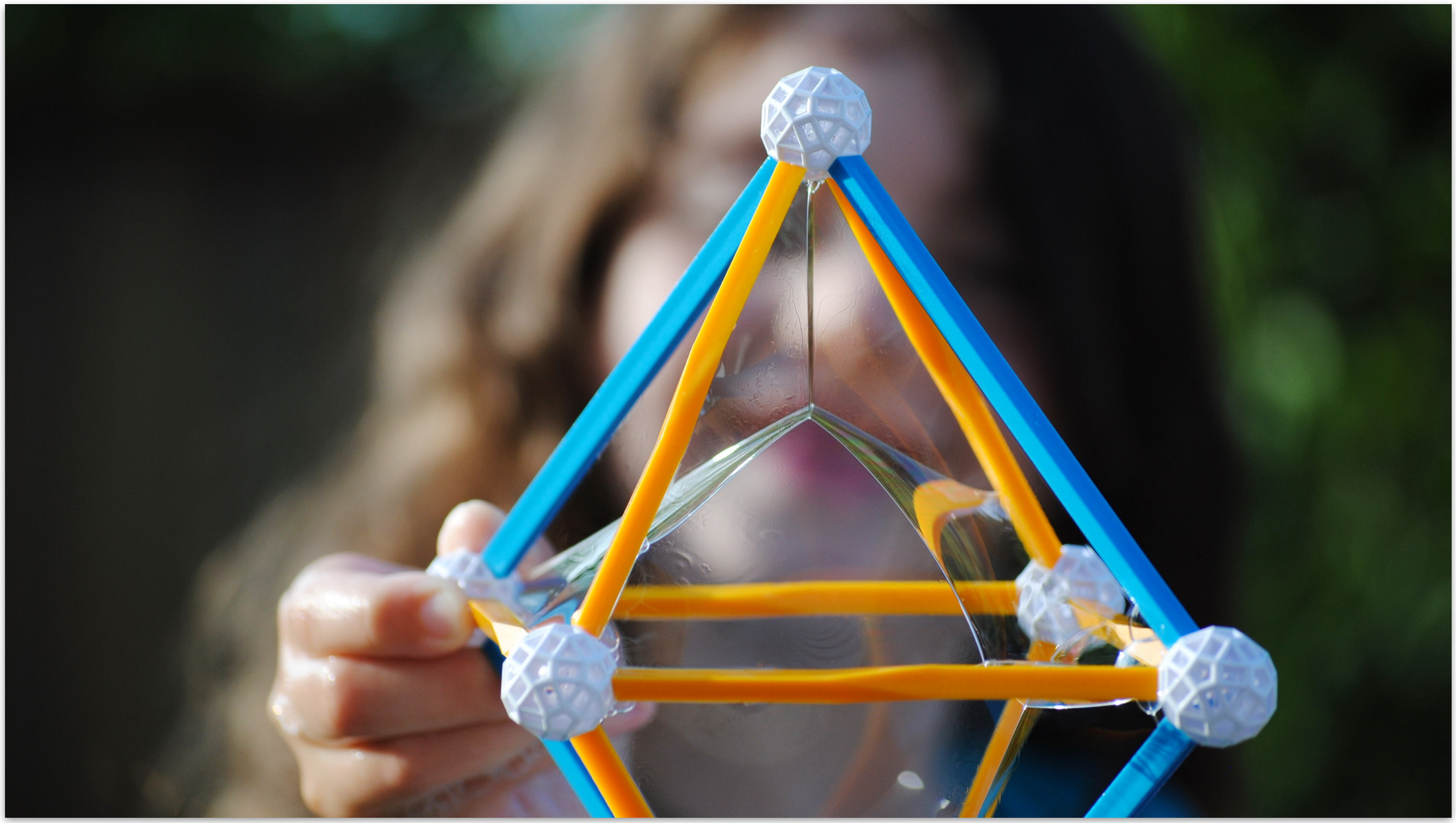


Complete the table for a line that has a rate of change of $-\frac{3}{4}$ and be prepared to explain your strategies.

x	y
	9
	-6
4	
20	

Complete the table for a line that has a rate of change of $-\frac{3}{4}$ and be prepared to explain your strategies.

x	y
	9
	-6
4	
20	



Chris Hunter • K-12 Numeracy Helping Teacher

hunter_c@surreyschools.ca

@ChrisHunter36

reflectionsinthewhy.wordpress.com/bcamt2019