Geometry, Measurement, and Data Science

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SANGIOMATH
UNLOCK THE POWER OF MATH

Somewhere Around…

What was the diameter of the world's largest pizza?

132 ft 1584 in 40.2 m

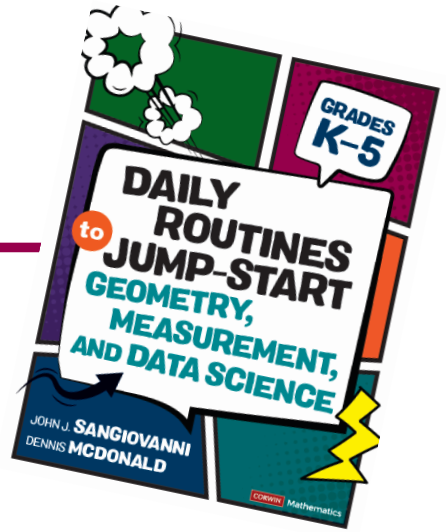
…around 288

… around 905

…around 8 pole vaults

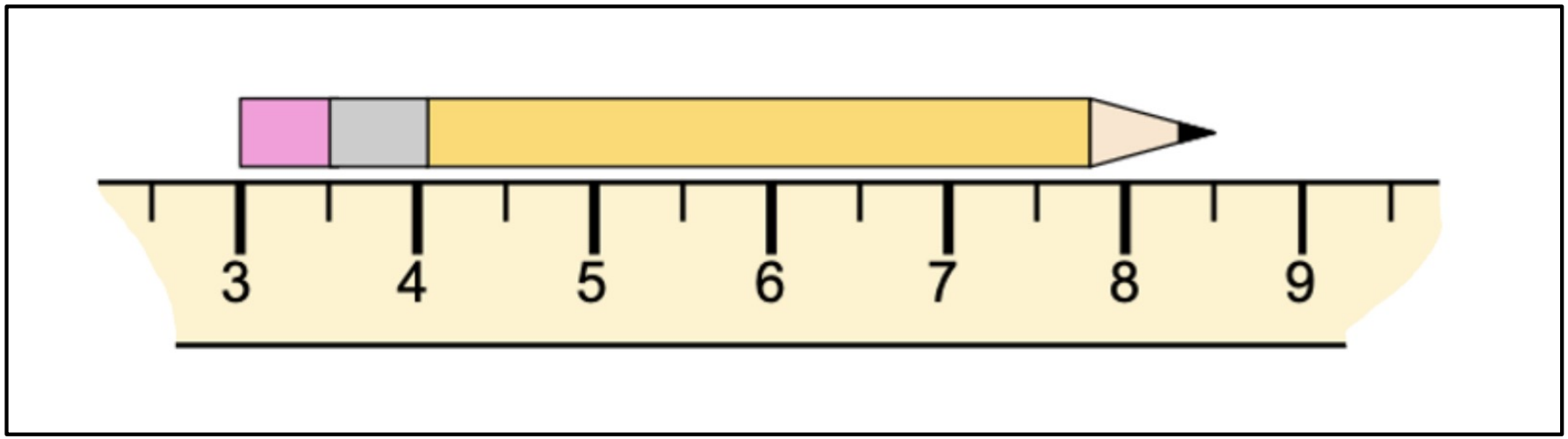
Dix (Orion, 2025)

About our time



- Identify essential understanding within geometry, measurement, and data.
- Consider a different approach to practicing these concepts for better retention and utility.
- Start a collection of resources to realize this.

But First: The Broken Ruler



Challenges

What challenges have you encountered within these domains?

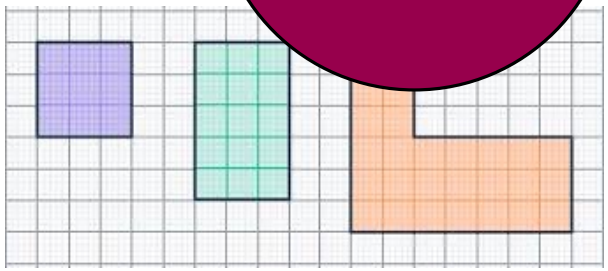
Geomerty

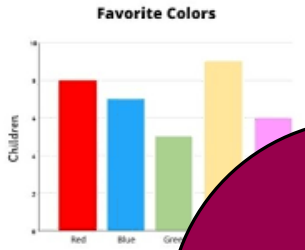
Measurement

Data

Reading a clock isn't a set of 10 lessons.

"Area is inside. Perimeter is outside."

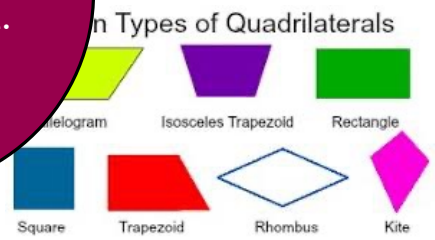




Bar graphs are about favorite things.

Conversions aren't a day each.

Quadrilaterals are just recall.



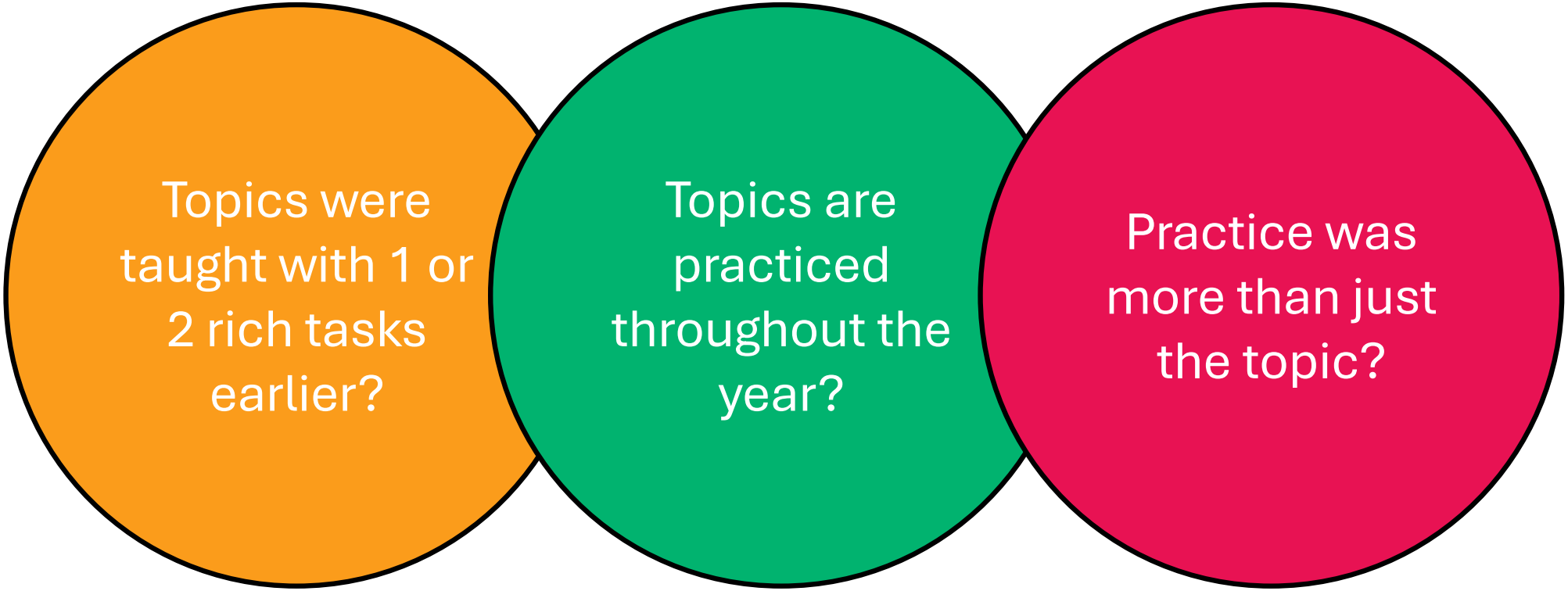
Other Real Challenges

- Geometry, measurement, and data topics usually appear at the end of the year.
- Lessons often appear after state assessments.
- These topics are included on the assessments (to some degree).
- There are feelings of setting kids up if we don’t cover things.
- There is pressure to do well on assessments.

Other Real Challenges

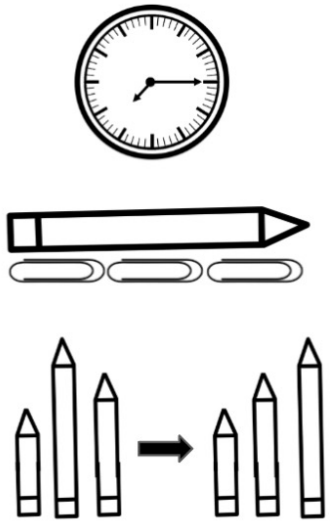
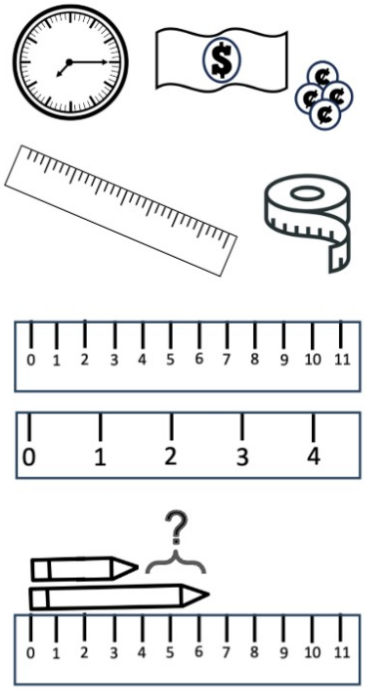
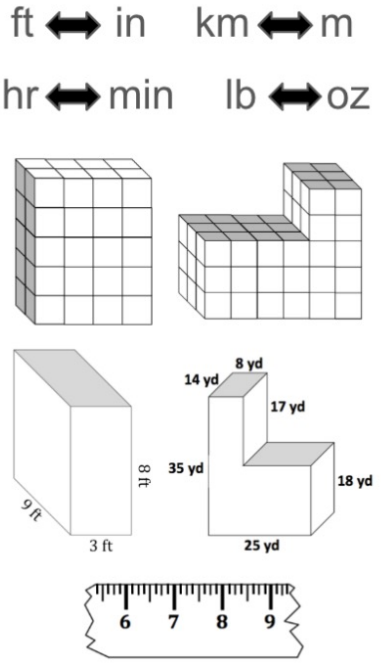
- So, these topics get crammed in just before.
- But, many of these topics take time to practice more than time to teach.
- And, these topics aren't featured in limited teacher preparation courses.
- Because, these topics are seemingly straightforward.

What If...



Big Ideas about Measurement

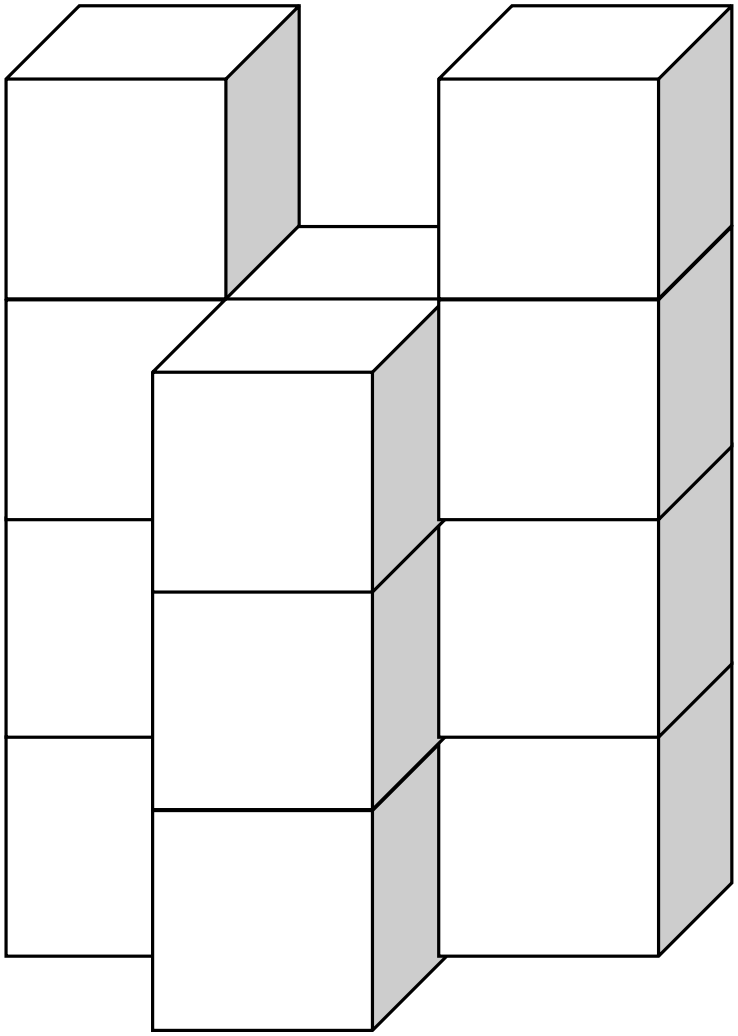
Big Ideas in Measurement Across Grades 1- 5

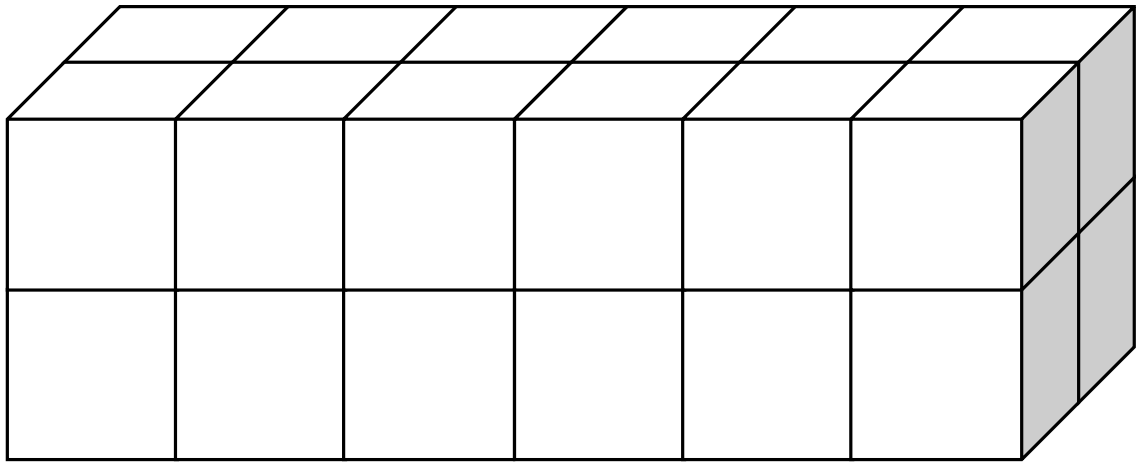
1	2	3	4	5
				

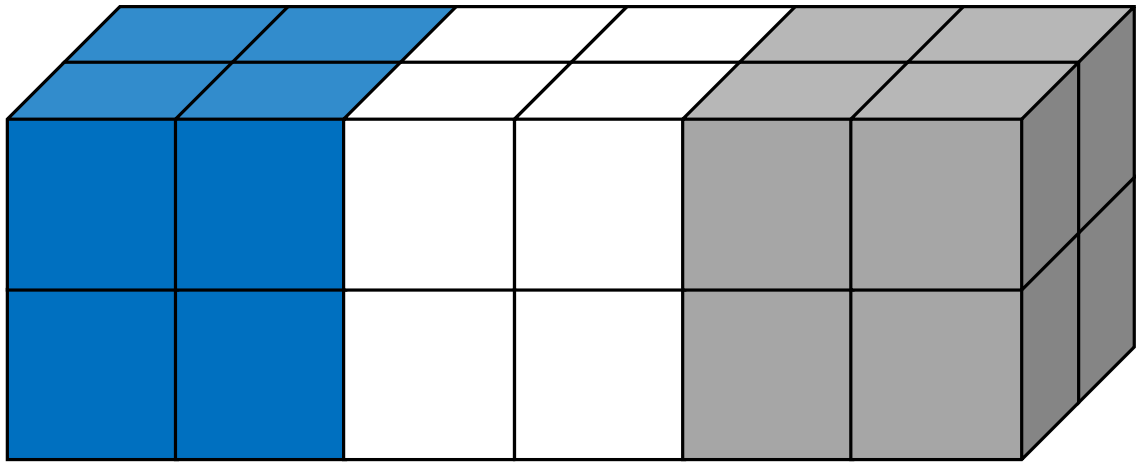
Graphic: SanGiovanni & McDonald (2025)

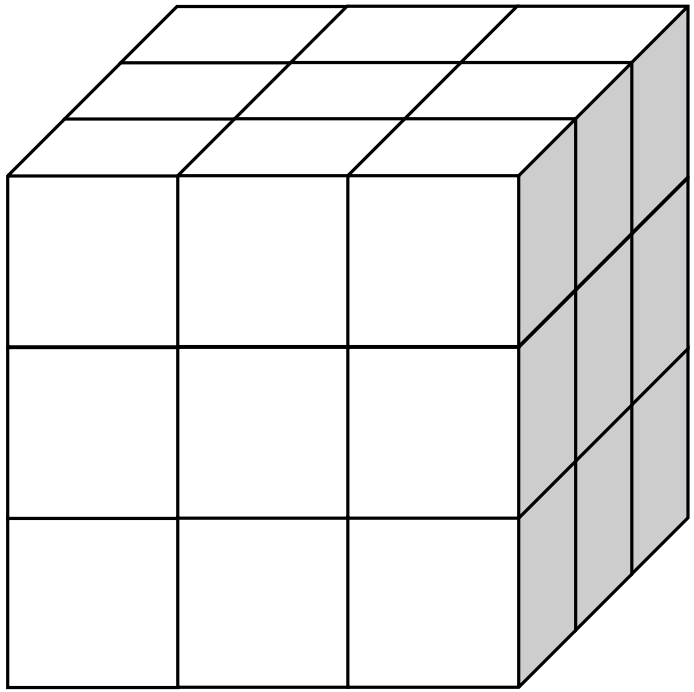
Volume Quick Images

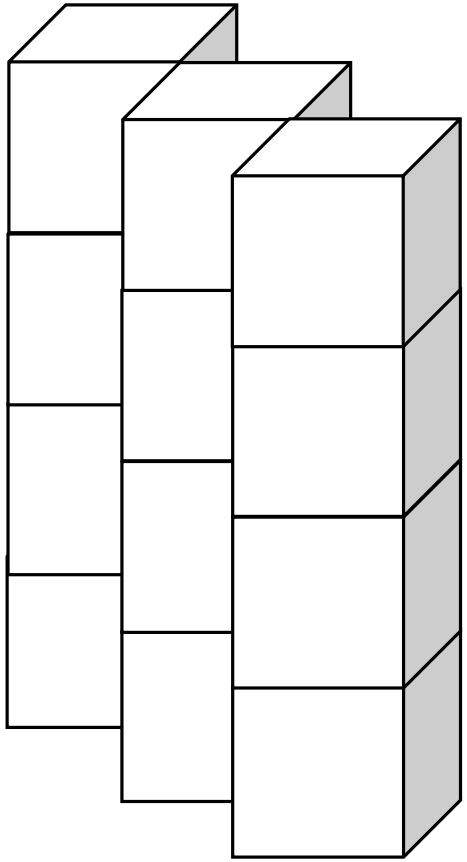
A routine for reasoning volume

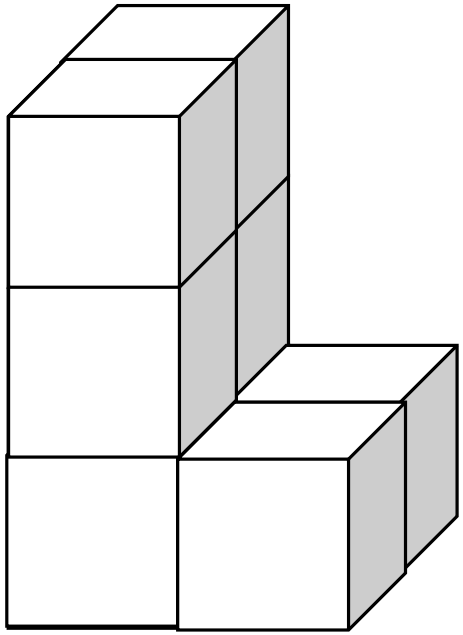


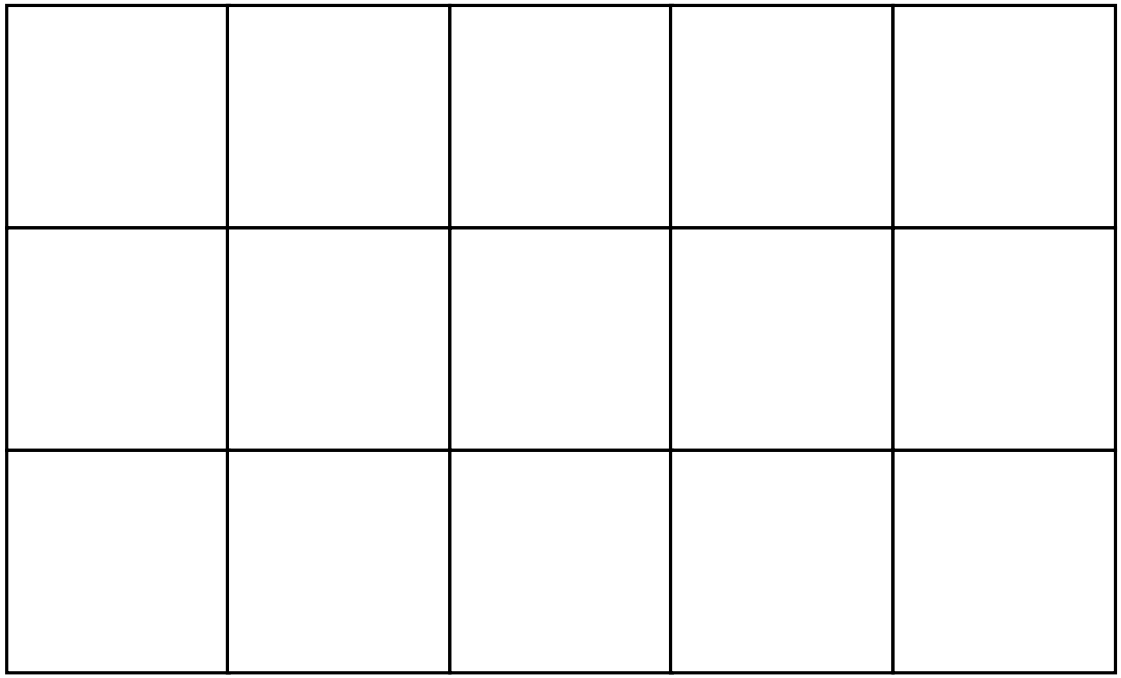


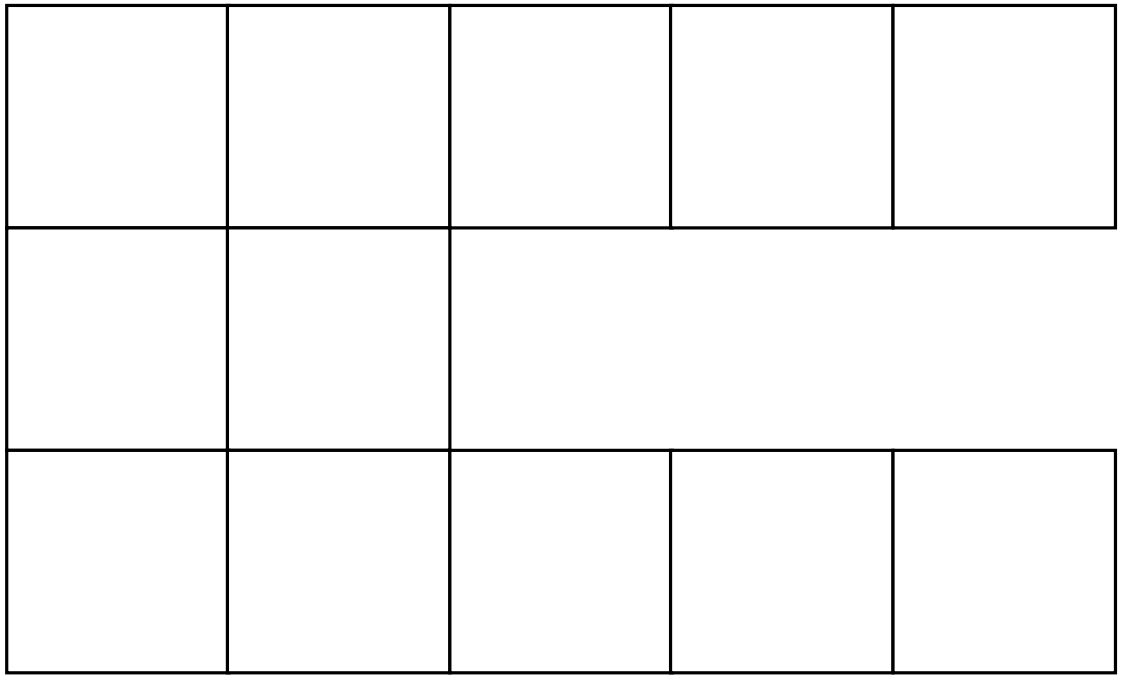






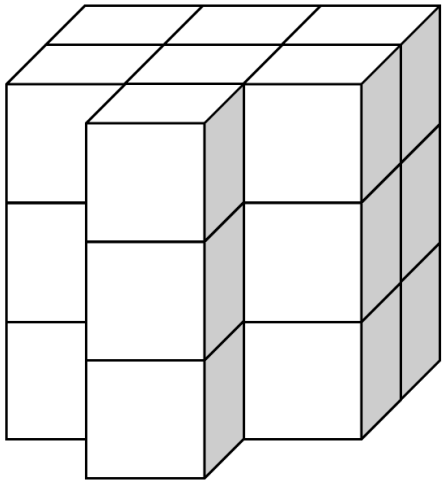






Volume Quick Images

- Create a prism or irregular, rectilinear figure.
- Flash the image.
- Have students estimate what the volume of the figure might be.



More or Less

A routine for estimating and converting

More or Less than 5 Lbs

A

2 lbs + 18 oz

B

4 lbs + 9 oz

C

3 lbs + 60 oz

1 lb = 16 oz
1 ton = 2000 lbs

More or Less than 5 Lbs

A

3 lbs + 9 oz

B

3 lbs + 21 oz

C

3 lbs + 75 oz

Pounds	Ounces
1	16
2	32
3	48
4	64
5	80

More or Less than 5 Miles

A

3,250 yds

B

29,000 ft

C

4,000 yds + 20,000 ft

1 mile = 1760 yards
1 mile = 5280 feet

More or Less than 12 Quarts

A

4 Gallons

B

9 Pints

C

3 Gallons + 8 quarts

1 cup	8 ounces
1 pint	2 cups
1 quart	2 pints
1 gallon	4 quarts

More or Less than 10,000 Lbs

A. 1 ton + 5,197 lbs

B. 5,000 lbs + 1.75 tons

C. 6,500 lbs + 3.8 tons

1 mile = 5280 ft
1 mile = 1760
1 ft = 12 in
3 ft = 1 yd
1 lb = 16 oz
1 ton = 2,000 lbs
1 qt = 2 pts
1 g = 4 qts
1 cup = 8 oz

More or Less than 5 ft?

A

2 yards

B

15 inches

C

½ mile

D

55 inches

E

5 yards

F

15 yards

More or Less than 75 minutes?

A

12:40 to 1:15

B

9:20 to 10:15

C

3:05 to 4:35

More or Less

- Give a benchmark.
- Give statements.
- Have students compare the results of the statements to the benchmark.

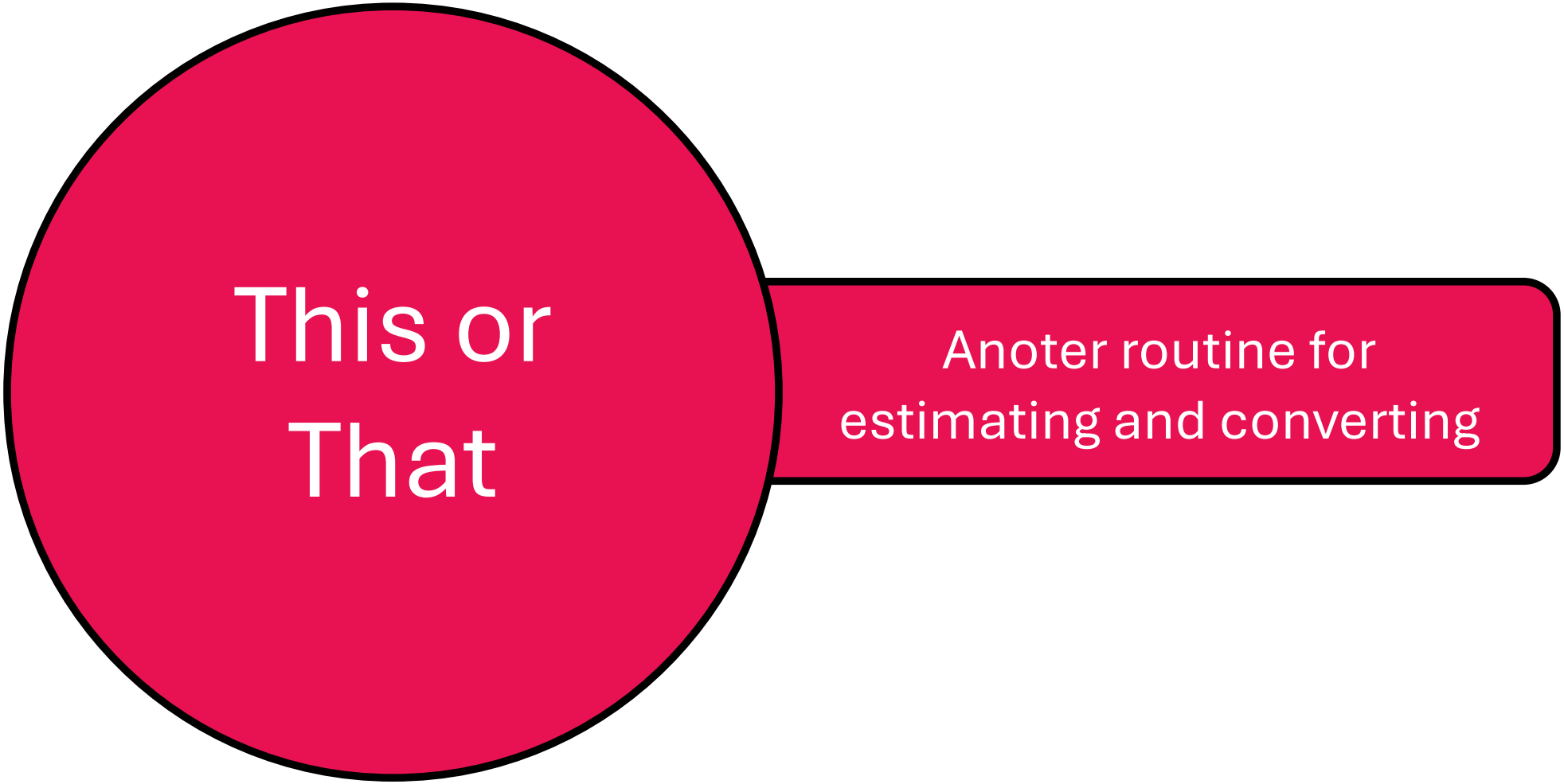
More or Less than 5 Lbs

A. 3 lbs + 9 oz

B. 3 lbs + 21 oz

C. 3 lbs + 75 oz

Pounds	Ounces
1	16
2	32
3	48
4	64
5	80



This or That?

Your Favorite Juice

THIS	THAT
3 cups	2 pints
13 quarts	3 gallons
16 ounces	2 quarts

Volume
1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts

This or That?

Chocolate Milk

THIS	THAT
6 pints	1 quart
1 gallon	3 cups
7 quarts	1 gallon

Volume
1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
Volume (Metric)
1 liter = 1,000 mL

This or That?

Twizzlers Ropes

THIS	THAT
16 inches	1 foot
26 inches	2 feet

This or That?

Length
1 foot = 12 inches
1 yard = 3 feet
1 mile = 1,760 yards
1 mile = 5,280 feet

Bike Ride

THIS	THAT
100 yards	1,200 inches
5,500 inches	1 mile
5 feet	4 yards

This or That?

Piggy Bank

THIS	THAT
	
	

This or That

- Create a set of comparisons.
- Students determine which amount is greater or more desirable.
- Students share their reasoning.

This or That?

Your Favorite Juice

THIS	THAT
3 cups	2 pints
13 quarts	3 gallons
16 ounces	2 quarts

Volume
1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts

That's a Fact

A routine for reasoning about measurement

That’s a Fact

5 15 50 100 500

The cafeteria table is about _____ hands long.

The cafeteria table is about _____ hands wide.

That’s a Fact

1 3 5 10 30

The book is about _____ inches long.

1 6 10 30 100

The ____ holds about _____ ounces of water.

That’s a Fact

Adults are about 6 feet tall.

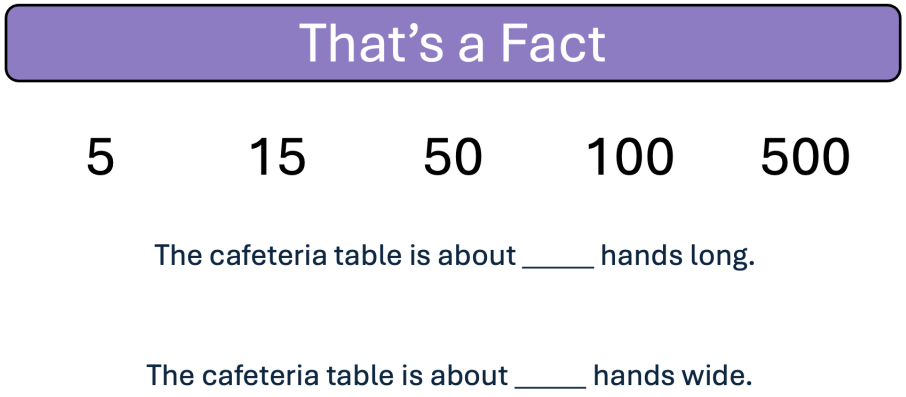
So, the door to our classroom is about _____ feet.

So, the height of a car is about _____ feet.

So, the tree in the front of our school is _____ feet.

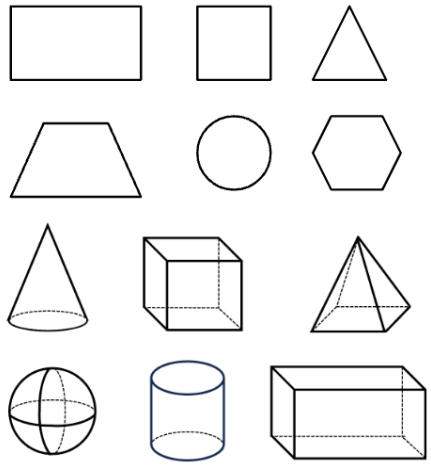
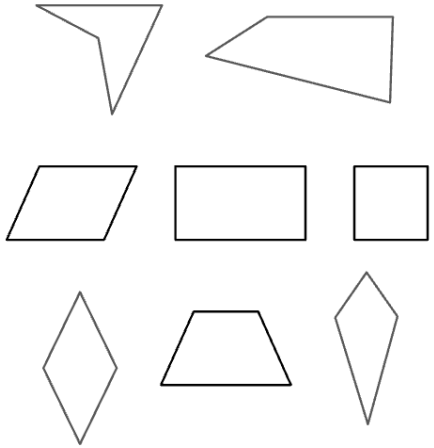
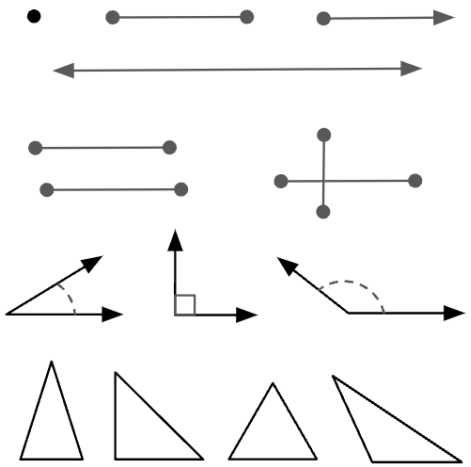
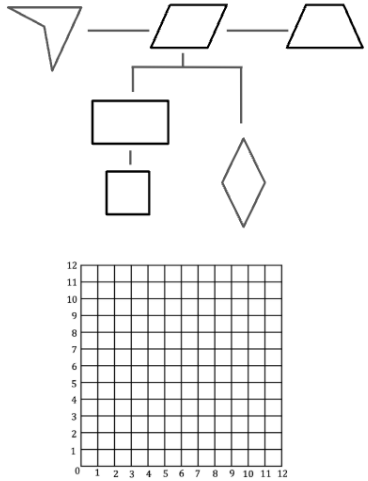
That’s a Fact

- Present a set of numbers.
- Present a set of open statements.
- Students determine which numbers complete each statement.



Big Ideas about Geometry

Big Ideas in Geometry Across Grades K -5

K-1	2-3	4	5
			

Graphic: SanGiovanni & McDonald (2025)

Van Hiele Levels

Van Hiele Level	Typical Grade Range	Characteristics
Level 0: Visualization	prek-2	Students focus on merely the “look” of a shape, i.e., pointy, looks like a house
Level 1: Analysis	2-5	Students can group shapes and see how all of a certain figure (e.g., triangles) are similar.
Level 2: Abstraction	5-8	Students can see how groups of shapes relate, such as how squares are all special rectangles.
Level 3: Deduction	8-12	Students can use deductive arguments to develop a proof for a given statement.
Level 4: Rigor	12+	Students can compare various axiomatic systems within geometry.

Van Hiele: So what?

Levels are sequential and experiential.

Levels can’t be skipped.

Movement from one to the next is based on experiences.

Movement from one to the next can’t be acquired rotely (simply told, even with pictures).

Van Hiele: So what?

A typical 3rd grader (having had rich experiences) is working at level 1.

A typical 3rd grade class has levels 0 – 2.

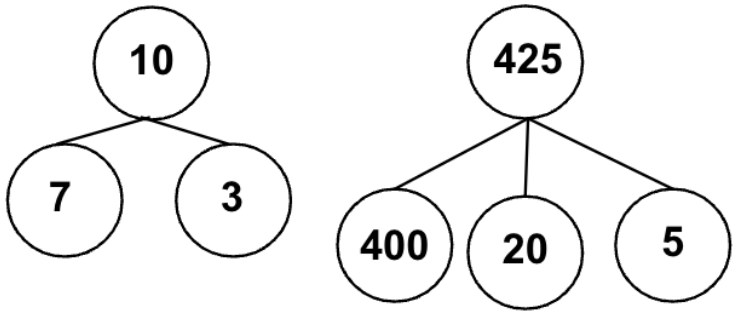
Students in a given level have great difficulty working with a task in a higher level.

Students at different levels have great difficulty sharing ideas because they're basically speaking a different language.

Composing and Decomposing

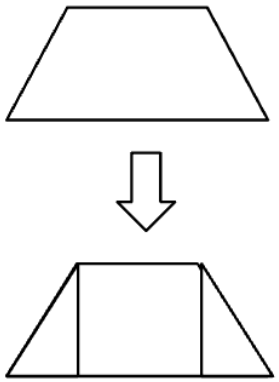
The idea that wholes can be composed and decomposed is one that crosses multiple mathematical domains. Key to this idea is the critical understanding that a whole is the sum of its parts.

Number

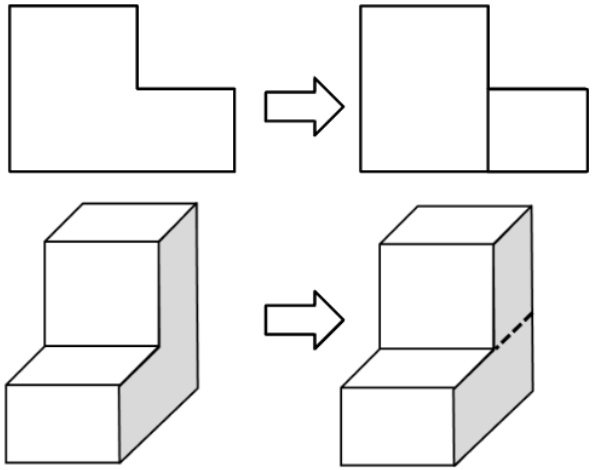


$$\frac{4}{5} = \frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5}$$

Geometry



Measurement



Graphic: SanGiovanni & McDonald (2025)

But wait, there’s more...

Spatial Awareness

Spatial awareness is one’s ability to understand, analyze, and interpret the relationships between objects and spaces.

Spatial awareness includes reasoning about how objects are positioned relative to one another or how an object or objects move.

Humans rely on spatial awareness everyday (hallways, packing a car, driving, etc).

But wait, there's more...

Spatial Awareness

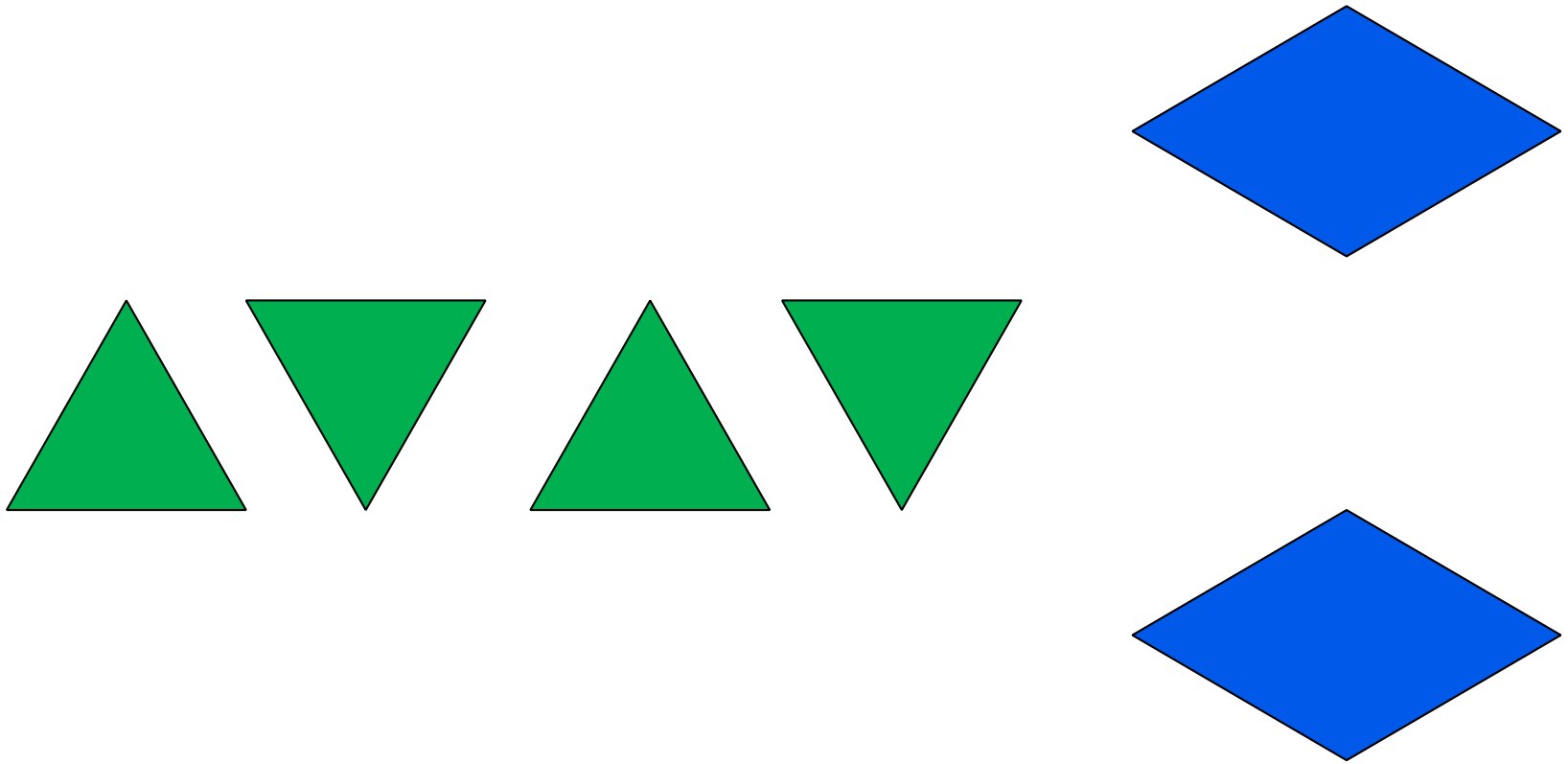
Spatial awareness directly connects to and/or contributes to number sense (Krasa, 2010).

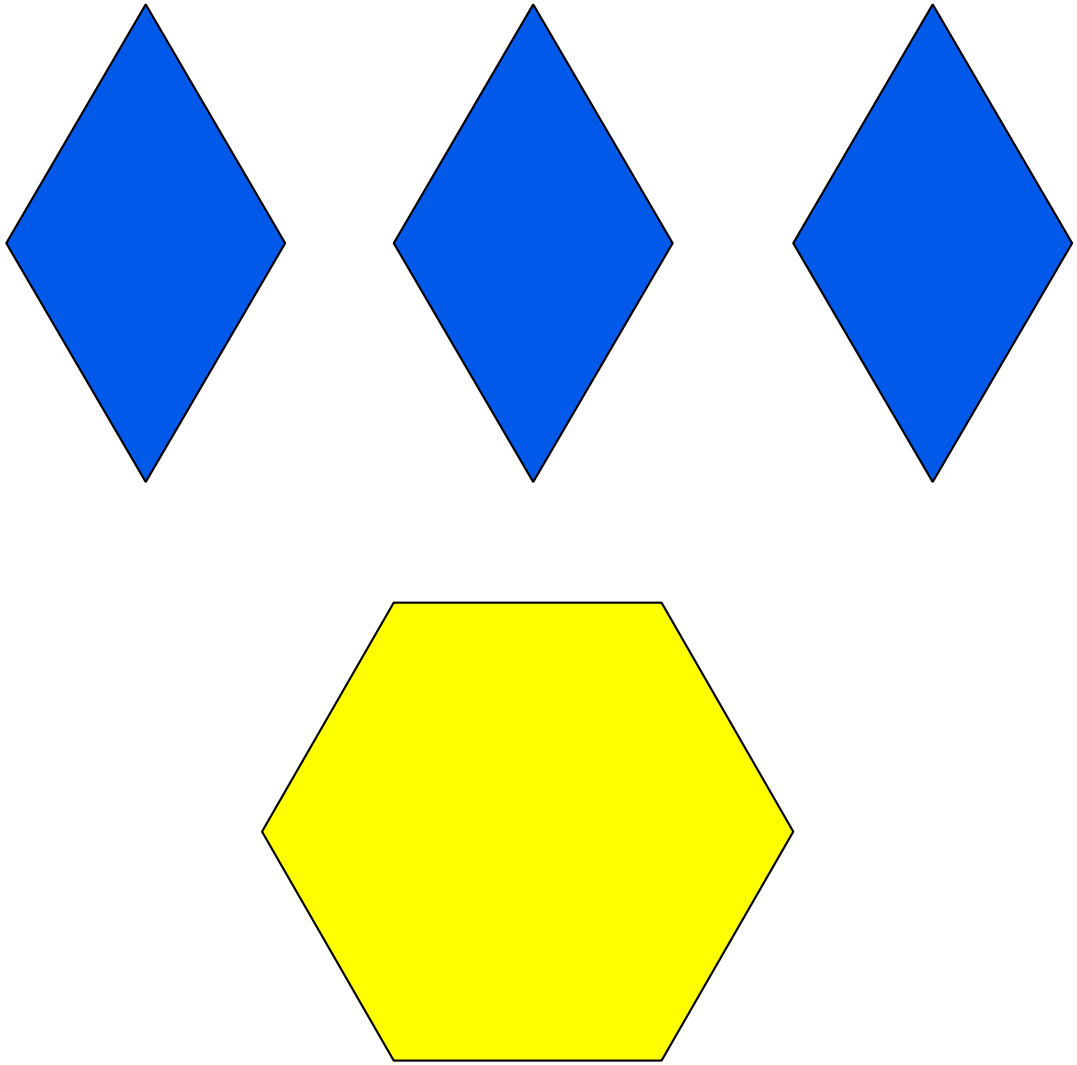
For example, number lines represent number and quantity spatially.

Spatial reasoning are not fixed. It is possible to train and improve spatial skills.

See It, SKETCH It

A routine for identifying shapes, orientation, and arrangement





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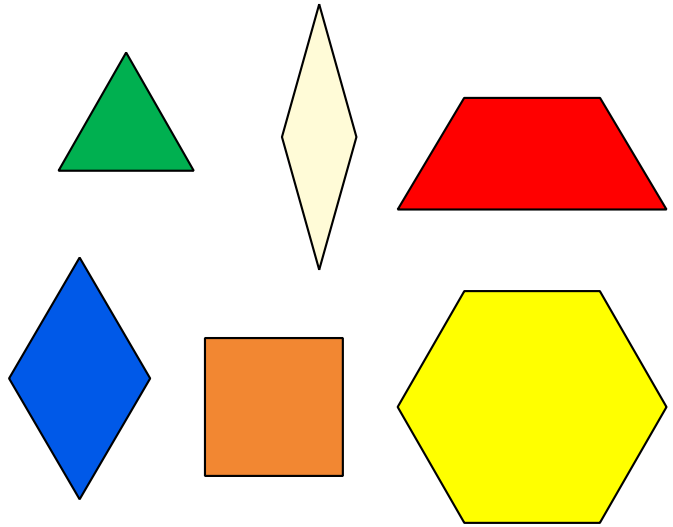

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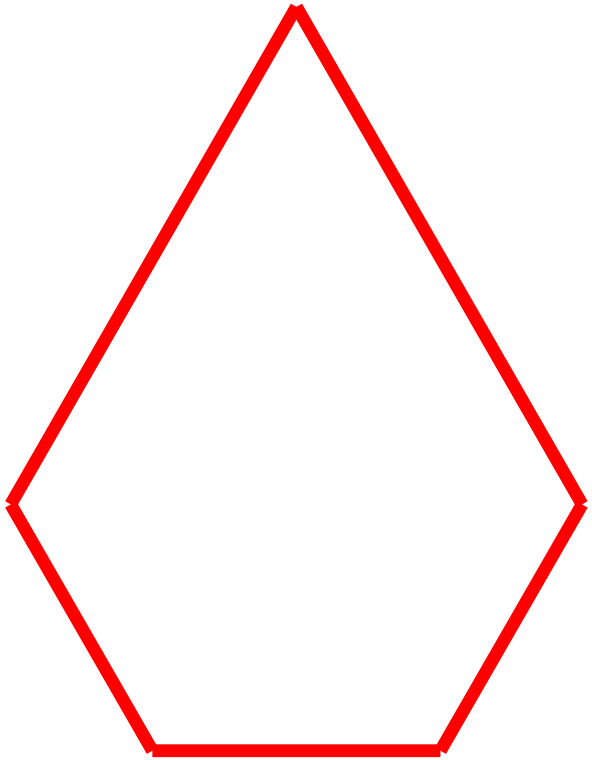

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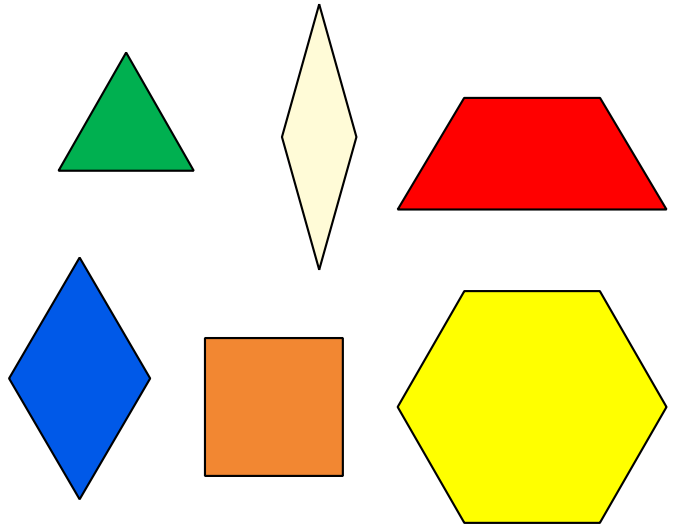

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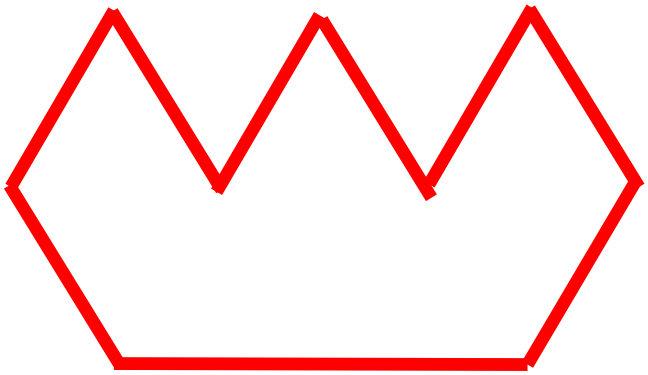

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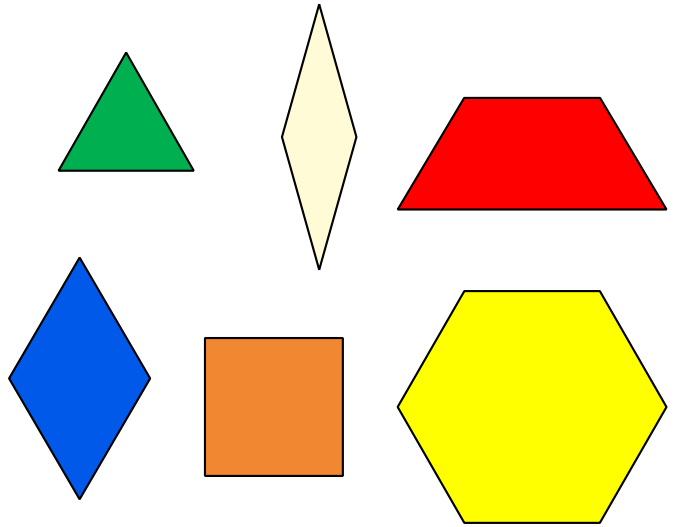

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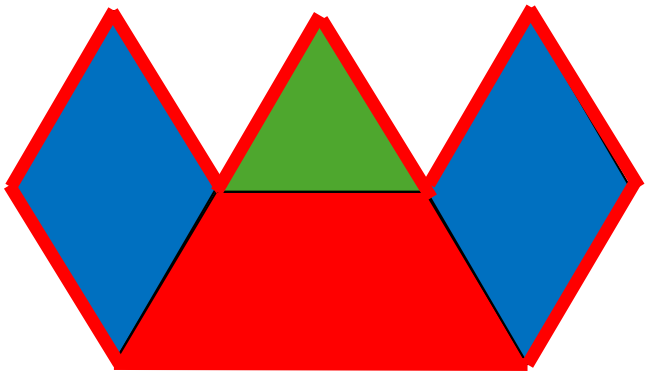

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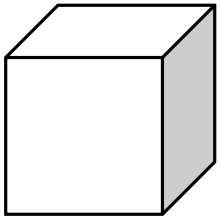

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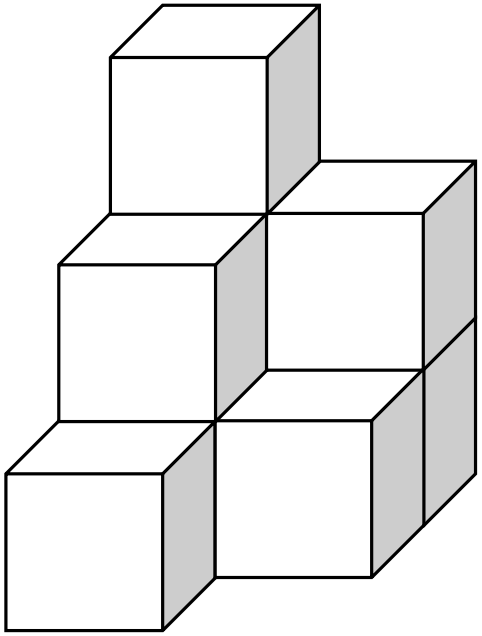


Make

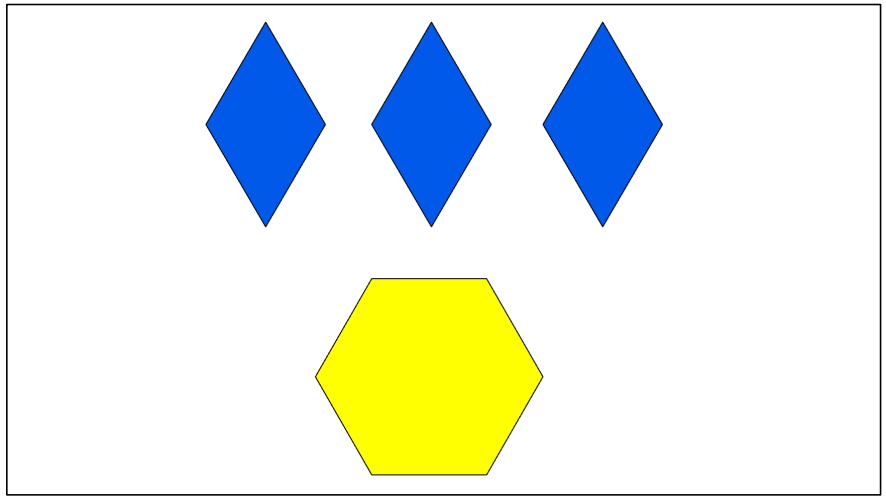
74¢

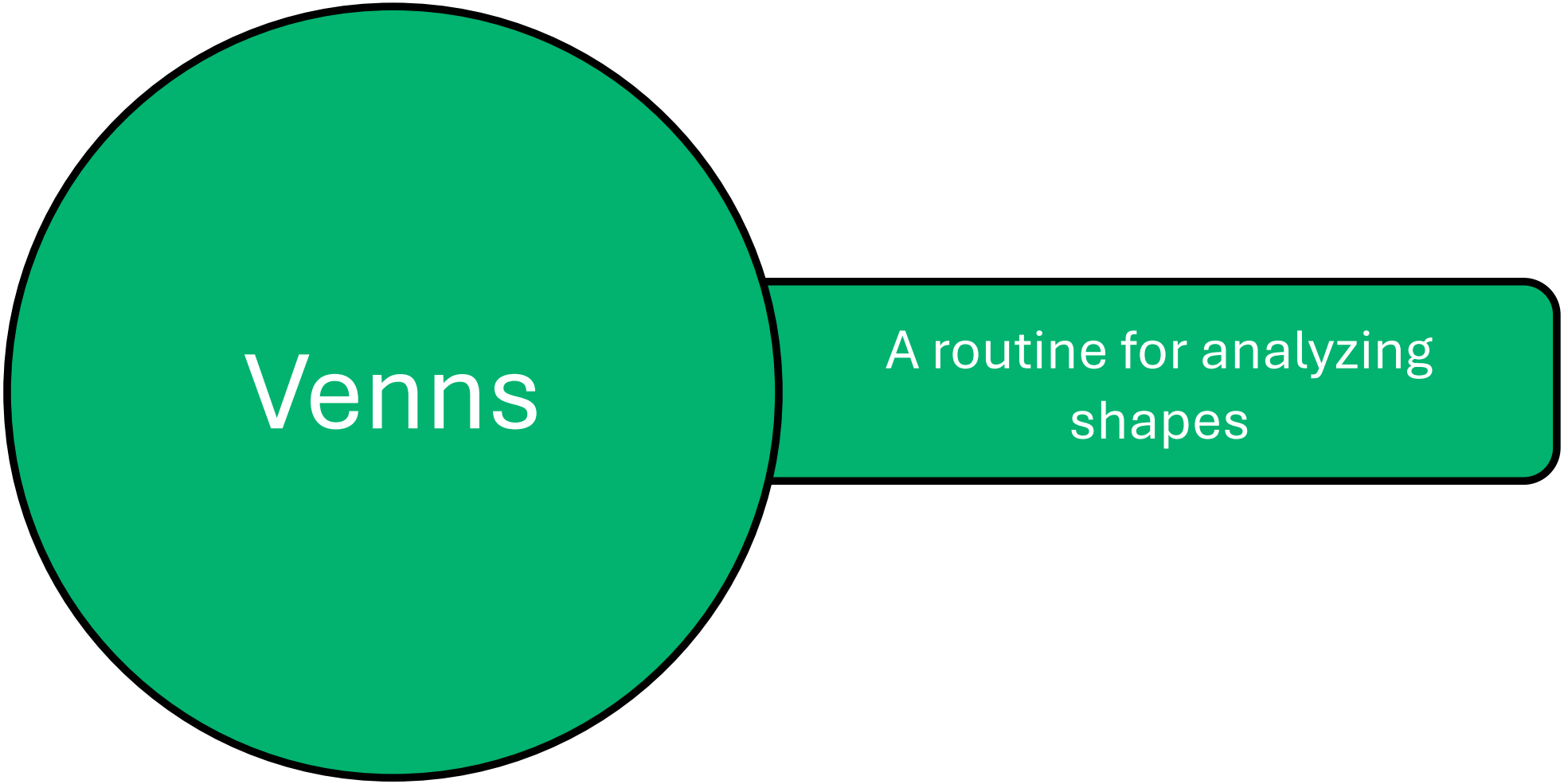
Make

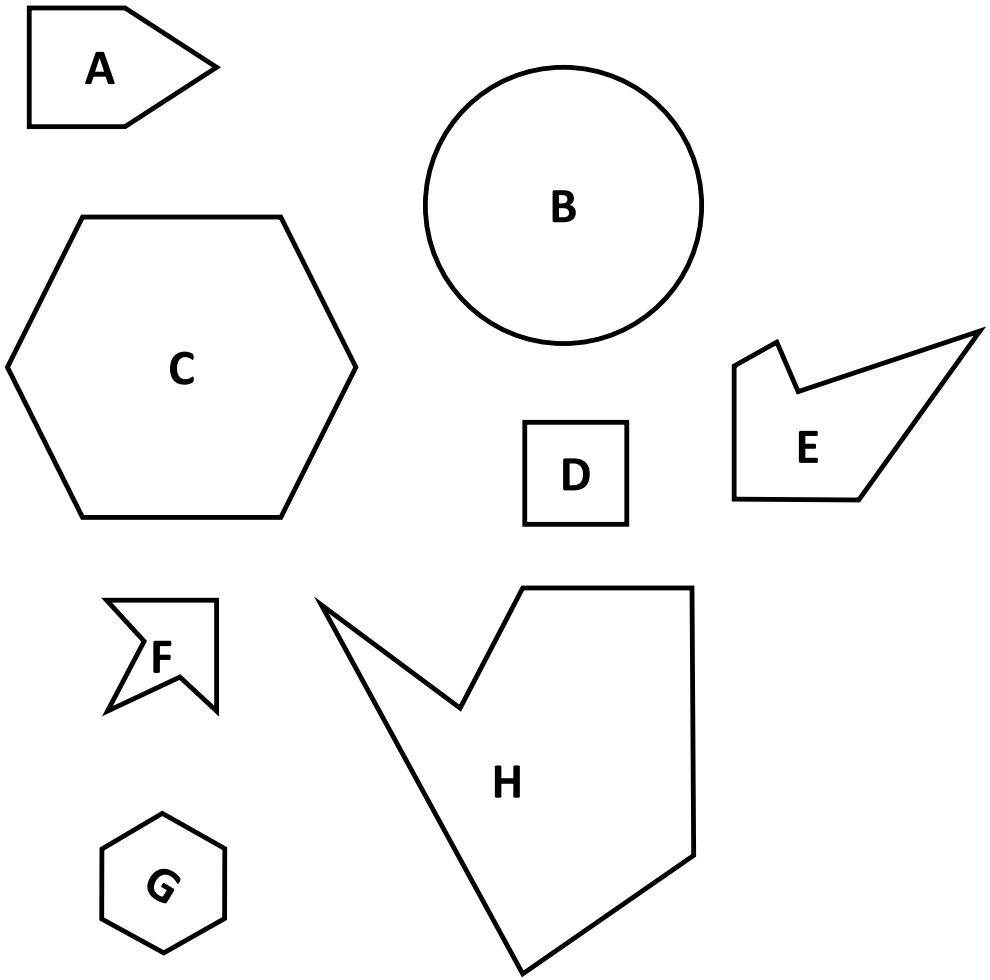
4:35

See It, Build It

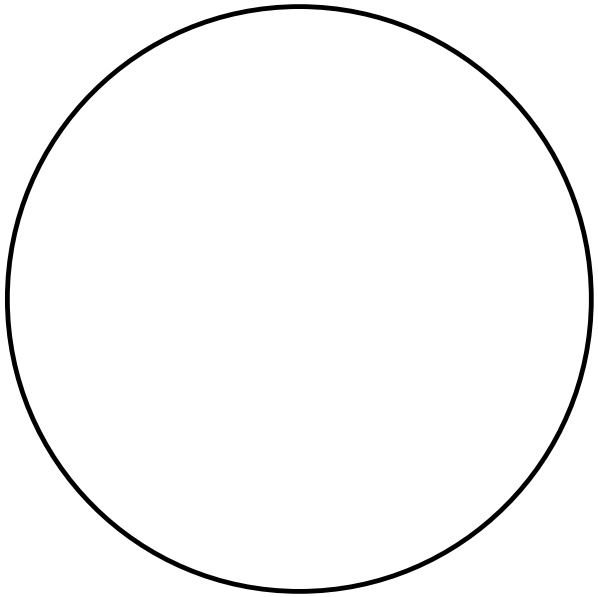
- Create a pattern or configuration.
- Flash the image.
- Have students recreate what they saw.

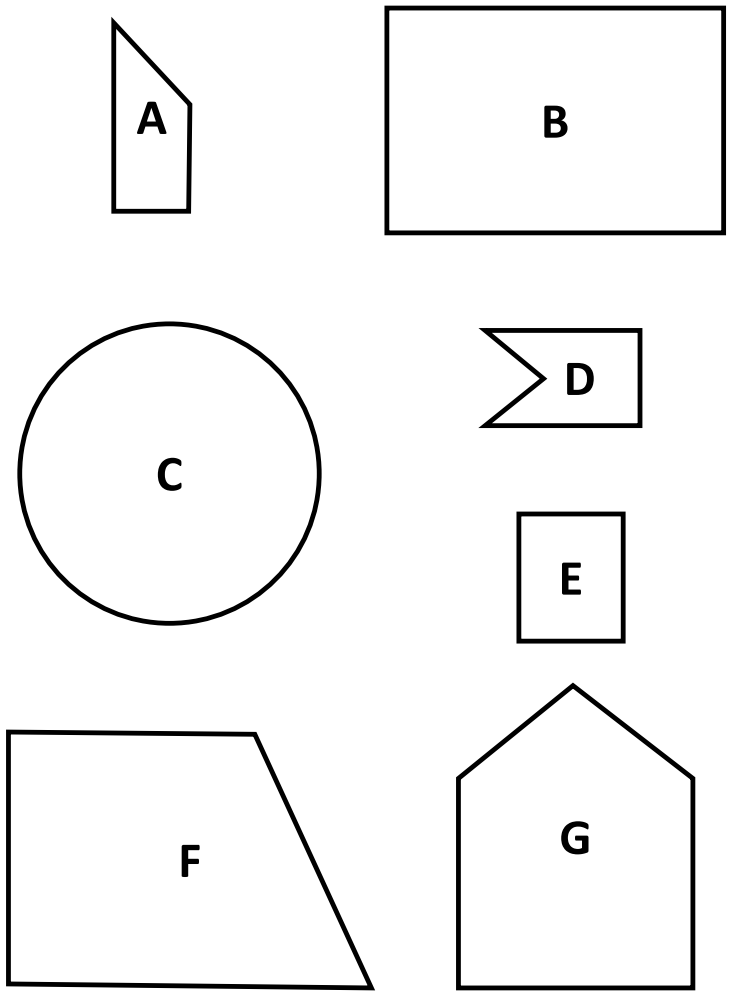


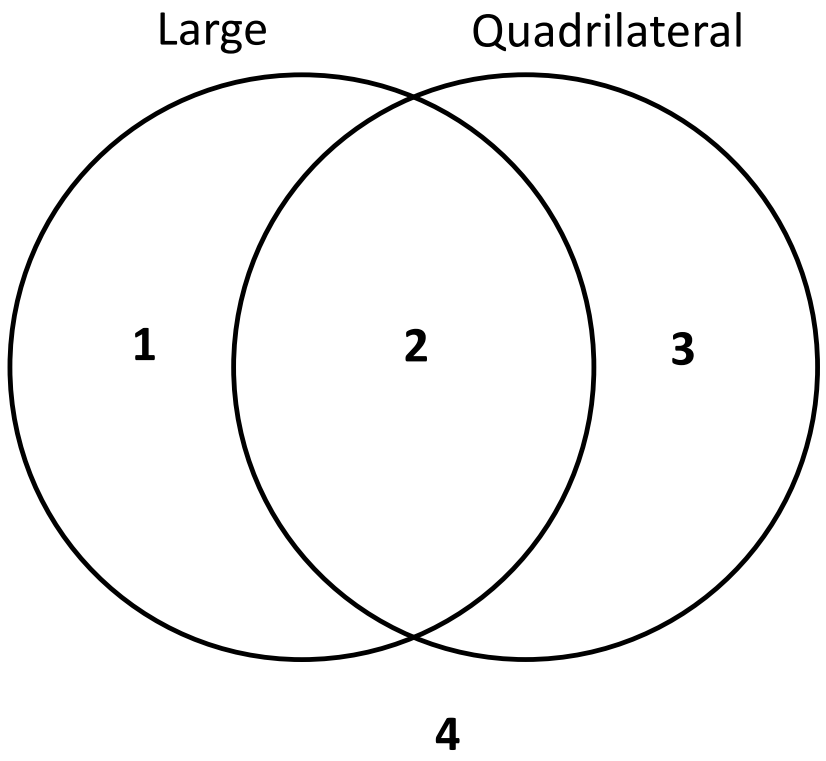


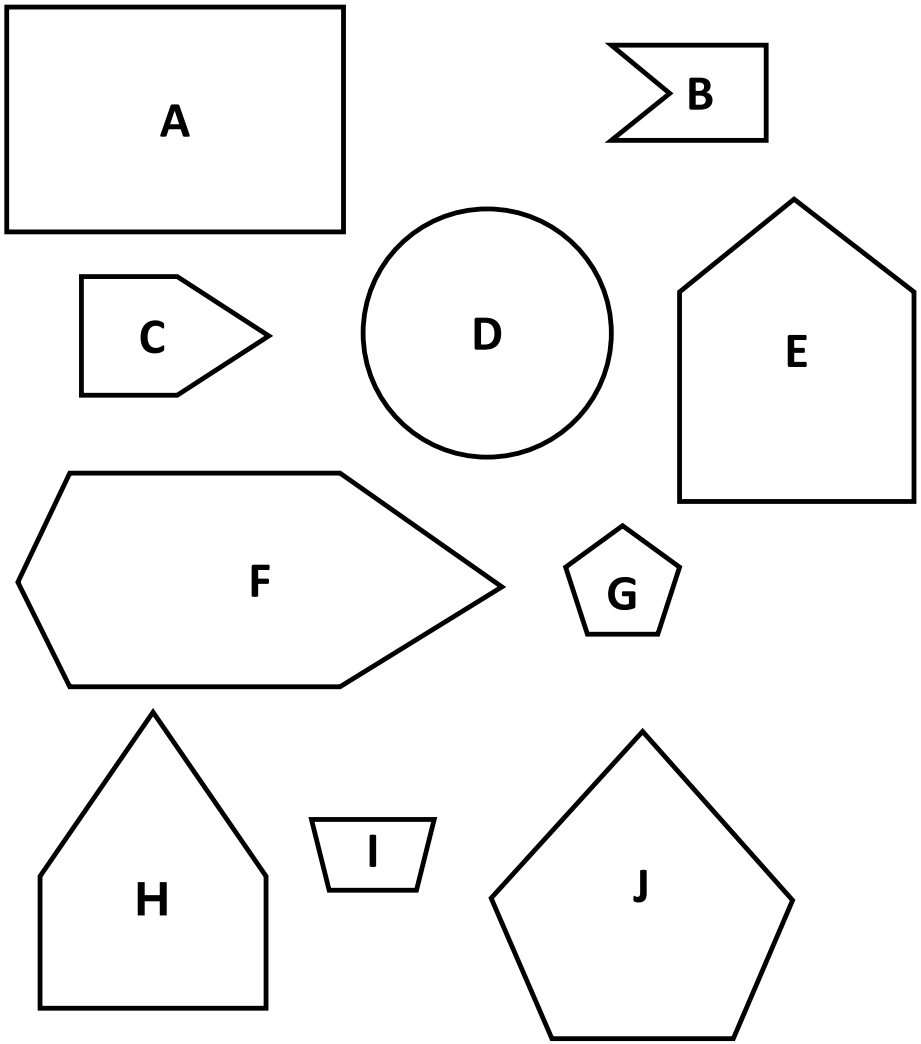


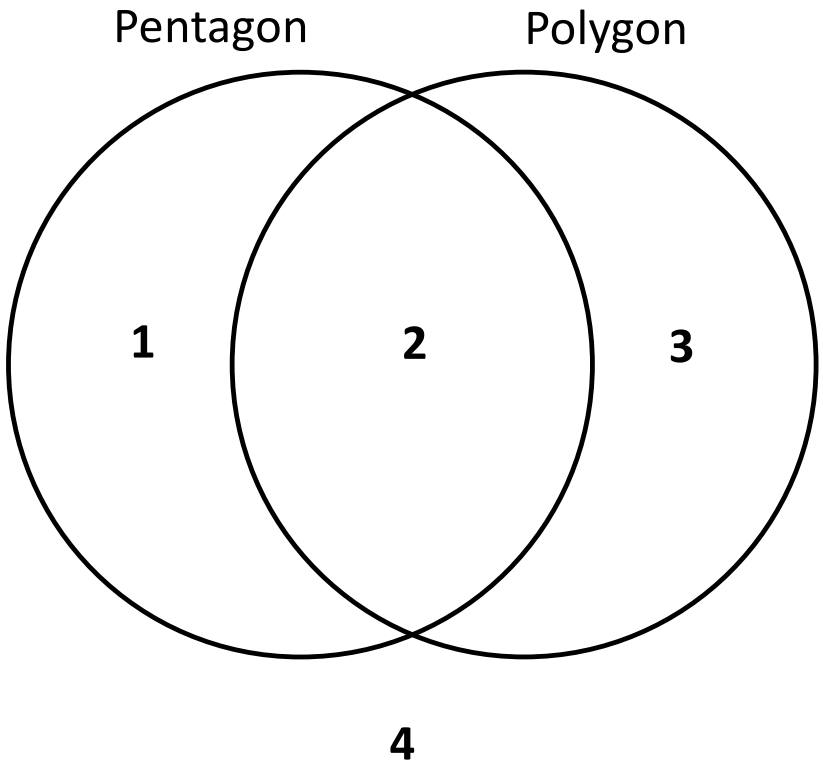
Hexagon

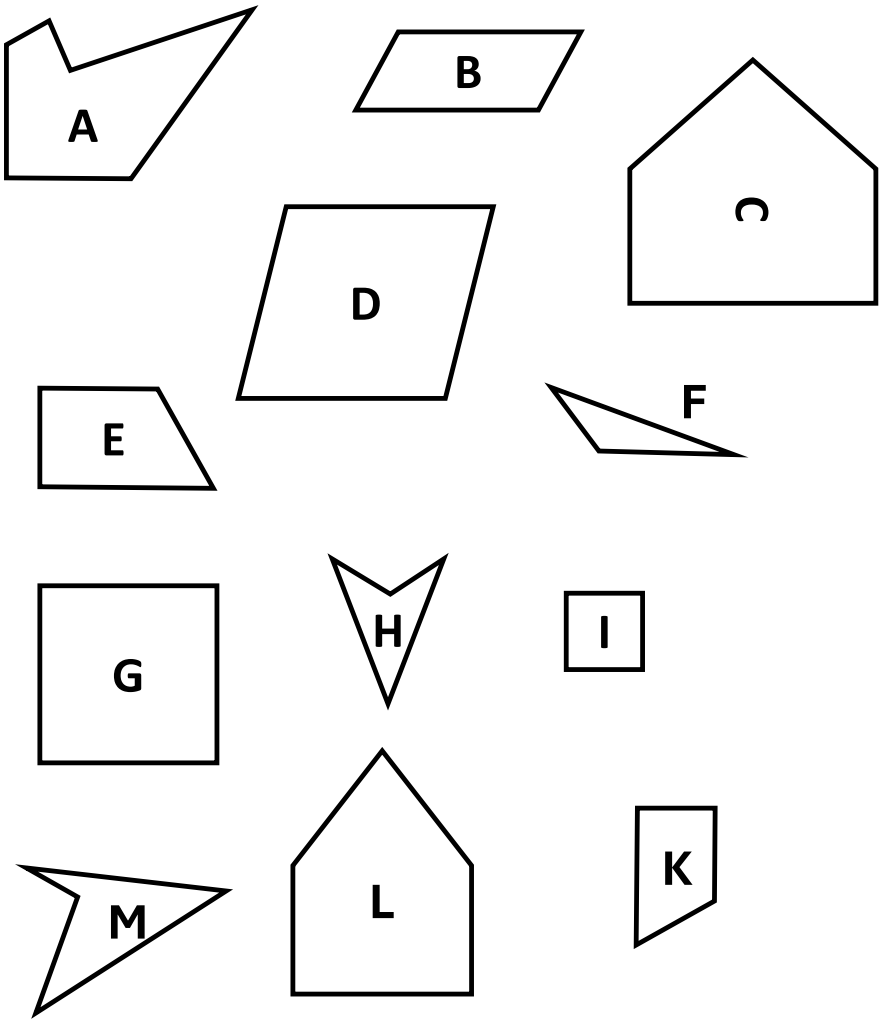


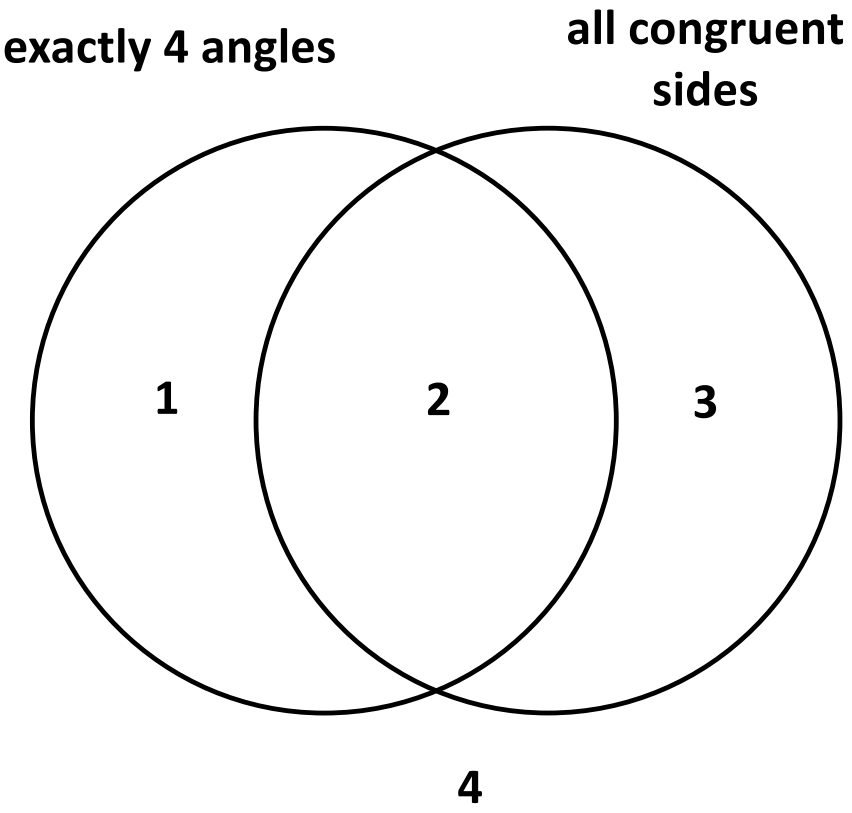






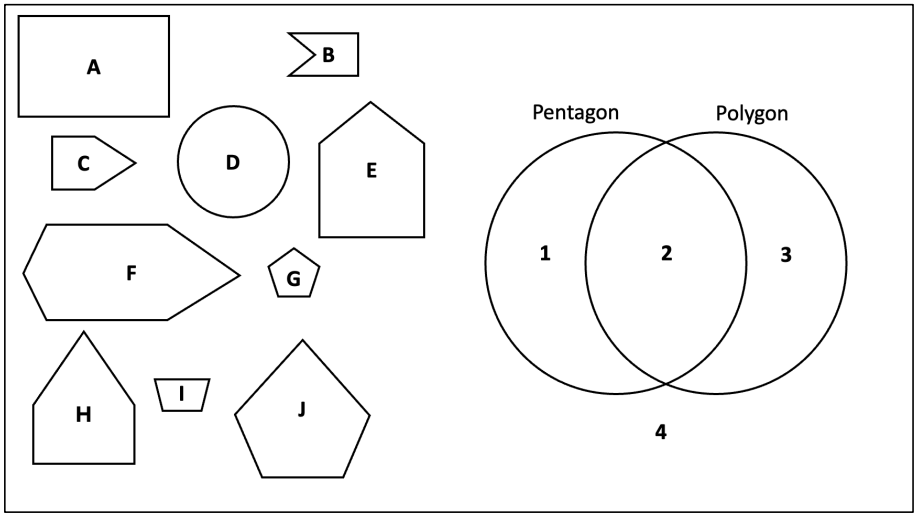


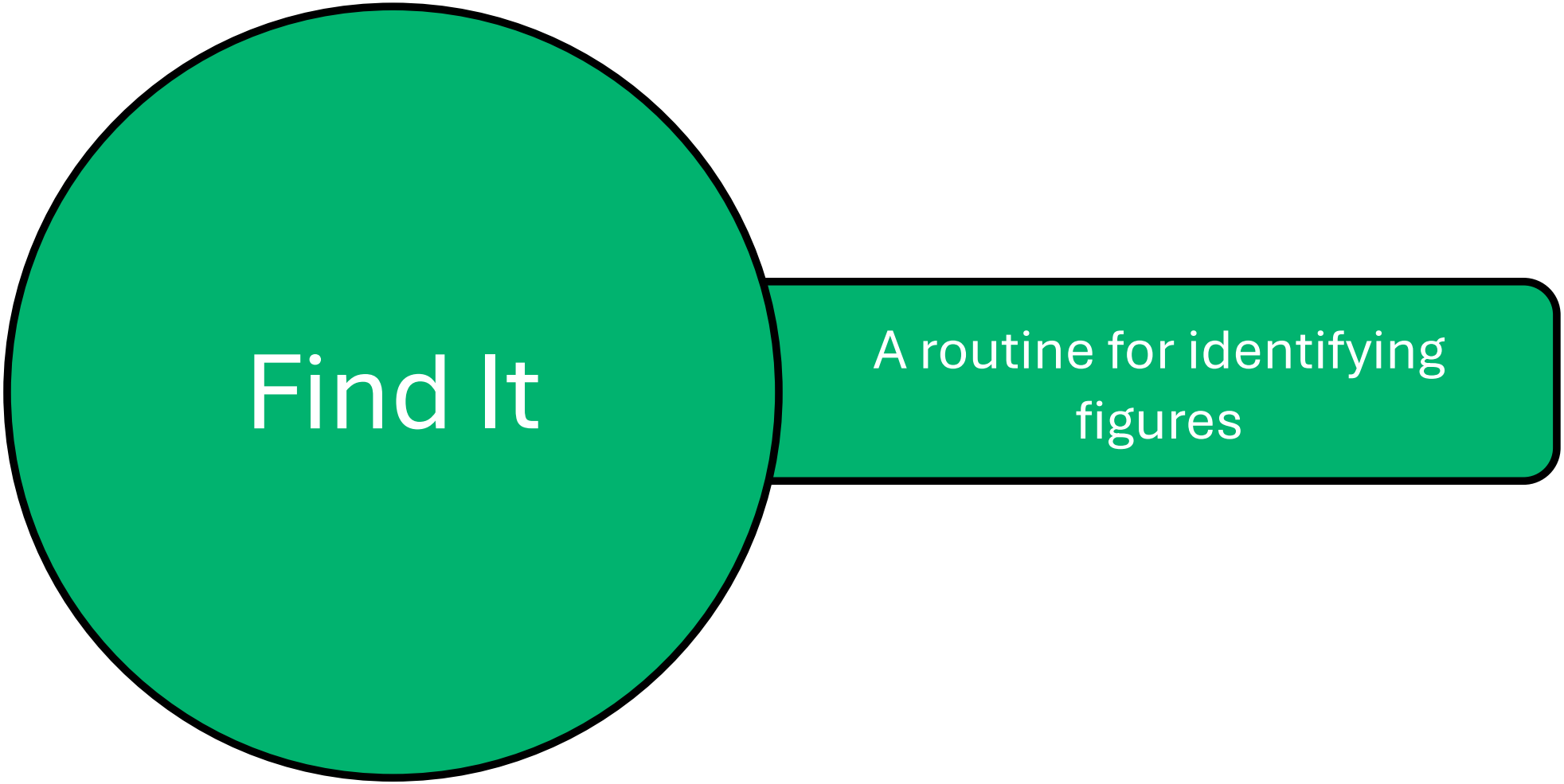




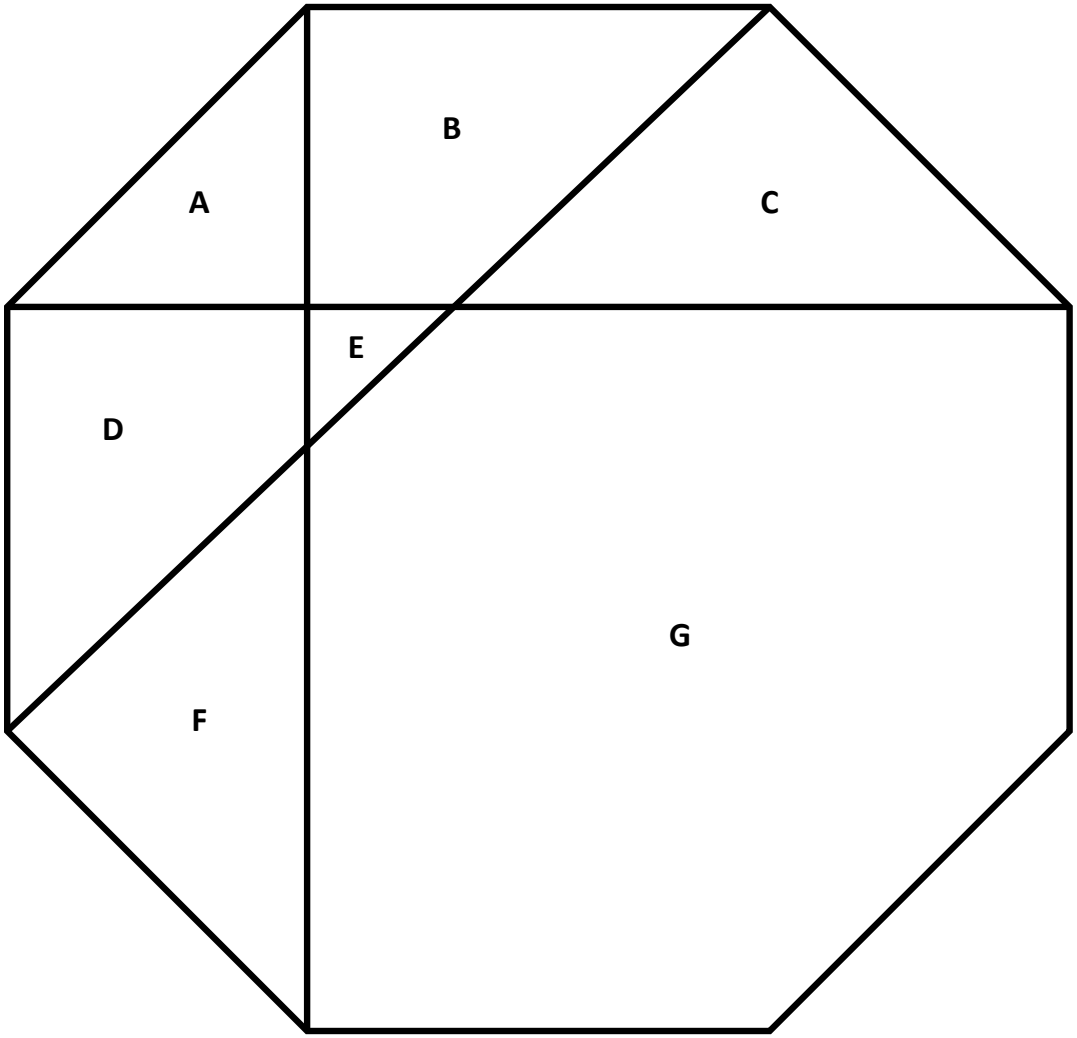
Venns

- Present shapes and a Venn diagram with categories.
- Students determine which shapes fit in which categories.
- Students agree and disagree with classmates' sorts.





Find 2 hexagons other than the big hexagon.

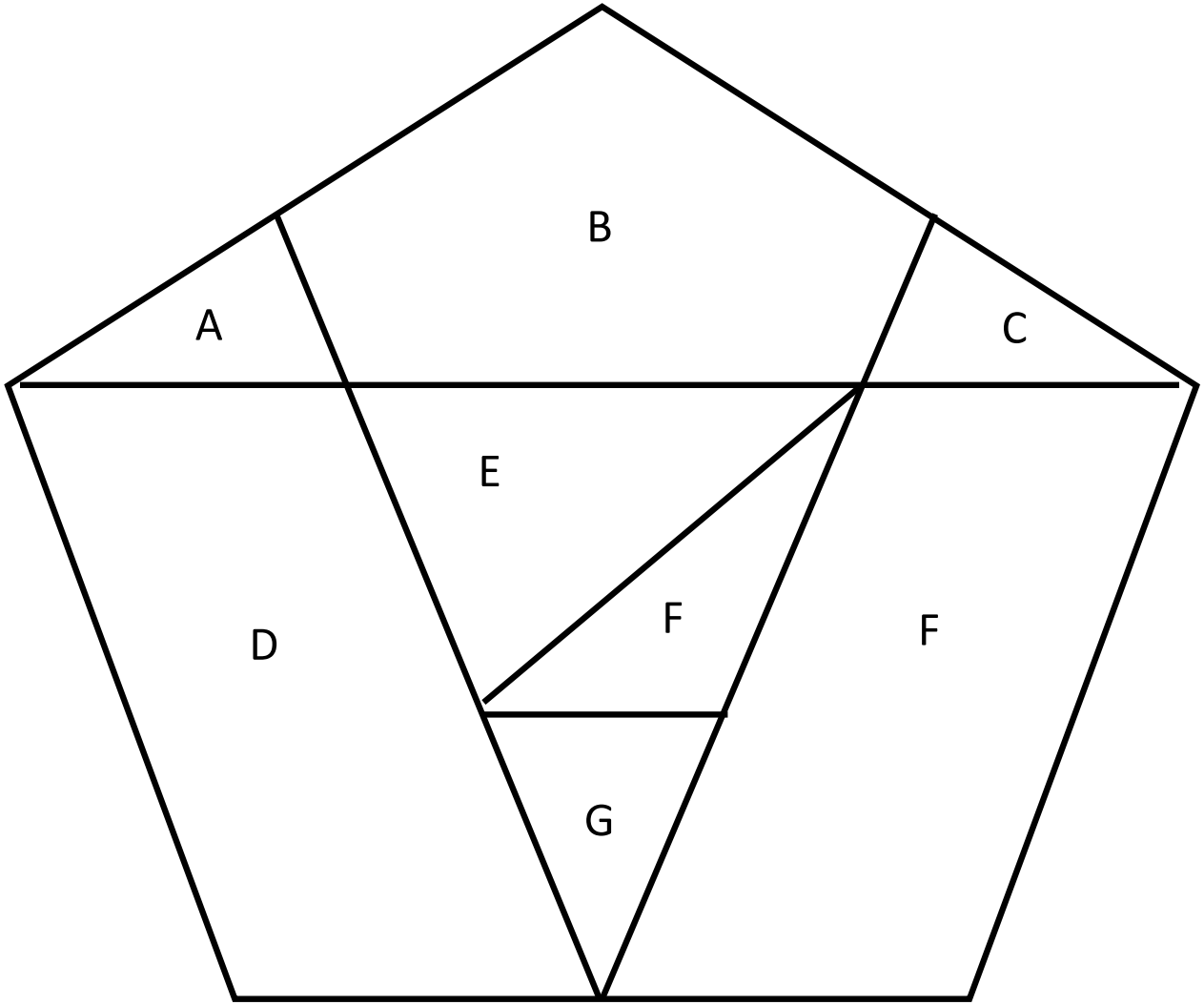


Find 3 triangles.

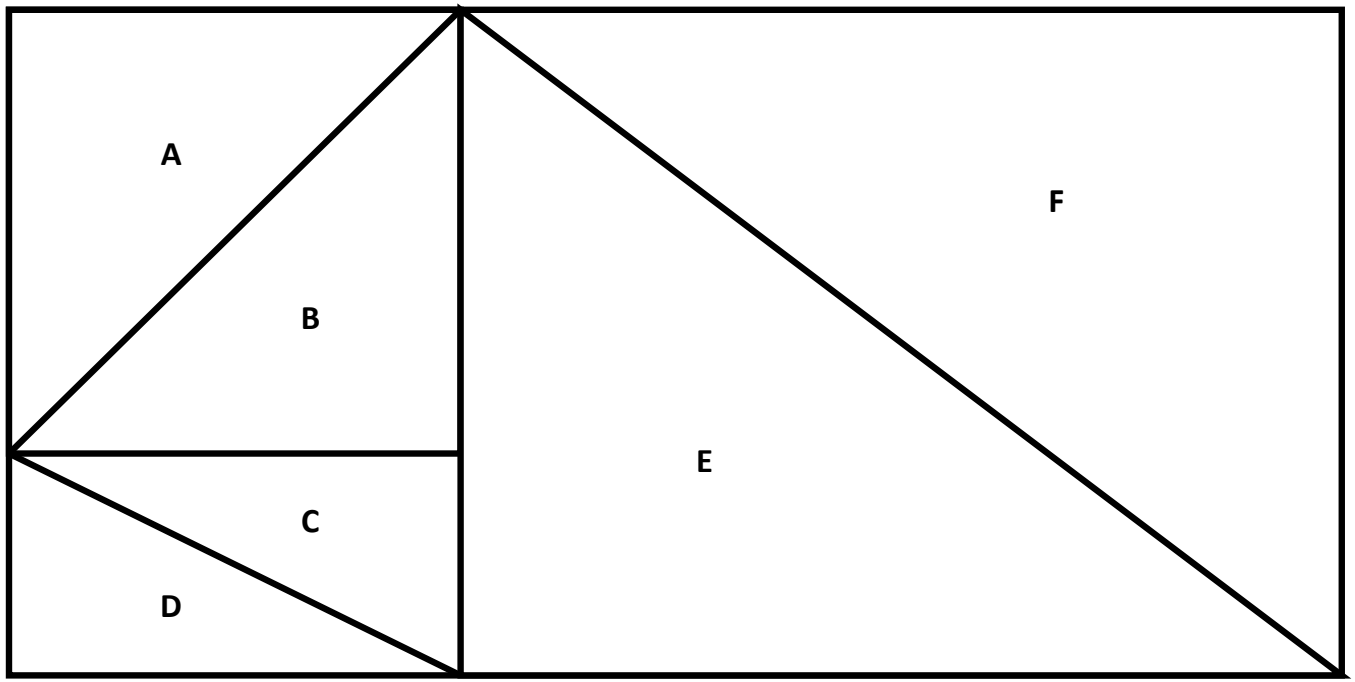
Find 2 parallelograms.

Find 2 pentagons.

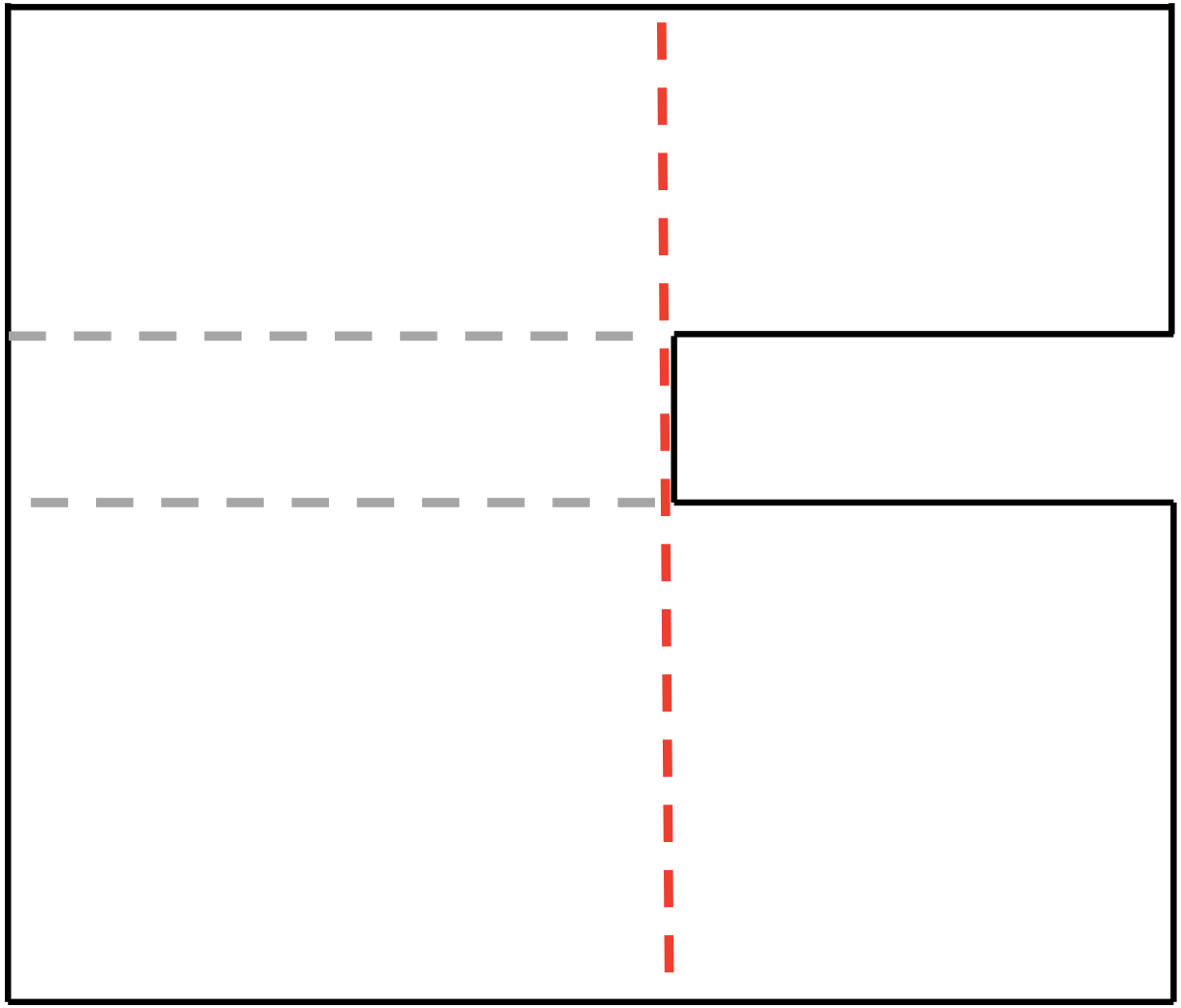
Find a trapezoid



Find 5 quadrilaterals.



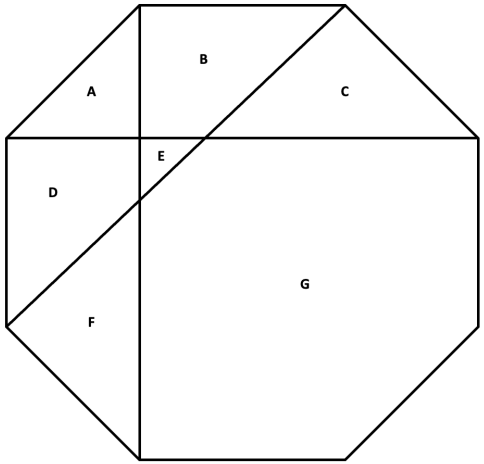
Can you break it into 3 rectangles?



Find It

- Create a shape and partition it.
- Pose a challenge to find composite shapes.
- Students complete the challenge and share their thinking.

Find 2 hexagons other than the big hexagon.



Data

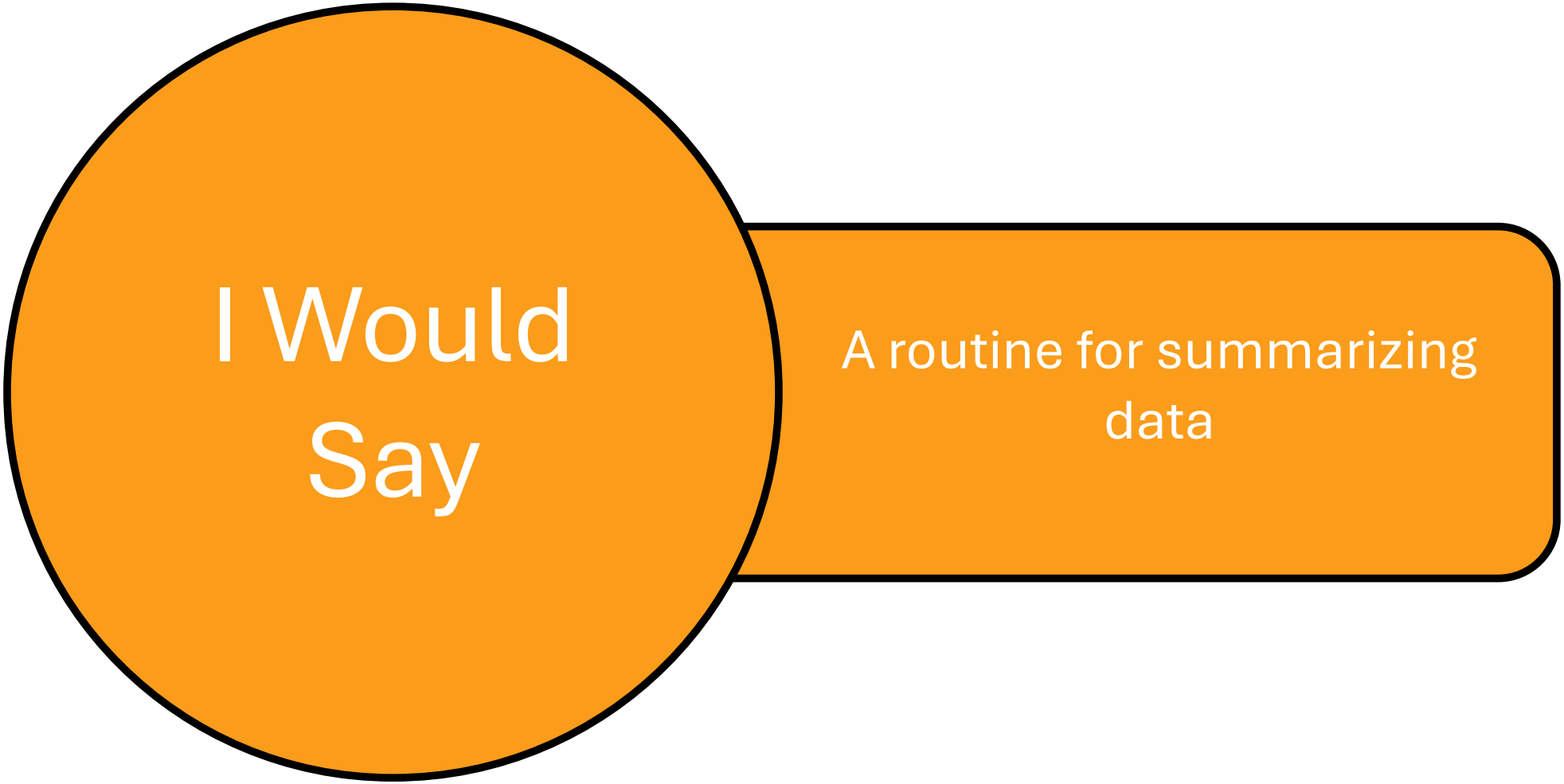
Data Considerations

Data literacy is a valuable 21st century skill.

Creating a bar graph **isn't** a 21st century skill.

Being data literate is grounded in a strong understanding of statistics and data displays.

Understanding displays is more than simply reading the data with certain displays (e.g., bar graphs).



Basketball Scoring Over the Years

1960s
115 ppg

1980s
109 ppg

2000s
97 ppg

2020s
112 ppg

ppg = points per game

How big are some of America's 62 national parks?

l Parks in Acres

Variation:
What can you say?

What questions do you have?

Yosemite
761,747

Everglades
1,400,539

Mammoth Cave
54,011

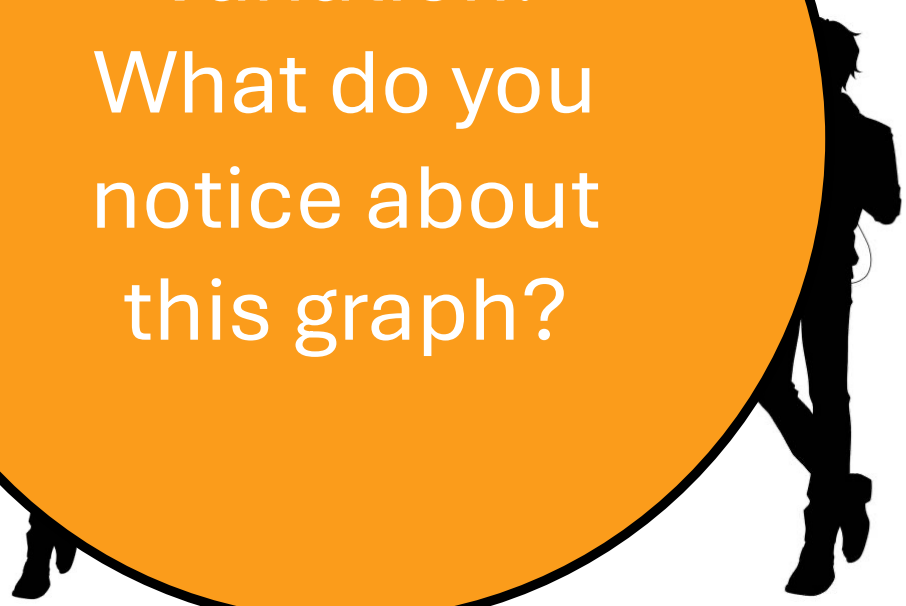
Great Smokey Mts
522,426

Redwood
138,999

Yellowstone
2,219,790

Average Male Height at Age 18

Variation: What do you notice about this graph?



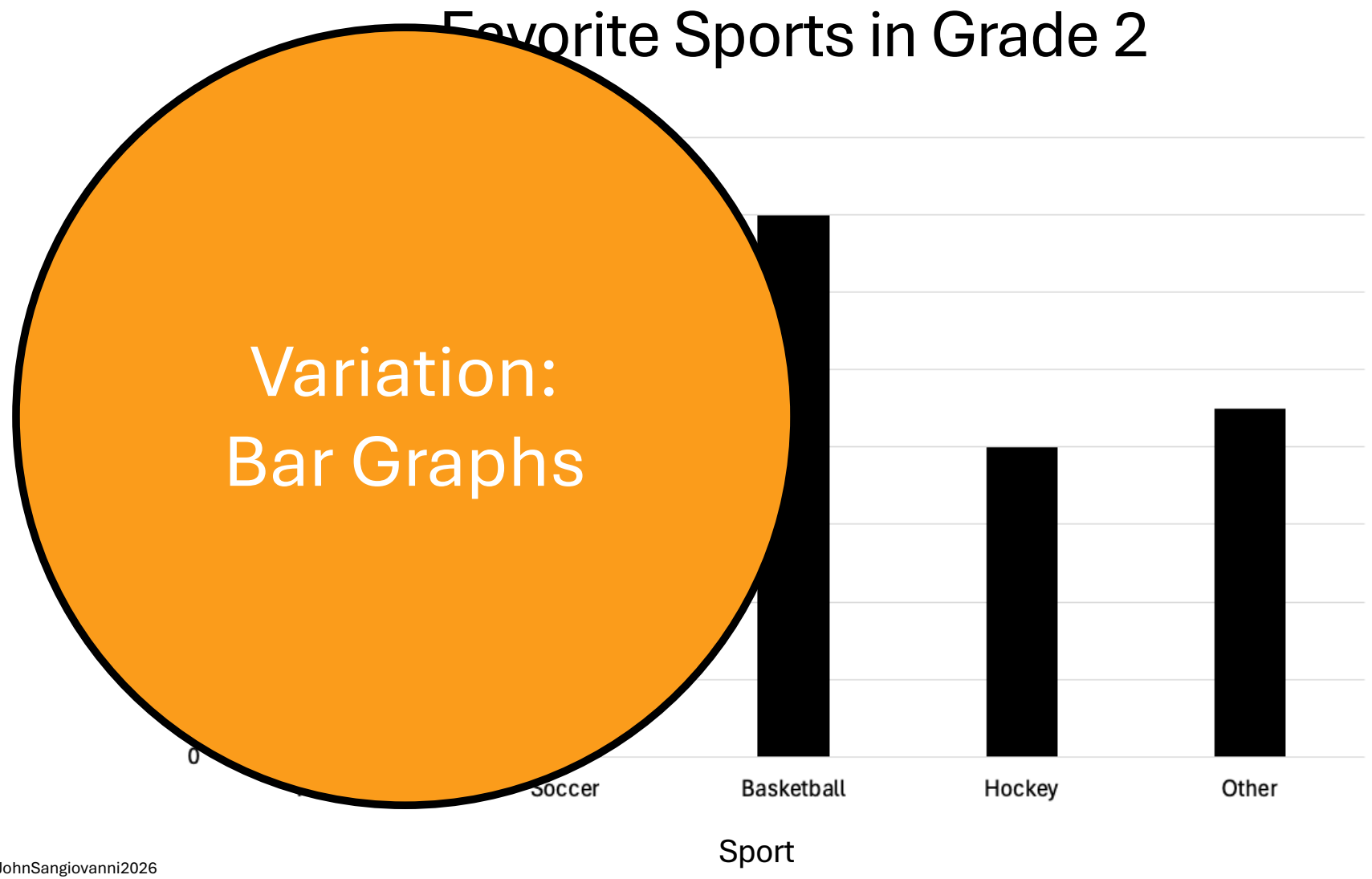
1914
162 cm

1934
165 cm

1954
168 cm

1974
170 cm

1994
172 cm



Topic	Important Features
What Is the Graph About?	What Does the Data Describe?

Summary	Important Features
Conclusions	Questions

Two Things That Resonate With You Today

SANGIOMATH
UNLOCK THE POWER OF MATH

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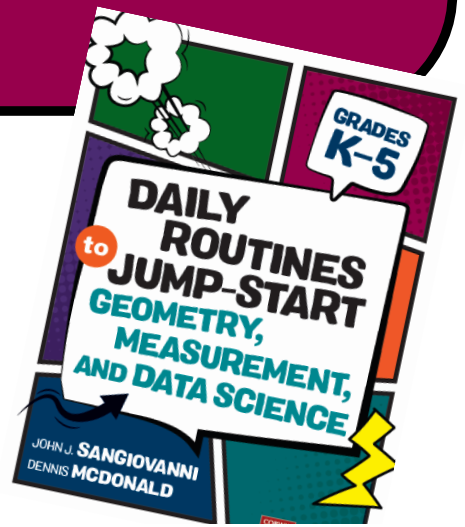

Geometry, Measurement, and Data Science

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