Kansas MTSS Symposium 2021

Teaching Vocabulary

From the Perspective of a Math Teacher

Presented by

Dean Ballard

Director of Mathematics

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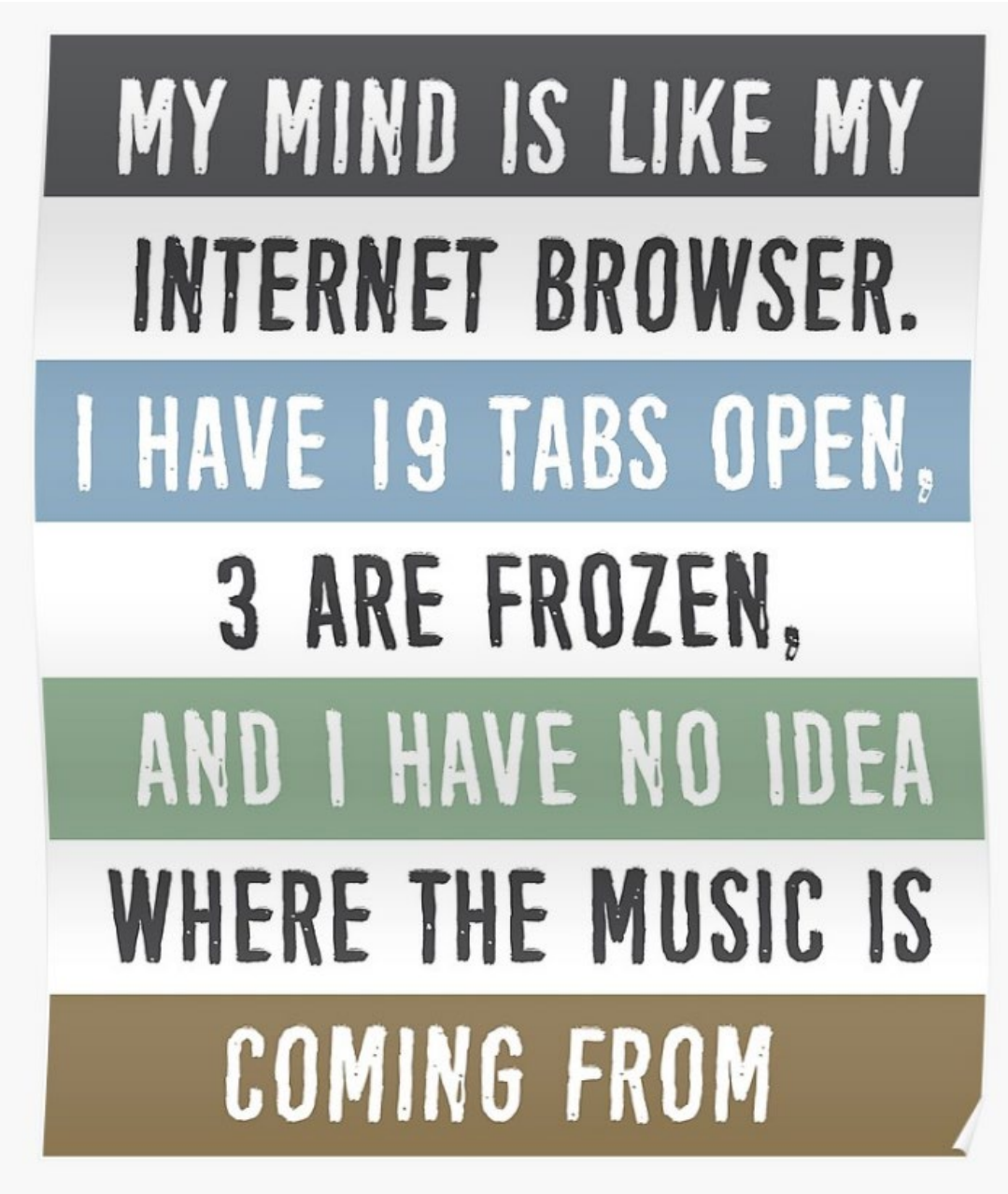

MY MIND IS LIKE MY
INTERNET BROWSER.
I HAVE 19 TABS OPEN,
3 ARE FROZEN,
AND I HAVE NO IDEA
WHERE THE MUSIC IS
COMING FROM

Learning Objectives

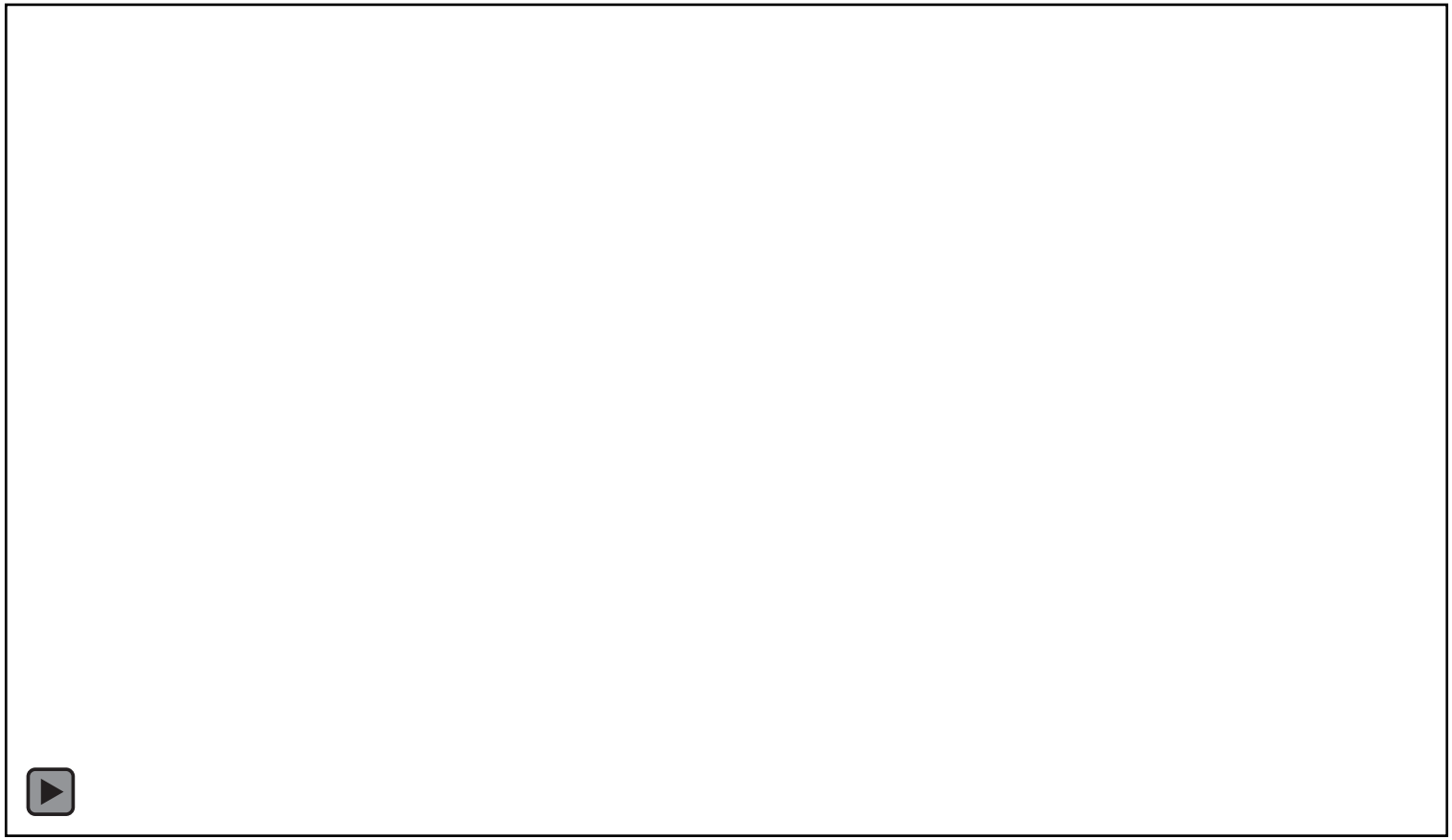
- Recognize how to make vocabulary instruction within math lessons an integral part of learning math.
- Learn language specific challenges with math that are obstacles for all learners including English learners.
- Learn techniques for overcoming these obstacles that lead to meaningful vocabulary instruction.

Essential Questions to Answer

- Why focus on vocabulary in math?
- What is different about vocabulary in math?
- What are some ideas to use that teach vocabulary as a means to learning math?

Brian Regan's UPS Math Vocabulary Challenge

(youtube: https://www.youtube.com/watch?v=89frRi8GgGA)



Communication Skills in Mathematics

The ability to use reading and writing, speaking and listening sufficiently well to engage in thinking and to communicate ideas.

—McKee & Ogle, 2005

Students rely on language skills to read, write, talk, and represent their mathematical thinking and problem solving.

—Fogelberg et al., 2008

Chat

Name an Important Math Term

- Think of one math term or phrase that is important for students to understand and that you find students often struggling to understand and/or use.
- What math concept(s) is this term or phrase associated with?

Words in Three Tiers

- **Tier 1 – Basic words:** Students know these words sufficiently on their own. For example, *a, the, an, daddy, food.*

- **Tier 2 – Frequent words central to comprehension:** Good candidates for direct instruction. For example*, problem, solve, explain, justify, compute, determine, connections, relationships, representations*, etc.

- **Tier 3 – Specialized words:** Words that are specific within a certain field, such as math. **BEST LEARNED IN CONTEXT.** For example, *place value, fraction, numerator, tens, tenths, polygon, area, perimeter, linear, point, equation, variable*, etc.

—Adapted from *Teaching Reading Sourcebook,* 2018

Why Is Vocabulary Important in Math?

- Research shows that reading comprehension positively affects achievement in arithmetic and problem solving.
- Math vocabulary is confusing for many students for a variety of reasons that impede their ability to understand what they read and hear.

Vocabulary instruction should focus on specific words that are important to what students are learning.

Marzano, 2001

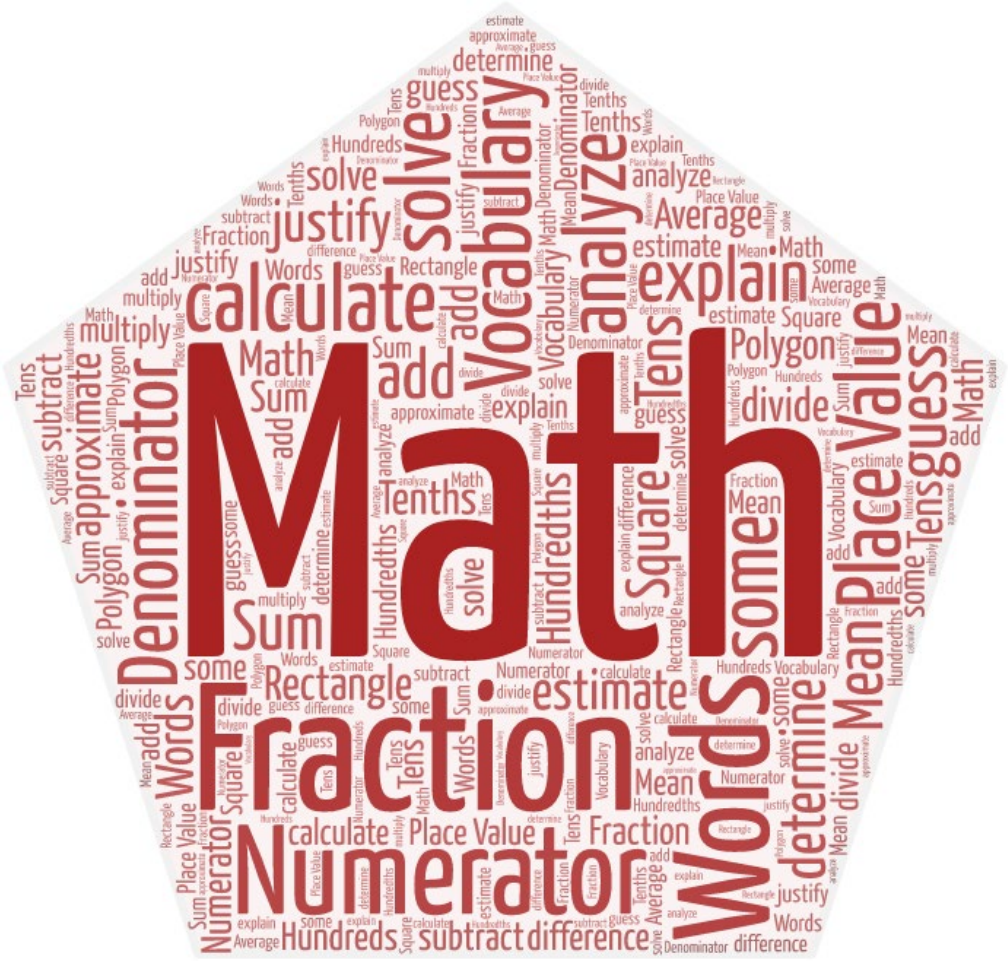
Considering the Needs of All Students

- Students not use to talking about math
- Struggling learners
- EL students
- Special needs
- **All students**

Even students who have good conversational English skills may lack the academic language necessary to fully access mathematics curriculum.

(summarized from multiple researchers)

Vocabulary Challenges in Math



Math Specific Vocabulary

Key Vocabulary from CCSSM Grade 6 Content Standards:
Ratio, rate, unit rate, unit pricing, constant speed, percent, percent of, common factor, greatest common factor, integers, positive numbers, negative numbers, rational number, opposite value, inequality, absolute value, coordinates, coordinate plane, quadrants, numerical expression, exponent, variable, algebraic expression, term, coefficient, evaluate expressions, Order of Operations, properties of operations, distributive property, equivalent expressions, equations, inequalities, substitution in an expression, making an equation or inequality true, constraint, dependent and independent variables, right triangle, volume, right rectangular prism, edge, face, vertex, surface area, nets for finding surface area, variability, measure of center, median, mean, measure of variation, range, interquartile range, deviation, dot plot, histogram, box plot

Challenging Semantic Features

- Long dense noun phrases
  - *The volume of a rectangular prism with sides 8, 10, and 12 cm*
- Classifying adjectives that precede the noun
  - *Prime number, rectangular prism*
- Qualifiers that come after the noun
  - *A number which can be divided by one and itself*
- Conjunctions
  - *If, when, therefore, given, assume*

—Schleppegrell 2007

Identify Challenging Words

Double Meanings:

Table	fraction	even
base	rational	tangent
side	irrational	variable
point	operation	volume
mean	expression	whole

Homophones:

Cent	→	sent or scent
plane	→	plain
two	→	to or too
sum	→	some
sine	→	sign

Multiple Terms for Same Idea:

- altitude, height or length
- add, sum
- solve, answer, compute
- justify, explain, prove

Small Words or Phrases:

or	fewer	less than
many	then	increase
and	of	decrease
any	all	left

Unique Terms:

hypotenuse, parallelogram, coefficient, quadratic, quadrilateral

Similar Sounding Words:

tens vs. tenths
sixty vs. sixteen
then vs. than

Symbol and Cue Card Matching (in Desmos)

Match Symbol cards with Cue cards (salmon)

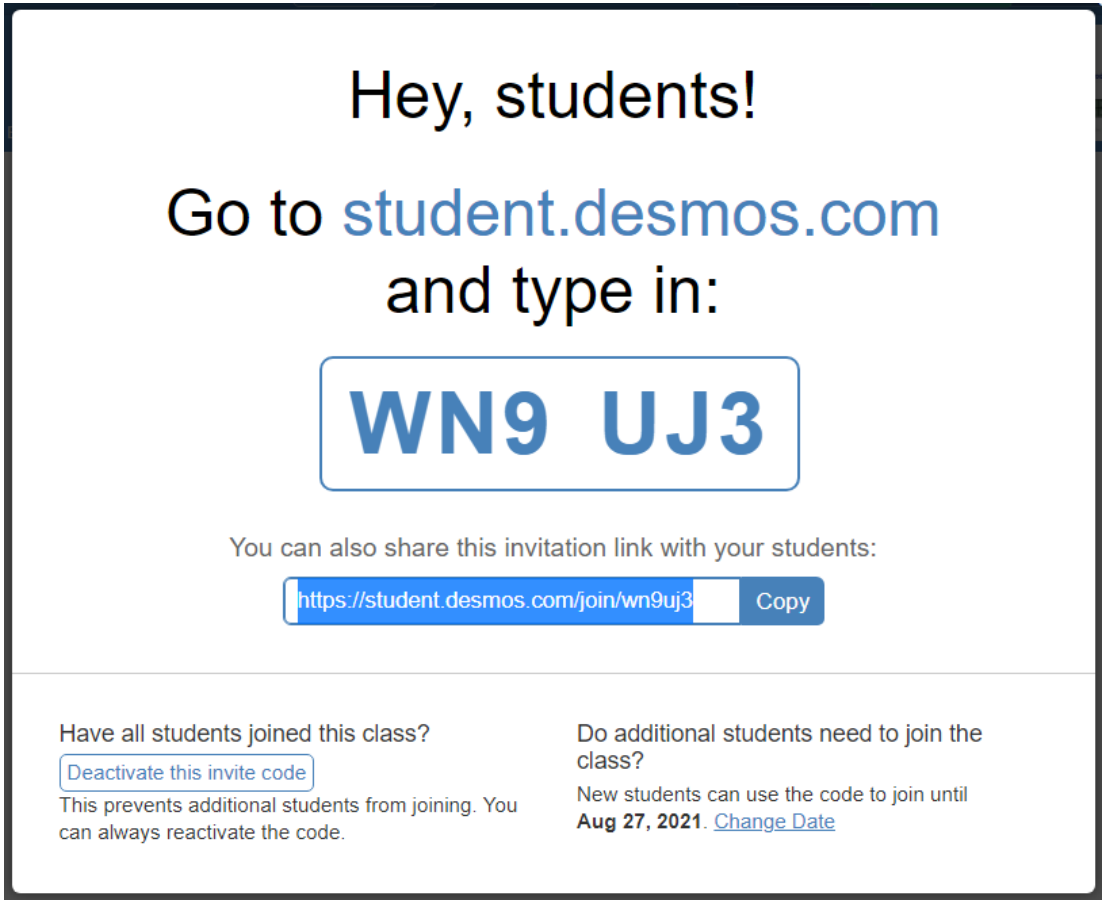
- In groups of 2-4, use envelopes provide.
- One person is the "judge" to check the answers.
- Other people take turns matching a Cue card to a Symbol until all Cue cards are used up.
- Record correct answers. **Put back if incorrect.**

NOTE: More than one correct match usually possible.

$8 - n$ → *n* less than 8

The difference between 8 and *n*

Symbol and Cue Cards on Desmos



Effective Vocabulary Instruction

Robust instruction "offers rich information about words and their uses, provides frequent and varied opportunities for students to think about and use words, and enhances students' language comprehension and production."

(Beck et al. 2002 as cited in Teaching Reading Sourcebook by Honig, Diamond and Gutlohn 2018)

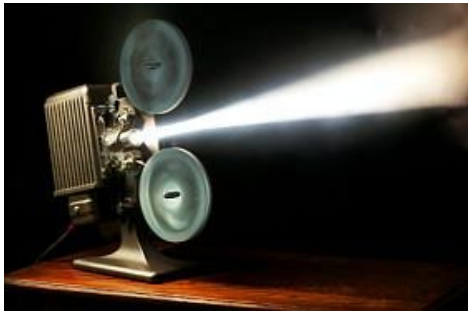
Receptive vs. Productive Use of Vocabulary

Receptive: Understand words and phrases when seen or heard.

Productive: Use words and phrases independently and correctly.

Amplify not Simplify

Teachers can foster students' sense-making by amplifying rather than simplifying, or watering down, their own use of disciplinary language.



Zwiers et al. 2017

Example:

Simplifying: Continually referring to the numerator as the "top number."

Amplifying: Build on a student saying, "the top number" by asking "what do we call that?", refer to an anchor chart, and/or have the class chorally repeat the term "numerator" while visually putting their hands above their heads.

Amplify or Simplify

Partitive and **quotitive** division (Simplify these):

- *I know how many groups*
- *I know how much is in each group*

Terms for division (Amplify these):

- ***dividend***
- ***divisor***
- ***quotient***

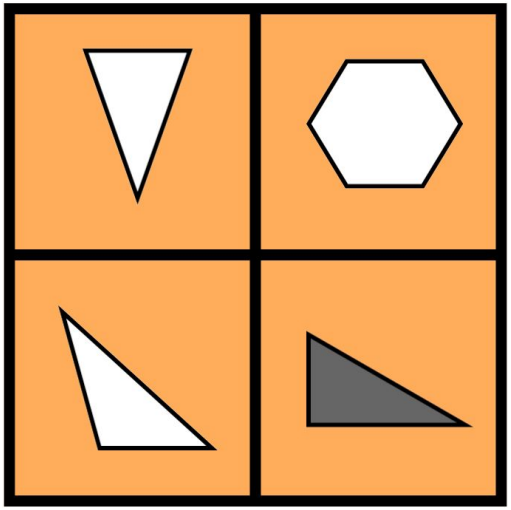
Anchor chart for division terms

dividend → $\frac{7}{10}$ ← divisor = 0.7 ← quotient

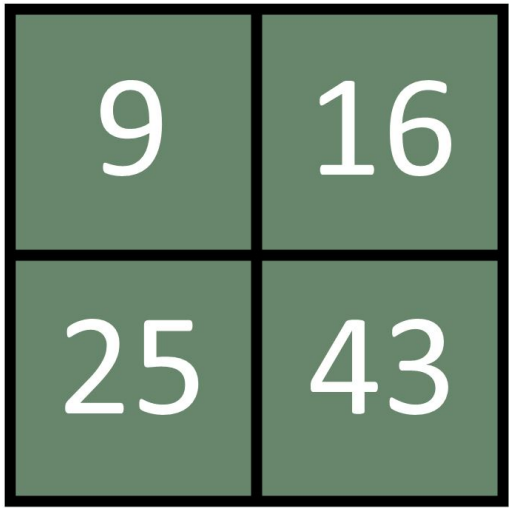
Which One Doesn't Belong

wodb.ca

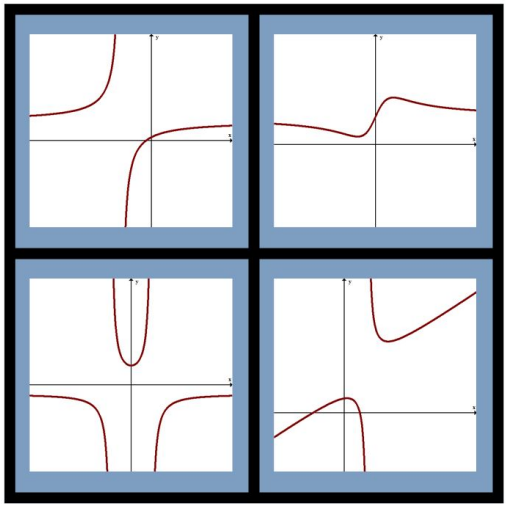
Shapes



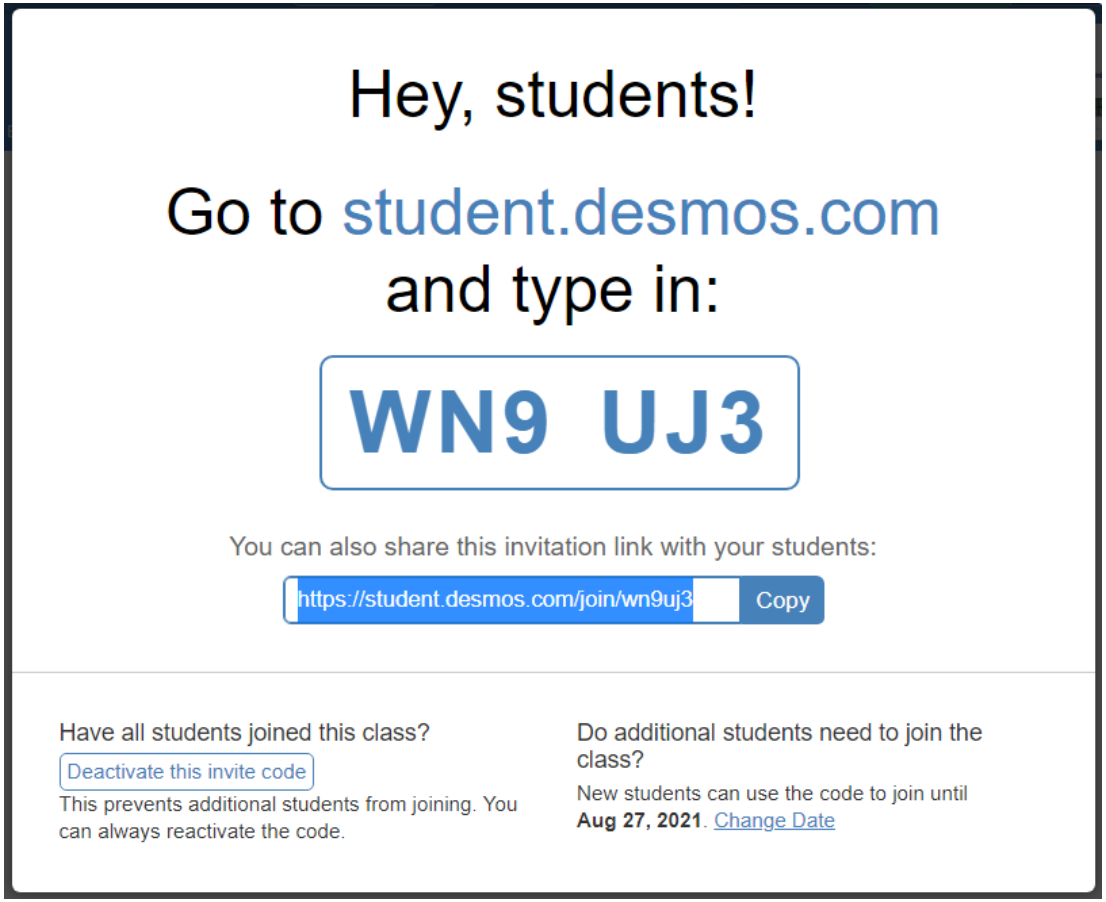
Numbers



Graphs

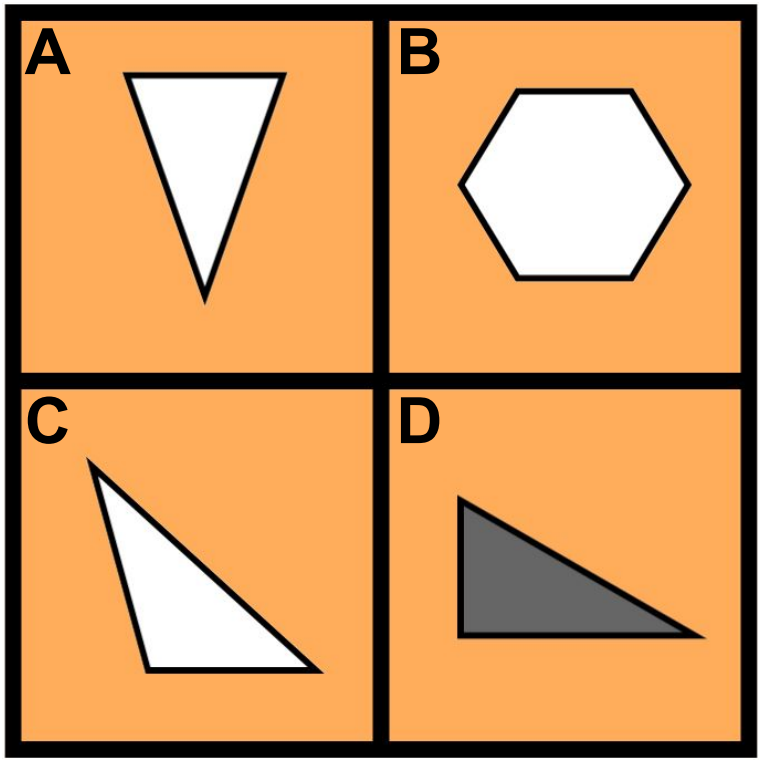


Which One Doesn't Belong on Desmos (same link as previously used)



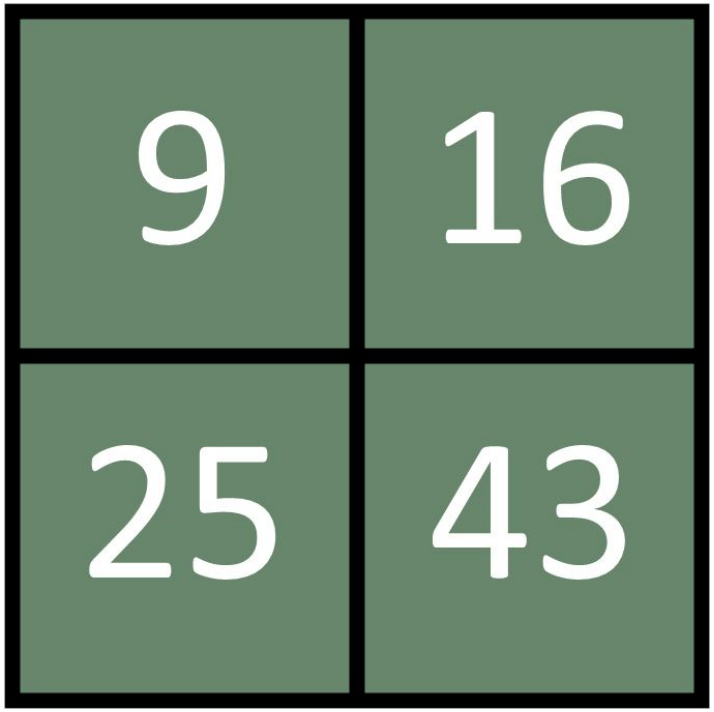
Which One Doesn't Belong
(in desmos in breakouts)
wodb.ca

Shapes 1



Which One Doesn't Belong
wodb.ca

Numbers



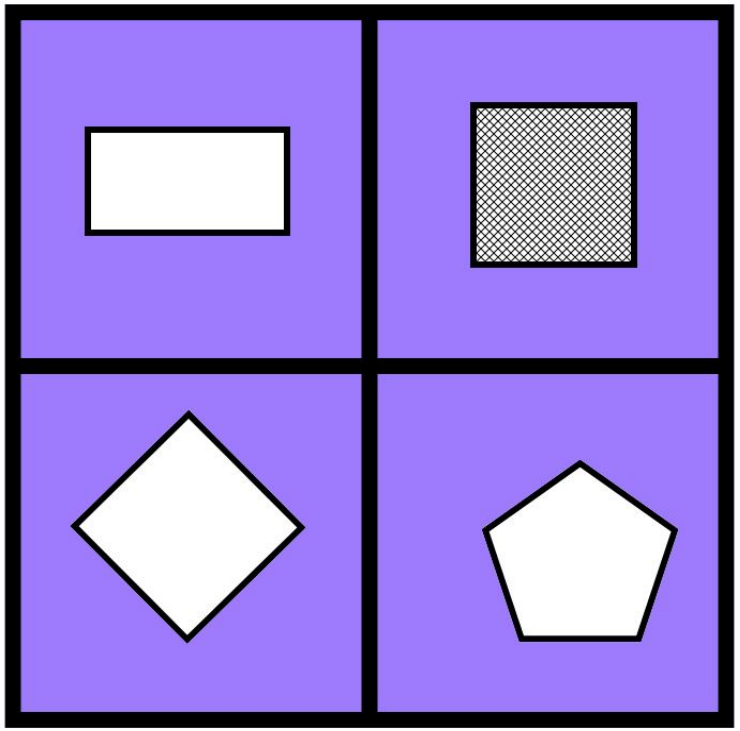
Which One Doesn't Belong

wodb.ca

Try to use some of these terms in your explanations:

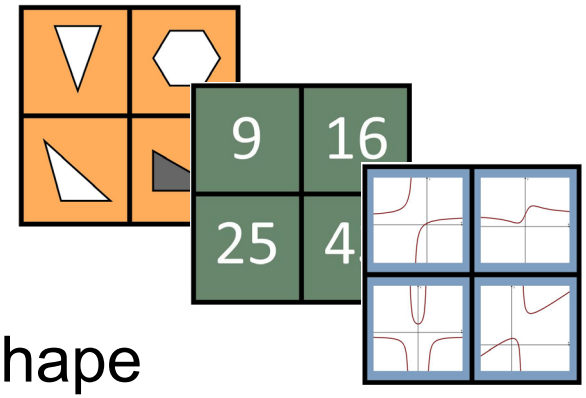
side
vertex or vertices
angle
right angle
obtuse angle
acute angle
square
rectangle
triangle
pentagon
hexagon

Shapes 2



Which One Doesn't Belong - wodb.ca

Tips for Implementation



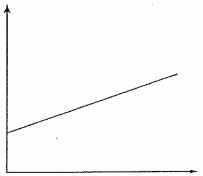
- Start with <u>shapes</u>
- Individual think time
- Limit telling all you know –
  each student share about one shape
- Students explain to each other first in pairs and groups the **why**
- Progress to Challenge: "find a reason for each shape"
- Whole class discussions with each set
- Affirm and amplify math vocabulary throughout the activity

Writing

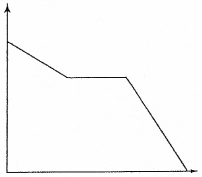
Graph Stories

What story might each graph be telling?

A.



B.



A.	B.
A tree growing planted a tree and going up steadily.	Going down a water slide. Going down the water slide steady then not changing at all then go down a dipp really fast.

Benefits of Writing in Math Class

What are the benefits of writing in math classes?

- Builds vocabulary
- Provides a source for reference
- Clarifies thinking
- Solidifies understanding
- Facilitates processing and deepens thinking
- Prepares students for discourse and further learning
- Assesses knowledge

More Benefits of Everybody Writes

1. Improved thinking and understanding
2. Students remember twice as much
3. Every student participates
4. Select effective responses
5. Cold call on students
6. Guide students toward what is most important

—*Teach Like a Champion*, 2010

Let's Look Into Some More Activities

Create Fraction Strips

- Take the two strips of paper provided and create two different fraction strips, one for 1/3 and 1/4.
  - On one side write "Three equal parts" (yellow paper), and "Four equal parts" (green paper).
  - On the other side write multiple representations for the fraction – **words and symbols**.

side 1

Two equal parts

side 2

half	$\frac{1}{2}$

Fraction Strips + Vocabulary

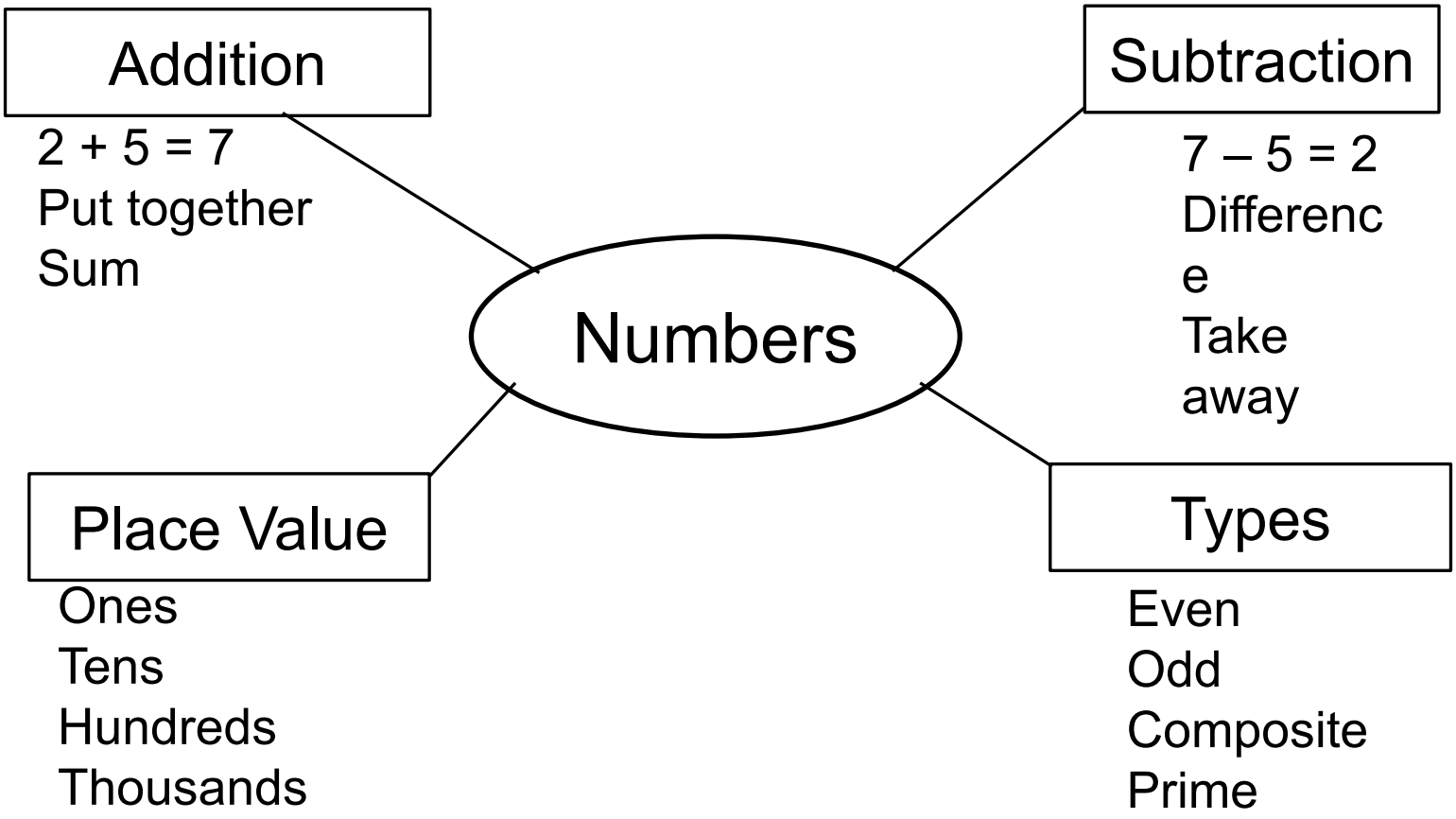
Three equal parts		
third	$\frac{1}{3}$	One-third

Four equal parts			
Fourth	one-fourth	$\frac{1}{4}$	One out of four

Graphic Organizers

- There are many types of graphic organizers. For example:
  - **Concept maps** to show connections between concepts and/or key vocabulary
  - **Agendas** to list the day's activities
  - **Advance organizers** to preview a unit
  - **Anchor charts** – illustrate and reinforce concepts and procedures

Concept Map


Addition
2 + 5 = 7
Put together
Sum
Subtraction
7 – 5 = 2
Differenc
e
Take
away
Numbers
Place Value
Ones
Tens
Hundreds
Thousands
Types
Even
Odd
Composite
Prime

CORE Word Knowledge Chart (Frayer type)

Word *Fraction*	
Meaning (in own words) *Part of a whole.* *Write it as one number over the other number.* *One number divided by another number.*	**Visualization or Drawing** $\frac{2}{5}$ 
Examples $\frac{2}{5}$ $\frac{7}{4}$	**Other Characteristics or related words** *Numerator* *Denominator* *Improper fraction*

Activity Idea: Create Word Knowledge Chart Round Robin Format

Pick a math term (from the assigned list). No two terms the same in any one group.

Round Robin Format - Create Chart for this term.

1. Fill in only the ***Word*** and ***Meaning*** sections on <u>your</u> chart.
2. Pass chart to left. Fill in ***Visual*** section on the chart received.
3. Pass chart to left. Fill in ***Example*** section on the chart received.
4. Pass chart to left. Fill in ***Other*** section on the chart received.
5. Pass chart to left.

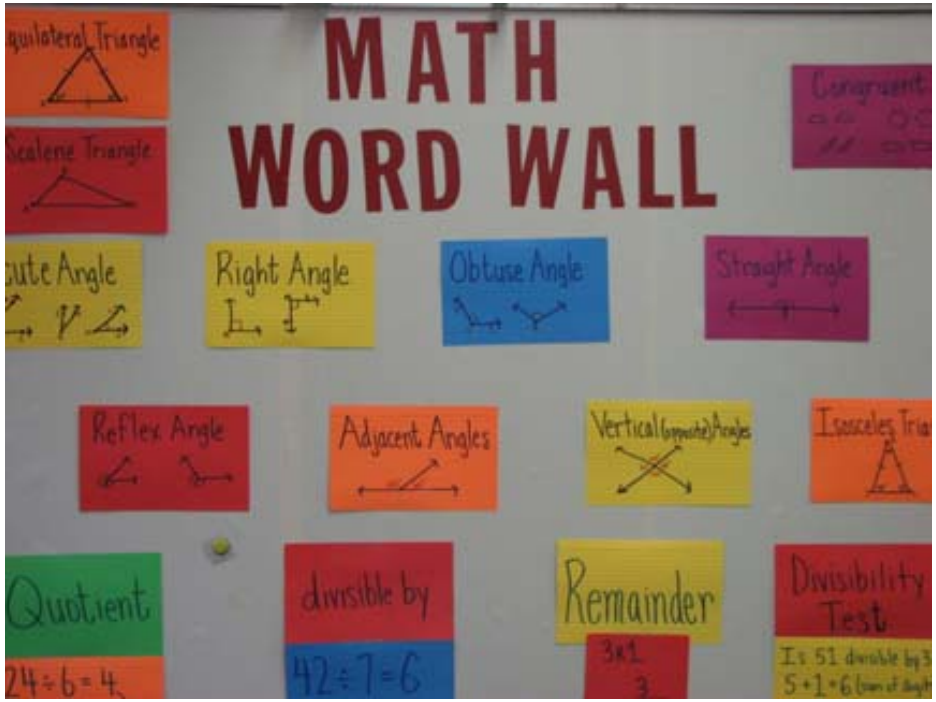
Activity Idea: Sorting Word Knowledge Chart

Play Mix and Match:

1. Students create Word Knowledge Charts for different terms or teacher uses charts already created.
2. Cut up the charts into 5 pieces (cut along the lines).
3. Mix all the pieces in your group together.
4. Trade piles of mixed-up pieces with another group.
5. Distribute the new pile of pieces randomly in group.
6. Re-create diagrams, matching pieces together (each person is in charge of the pieces dealt to her/him).

On the Wall

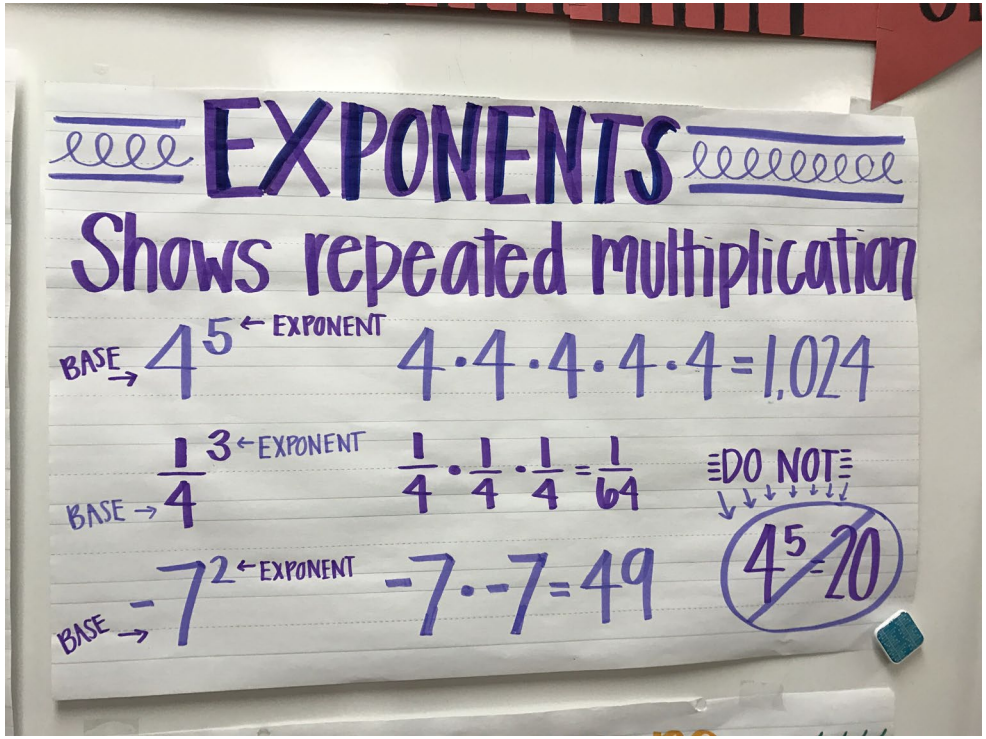
- **Word Walls**
- Anchor Charts
- Number Lines



From: http://schools.nyc.gov/

On the Wall

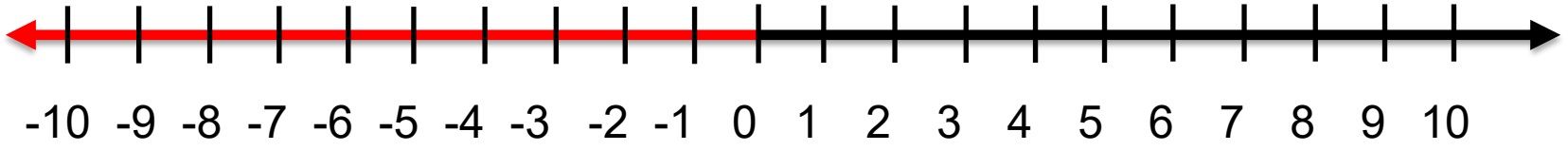
- Word Walls
- **Anchor Charts**
- Number Lines

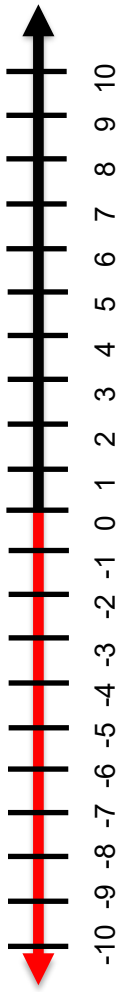


Shared on Pinterest:
https://www.pinterest.co.uk/pin/258957047307257739/

On the Wall

- Word Walls
- Anchor Charts
- **Number Lines**





activity

Guess My Polygon

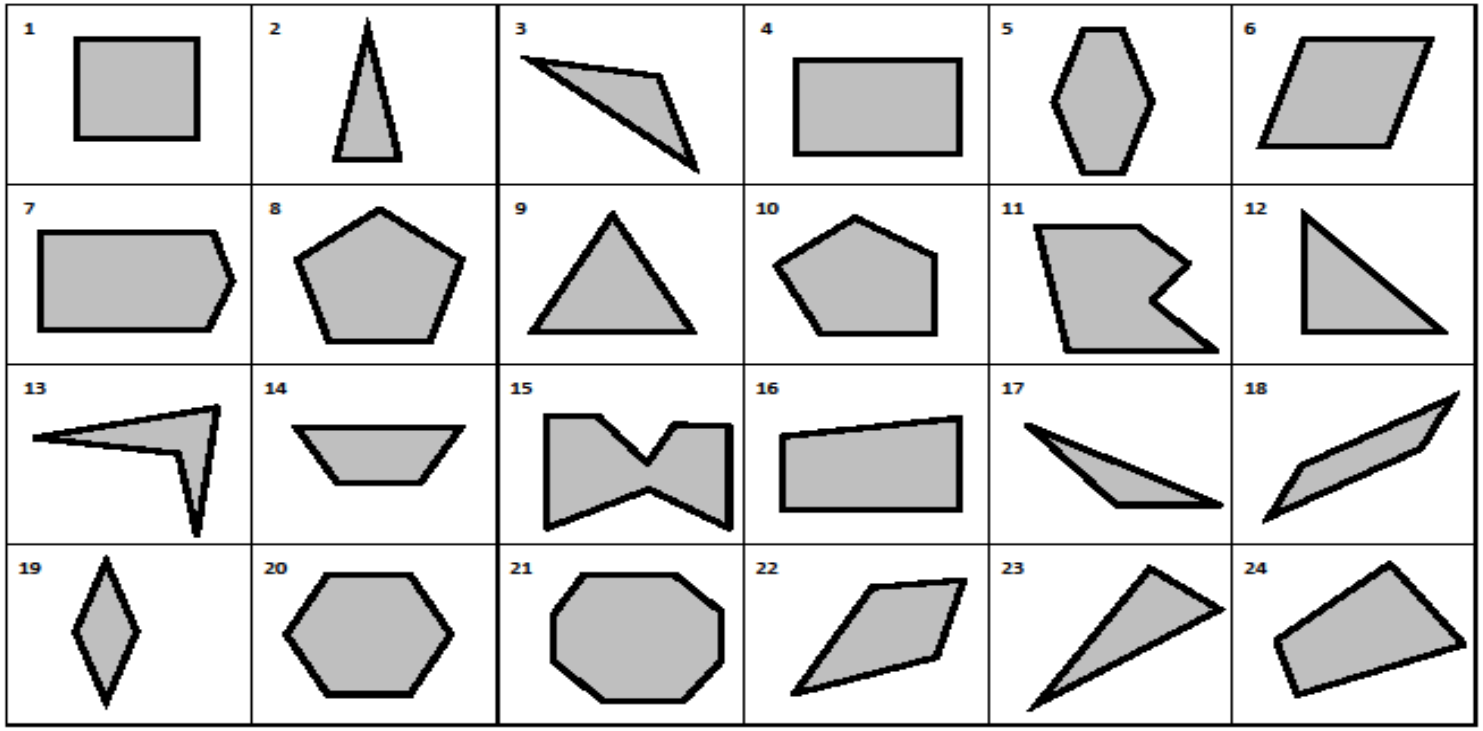
Chat

1. Play the game in groups of two or three.
2. Switch roles and play again.
3. Create teams of two and play against another team.

Alternative: ***Three Player version with vocabulary focus:***

- Two players compete in the game using the polygon chart.
  - Player 1 picks a polygon from the chart but does not tell player 2 which polygon he/she chose.
  - Player 2 asks yes/no questions to figure out which polygon player 1 chose. The goal is to be able to know within four or five questions.
- Third person tallies the math terms used correctly.

activity Guess My Polygon



Questions

- Yes/No questions only
- Must be related to shape characteristics

Learning Vocabulary Every Day?

What about everyday work on math vocabulary?

- Grow as You Go
- Plan and Promote
- Record and Review

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Thank you!

Dean Ballard

dballard@corelearn.com