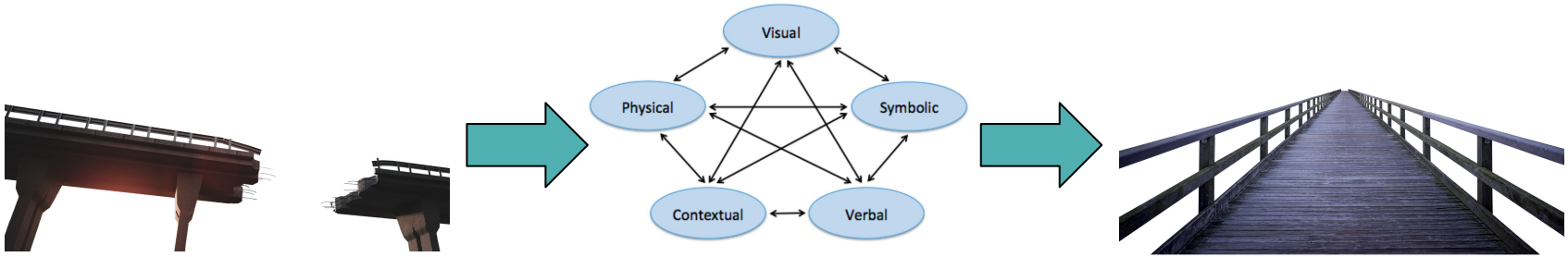
Bridging Understanding: Connecting Representations in K-8 Mathematics



Bridging Understanding: Connecting Representations in K-8 Mathematics

Shannon Olson
President & Founder
Olson Educational Services, LLC

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Welcome

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About Shannon Olson

Shannon Olson is an Educational Consultant and Professional Learning Provider for schools, districts, and agencies across the United States.

She has experience as an elementary school teacher, math teacher leader, instructional coach, district-level specialist, university instructor, and curriculum writer.

She specializes in standards, progressions, effective instruction, assessment and intervention, and building capacity in coaches and specialists.

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About this Session

In this interactive session, we'll explore the power of **using multiple representations—physical, visual, symbolic, verbal,** and **contextual**—to deepen student understanding of K-5 mathematics. Participants will learn strategies for **effectively using and connecting these representations** as tools to observe and assess student thinking, identify misconceptions, and guide instruction. Through hands-on activities and guiding questions, teachers will gain practical tools for fostering a more comprehensive mathematical understanding in their classrooms.

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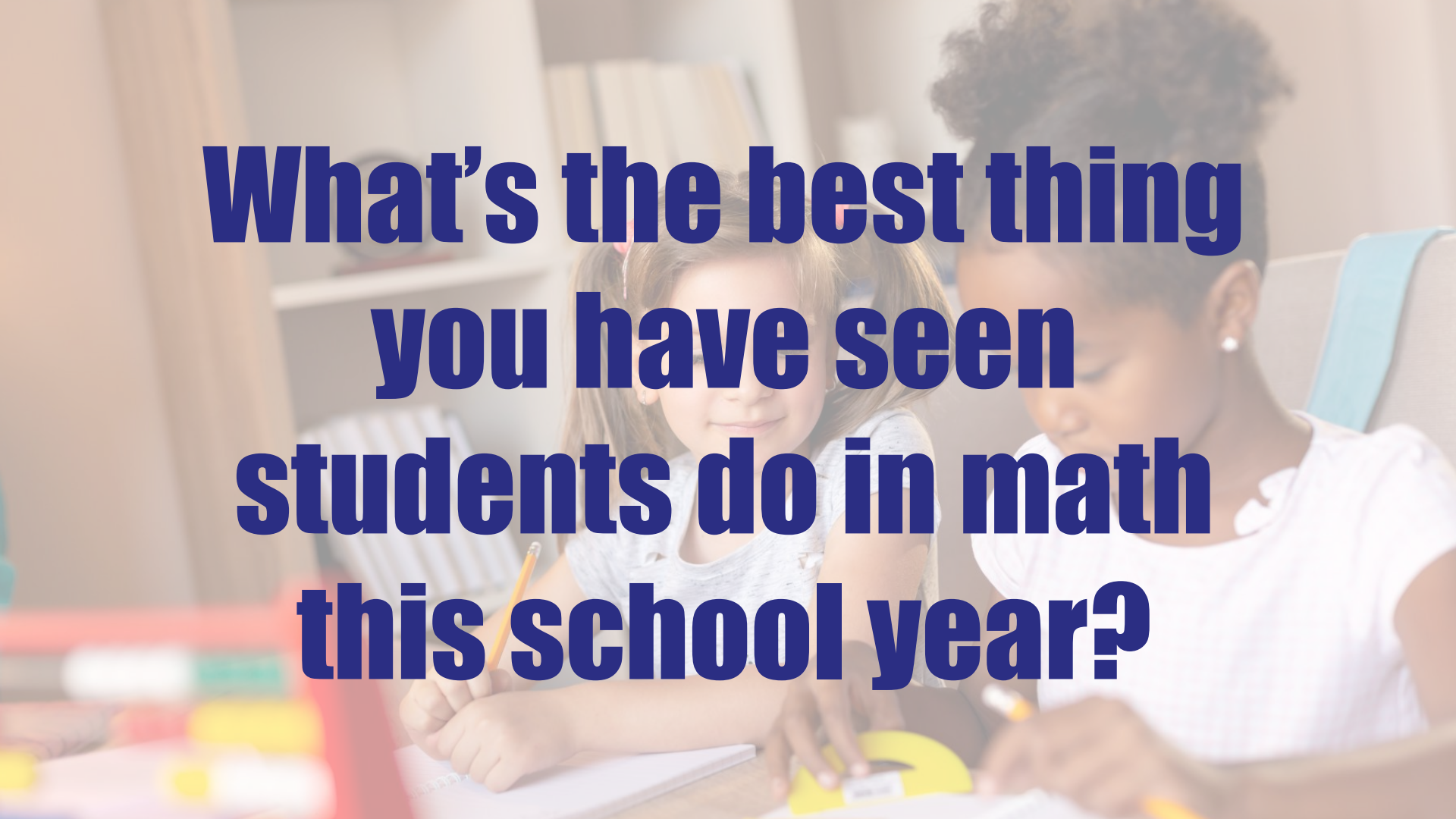

What's the best thing you have seen students do in math this school year?

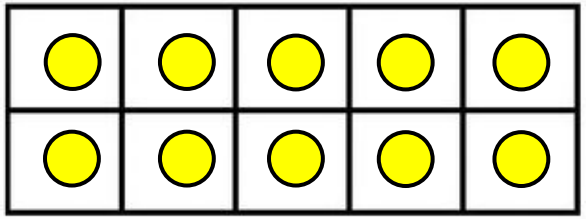

WACO ISD
WACO ISD


PARKDALE
ELEMENTARY
SCHOOL
PLEASE PARK
& MEET US AT THE DOOR
SCAN TO JOIN US!

1st Grade Number Talk

What number do you see?

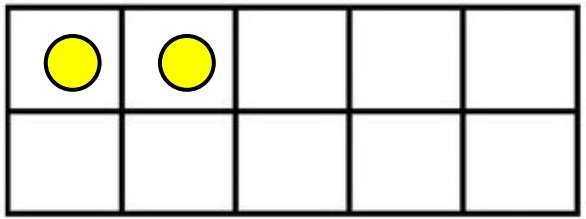
I saw the number _____.

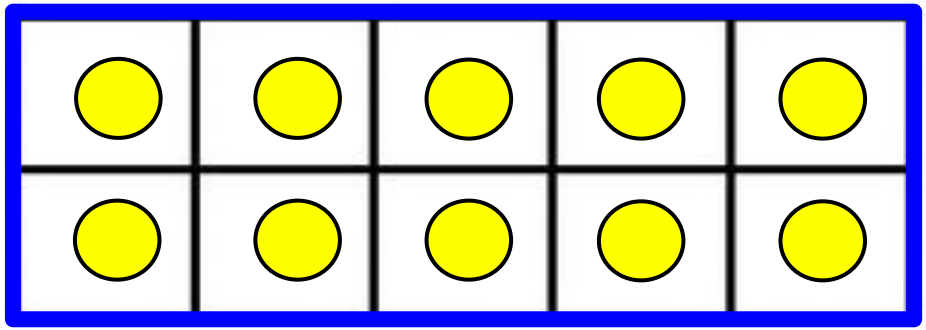


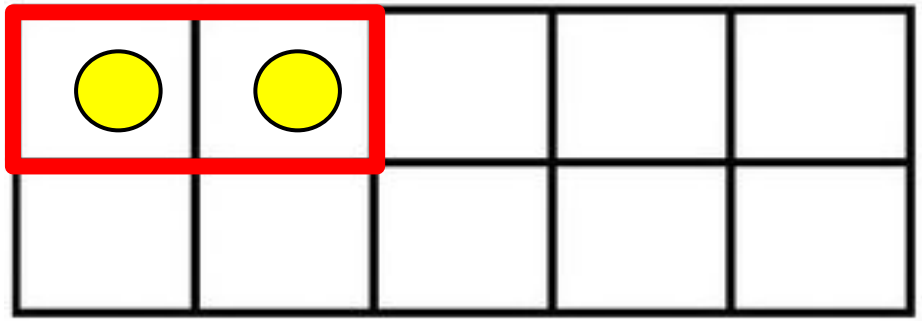
How did you see it?

I saw _____.

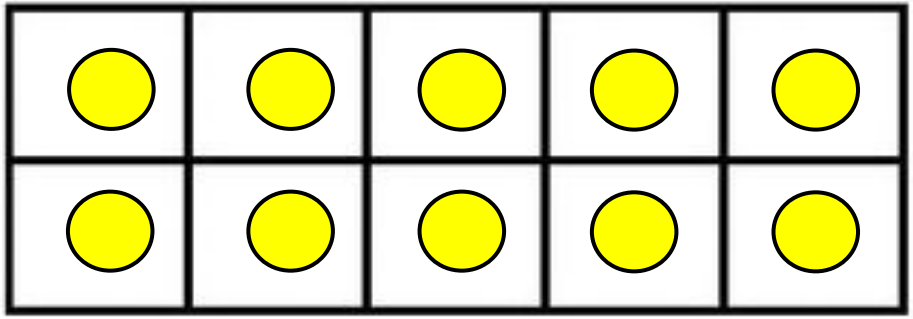
I counted _____.

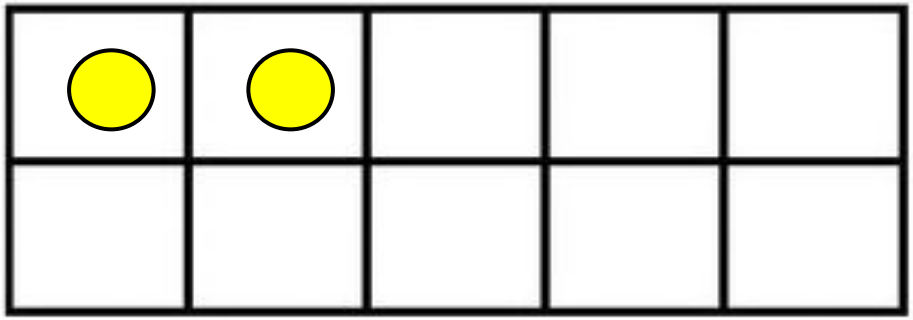




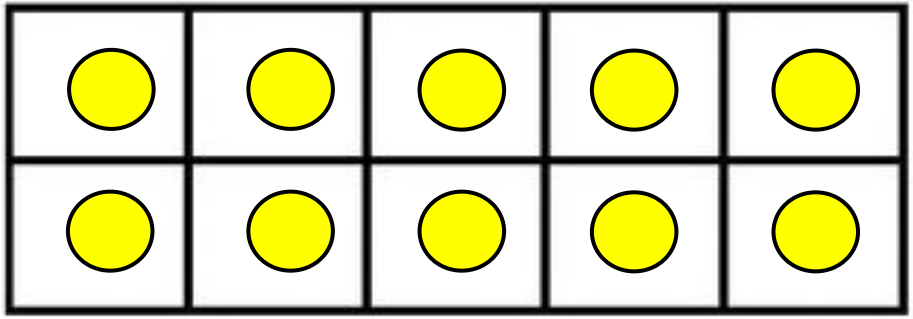


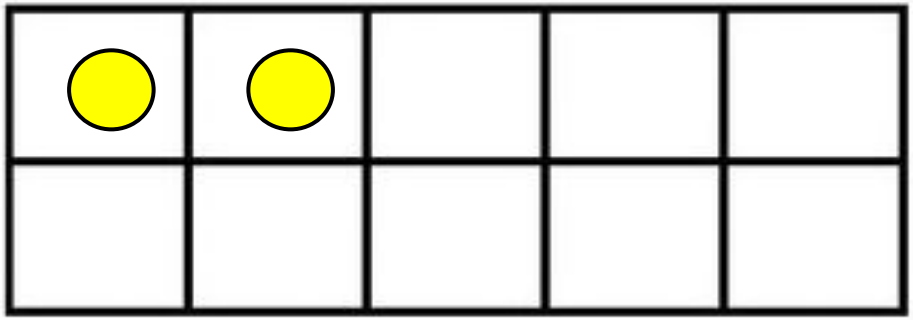
$10 + 2 = 12$



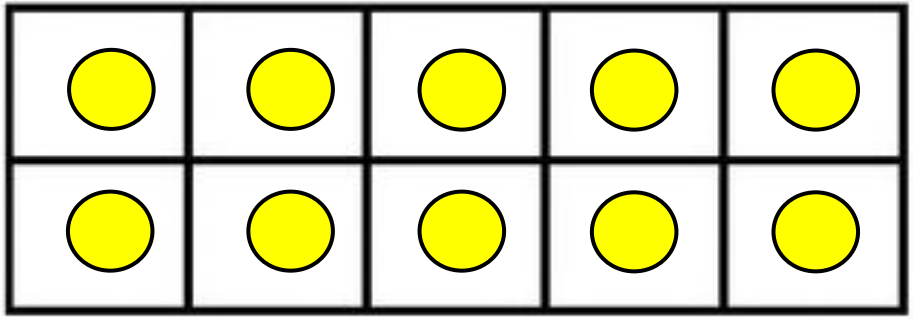


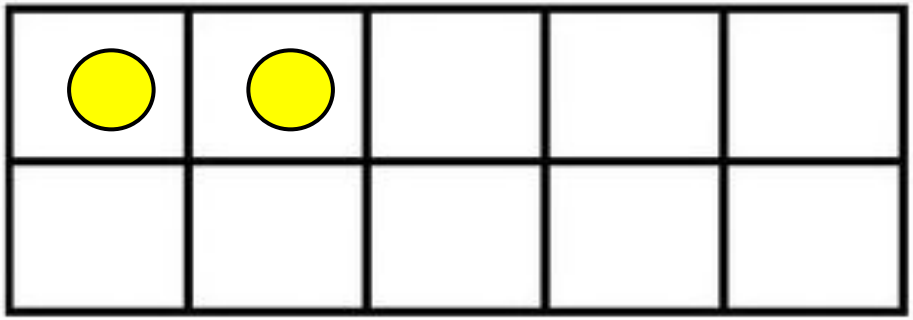
I see
6 and 6



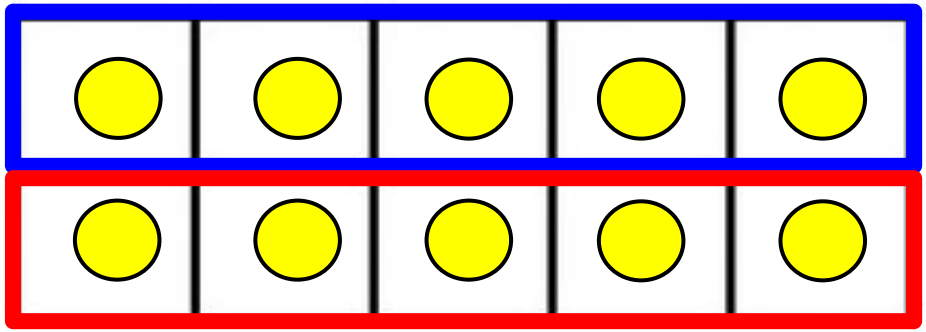


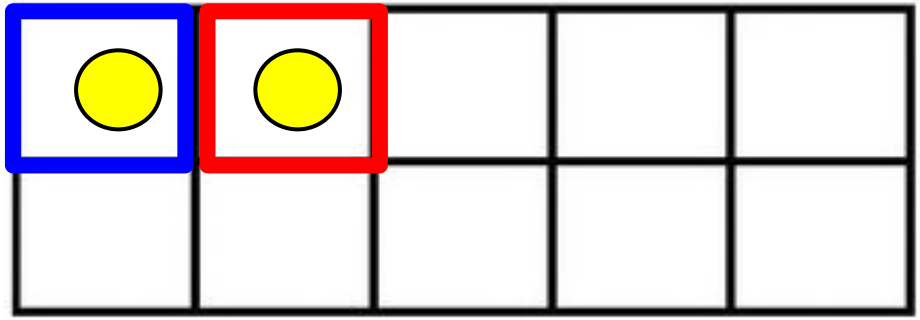
Tell me how you see 6 and 6



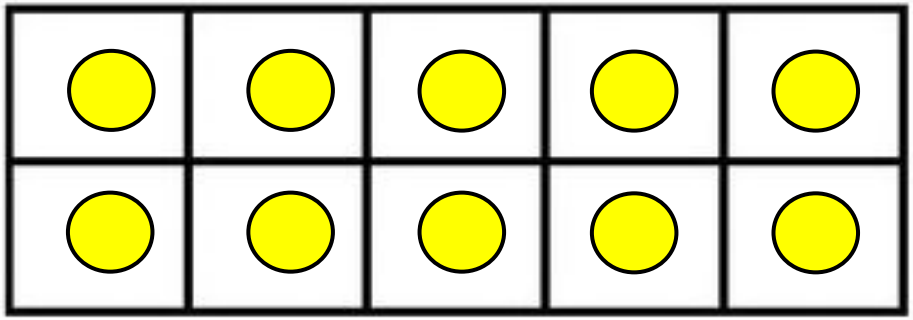


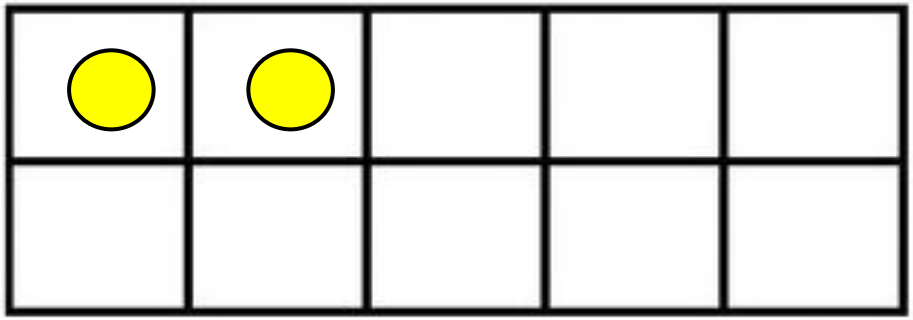
I see
5 and 1 two
times



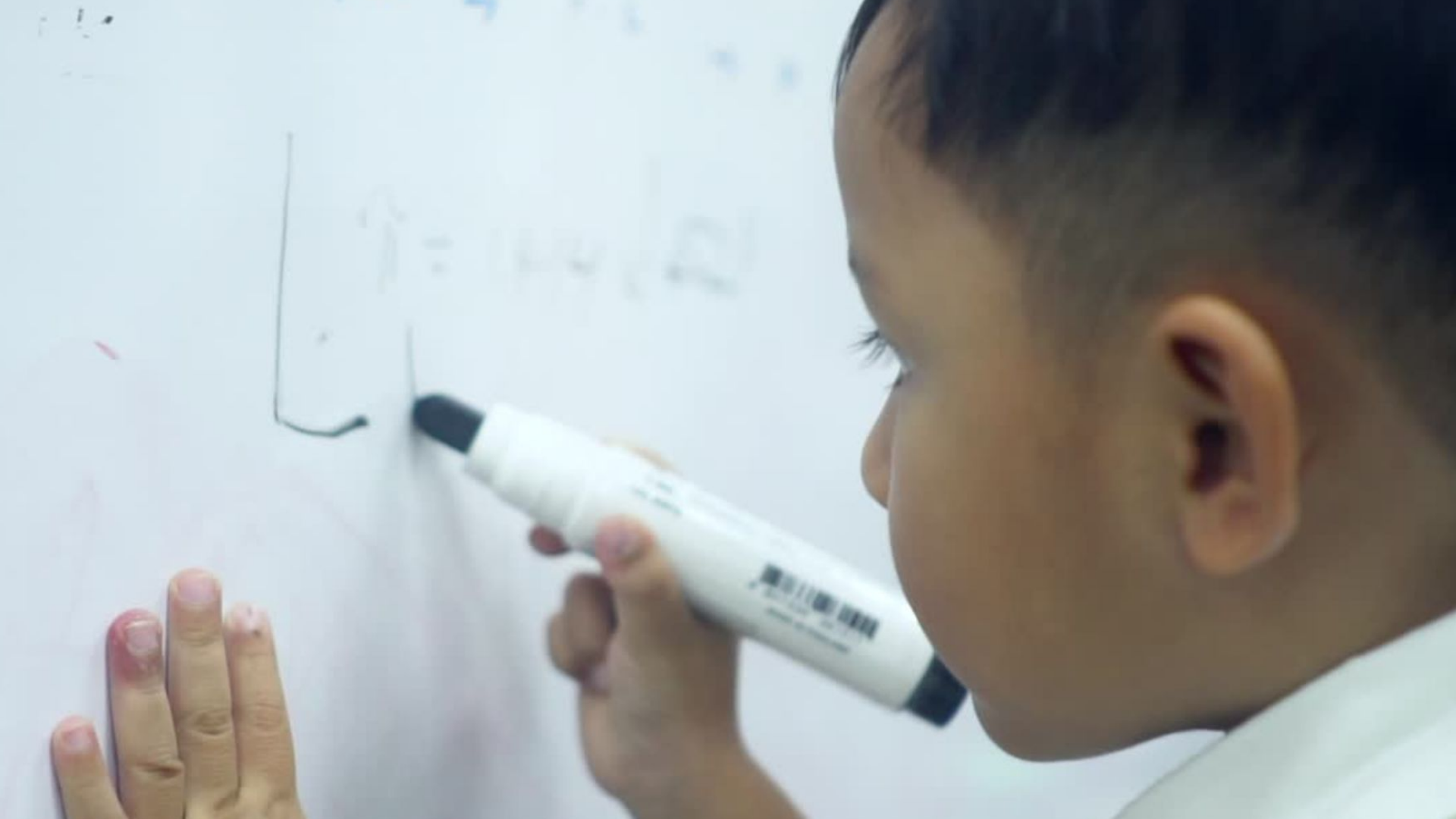


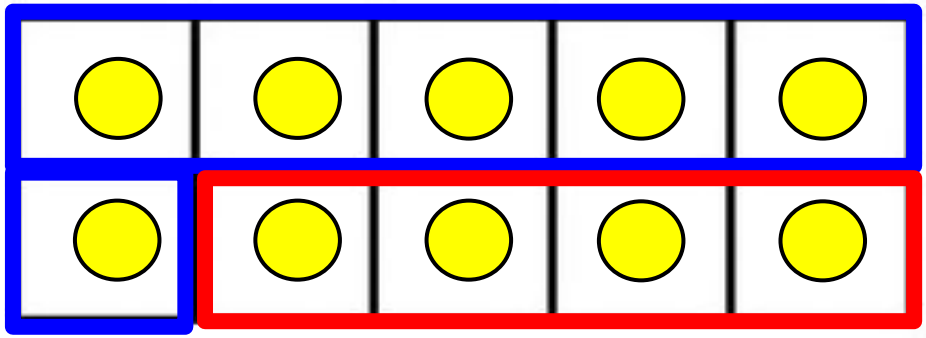
You see 5 and 1 two times like this?

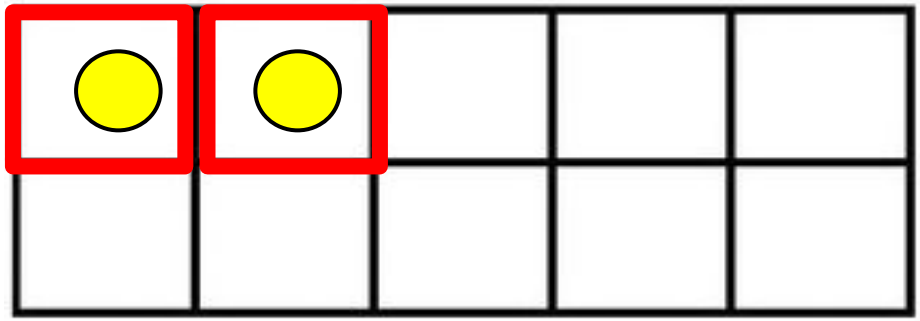




No, Can I show you how I see it?







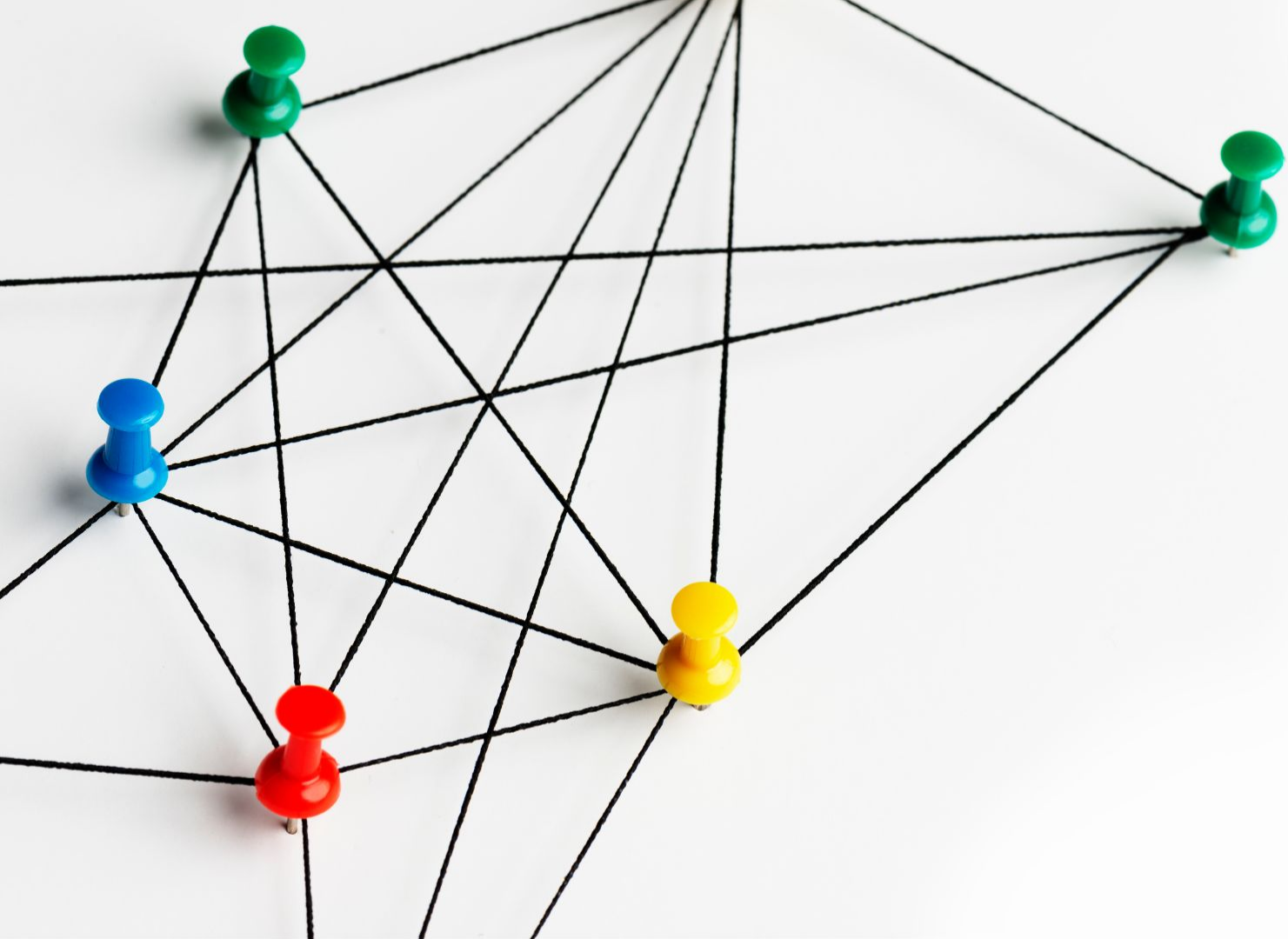
$5 + 1 = 6$

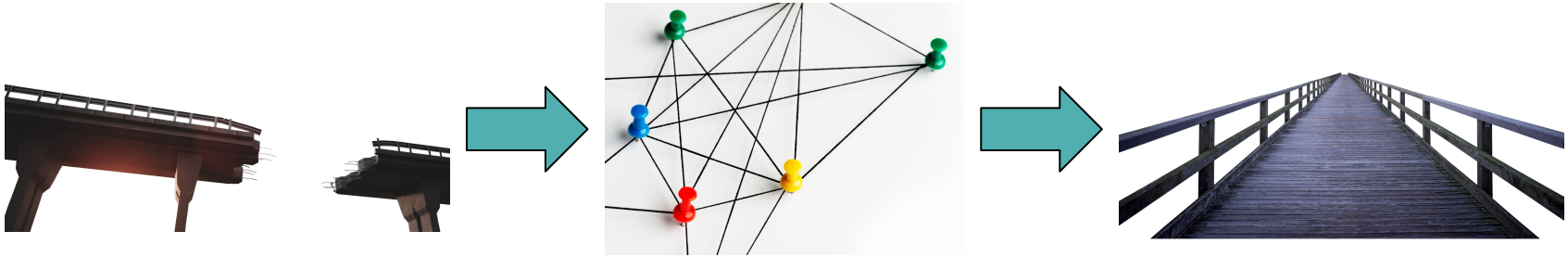
$5 + 1 = 6$

$6 + 6 = 12$

This is how I see 5 and 1 two times to make 6 and 6!


WHY?





Connecting Representations

Bridging Understanding

Why We Are Here

To bridge student understanding in mathematics by increasing the implementation of **Using and Connecting Mathematical Representations**

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Agenda

- Welcome
- Math Task
- Types of Representations
- Connecting Representations
- Why Representations
- Closing

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Math Task

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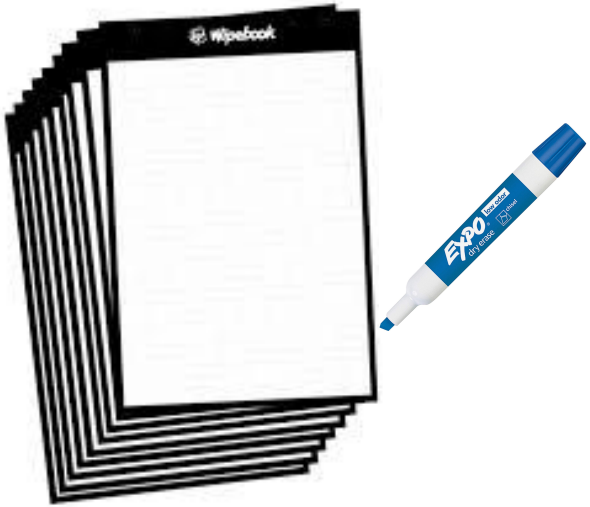

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Math Task

1. Grab a pile of small items around you (coins, pens, paper clips, etc.)
2. Physically count and put the items in groups in a way that makes sense to you
3. Draw a picture of your sets
4. Write numbers or equations to represent your sets
5. Write a sentence to describe your sets

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share
share
share
share
share
share

Math Task

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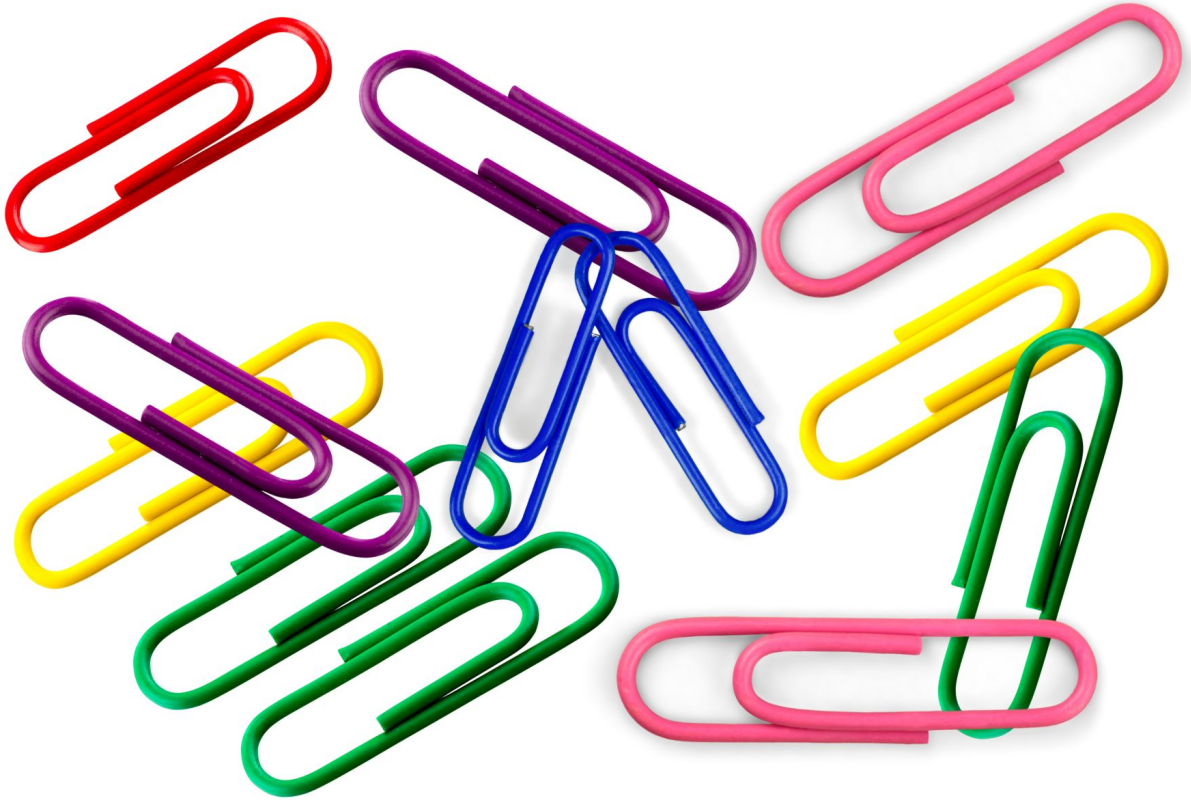

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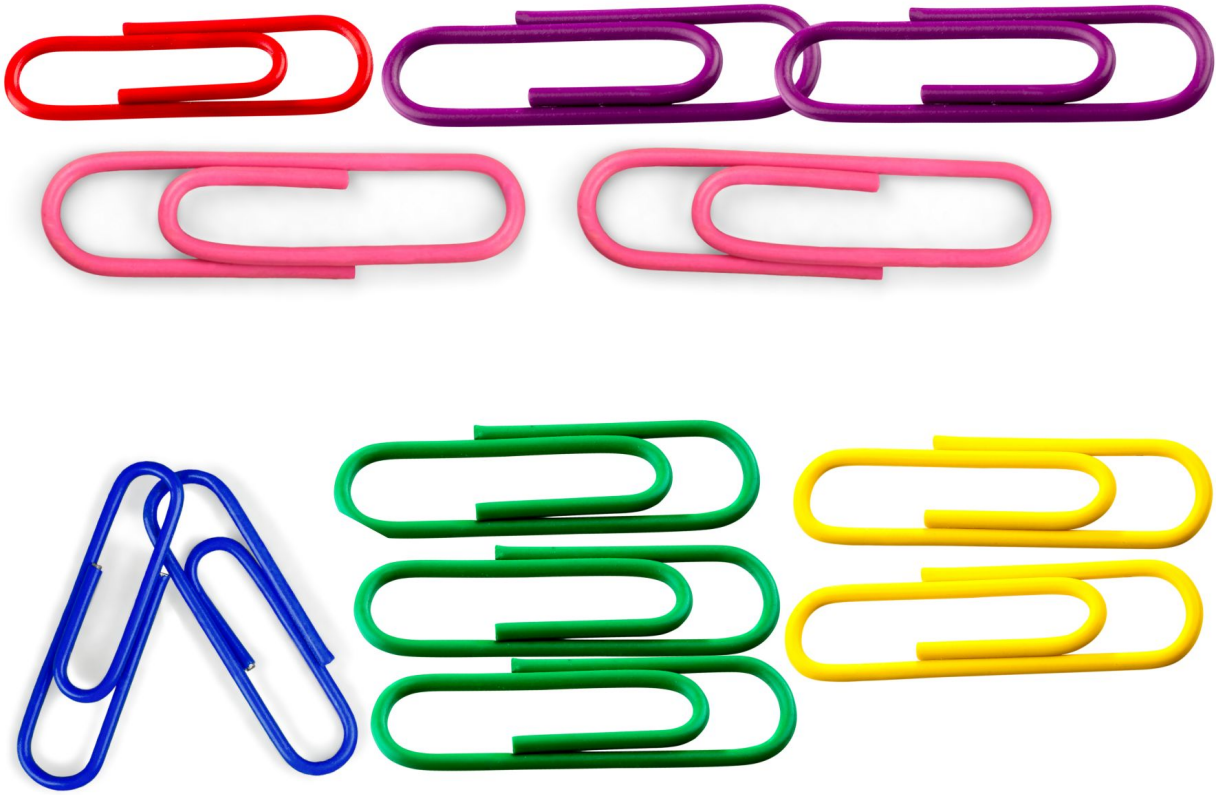
2. Physically count and put the items in groups in a way that makes sense to you



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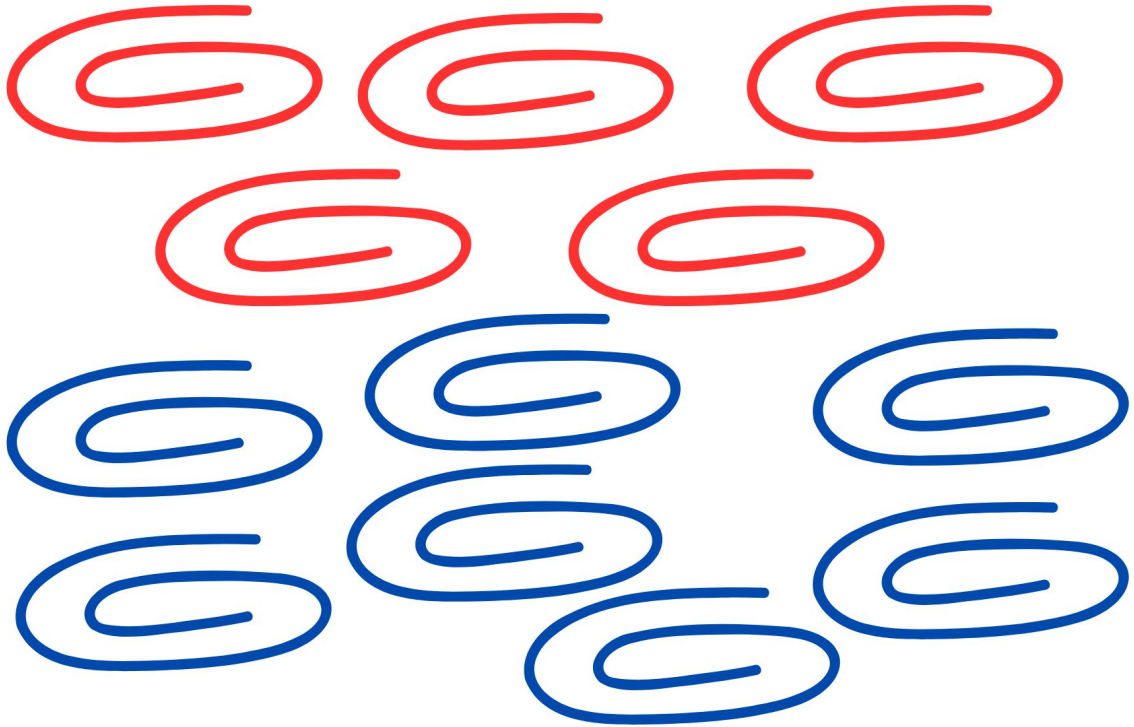
3. Draw a picture of your sets



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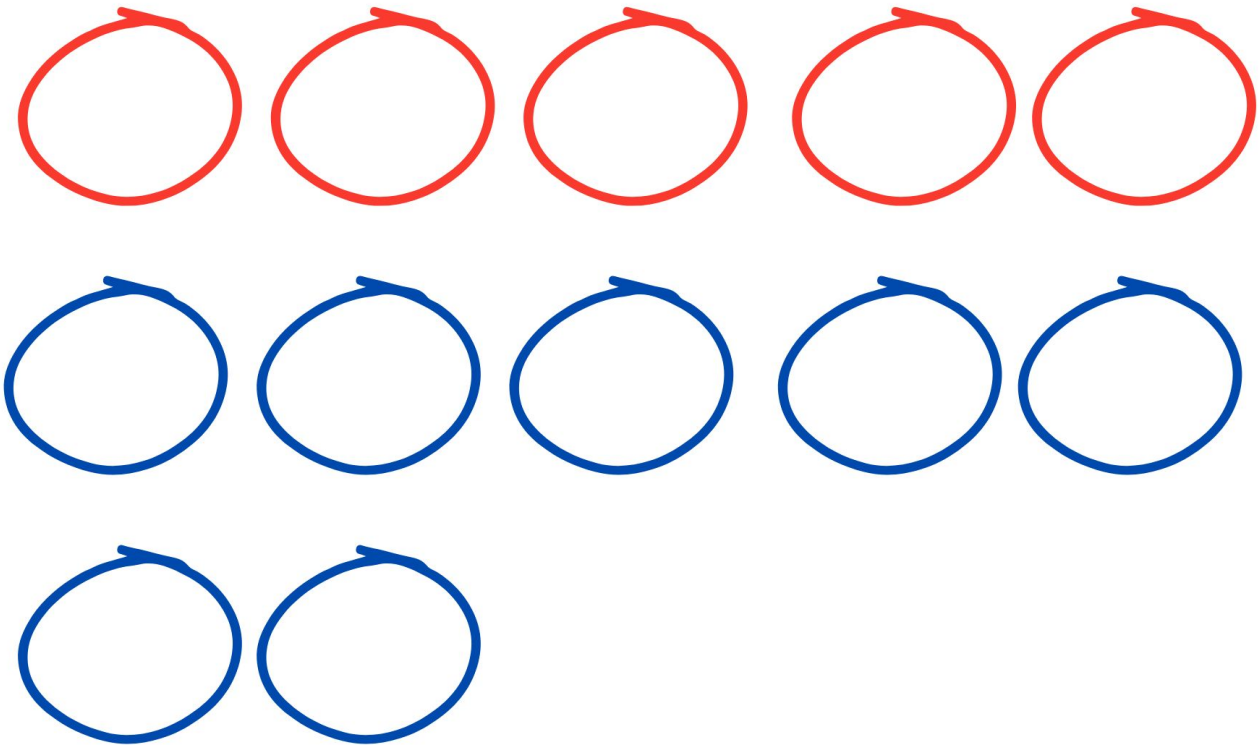
3. Draw a picture of your sets



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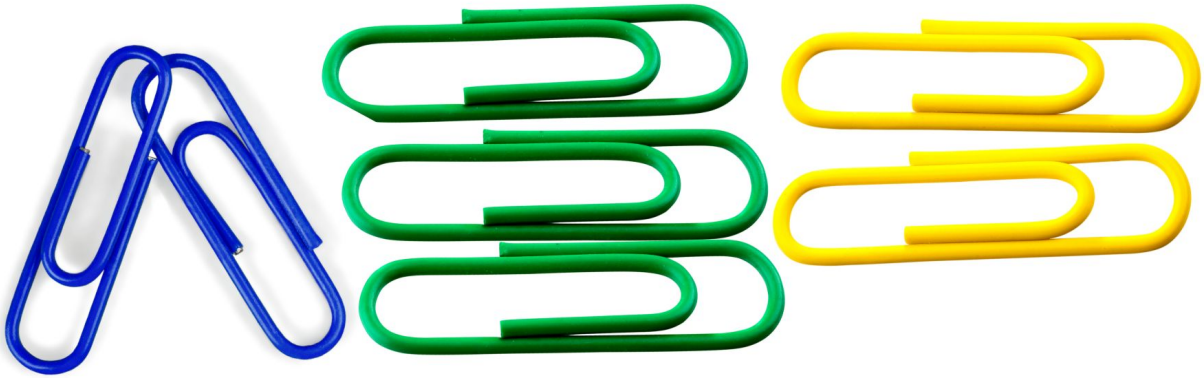
4. Write numbers or equations to represent your sets

1 2 2



2 3 2

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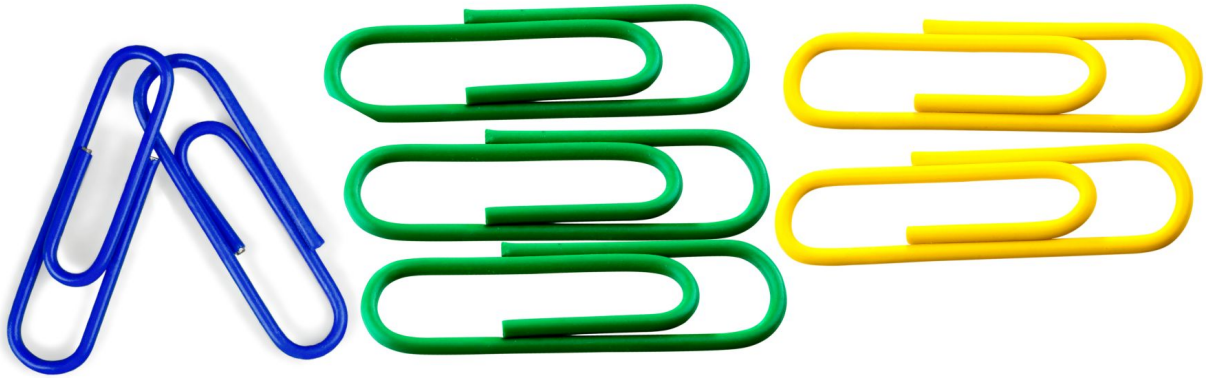
4. Write numbers or equations to represent your sets

5



7

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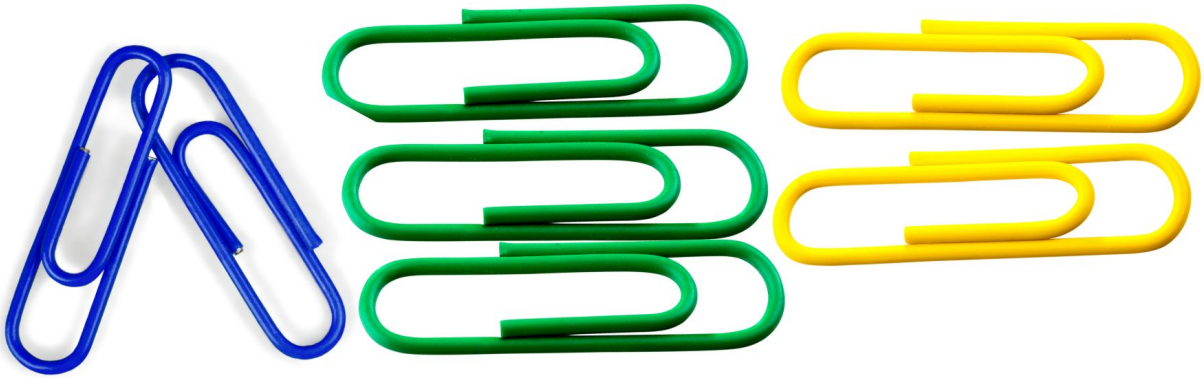
4. Write numbers or equations to represent your sets

12



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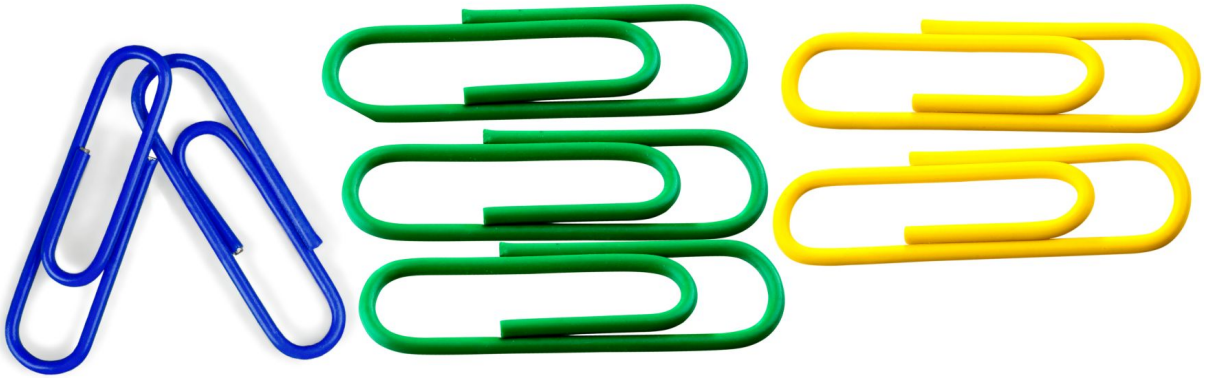
4. Write numbers or equations to represent your sets

$5+7=12$



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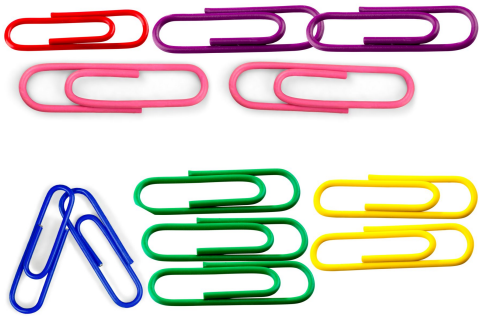
5. Write a sentence to describe your sets



I have 5 paperclips in the red and pink pile and 7 paperclips in the blue and green pile.

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Types of Representations

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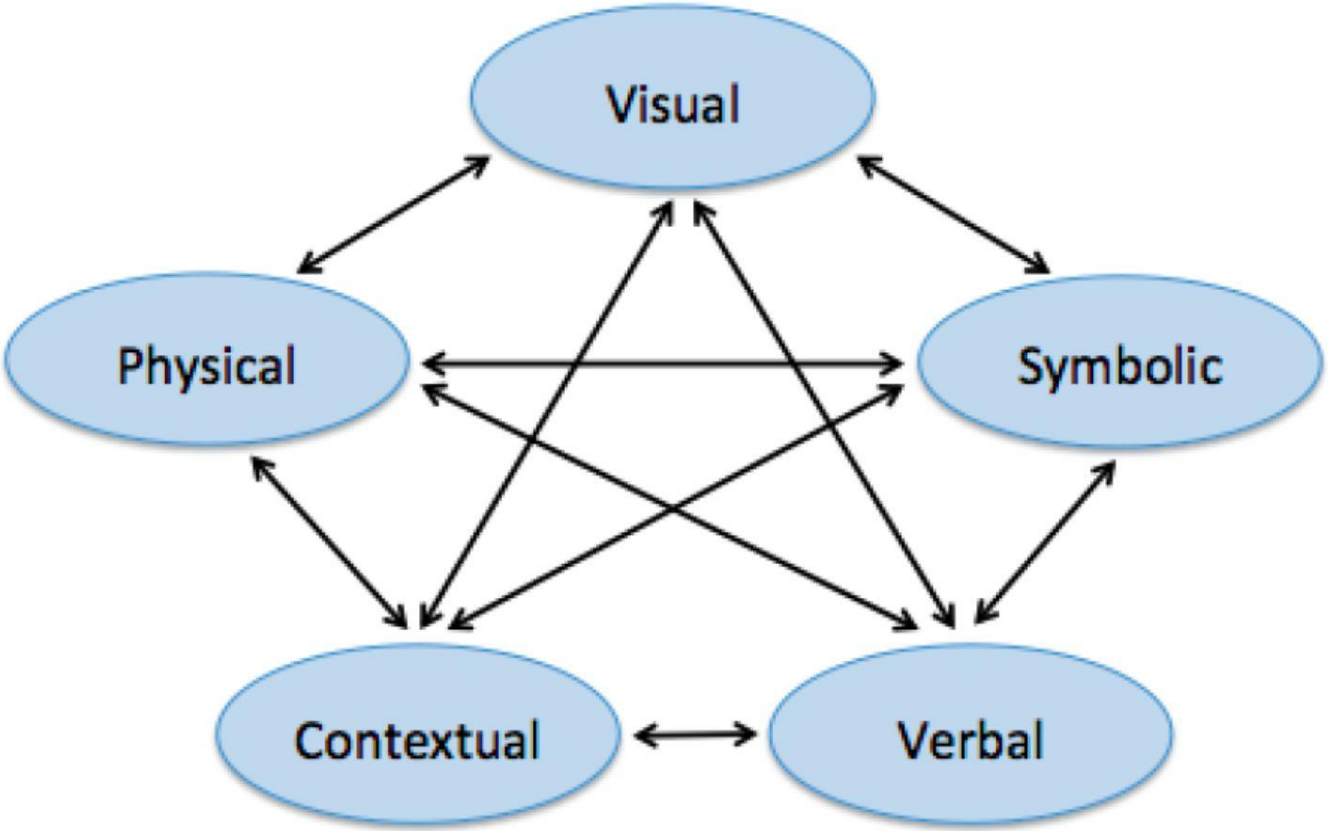
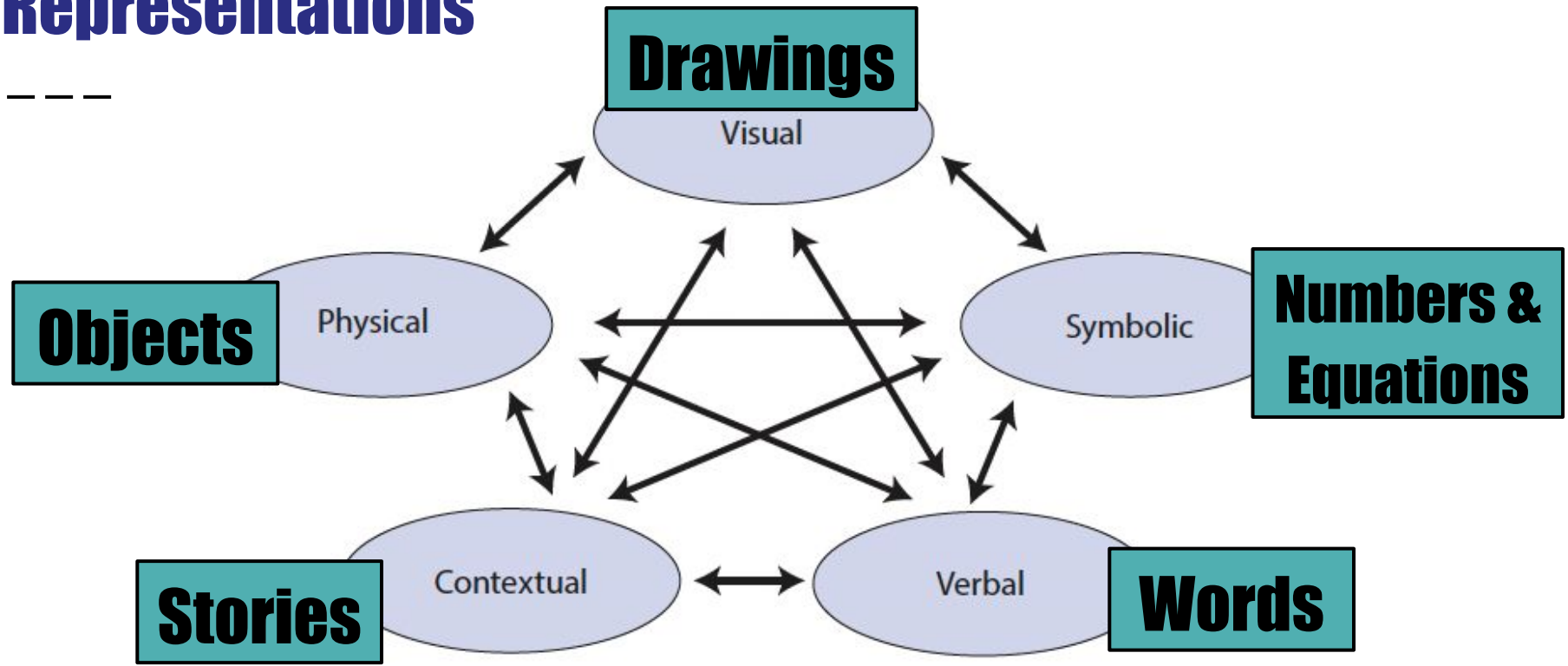

Visual
Physical
Symbolic
Contextual
Verbal

Representations



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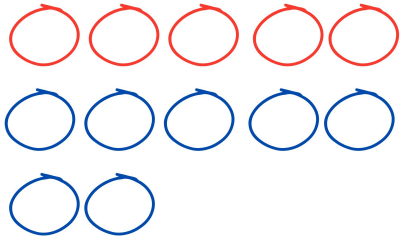
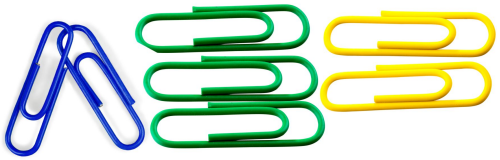
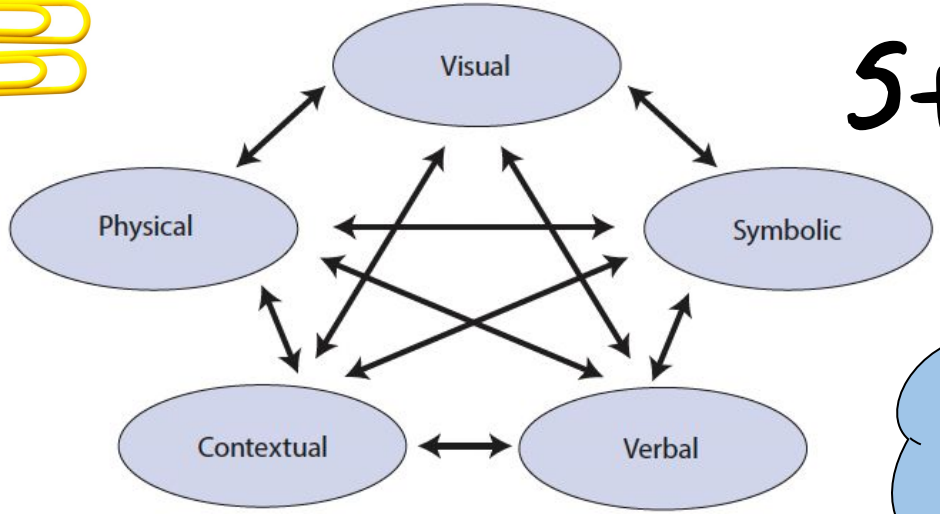


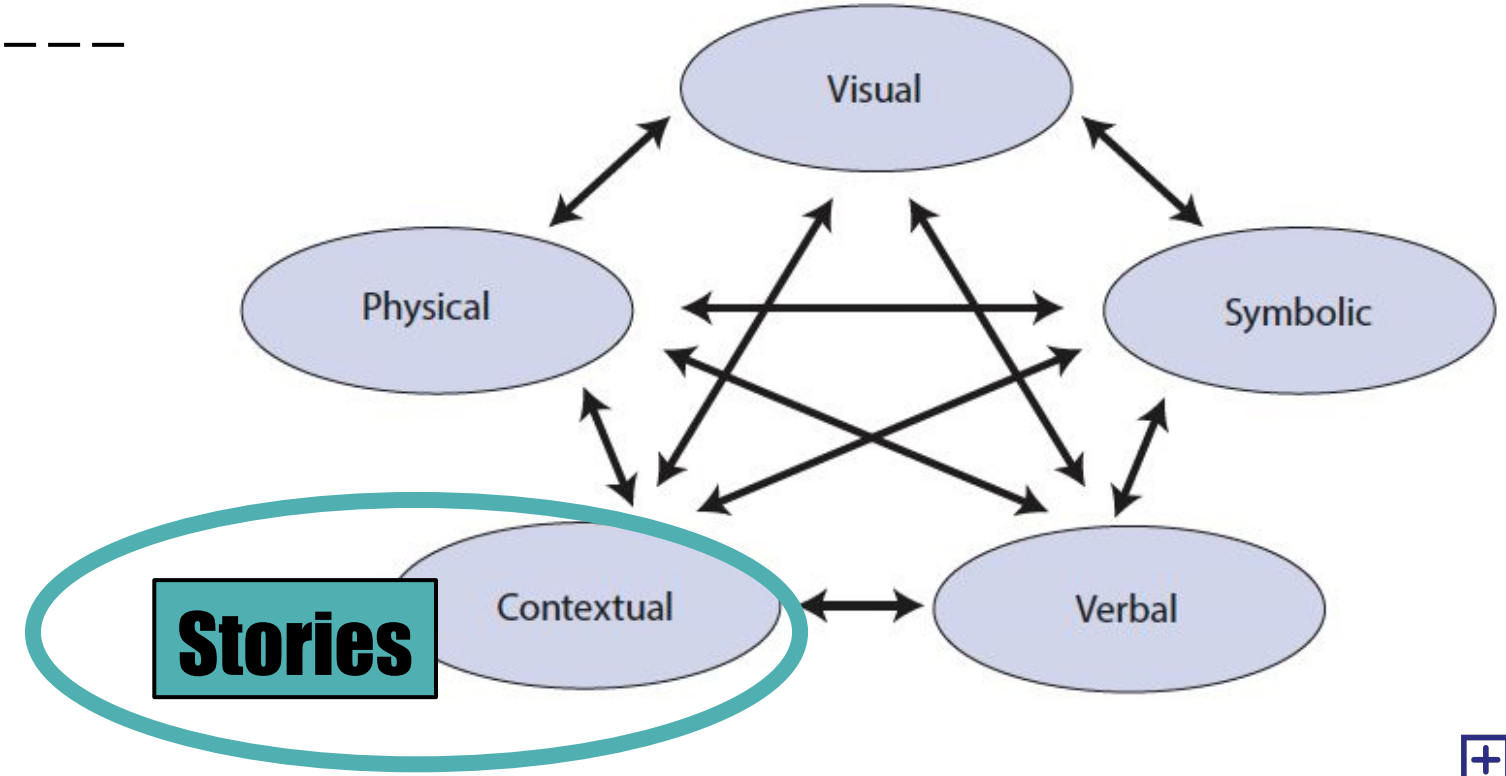




5+7=12

I have 5 paperclips in the red and pink pile and 7 paperclips in the blue and green pile :).

Contextual



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CONTEXT

Mrs. Tatum's Paint

Mrs. Tatum shares 4 fluid ounces of red paint equally among 5 art students.

How many fluid ounces of red paint does each student get?

Task

Mr. Guzman ordered 36 cookies from a bakery. He wants to separate the cookies so that each box has the same number of cookies inside. Show the different ways that the workers can box up the cookies.

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DOTS
SOUR
Smarties
JUICY DROP
JUICY DROP POP
JUICY DROP GUMMIES
JUICY DROP TAFFY
SUPER SOUR


DOTS
JUICY DROP POP
JUICY DROP GUMMIES

Our class bought a candy factory. Our factory produced 4824 bags of candy to sell! If we distribute the bags of candy equally to sell at 8 different stores, how many bags of candy will each store get?


JUICY DROP
POPS

Pro Tip:

Then ask:
What do you notice?
What do you wonder?

Start a lesson by showing an image related to the context of a word problem before showing the word problem.

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More Ideas

- Provide students with numberless word problems
  - Once they have an understanding of the context, provide numbers for them to solve
- Provide students with equations or pictures and ask them to create their own word problems

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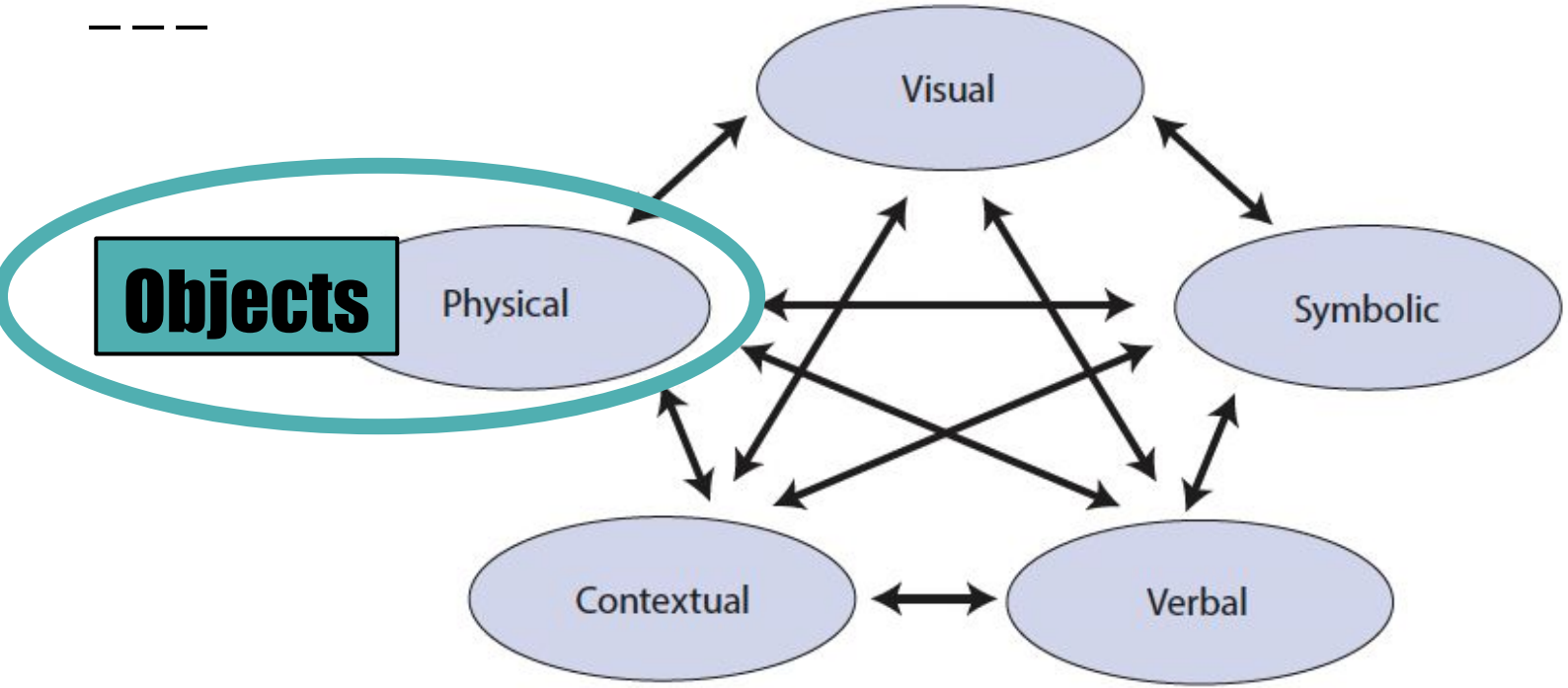
Physical



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“Students, especially young learners, benefit from using physical objects or acting out processes during problem solving.”

-National Research Council, 2009

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Math manipulatives help students develop conceptual understanding by empowering them to build concrete models of abstract ideas ...

- The Math Manipulatives Hiding in a Junk Drawer

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... It provides a common language with which students can describe phenomena and communicate with peers and teachers.

- The Math Manipulatives Hiding in a Junk Drawer

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Pro Tip:

Think: Is the teacher or are the students using the manipulatives?

Make sure your students are the ones using the physical representations and be sure to provide clear directions on how you want students to access the physical tools!

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More Ideas

- Use real life objects in a addition to commercial manipulatives
- Create a system for management
  - Trays and bins
  - Pencil boxes
- Allow student choice in the tools they use

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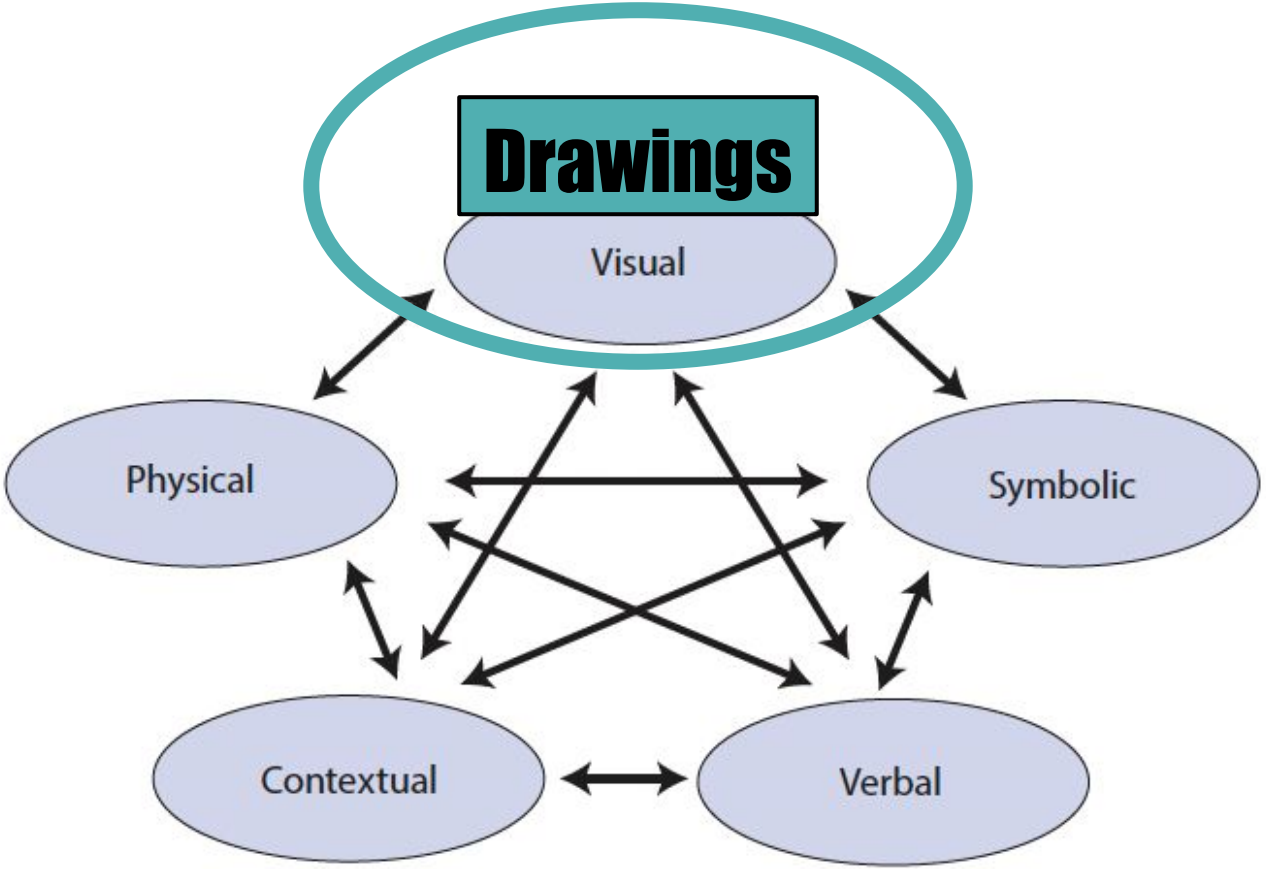
Visual



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70°
(d)
65°
50°
65°
(e)
(h)
85°
85°
(g)
106°

“Visual representations are of particular importance in the mathematics classroom, helping students to advance their understanding of mathematical concepts and procedures, make sense of problems, and engage in mathematical discourse.”

-National Council of Teachers of Mathematics, 2014

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Pro Tip:

Think: Is the teacher or are the students creating math drawings?

Make sure your students are the ones drawing visual representations and be sure to connect them to other types of representations.

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More Ideas

- Visual models can be used to represent the same ideas and actions as physical representations, but more efficiently
- Students are more likely to use and make sense of visual representations when they are consistently expected to use them

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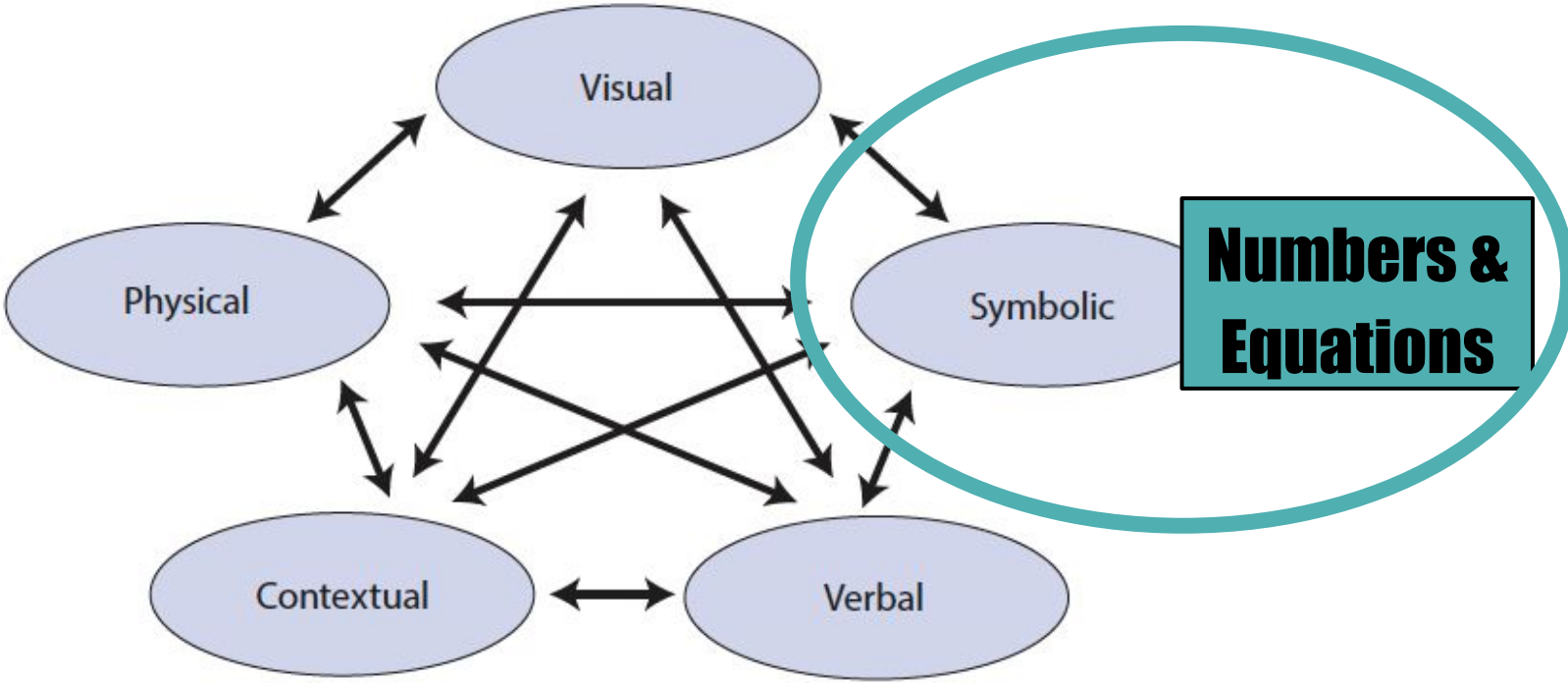
Symbolic



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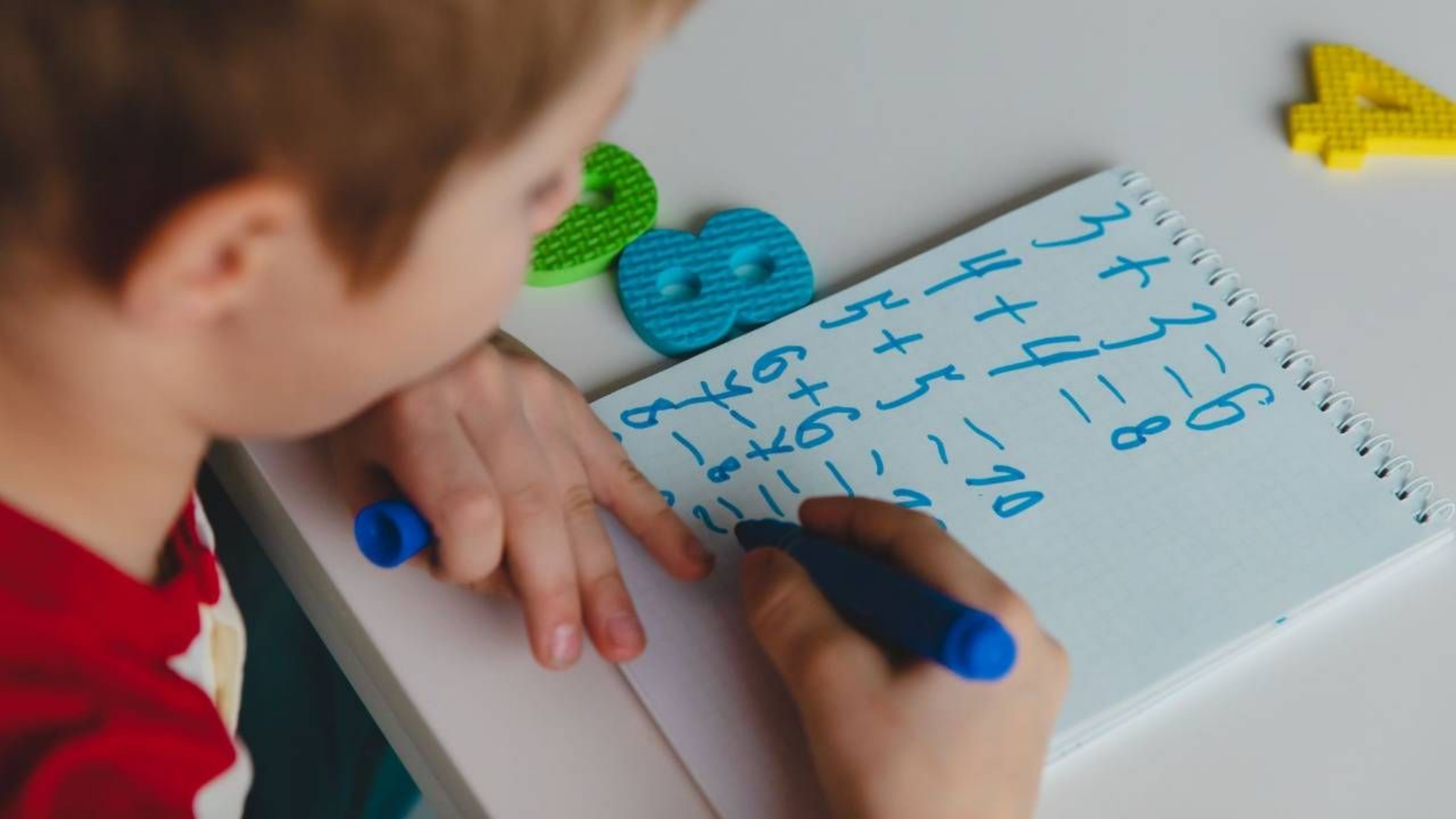

"Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving."

-National Council of Teachers of Mathematics, 2014

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Pro Tip:

Physical & Visual BEFORE Symbolic

Expose students to physical and visual representations before expecting them to formally use symbolic representations.

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More Ideas

- Symbolic representations are essential to showing mathematical situations and solutions, but they are best understood when connected to other types of representations
- It's recommended to explicitly teach students proper notations and symbols after they have experience with real life situations through rich contexts, physical, and/or visual representations.
- It's okay to let students explore writing symbolic representations before they learn proper ways to write symbols

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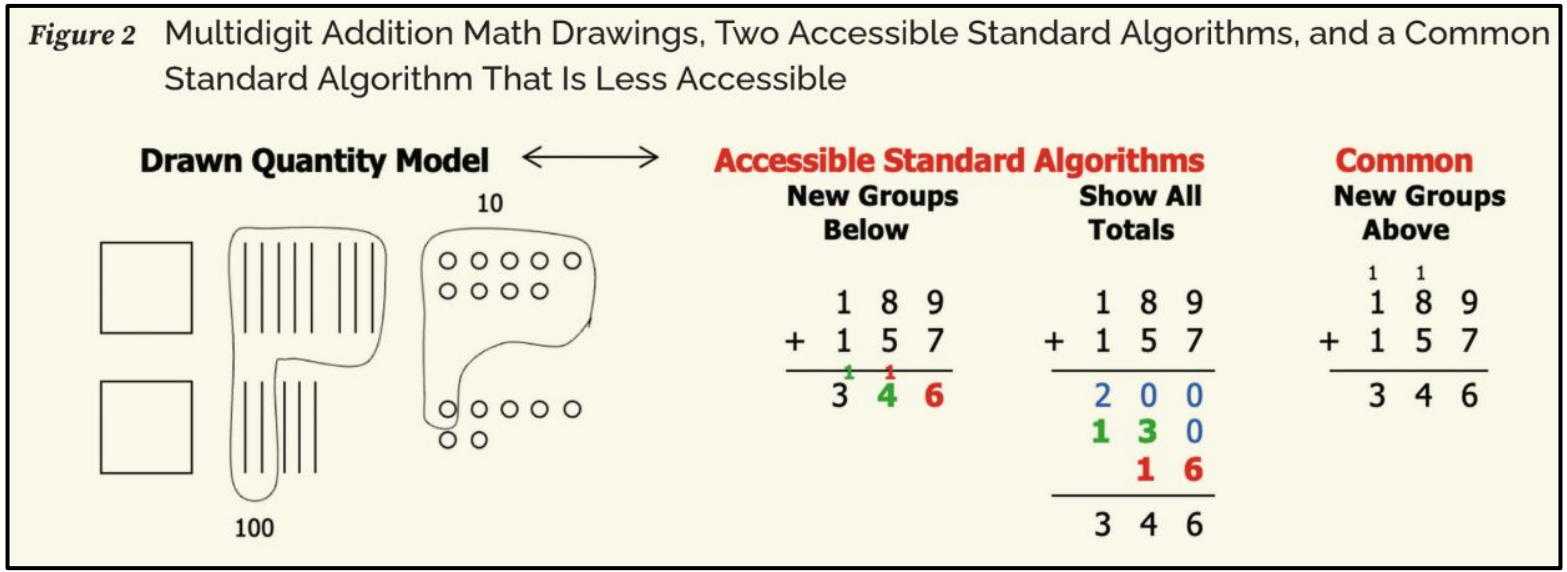
Accessible Algorithms

– – –

"Historically, algorithms often have been taught as a meaningless, step-by-step procedure. Therefore, some educators think that algorithms are “bad” or “difficult” and that teaching algorithms should be delayed as late as possible or not taught at all. However, accessible standard algorithms can and should be taught with meaning from the beginning grade at which a kind of calculation is introduced.”

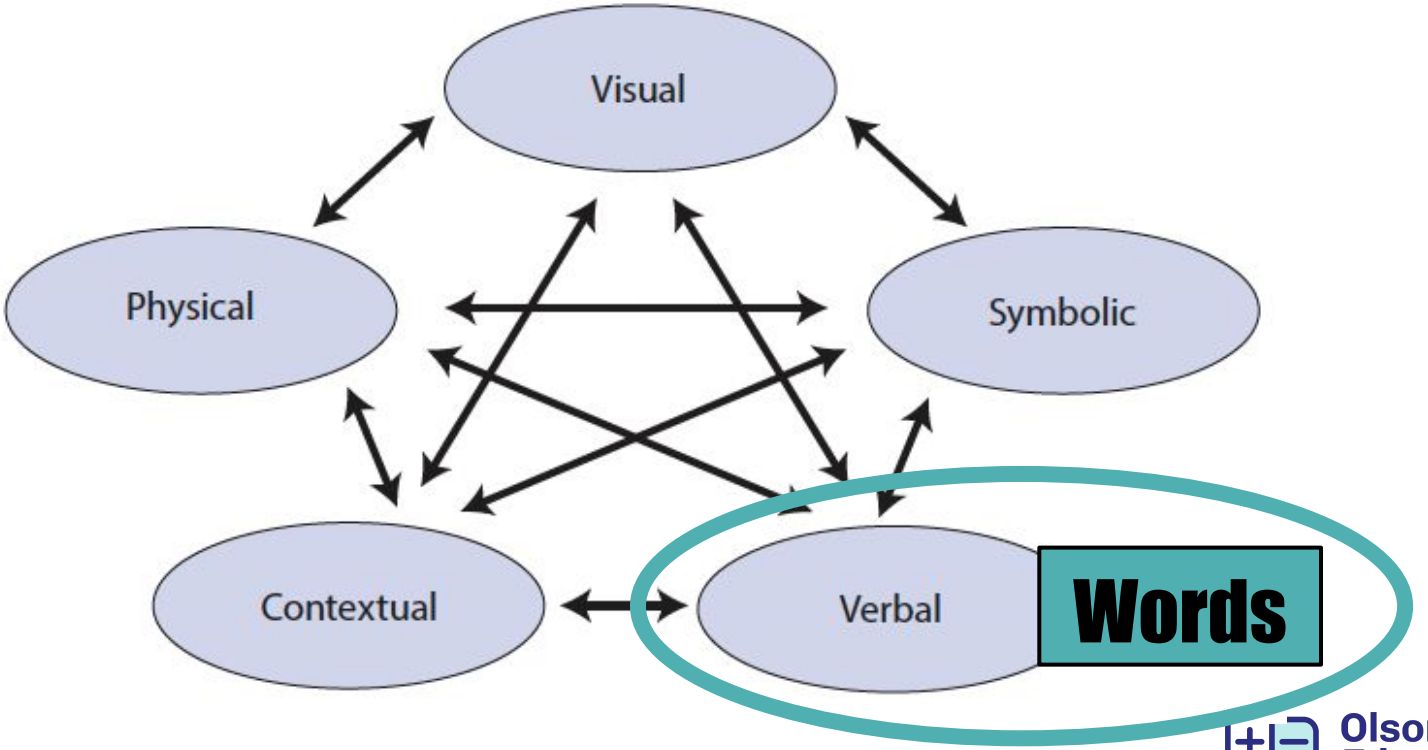
Fuson, K. C., Kiebler, S., & Decker, R. (2024). *Accessible standard algorithms*. Mathematics Teacher Learning & Teaching PK-12. National Council of Teachers of Mathematics.

Accessible Algorithms



Fuson, K. C., Kiebler, S., & Decker, R. (2024). *Accessible standard algorithms.* Mathematics Teacher Learning & Teaching PK-12. National Council of Teachers of Mathematics.

Verbal



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“When students learn to represent, discuss, and make connections among mathematical ideas in multiple forms, they demonstrate deeper mathematical understanding and enhanced problem-solving abilities.”

-National Council of Teachers of Mathematics, 2014

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Pro Tip:

Think: Is the teacher or are the students talking more in math?

Make sure your students are talking more than you are in math class!

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More Ideas

- May include small group and whole group discussion as well as writing
- It's just as important for students to be able to explain mathematical ideas as it is for them to build, draw, or write equations to represent their thinking about math
- Providing sentence stems (sentence starters) and sentence frames (sentences with blanks) for students
- Provide appropriate vocabulary activities regularly

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Connecting Representations

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“As students use and make connections among contextual, physical, visual, verbal, and symbolic representations, they grow in their appreciation of mathematics as a unified, coherent discipline.”

-National Council of Teachers of Mathematics, 2014

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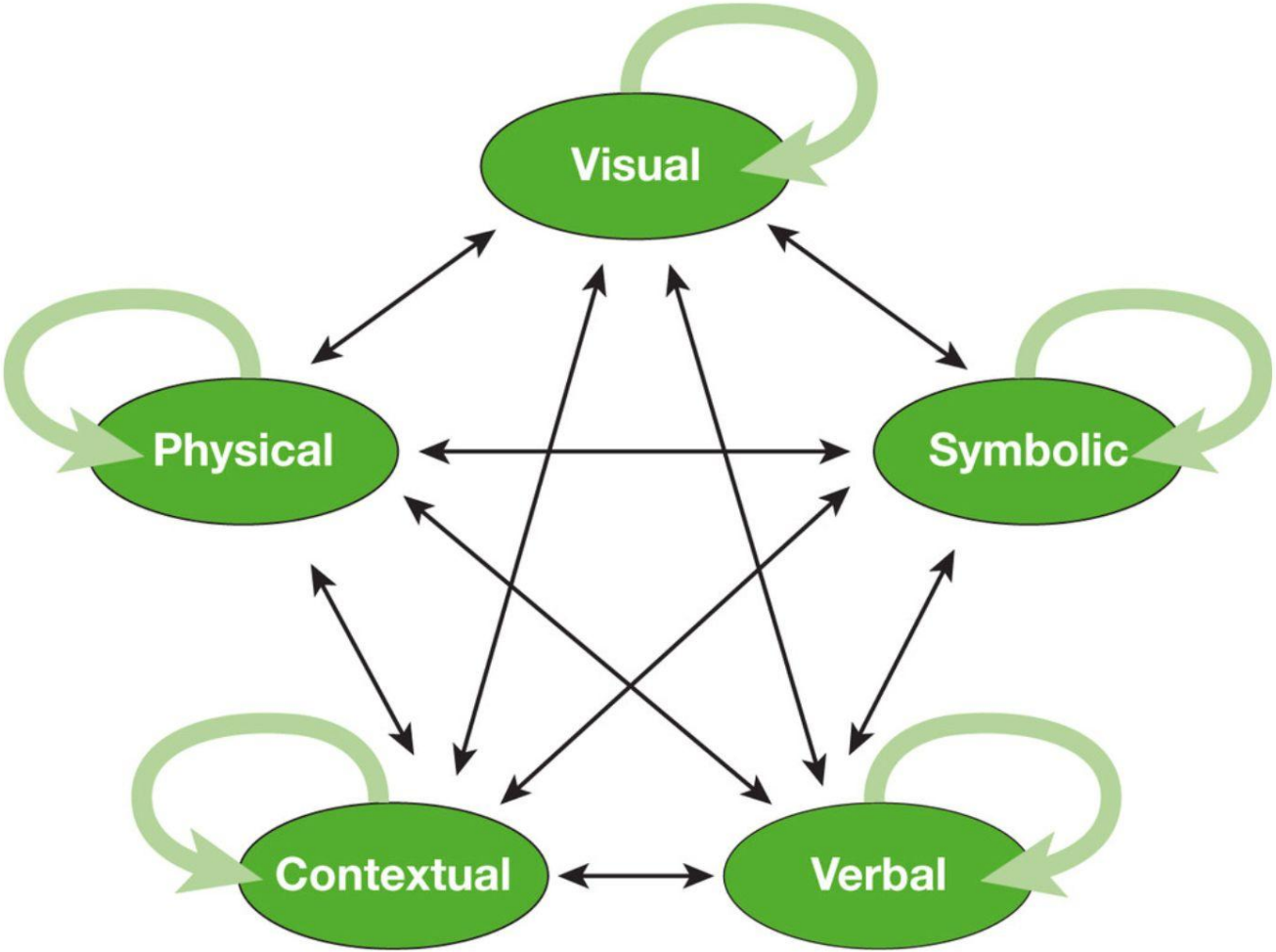
Visual
Physical
Symbolic
Contextual
Verbal

Let's anticipate student thinking and how representations can be used and connected for a task ...

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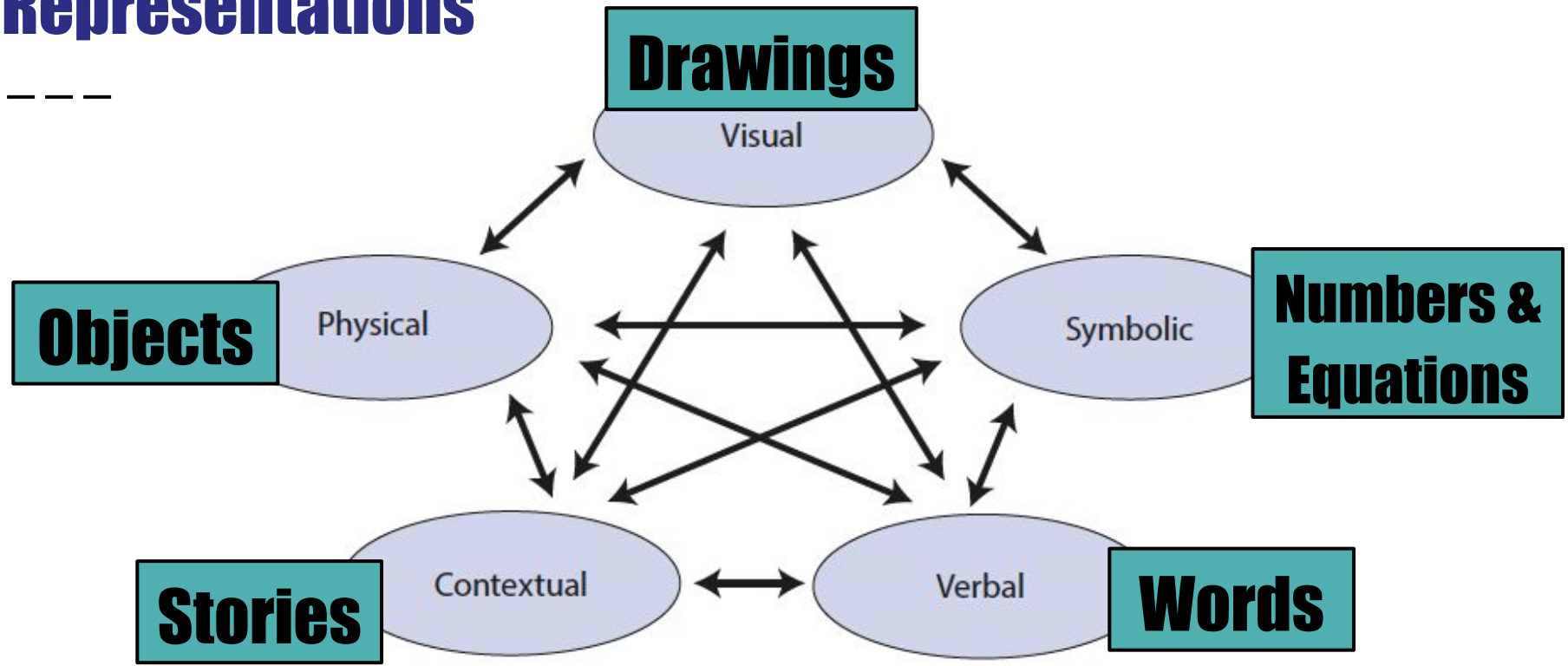
Representations



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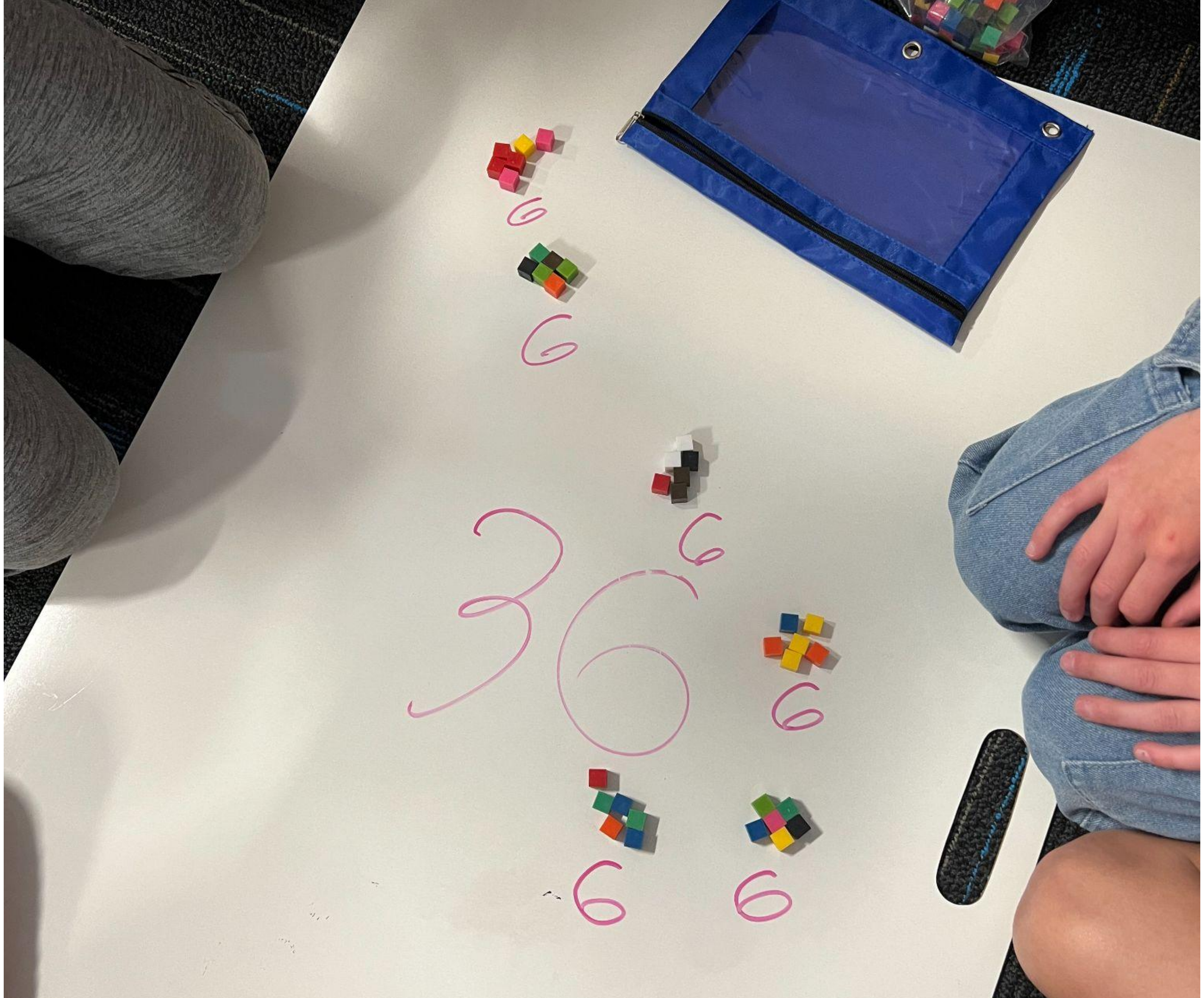
Grades 1-2	Grades 3-4	Grade 5	Grades 6-8
			
Diva has _ stickers. She then goes to the store and gets _ more. How many stickers does Diva have now?	Mr. Guzman ordered 36 cookies from a bakery. He wants to separate the cookies so that each box has the same number of cookies inside. Show the different ways that the workers can box up the cookies.	Mrs. Tatum shares 4 fluid ounces of red paint equally among 5 art students. How many fluid ounces of red paint does each student get?	A class needs 5 leaves each day to feed its 2 caterpillars. How many leaves would the students need each day for 12 caterpillars?

Mr. Guzman ordered 36 cookies from a bakery. He wants to separate the cookies so that each box has the same number of cookies inside.

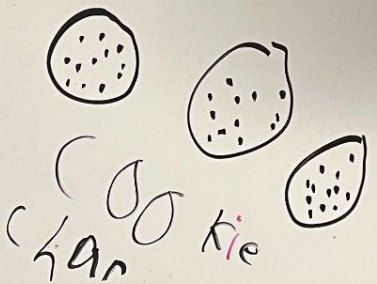
Show the different ways that the workers can box up the cookies.


Monday
Tuesday
Thursday
Friday


36 =


6
6
6
36
6
6
6

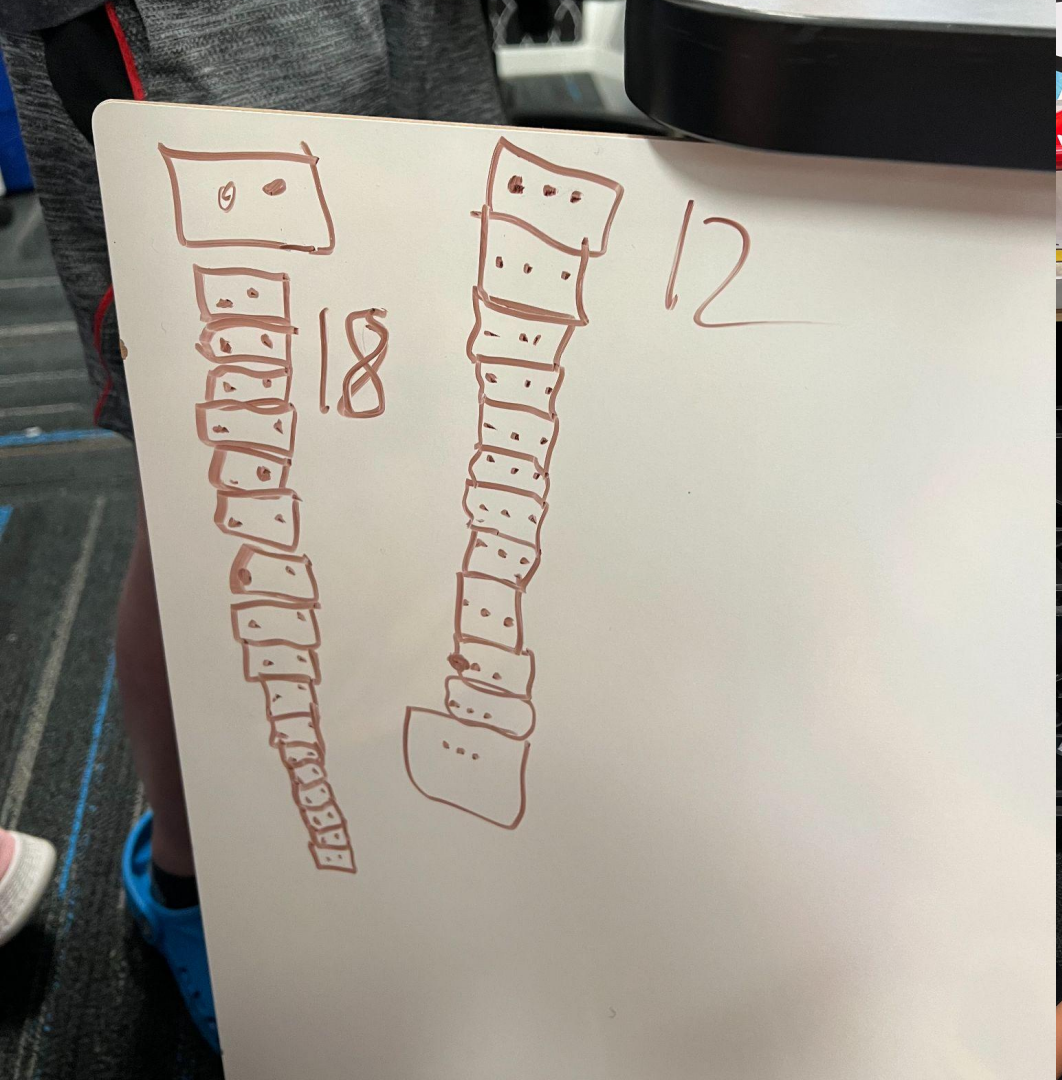
EXPO
Item # M2436
The Marketboard People
www.DryErase.com
1-800-DRY-ERASE

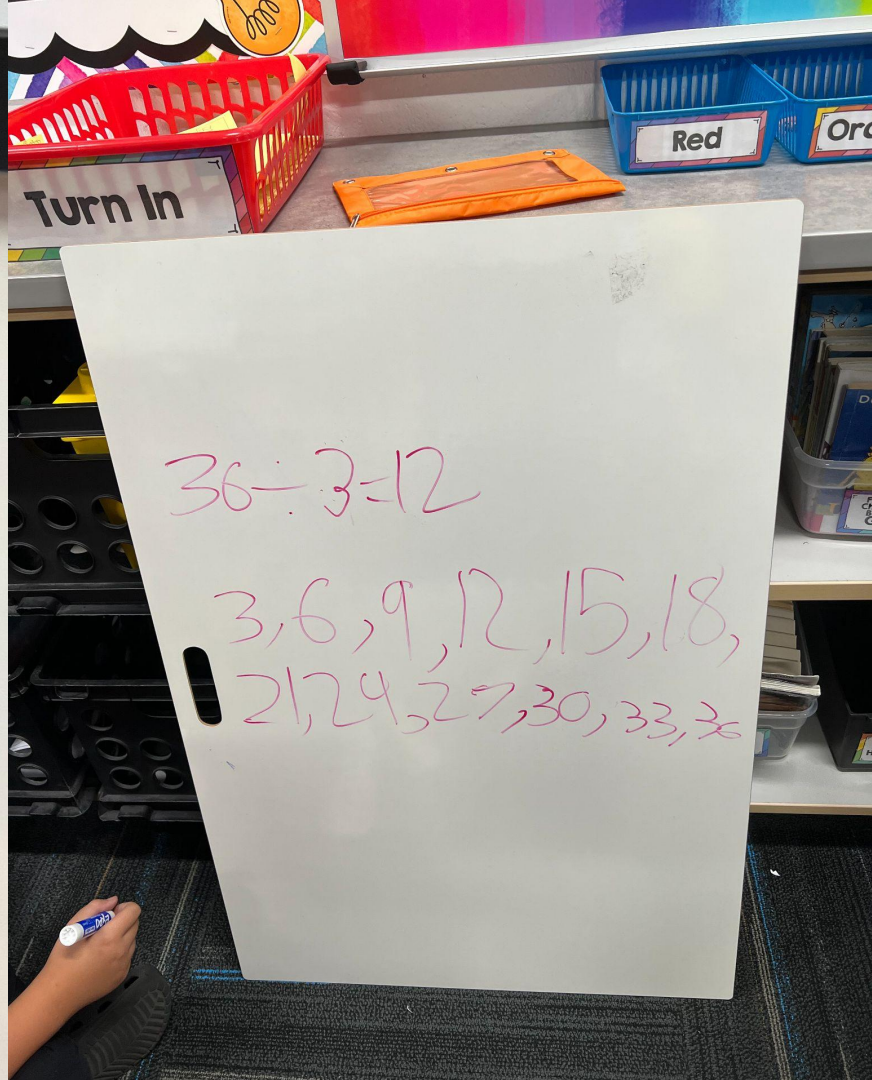


6, 12, 18, 24, 30, 36

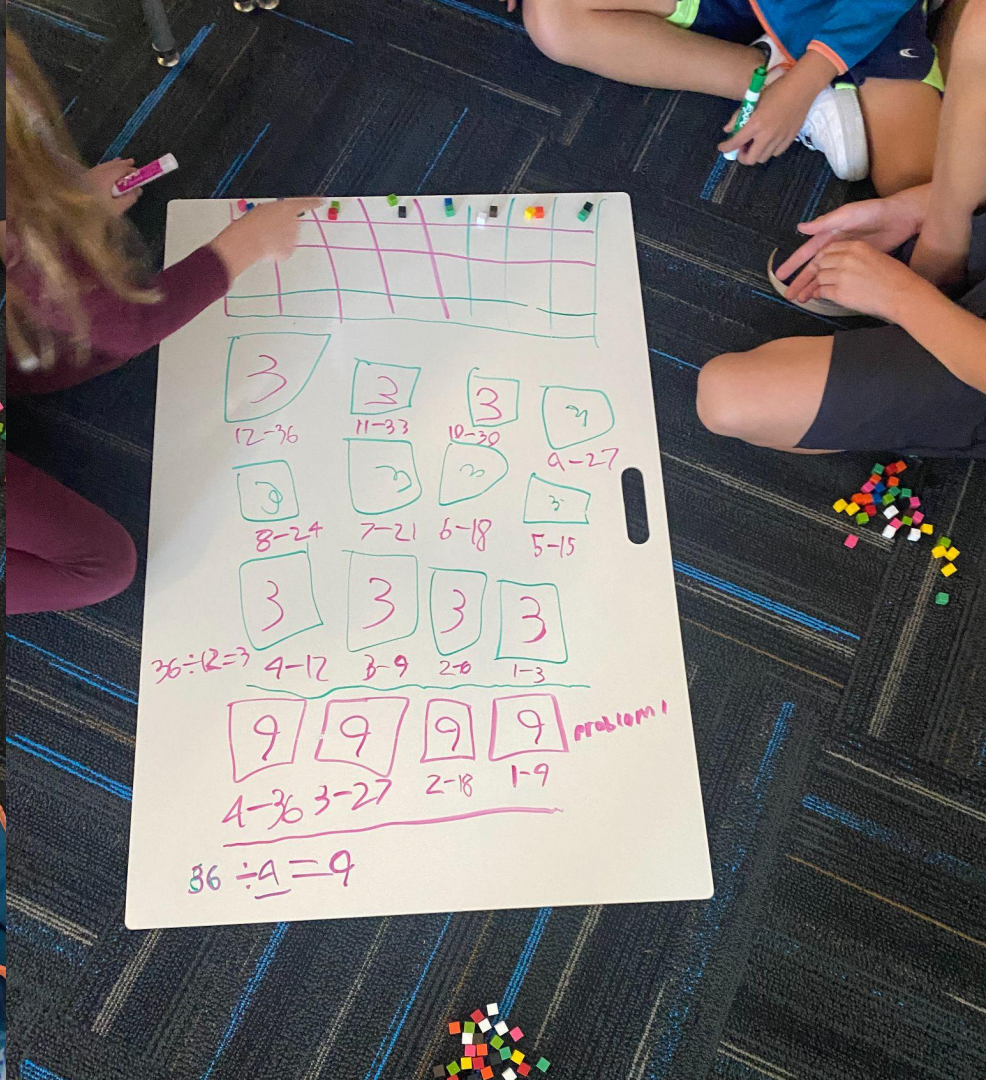
6 of 6
3 of 12
15 of 2

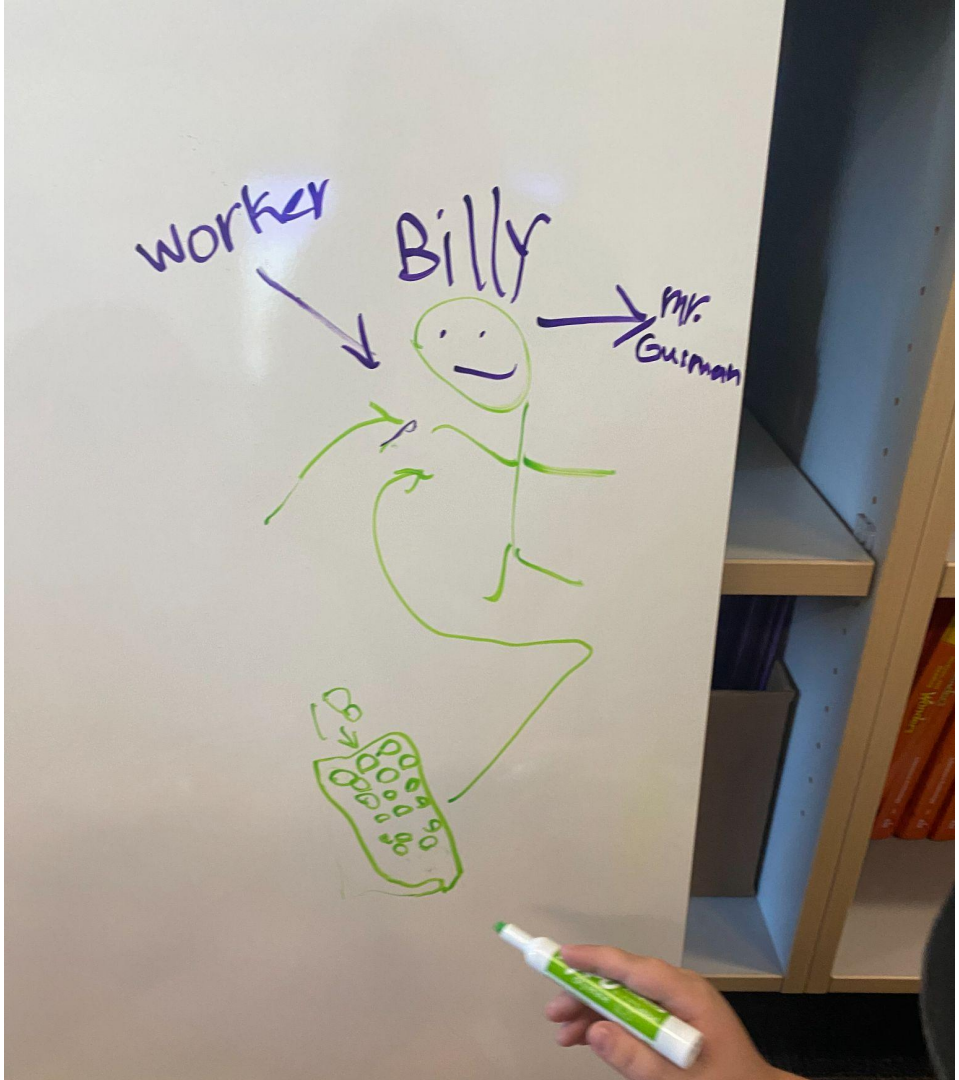
cubes
skip counting

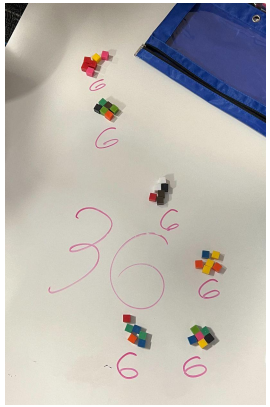

12

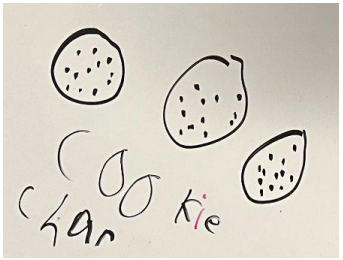

Turn In
Red
36÷3=12
3,6,9,12,15,18,
21,24,27,30,33,3

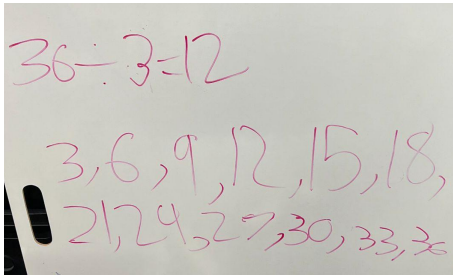

3-27
2-18
1-9

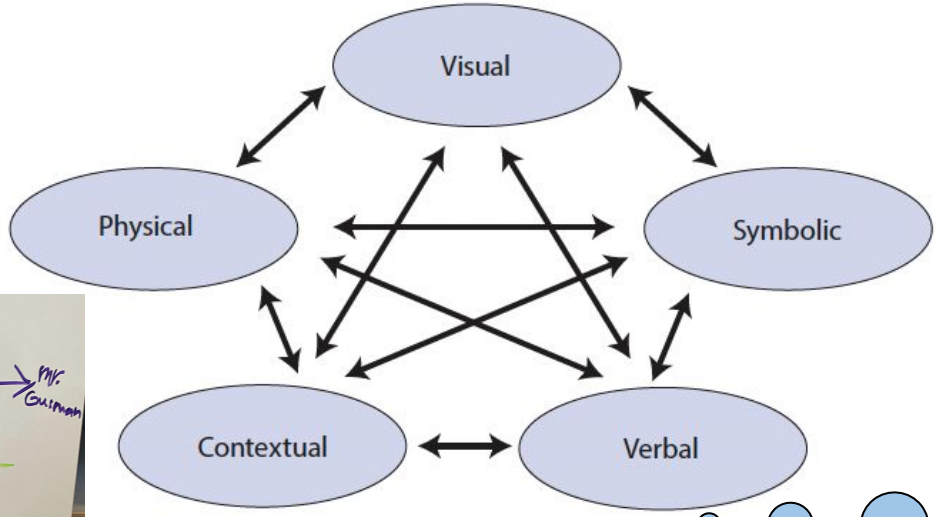

12-36
11-33
10-30
9-27
8-24
7-21
6-18
5-15
36÷12=3
4-12
3-9
2-6
1-3
4-36
3-27
2-18
1-9
problem!
36 ÷ 9 = 9

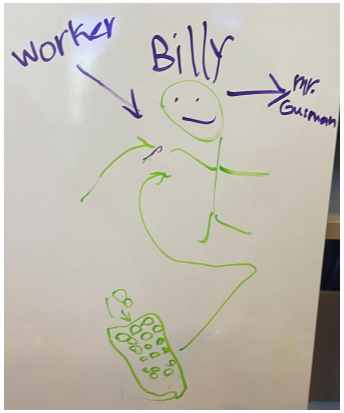

worker
Billy
Mr.
Guzman











"I put the cookies into 6 groups. I had 6 cookies in each group".

Why Representations

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16 + 18

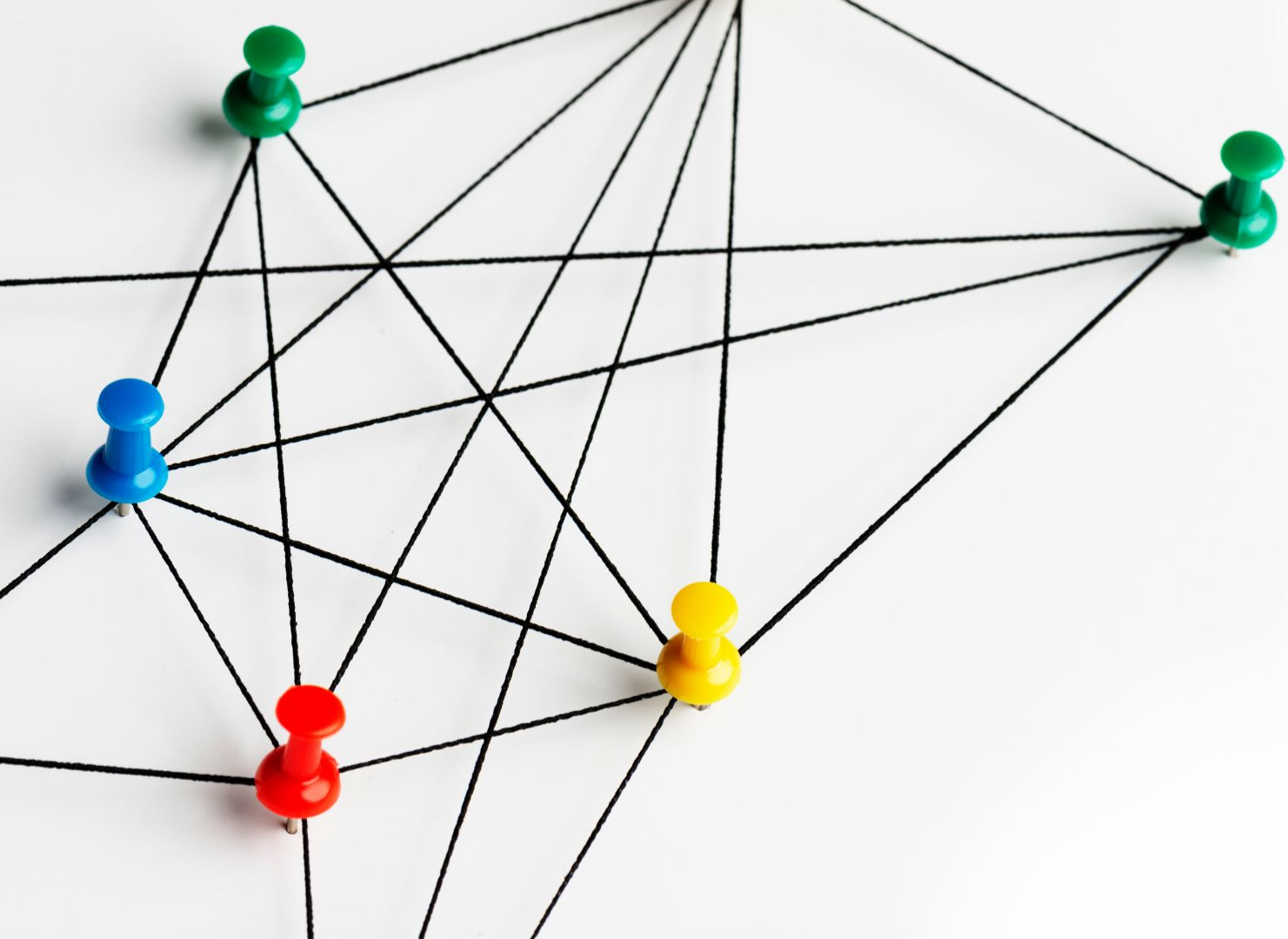
No access to multiple representations

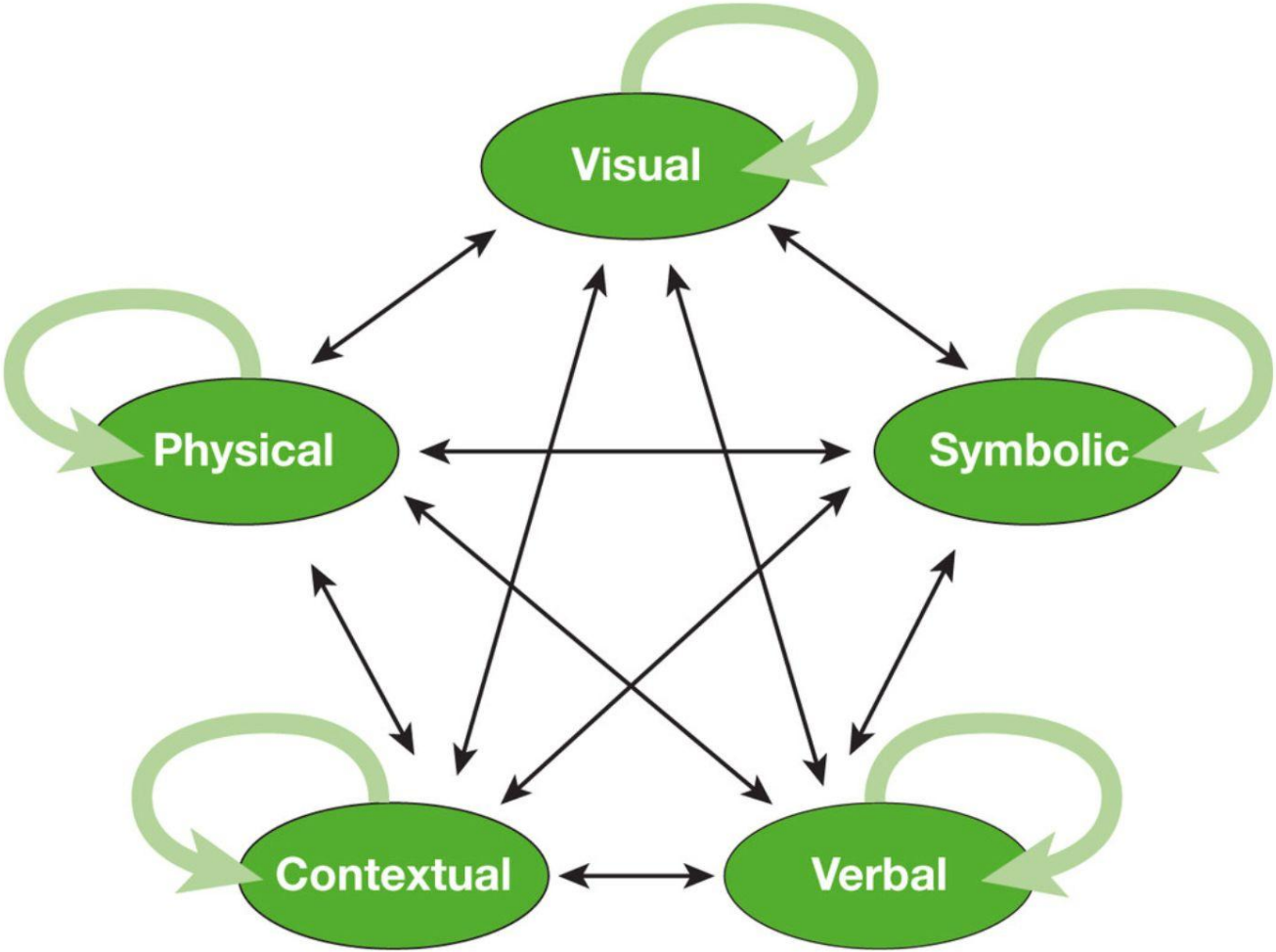
36 + 15

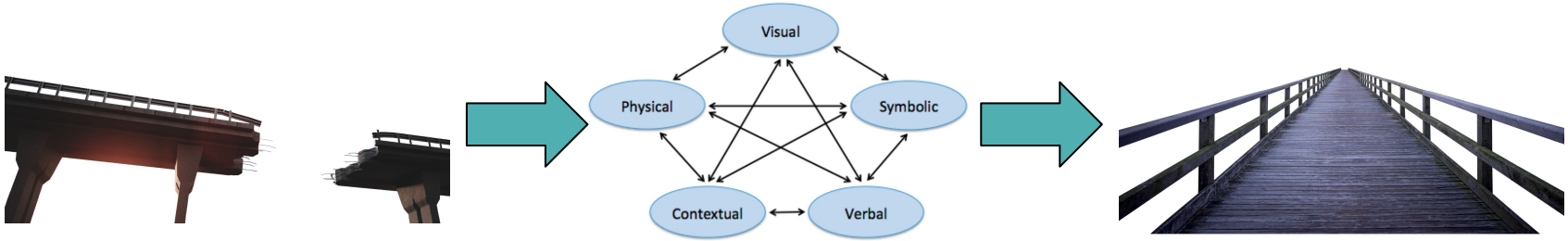
Access to physical representations (base ten blocks)

24 + 12

Connecting representations (base ten blocks and drawings)




Visual
Physical
Symbolic
Contextual
Verbal



Connecting Representations

Bridging Understanding

Closing

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What new ideas did you learn?

What might you want to try?

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If we don't use and connect representations, we don't have much to talk about in math.

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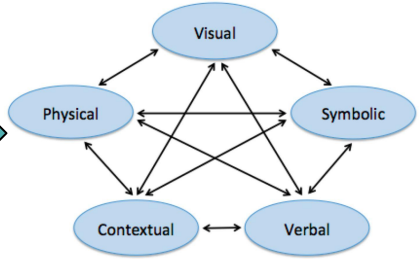

Connecting Representations

Bridging Understanding

Thank You!

Connect with me

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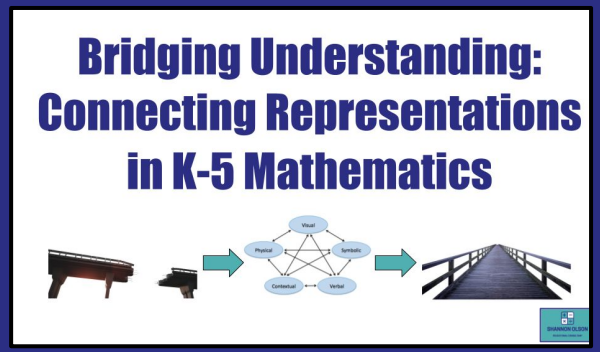
Session Resources



To access session materials, please go to:

shannonolson.com/uctm

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