

Example ONE: Understanding Part, Part Whole Model and Writing Equations in Kindergarten

·Interactive Lesson

·Overview: Children will write equations that represent the decomposition of 6 and 7 into two parts.

·Math Practices: Reason abstractly by representing a situation symbolically (#2) and model with mathematics (#4)

Problem:

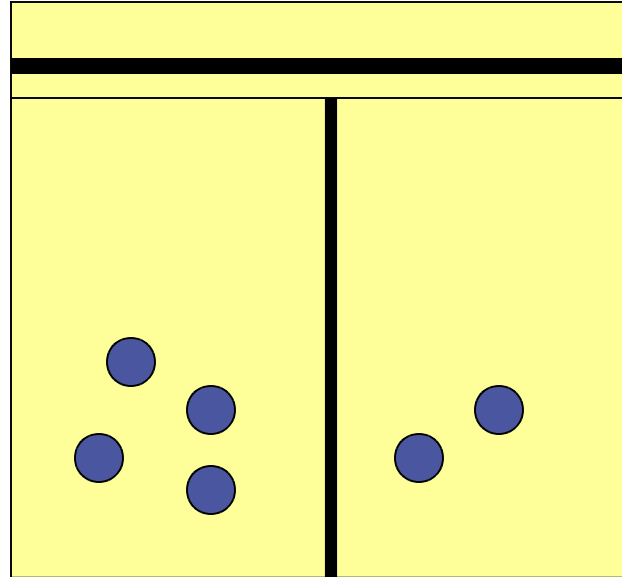
Describe the number of counters in your bag.

$$6 = 4 + 2.$$

$$6 = 2 + 4$$

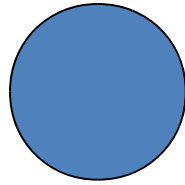
$$4 + 2 = 6$$

$$2 + 4 = 6$$



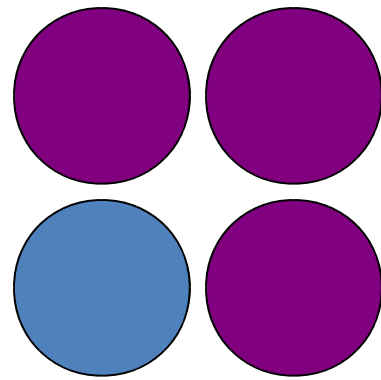
Draw a picture to represent the number sentence $7 = 6 + 1$

Could you ever have 4 counters on one side of the bag and 4 counters on the other side in your bag with 7 counters? Why or why not?

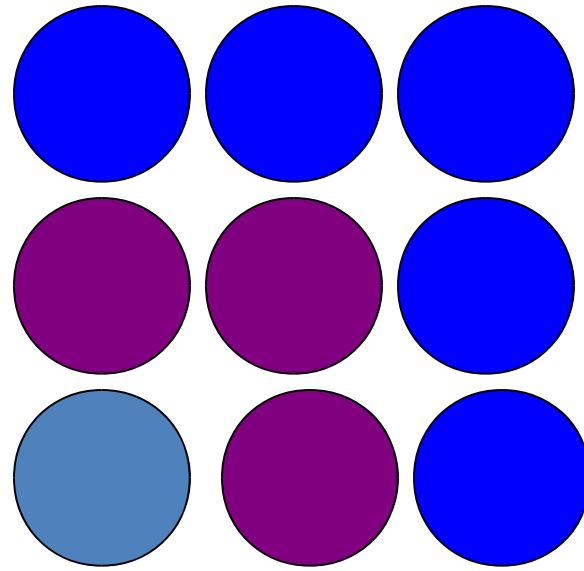


Step	Number Added	Total Number
1	1	1

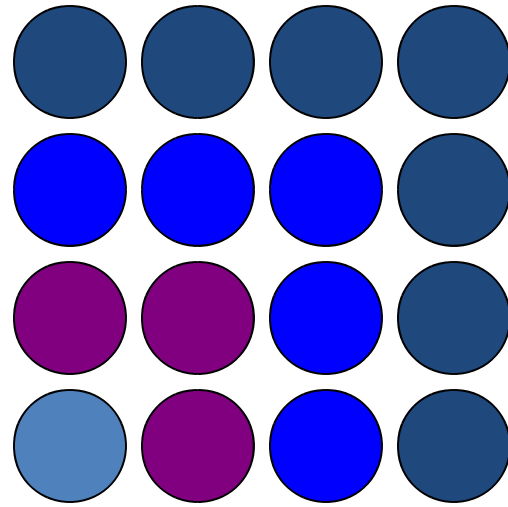
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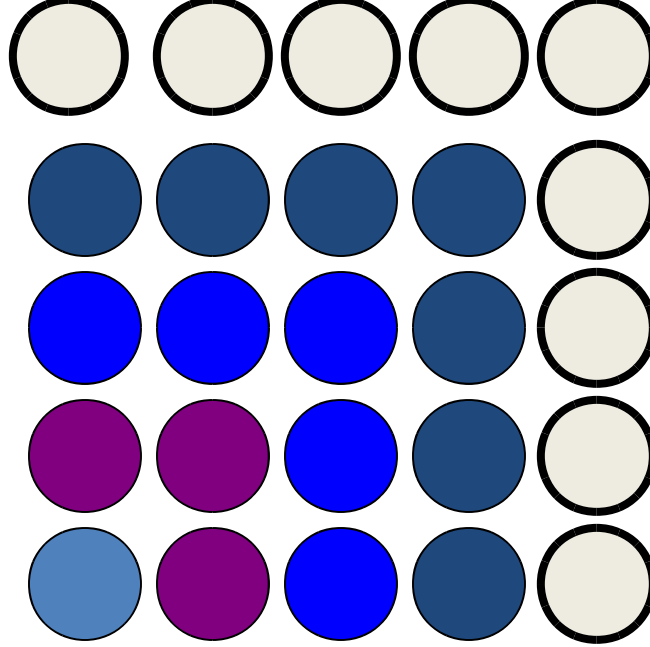
Step	Number Added	Total Number
2	3	4



Step	Number Added	Total Number
3	5	9



Step	Number Added	Total Number
4	7	16



Step	Number Added	Total Number
5	9	25

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Step

**Number
Added**

**Total
Number**

1

1

1

2

3

4

3

5

9

4

7

16

5

9

25

6

?

?

Step

**Number
Added**

**Total
Number**

1

1

1

2

3

4

3

5

9

4

7

16

5

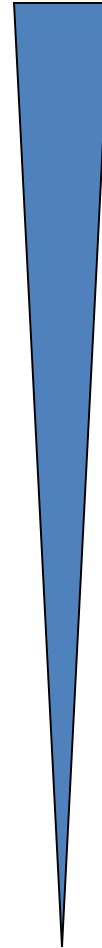
9

25

6

?

?



Step

**Number
Added**

**Total
Number**

1



1

1

2



3

4

3



5

9

4



7

16

5



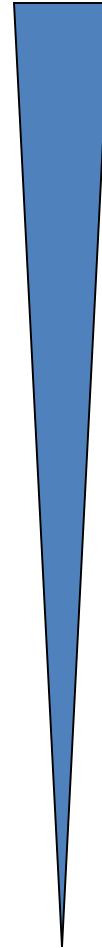
9

25

6

?

?



Step	Number Added	Total Number
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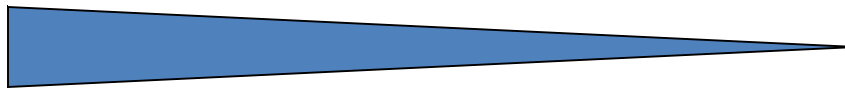
1	1	1
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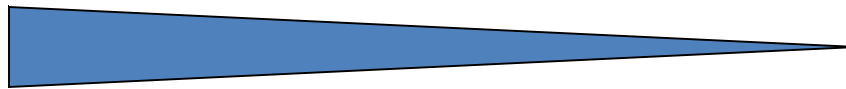
2	3	4
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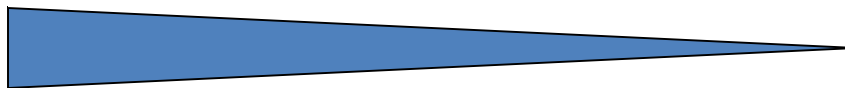
3	5	9
----------	----------	----------



4	7	16
----------	----------	-----------



5	9	25
----------	----------	-----------



6	?	?
----------	----------	----------

Step

**Number
Added**

**Total
Number**

1

1

1

2

3

4

3

5

9

4

7

16

5

9

25

6

11

36

Step

**Number
Added**

**Total
Number**

10

19

100

100

199

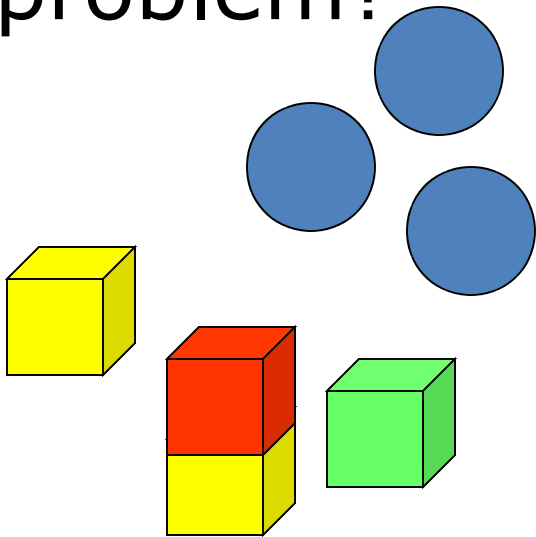
10000

$$\begin{array}{l} n + n - 1 \\ 2n - 1 \end{array}$$

$$\begin{array}{l} n \times n \\ n^2 \end{array}$$

Use Tools

- FIVE: Use appropriate tools strategically.
- How did we use tools to solve our problem?



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Use Tools Strategically



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Example THREE: Using a 100s Board to Mentally Add and Subtract in First Grade

Interactive Lesson

CC Standard: 1.NBT.5 Given a two-digit number, mentally find 10 more or 10 less than the number without having to count; explain the reasoning used.

Math Practices: Use appropriate tools strategically (#5) and look for and make use of structure (#7).

The orange boxes show skip counting by 5s.

The purple boxes show skip counting by 10s.

Word Bank
pattern
skip counting

Independent Practice
Color skip counts by 5s. Circle skip counts by 10s.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Number Sense Find the pattern.
Write the next three numbers.
3. 5, 10, 15, 20, _____, _____, _____

one hundred thirty-three

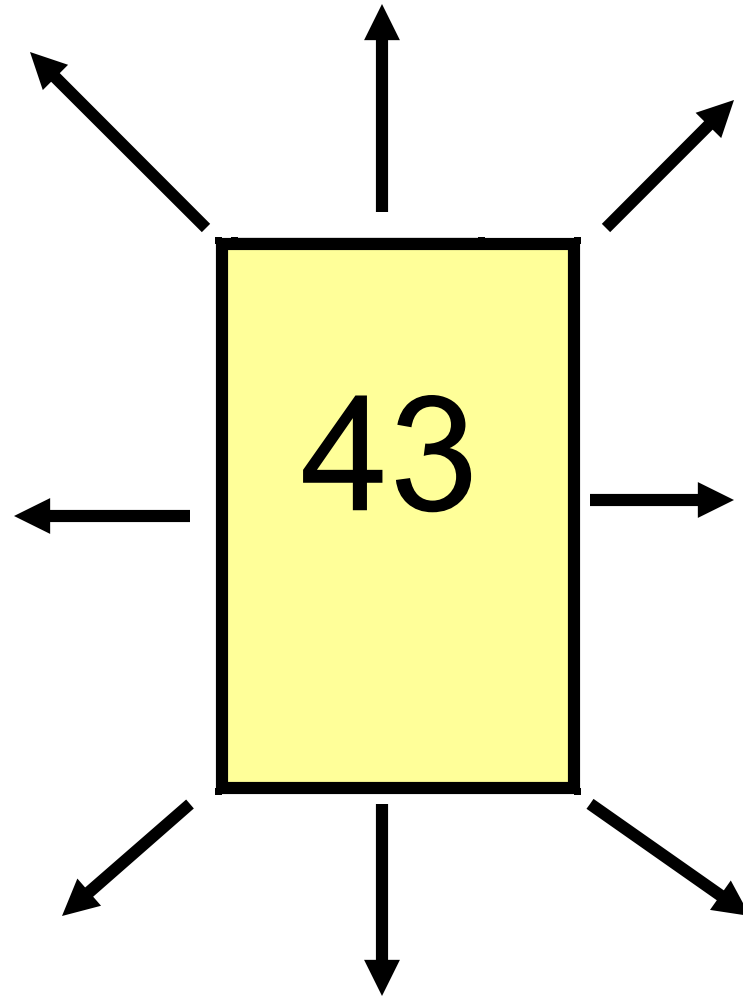
What patterns do you notice in the tens digits as you go from top to bottom?

What patterns do you notice in the tens digits as you go from bottom to top?

What patterns do you notice in the ones digits as you go from left to right?

What patterns do you notice in the ones digits as you go from right to left?

What numbers would touch this number on a hundreds board?



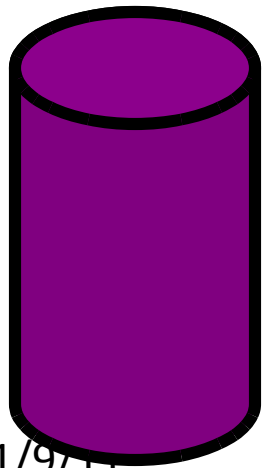
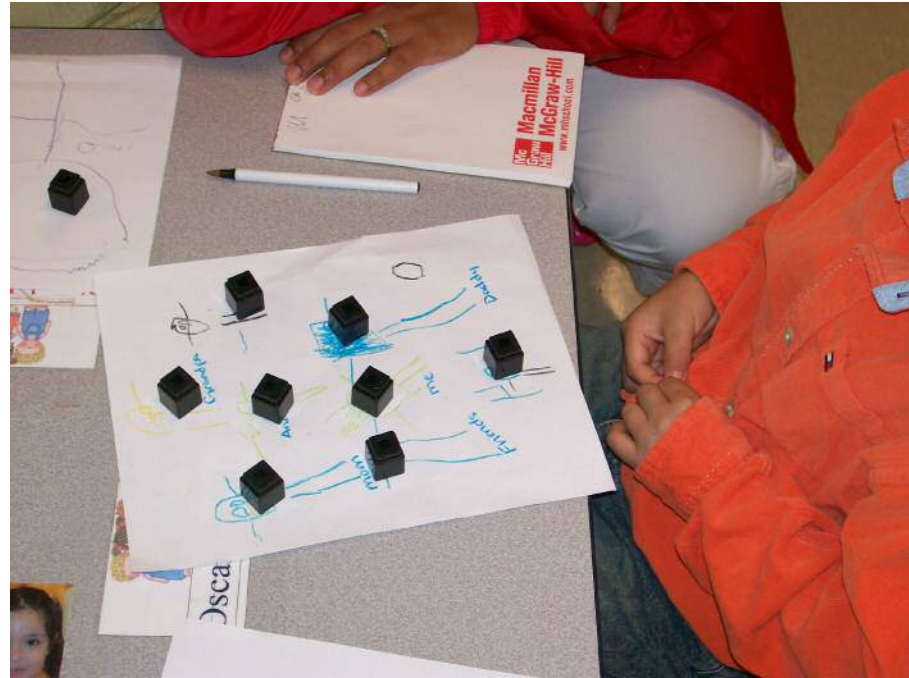
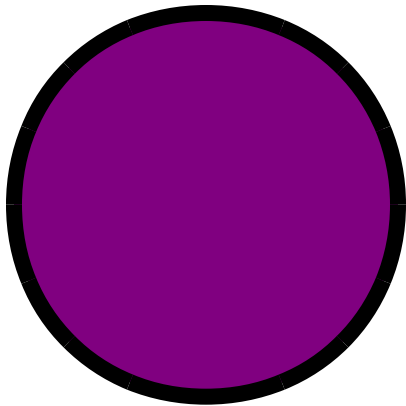
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Attending to Precision

- SIX: Attending to precision, (i.e., with number quantities as well as precise mathematical vocabulary.)
- How did we attend to precision in our problem?

Attending to Precision for the Young Child

“Looks like a ball” - sphere



“Looks like a can” - cylinder

Example TWO: Geometry Vocabulary for Polygons in 2nd Grade

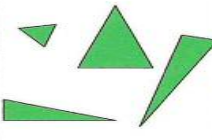
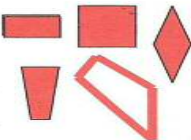
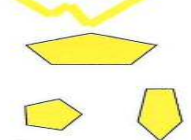
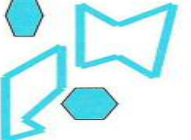

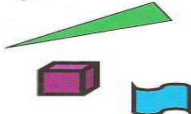

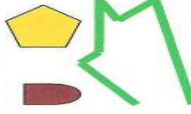
·Visual Learning Bar

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·CC Standard: 2.12.3. Identify triangles, quadrilaterals, pentagons, and hexagons.

·Math Practices: Attend to precision with the use of vocabulary (#6). Look for and express regularity in repeated reasoning by making generalizations (#8).

Visual Learning Bar

<p>Triangles</p>  <p>3 sides, 3 vertices, 3 angles</p>	<p>Quadrilaterals</p>  <p>4 sides, 4 vertices, 4 angles</p>	<p>Pentagons</p>  <p>5 sides, 5 vertices, 5 angles</p>	<p>Hexagons</p>  <p>6 sides, 6 vertices, 6 angles</p>
<p>Triangles</p> 	<p>Quadrilaterals</p> 	<p>Pentagons</p> 	<p>Hexagons</p> 

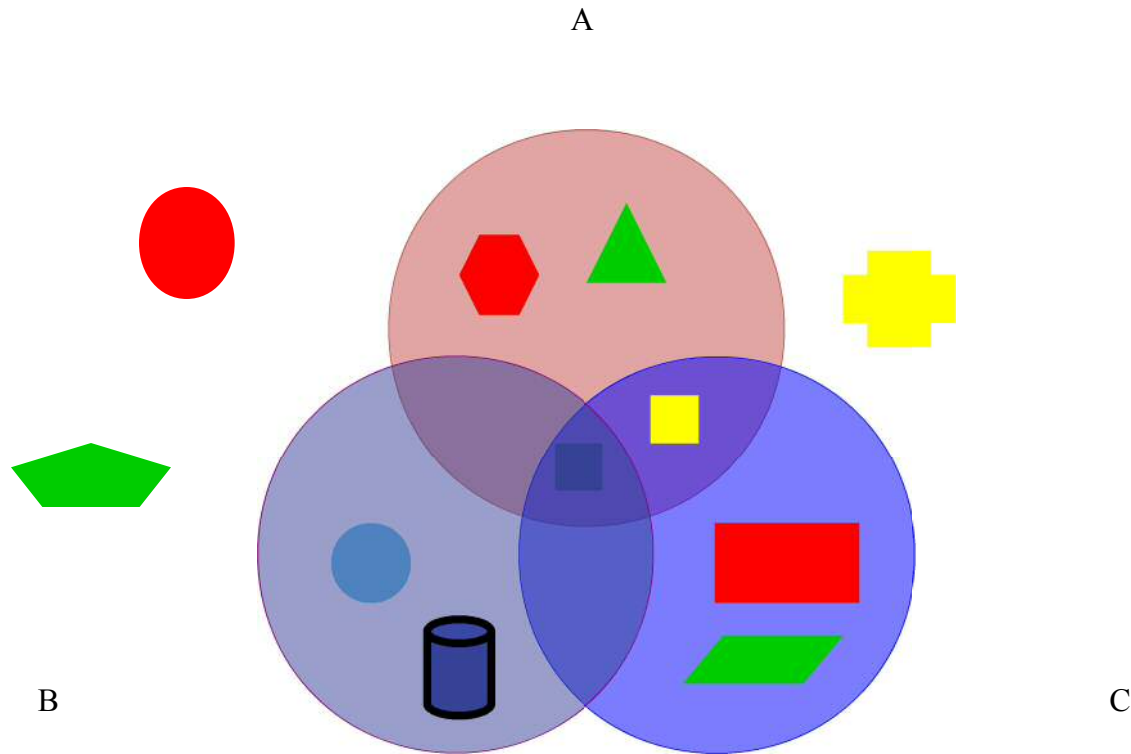
3. Construct viable arguments and critique the reasoning of others.

Viable arguments for young children will be substantively different than for older students. However, they can begin to explain their conclusions and ideas and

•Why are these shapes ?

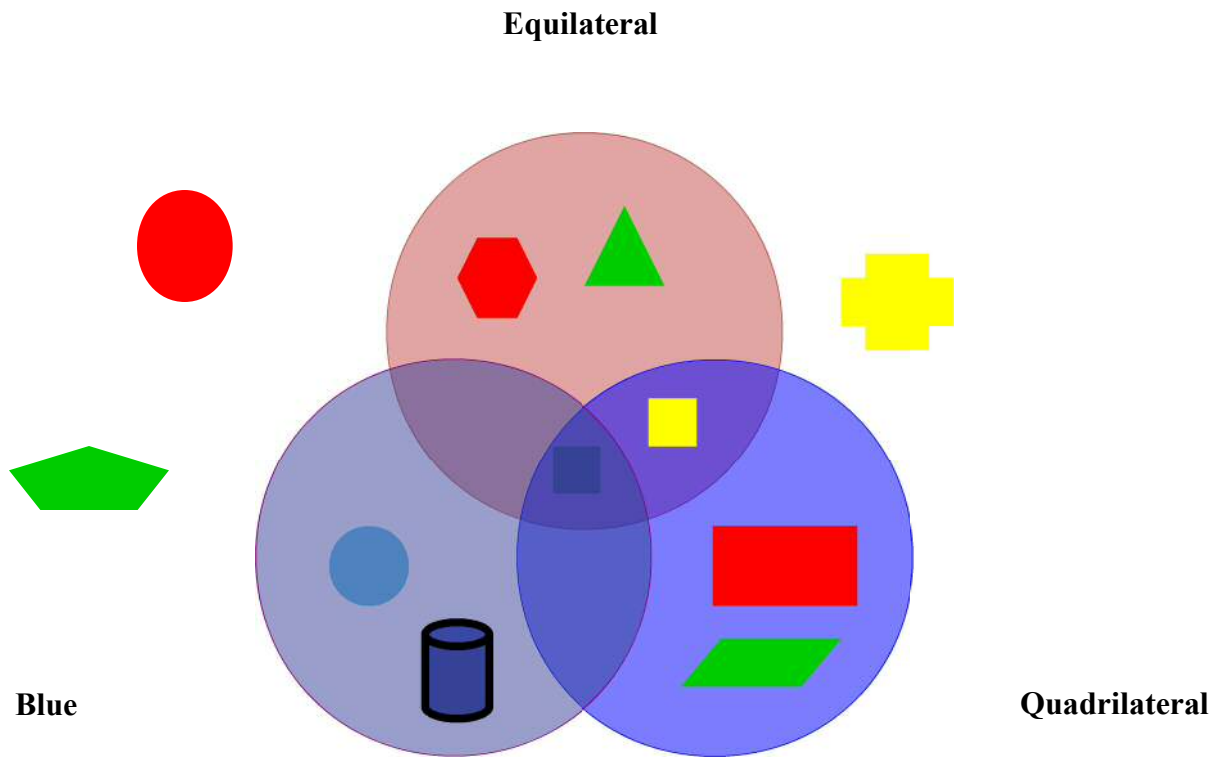
•Why are these shapes NOT ?

What are the Labels?



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What are the Labels?



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Using Structure

- SEVEN: Look for and make use of structure (i.e, analyze a problem, structure, or pattern).



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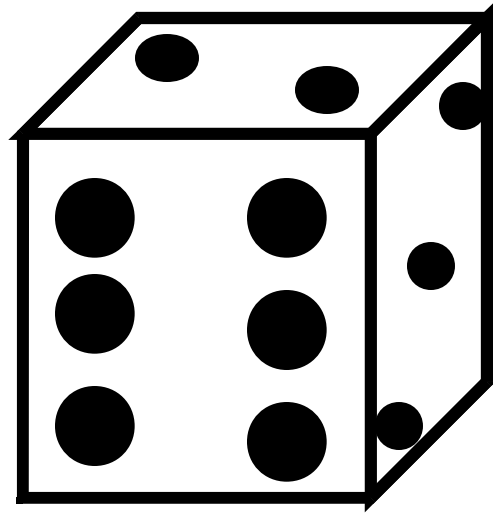
Finger Math Switch!



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Dice Tower : How Many Pips are Hidden?

A tower of
9 dice... 2
on top...



$$9 \times 7 - 2 = 61$$

Double Patterns

“ My 3 friends and I have
8 shoes, 8 earrings, 8
eyes, 8 hands, 40 fingers,
and 1 friendship!”



“Eight animals
have 16 eyes!”

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Creating Generalizations

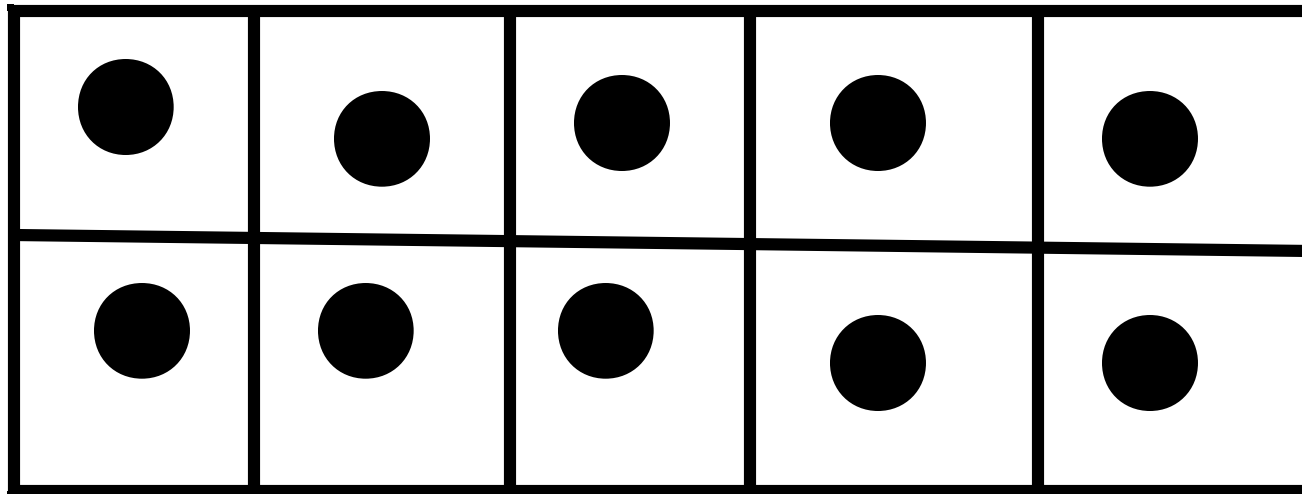
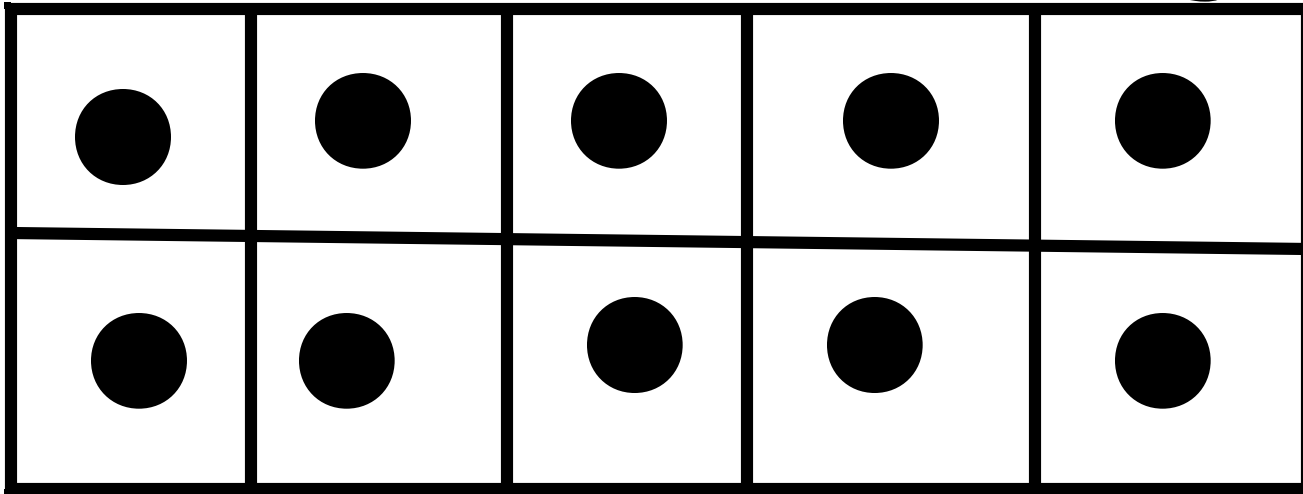
- Look for and express regularity in repeated reasoning, (i.e., creating a generalization).

Creating Generalizations



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Pattern Counting



Bulgarian Solitaire

- Rules:

Use 10 cards. Divide them into two piles.

Take one card from each pile and make a new pile.

Continue taking one card from each pile and making a new pile each time.

Continue this process even if a pile disappears.

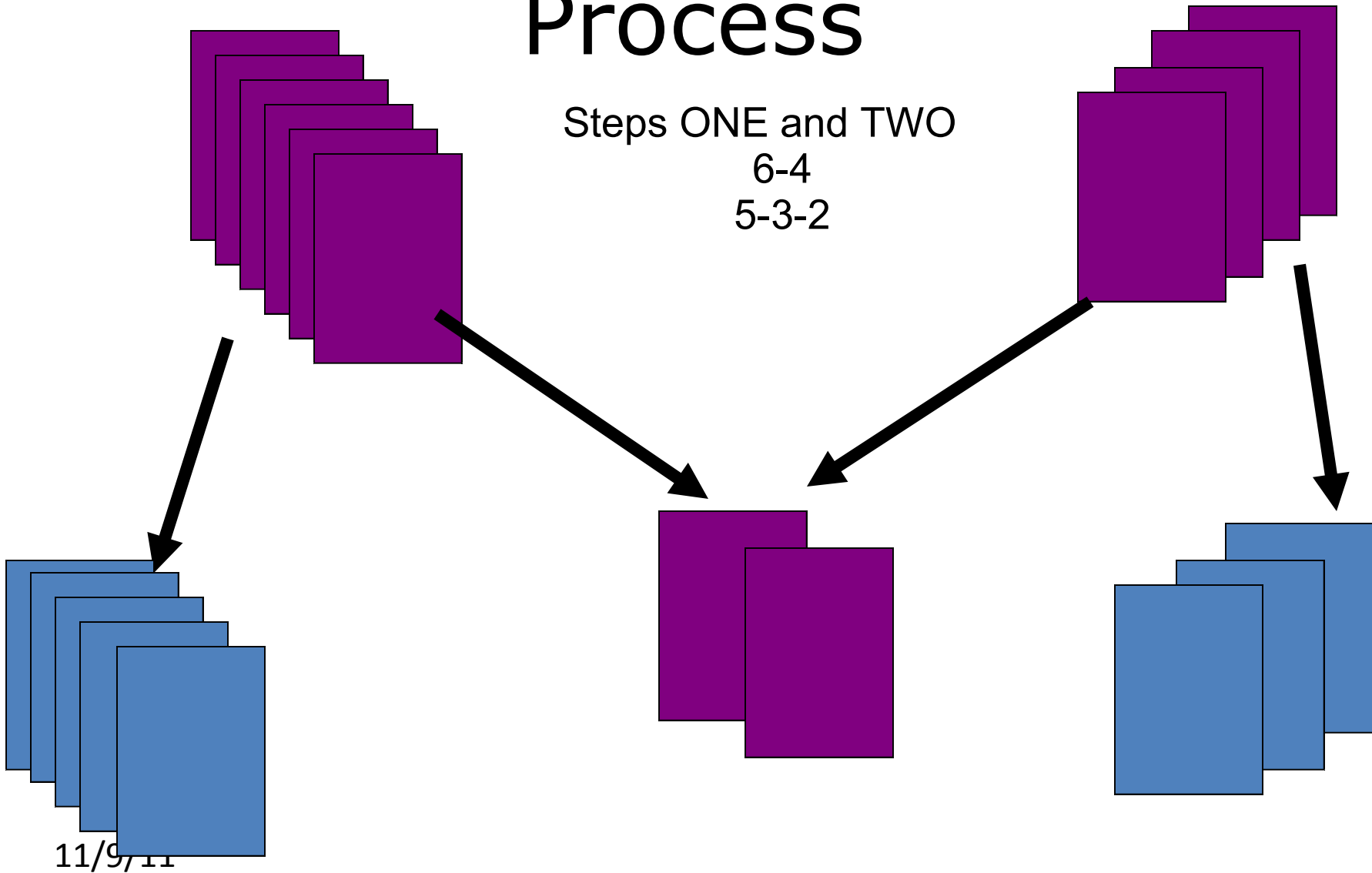
Continue this process until you “know you are done!”

A Visual Picture of the Process

Steps ONE and TWO

6-4

5-3-2



Look for Patterns

- Write the NUMBER of cards in each set.
- List the number of cards in each pile in order from the largest number in the pile to the smallest number in the pile.
- Look for patterns in your lists.
- Example:
 - Step ONE 6-4
 - Step TWO 5-3-2

What Happens with 10 cards?

·Pile A – 5; Pile B -5

-4 and 4 and 2

-3 and 3 and 3 and 1

-4 and 2 and 2 and 2

-4 and 3 and 1 and 1 and 1

-5 and 3 and 2

-4 and 3 and 2 and 1

-4 and 3 and 2 and 1

-4 and 3 and 2 and 1

-4 and 3 and 2 and 1

·Pile A – 9; Pile B – 1

-9 and 1

-8 and 2

-7 and 2 and 1

-6 and 3 and 1

-5 and 3 and 2

-4 and 3 and 2 and 1

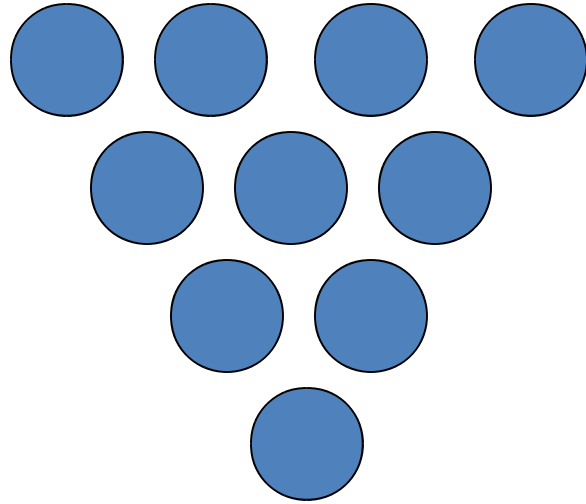
-4 and 3 and 2 and 1

-4 and 3 and 2 and 1

-4 and 3 and 2 and 1

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10 is a "Special" Number!



What about other
numbers?

What would happen if you used ...

·9 cards?

·8 cards?

·7 cards?

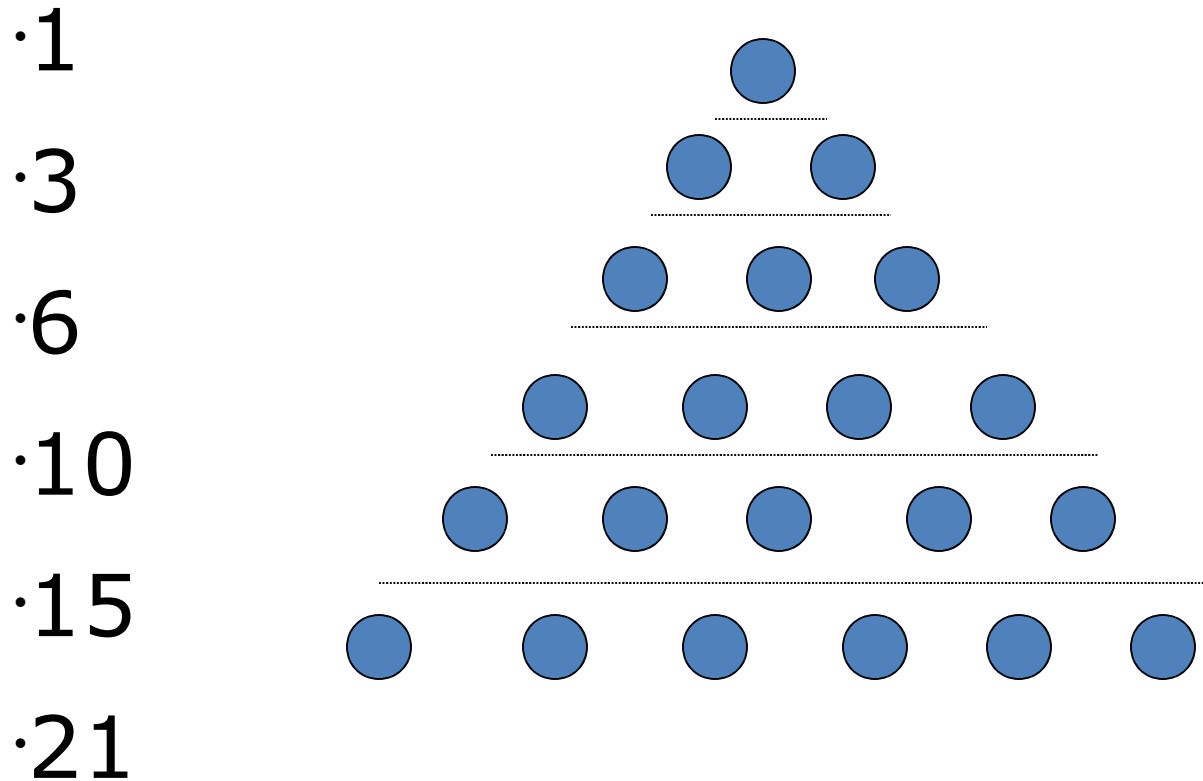
·6 cards?

·5 cards?

·4 cards?

·3 cards?

Triangular Numbers



Getting Ready!



Have trouble remembering properties? You can always come back to this activity to remind you of the properties in this lesson.



Getting Ready!

Copy and complete the table. Make a conjecture about how the value of an exponential expression, an expression containing an exponent, changes when you decrease the exponent by 1. What do you think the value of 5^{-2} is? Explain your reasoning.

2^x	10^x
$2^4 = \square$	$10^4 = \square$
$2^3 = \square$	$10^3 = \square$
$2^2 = \square$	$10^2 = \square$
$2^1 = \square$	$10^1 = \square$
$2^0 = \square$	$10^0 = \square$
$2^{-1} = \square$	$10^{-1} = \square$
$2^{-2} = \square$	$10^{-2} = \square$





Have trouble remembering properties? You can always come back to this activity to remind you of the properties in this lesson.



Copy and conjecture exponential containing of you decrease What do you Explain you

1 Interactive Learning

Solve It!

PURPOSE To use patterns to derive the properties of zero and negative exponents.

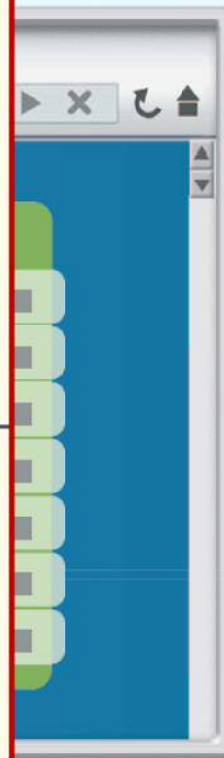
PROCESS Students may determine a pattern to complete the final three rows of the table. Students may construct a table for an expression such as 5^x to test their conjectures.

FACILITATE

- Q What pattern do you see as you complete the 2^x column? [As the exponent decreases by 1, each term is $\frac{1}{2}$ of the previous term.]
- Q What pattern do you see as you complete the 10^x column? [As the exponent decreases by 1, each term is $\frac{1}{10}$ of the previous term.]
- Q What do you notice in the row where zero is the exponent? [An exponent of zero results in a value of 1 in both tables.]
- Q How are the terms x^2 and x^{-2} related? [x^2 and x^{-2} are reciprocals.]

ANSWER See Solve It in Answers on next page.

CONNECT THE MATH Positive exponents are a notation for repeated multiplication. Students should understand that negative exponents are a notation for repeated division.



Addressing the CC Practice Standards

- Think about the tasks...
 - Involve practice activities as well as introductory and instructional activities
 - Require reasoning, interactions, problem solving, a search for patterns...interactive problem solving
- Think about the questions...
 - Specific questions that require reasoning, a search for patterns, interactions, problem solving
 - Supporting questions that promote more in-depth reasoning
- Think about your responses...
 - Encourage thinking by ALL students

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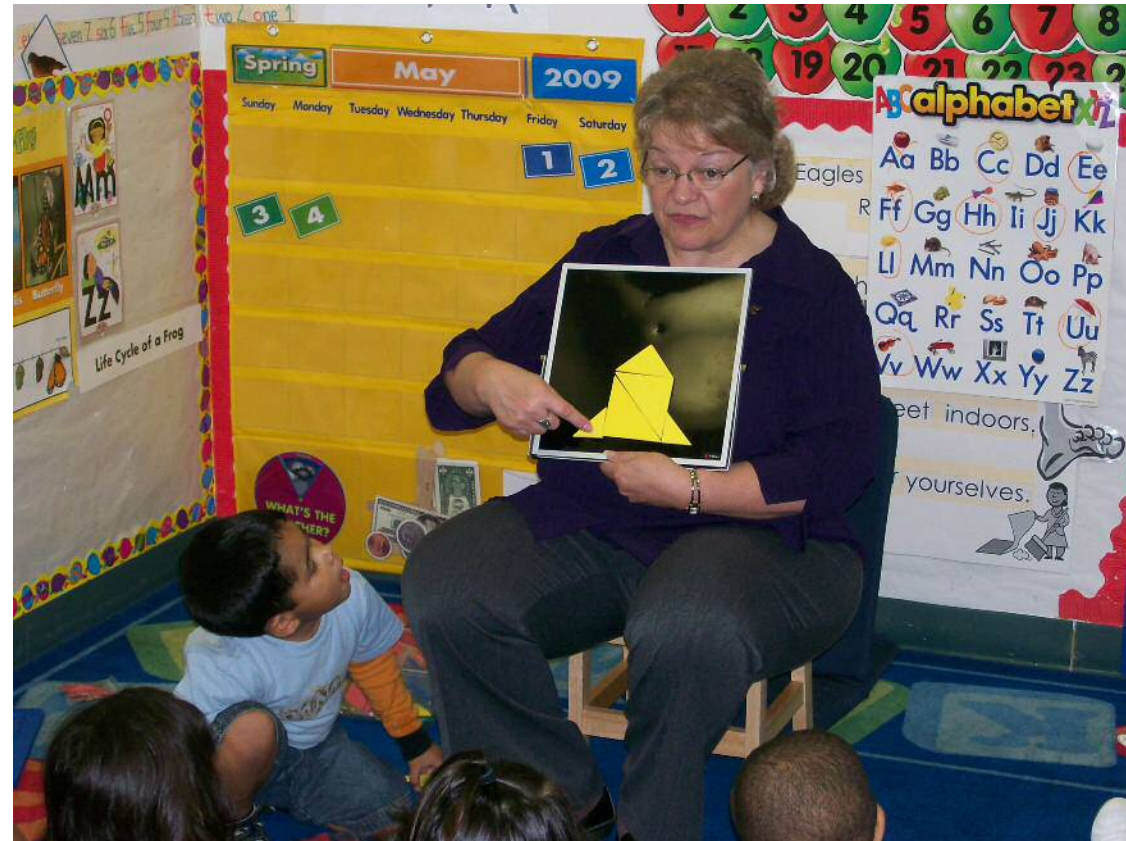
Mathematical Practice Standards

1. Problem Solving
2. Reasoning Quantitatively and Abstractly
3. Justifying and Critiquing
4. Modeling with Math
5. Use Appropriate Tools Strategically
6. Attending to Precision
7. Using Structure
8. Creating Generalizations

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• You always have lots of problems teacher! Come by any time and we will help!”

• A five year old



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