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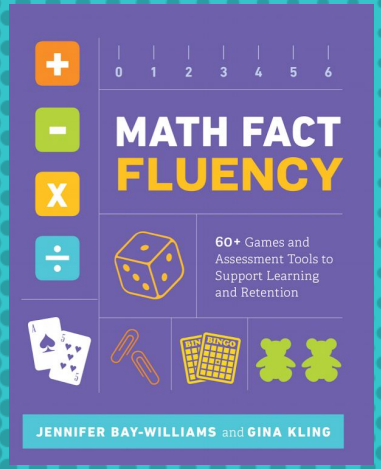
University of Arizona Center for Recruitment and Retention of Mathematics Teachers

GAMES THAT BUILD FLUENCY THROUGH A FOCUS ON FLEXIBILITY GRADES PK-2



Many of these ideas come from the work of Jennifer Bay-Williams

OUR AGREEMENTS

- ★ Play is **play**, if it is not fun then it is **not** play.
- ★ Math play does not have to look different from “real” play.
- ★ Math play does not require expensive manipulatives.
- ★ Math play requires studying the child throughout.
- ★ Math play does not always require our help.
- ★ Math play requires precision of language.

A PARADIGM SHIFT: STUDYING THE CHILD NOT THE TEACHER

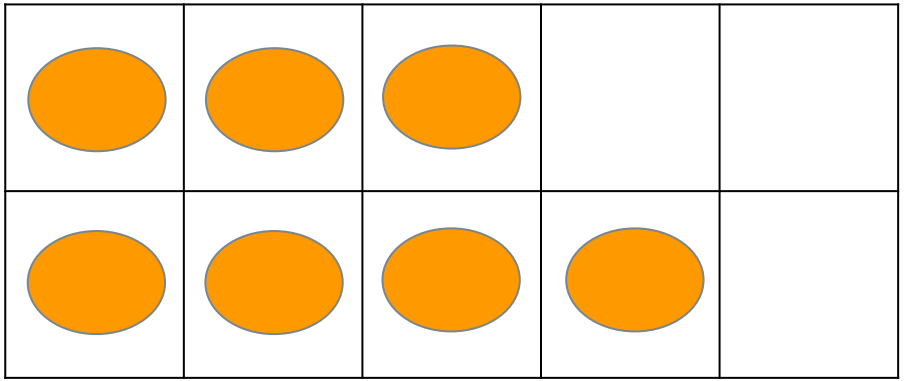
"In the US, kids try to figure out what the teacher is thinking (and then do that).
In Japan, the teachers try to figure out what the students are thinking so that they can help the students make more sense of the mathematics."
Patsy Wang-Iverson

LEARNING TARGETS

I CAN DECIDE WHETHER A GAME IS MATHEMATICAL POWERFUL.

I CAN USE GAMES TO HELP BUILD FLUENCY WITH MY YOUNG LEARNERS

How many do you see How do you see them?



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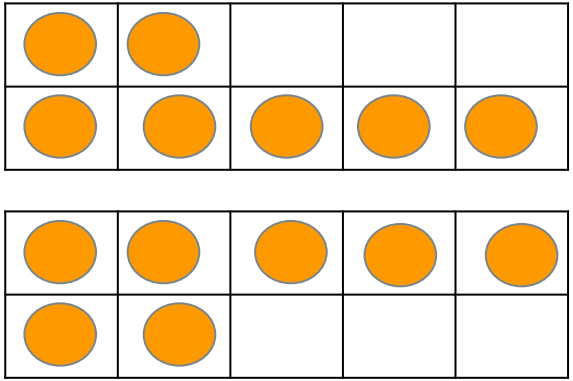
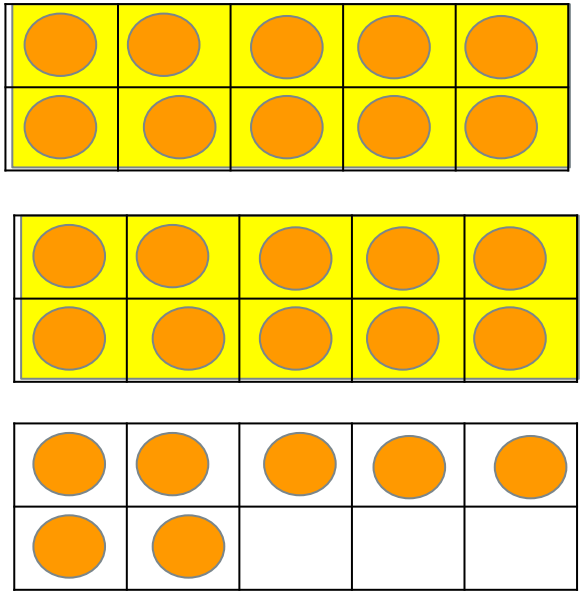


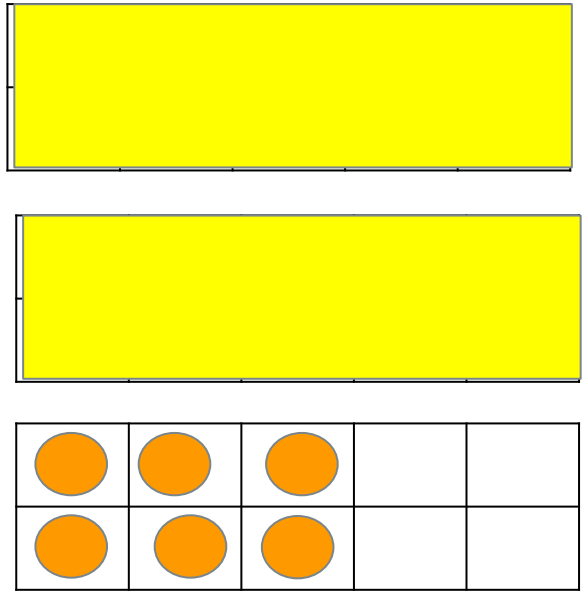
Our equations:

HOW MANY DO YOU SEE HOW DO YOU SEE THEM?



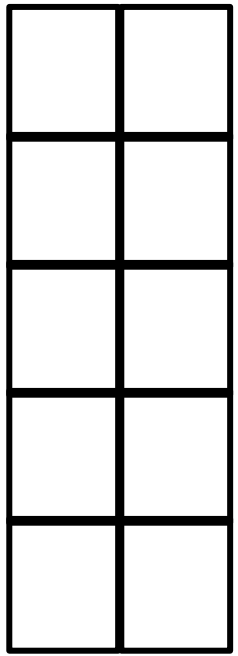
Our equations:

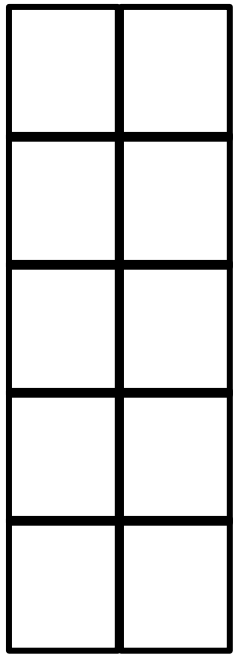
HOW MANY DO YOU SEE HOW DO YOU SEE THEM?

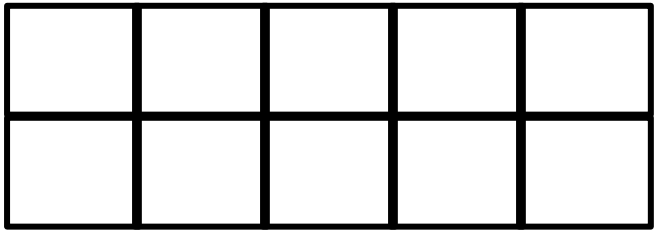


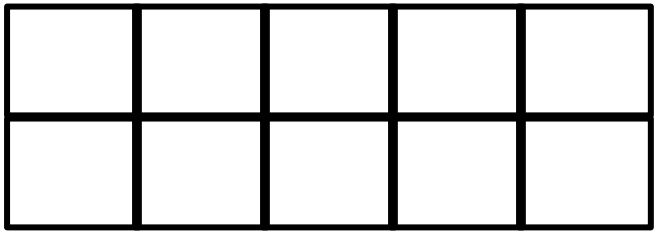
Our equations:

WHAT SHOULD 8 LOOK LIKE?

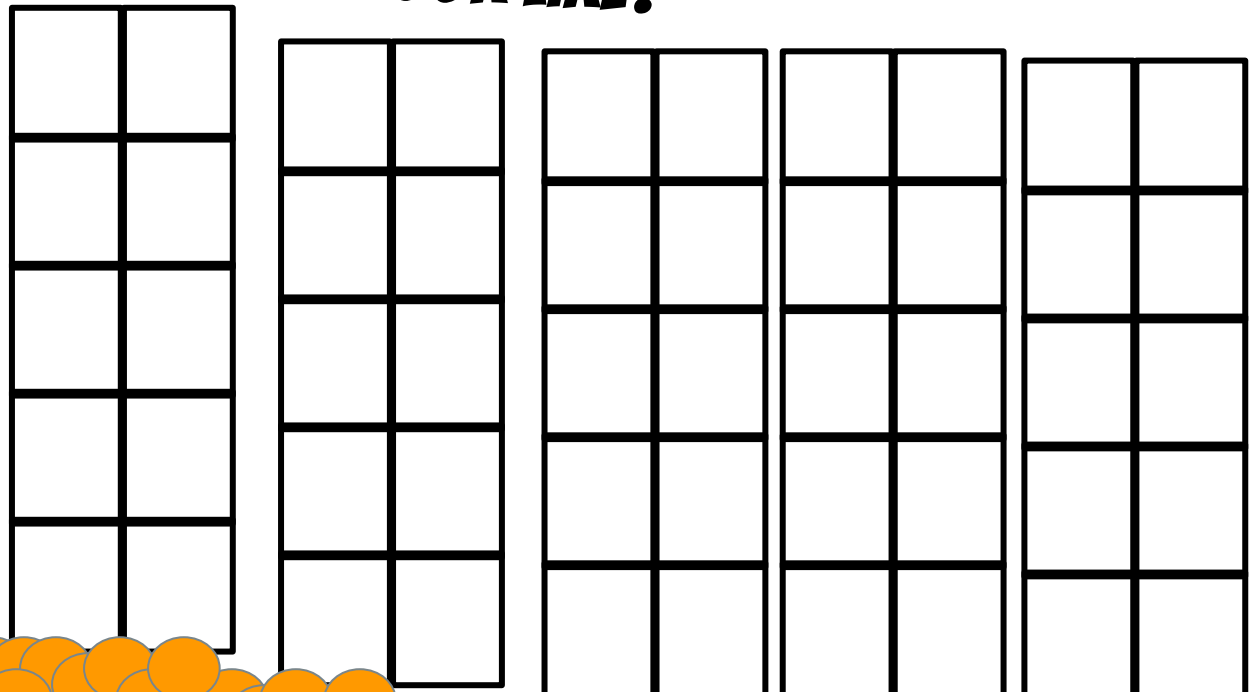




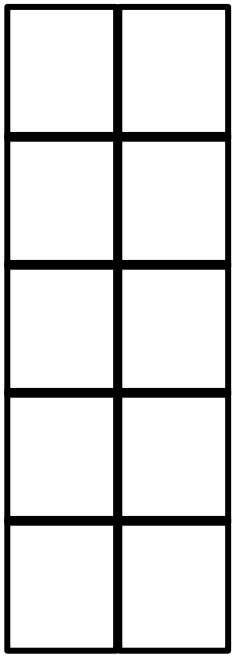


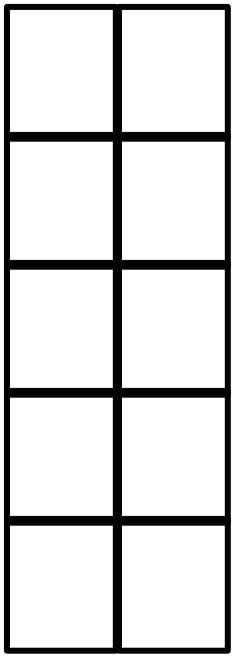


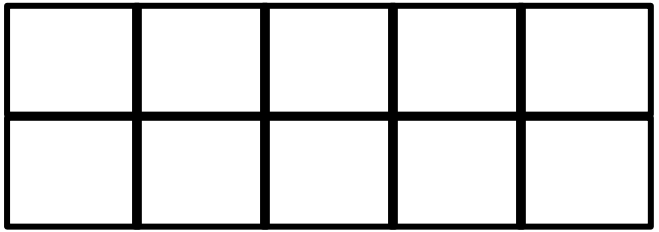
WHAT SHOULD 24 LOOK LIKE?

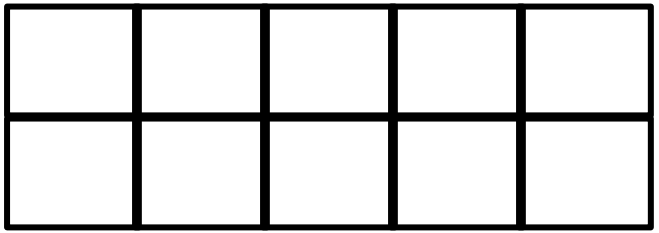


WHAT SHOULD 1 MORE THAN 6 LOOK LIKE?

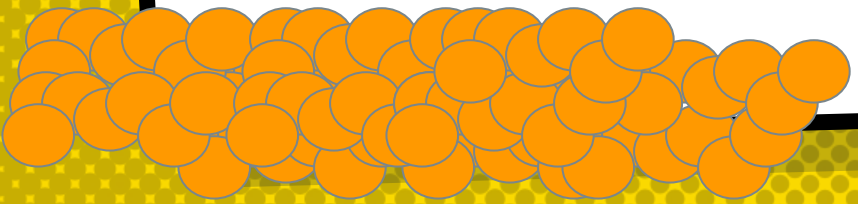




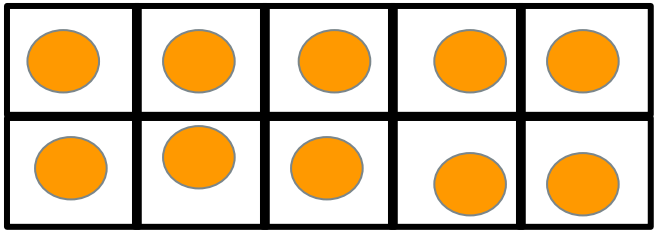


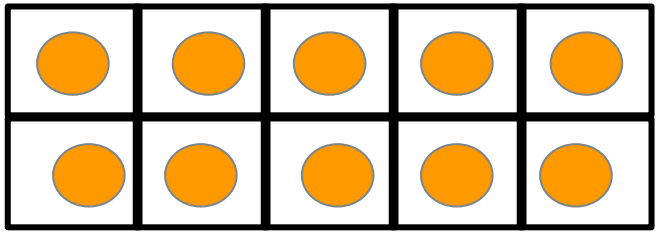


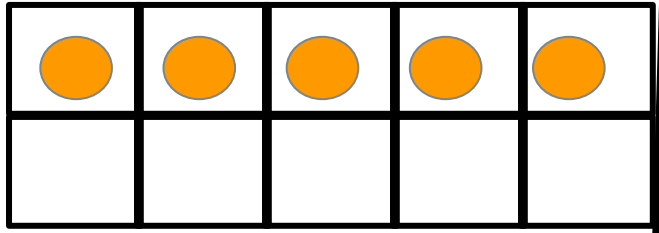
WHAT SHOULD 10 LESS THAN 39 LOOK LIKE?

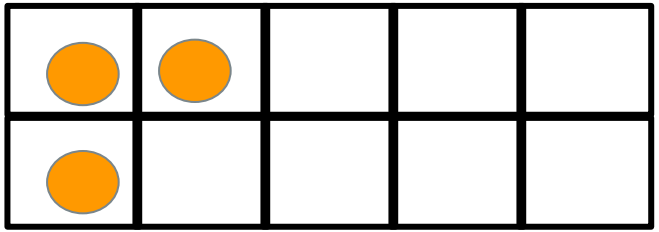


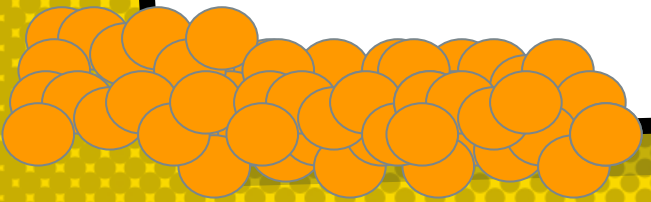
WHAT WOULD THE TOTAL BE, HOW DID YOU THINK ABOUT IT?

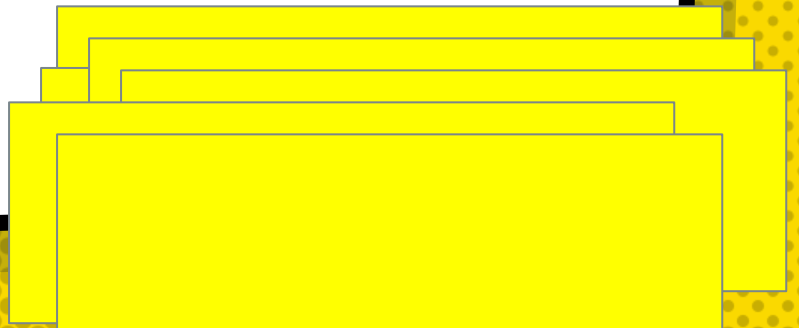






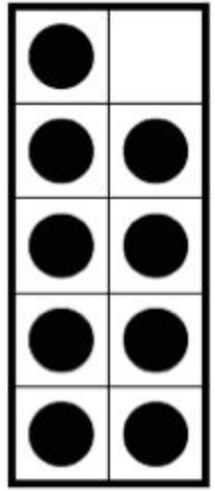






USE QUICK LOOKS: A PROGRESSION

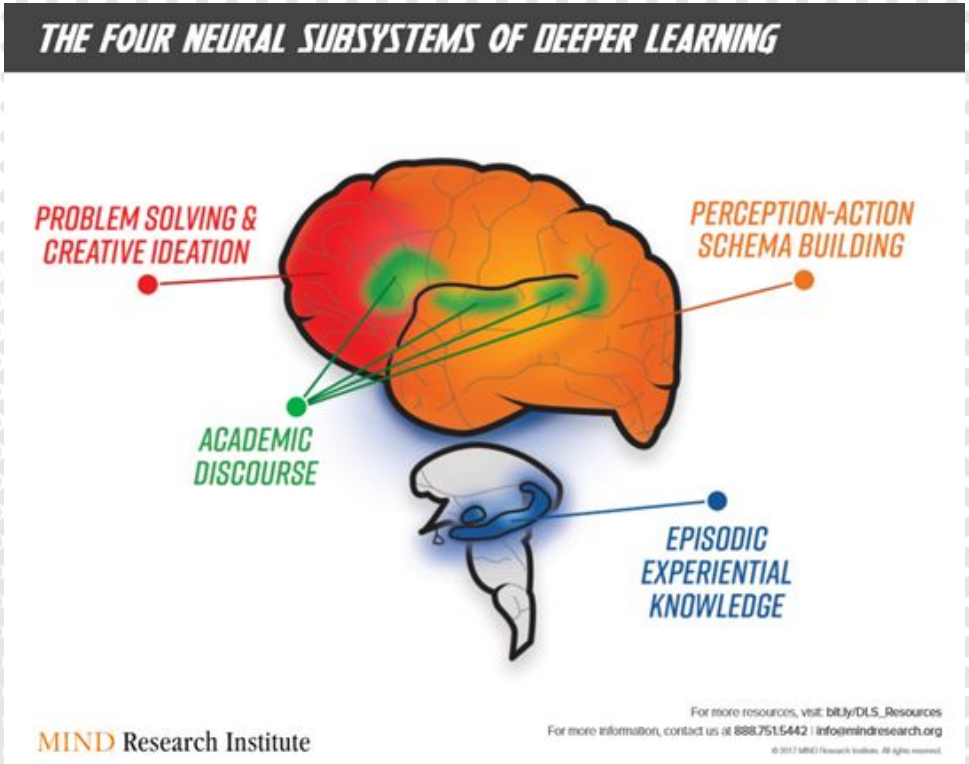
- Quick Looks
- Quick Looks + Record Equations
- Numeral/Equation and "Imagine" a Quick Look
- Explicitly encourage selected strategies



WHY GAMES?

Using play is 20-40 times **more** effective/efficient at building new brain synapses.

Ohio Association for the Education of Young Children



Lowers the affective filter of the learner.

Opens up Perception-Action Schema Building (cause-effect-reflect-adjust).

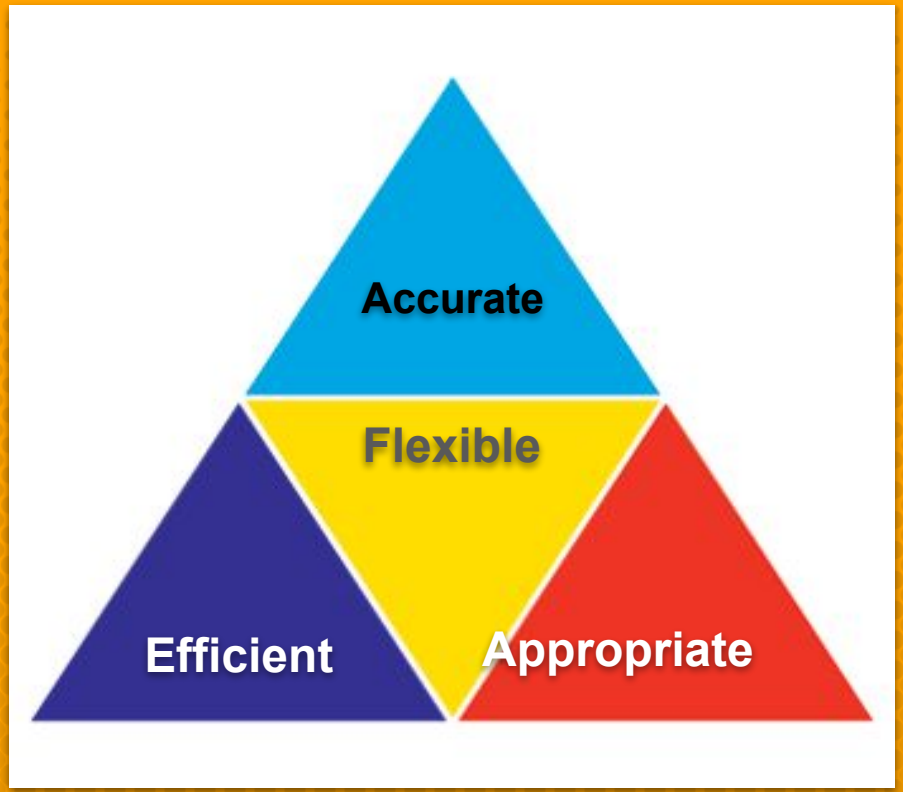
Encourages academic discourse.

Enriches the child's background experiences.

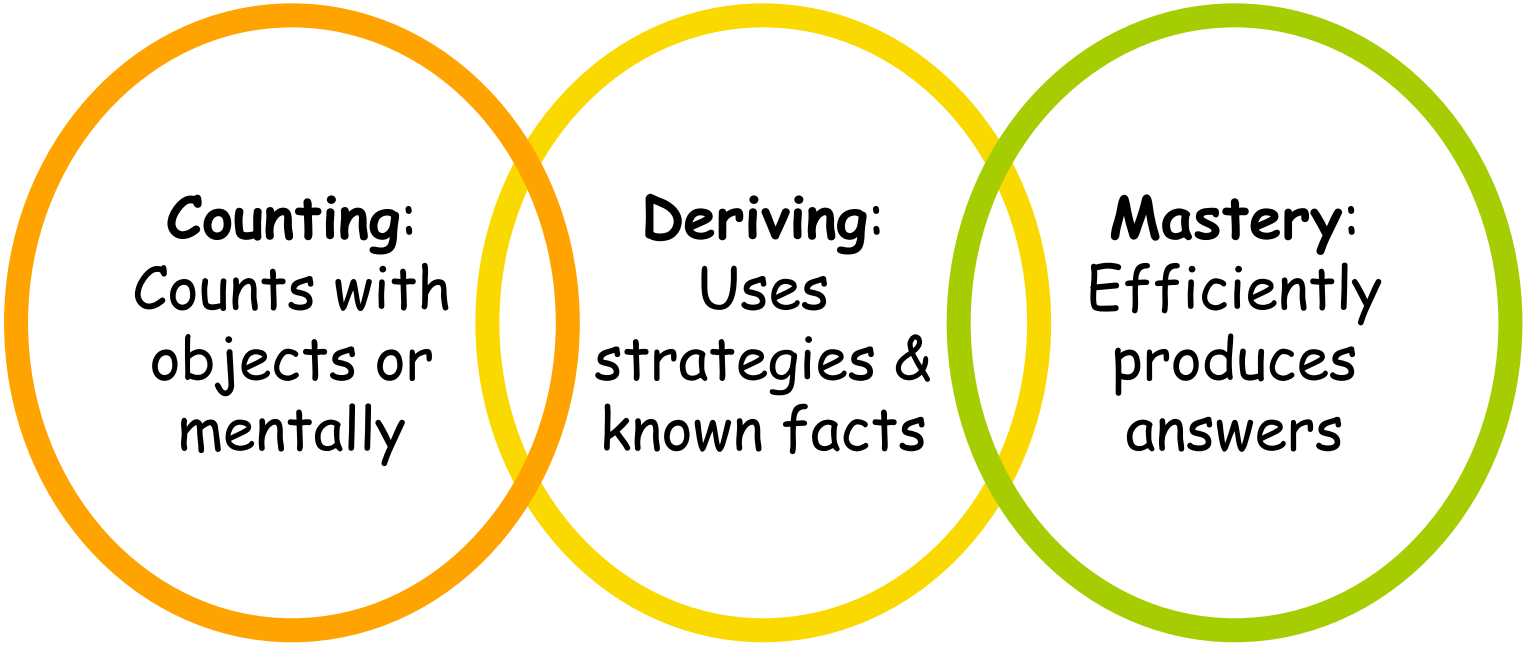
Fosters Problem Solving and Creative Thinking

WHAT IS FLUENCY?

FLUENCY



PHASES OF FLUENCY



FLUENCY DEVELOPS MOST EFFICIENTLY WHEN IT IS FUN, ESPECIALLY REPEATABLE FUN!

GAMES

- ✓ Are engaging.
- ✓ Provide opportunities for strategy discussion and assessment.
- ✓ Should be sequenced developmentally (for example, playing combinations of ten games before exploring making ten strategies).
- ✓ Can be targeted practice or general practice.
- ✓ Allow for differentiation

FOUNDATION-BUILDING GAME CRITERIA

CONCEPTUAL

- Understanding-focused
- Fundamental content
- Profound content
- Builds from what the student KNOWS
- Includes visual and physical models
- Provides feedback
- Is open-format

PROCEDURAL

- Practice-focused
- Extension/Enrichment/Advanced content
- Surface content
- Builds from the student's identified gap/deficit
- Is largely numeric or algebraic in form
- Provides "hints" or answers
- Is timed

STRATEGY GAMES

- ✓ Are targeted toward a single strategy, fact group or set of reasoning strategies
- ✓ Do not have time-pressure as an element of the game.
- ✓ Have each student in the group solving different problems.
- ✓ Encourage discourse (discussion of strategies used)
- ✓ Have **NO** time/speed component.

4 TEACHER ACTIONS FOR BASIC FACT FLUENCY

Exposing facts: use patterns, strategies, and visuals to explore fact relationships.
Practicing facts: students continue to share their strategies in number talks & games.
Assessing fluency: Record where each student is with each strategy
Intensification/Enrichment: work with small groups of students on specific strategies as needed, assign specific games for home use.

Choosing the Game--Be Strategic!

1. Which **concepts** are supported?
2. Which **strategies** are supported?
3. How might the game be **adapted**?

Fishing for Five

(Like Go Fish)

Goal: Make five

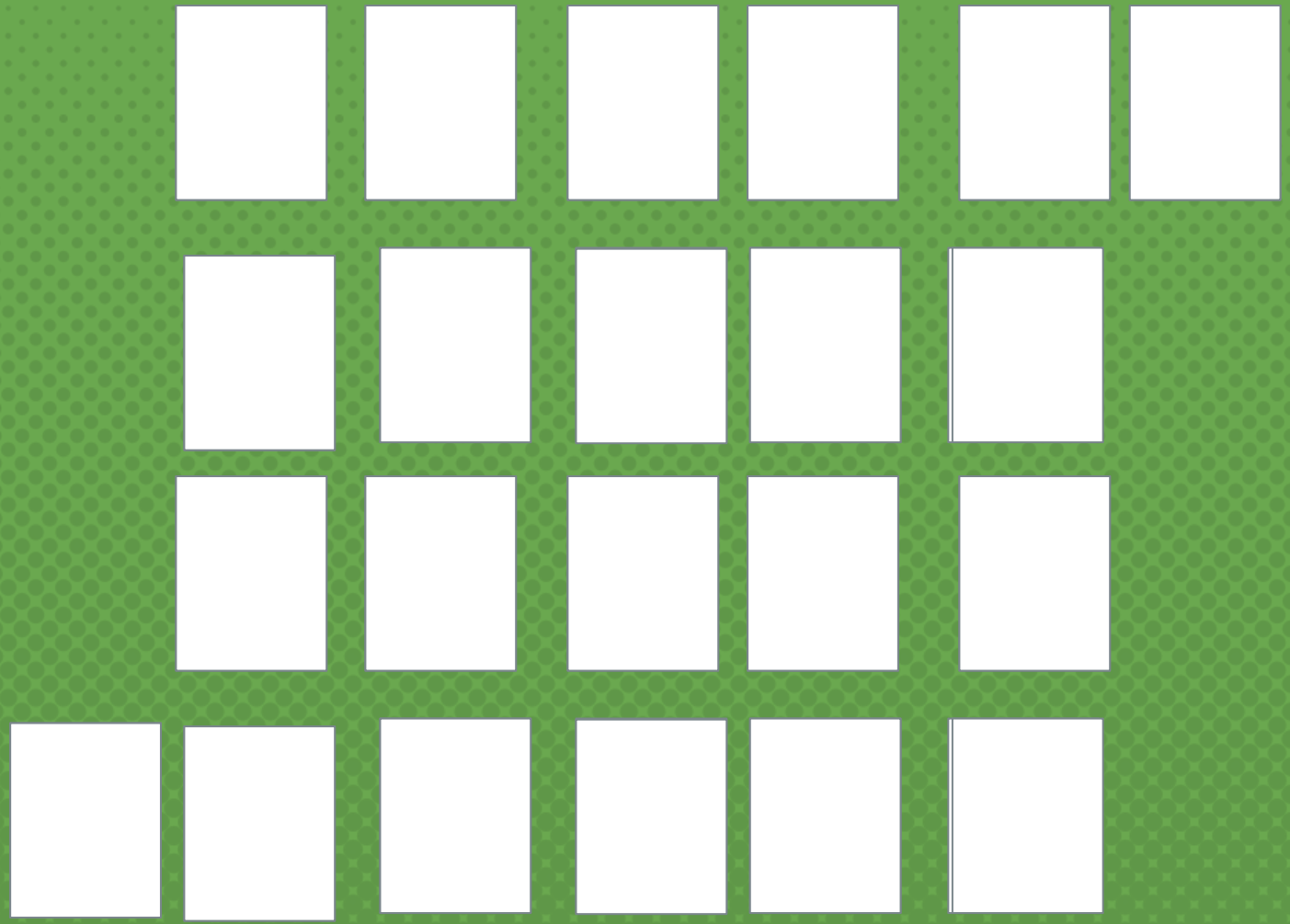
Tools: dot cards (two sets) of 1-5 OR two sets of 0-5

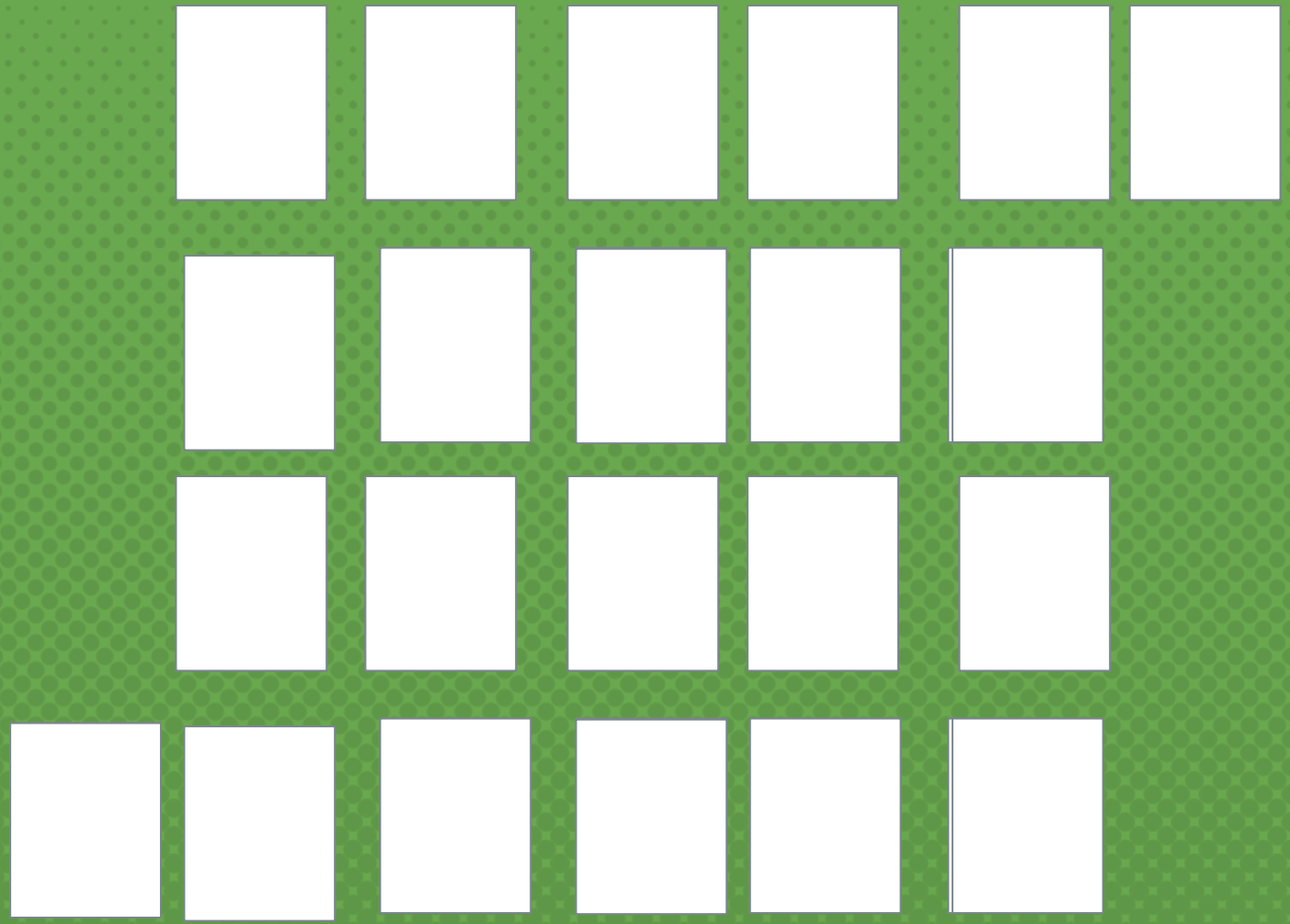
Place all of the cards in the pond.

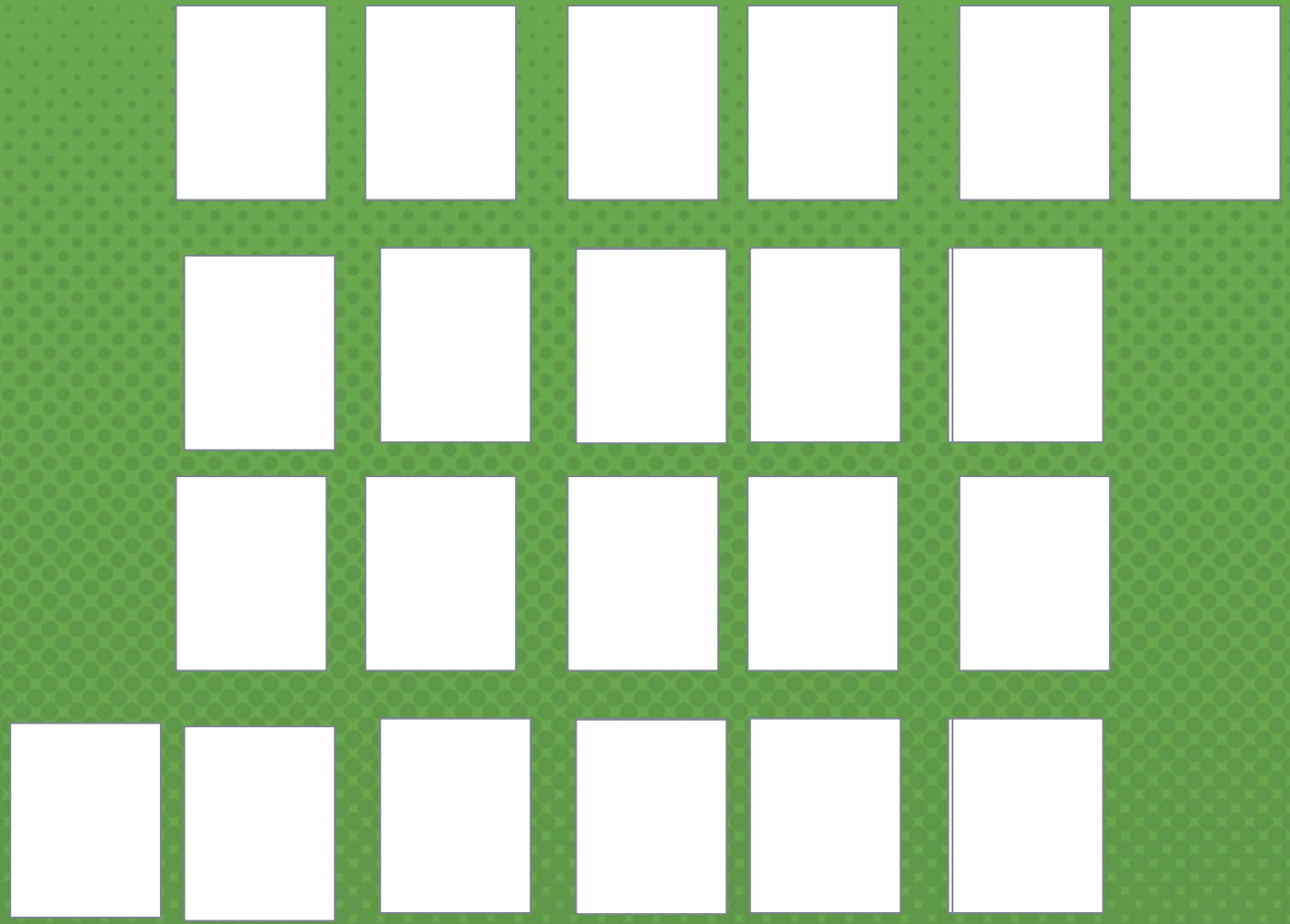
Each player draws 3 cards. The rest remain in the pond.

Player 1 has a four, so she asks "do you have a 1"

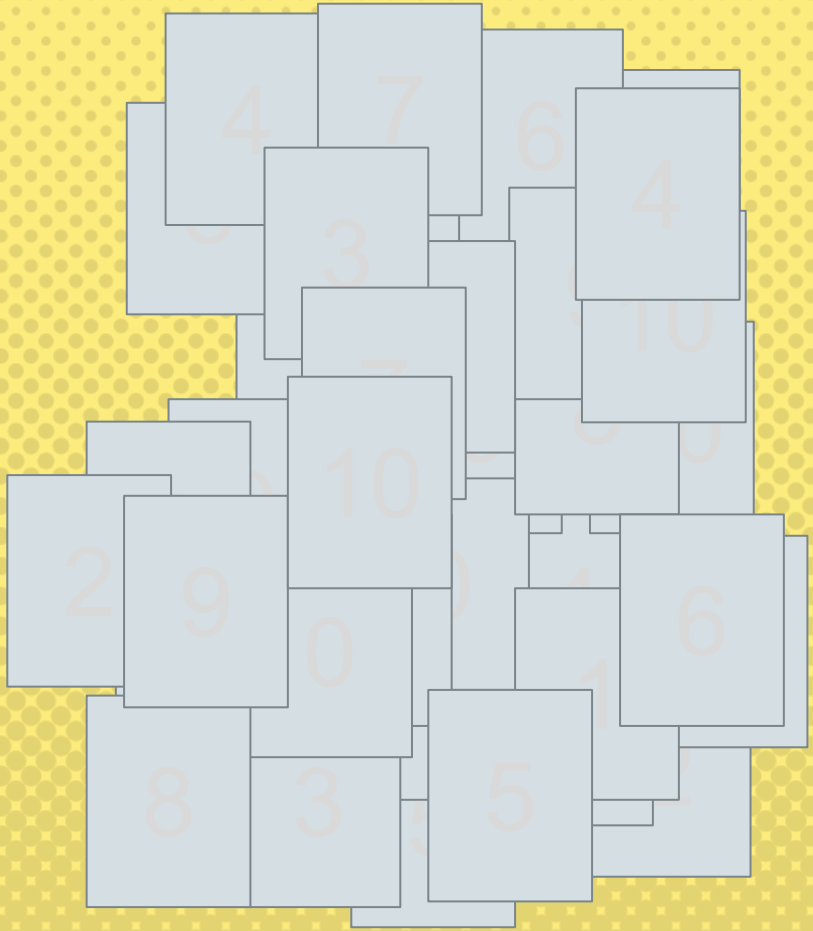
The response is to give a card or to say "Go Fish"

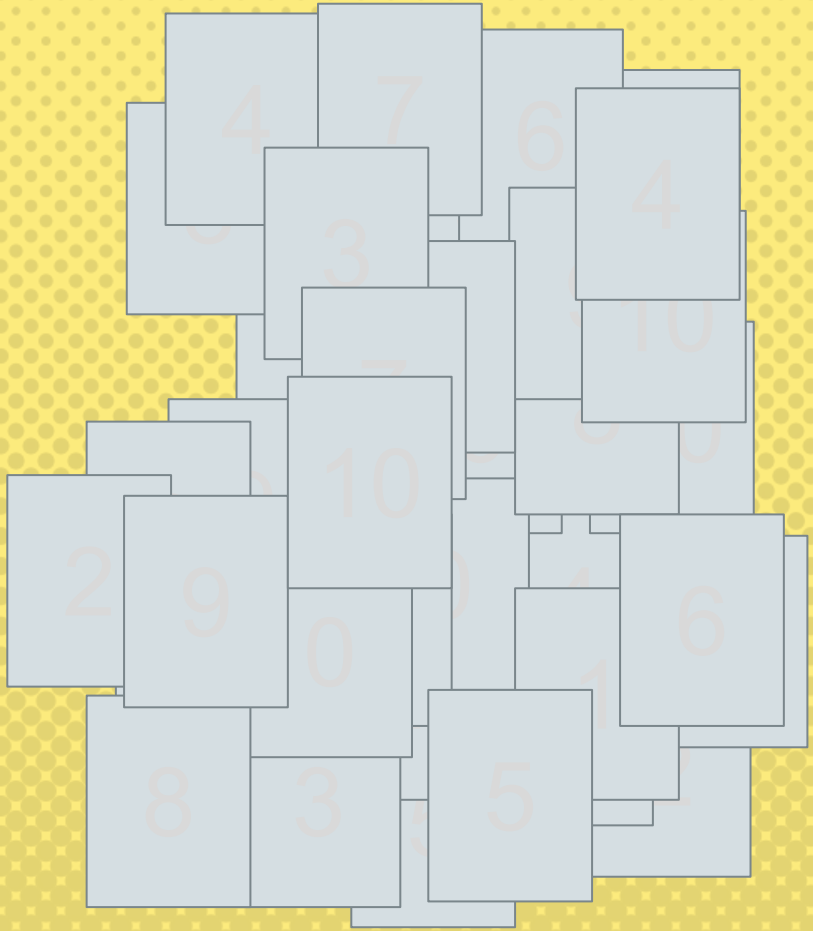


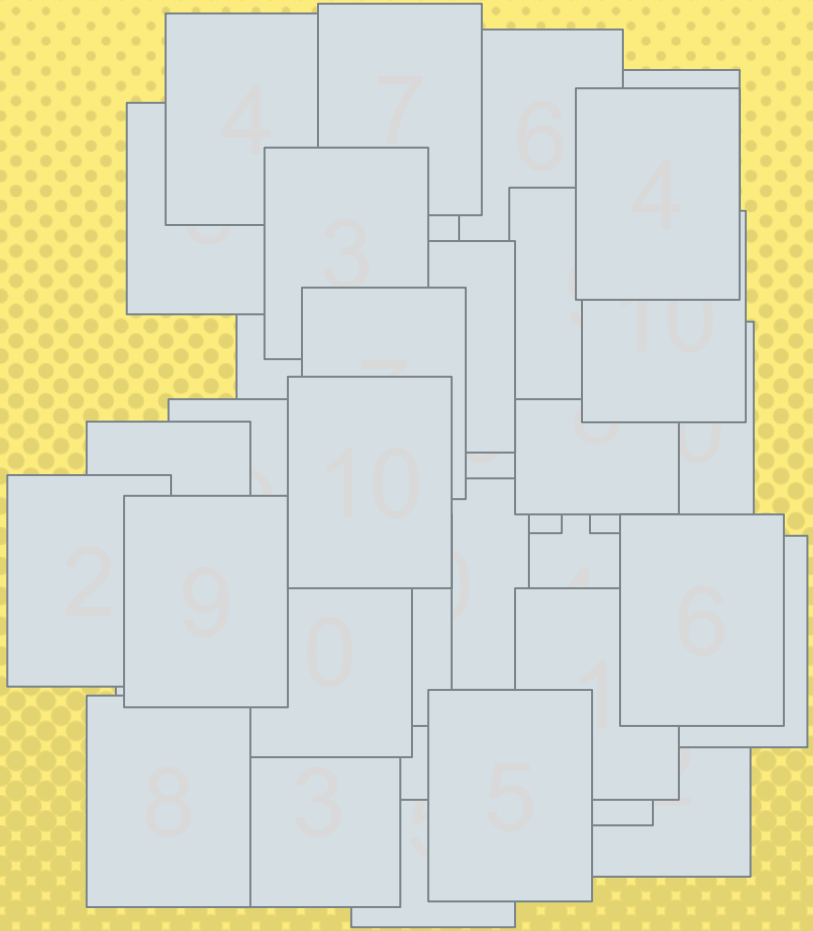




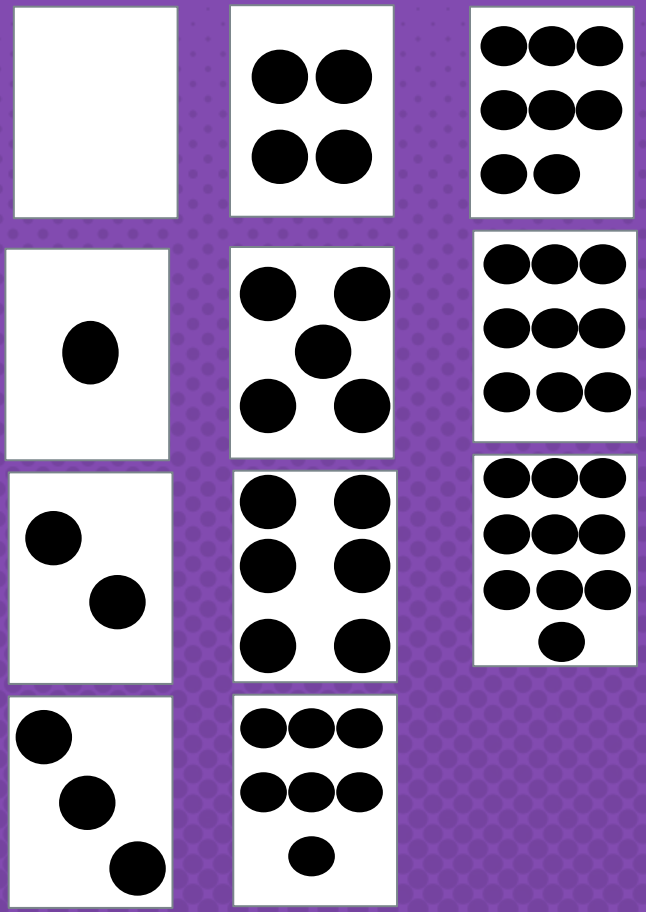
Fishing for Ten
(Like Go Fish)
Goal: Make ten pairs
Tools: Numeral or Dot cards 0-10
Each player draws 5 cards. The rest remain in the pond.
Player 1 has a four, so she asks "do you have a 6"
The response is to give a card or to say "Go Fish"





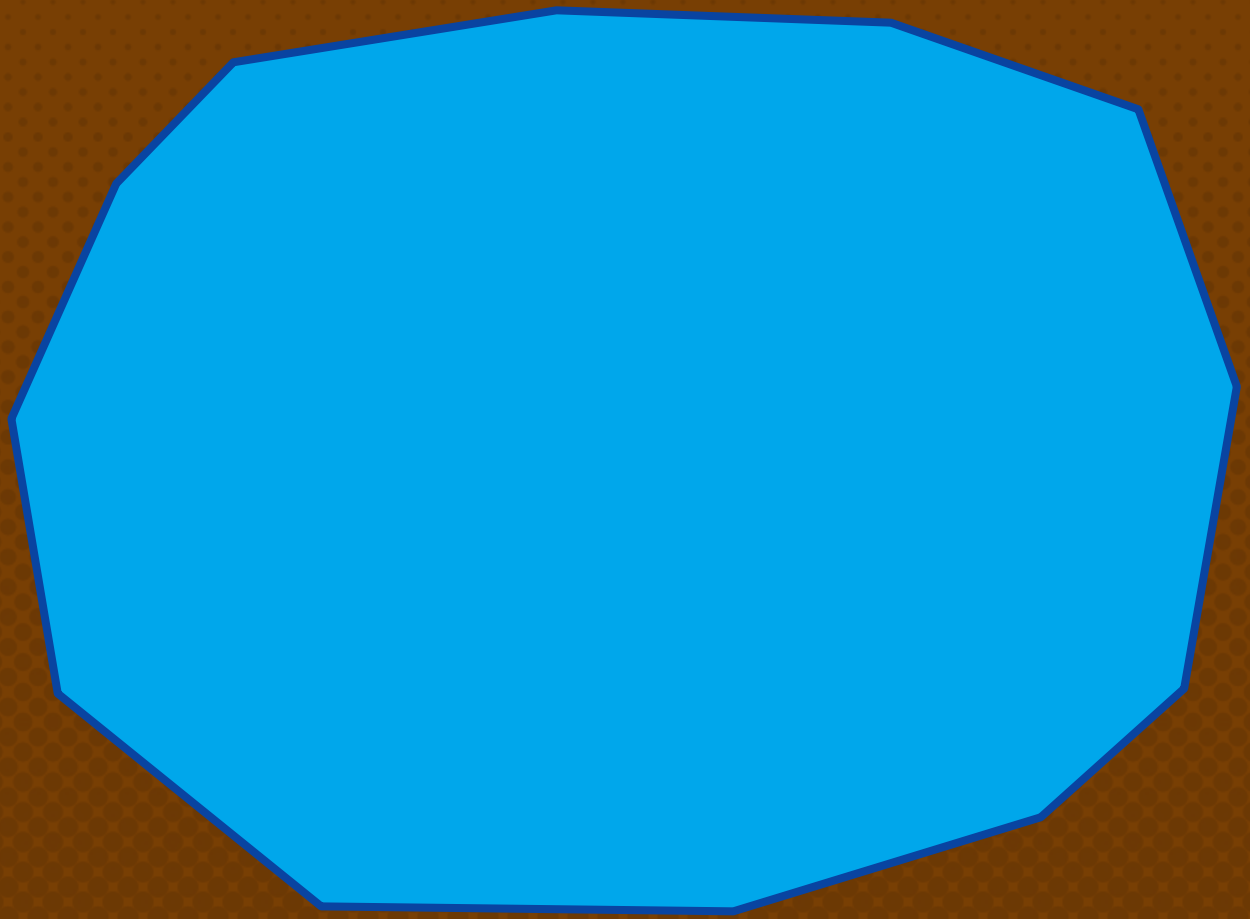


0	4	8
1	5	9
2	6	10
3	7	



0	4	8	12	16	20	24	28	32	36
1	5	9	13	17	21	25	29	33	37
2	6	10	14	18	22	26	30	34	38
3	7	11	15	19	23	27	31	35	39
40	41	42	43	44	45	46	47	48	49

50	54	58	62	66	70	74	78	82	86
51	55	59	63	67	71	75	79	83	87
52	56	60	64	68	72	76	80	84	88
53	57	61	65	69	73	77	81	85	89
90	91	92	93	94	95	96	97	98	99



Reflecting on the Game

- Which **strategies** are supported?
- What makes this game grow in strategy?
- How might the game be **adapted** at this level?
- How might the game be **adapted** for 1st? 2nd?

COMMON ADAPTATIONS

DO NOT MOVE ME PLEASE

How was that experience different from flash cards?

NUMERAL VALUE MATCH

2 number cubes

2 Stack Play Cards

20 counters

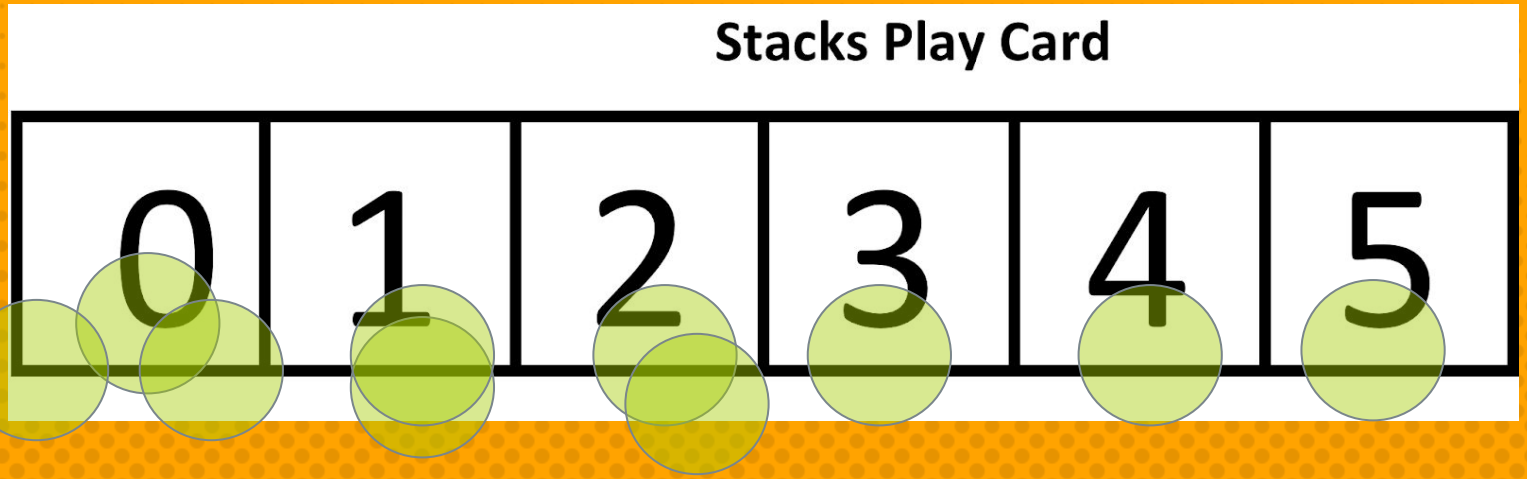
Each player counts out 10 counters.

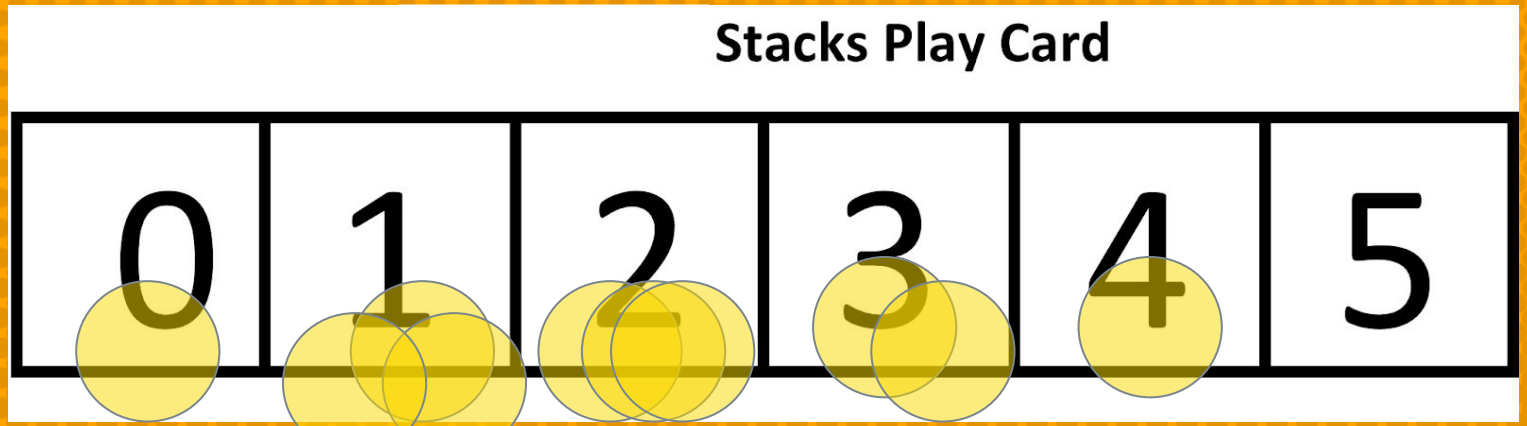
Players stack the counters, in stacks of any size, on and numbers they want from the Stack play Card.

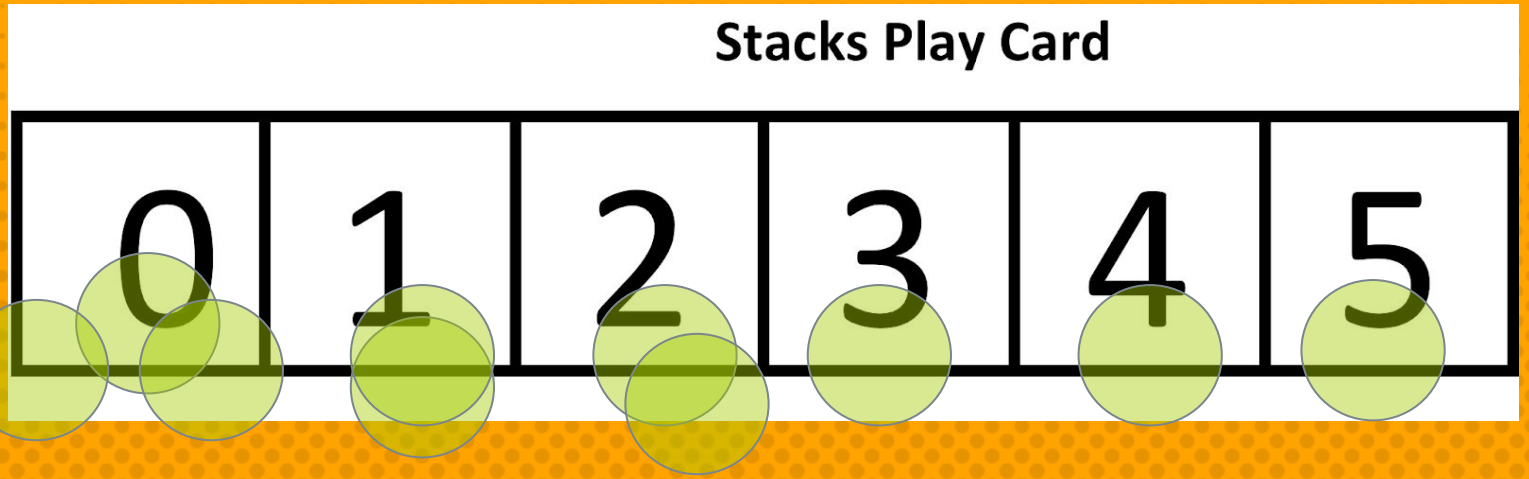
Each player will roll one dot cube and count its value.

Each player may remove a counter from the numeral that matches their value. If no counter is there, none may be removed.

The winner is the first to remove all counters.


Stacks Play Card
0
1
2
3
4
5


Stacks Play Card
0
1
2
3
4
5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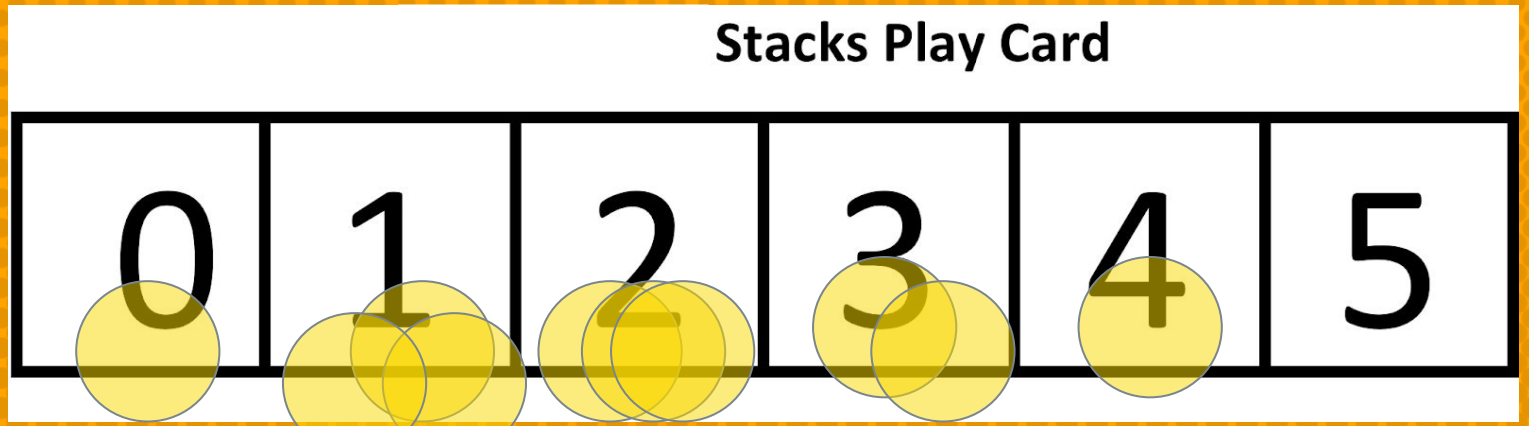
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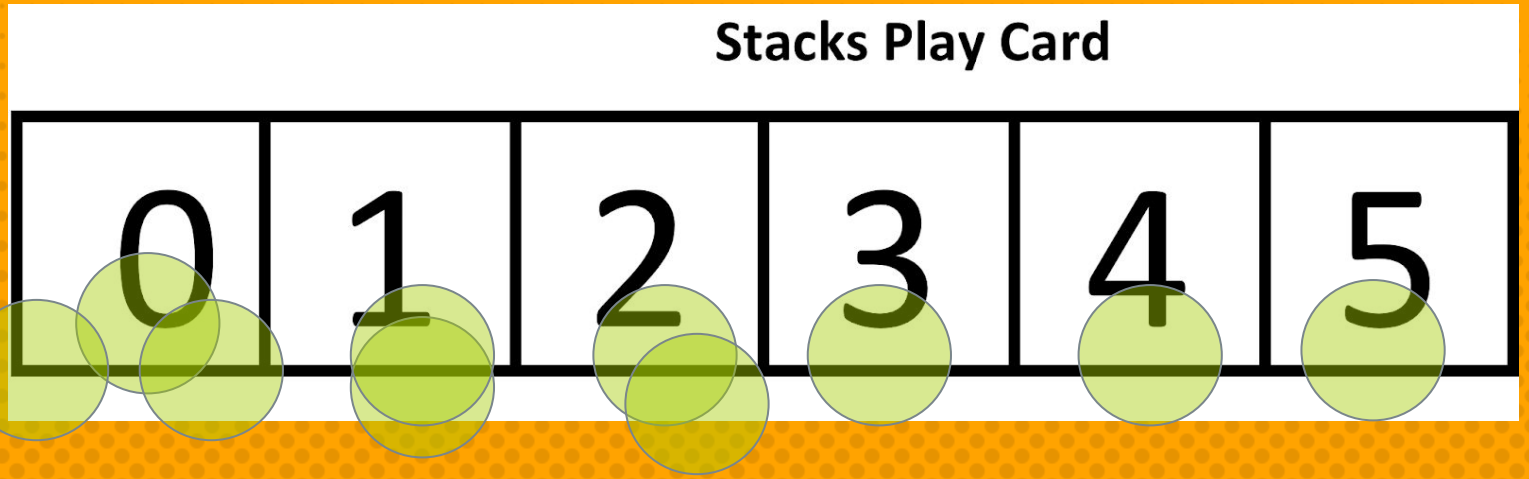
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0
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2
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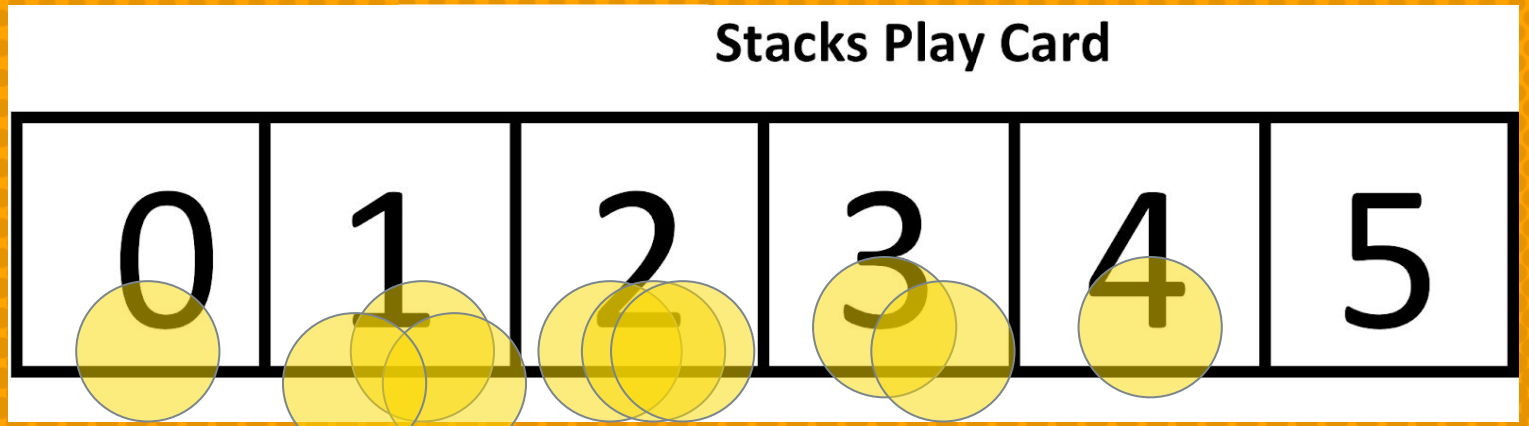

Stacks Play Card
0
1
2
3
4
5

SUBTRACTION STACKS

2 number cubes

2 Stack Play Cards

20 counters

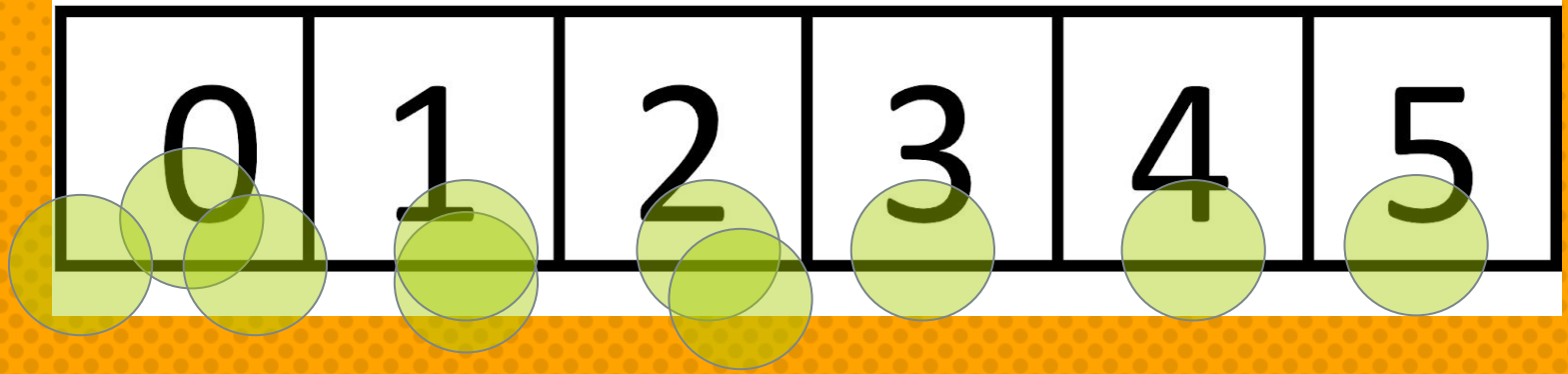
Each player counts out 10 counters.

Players stack the counters, in stacks of any size, on and numbers they want from the Stack play Card.

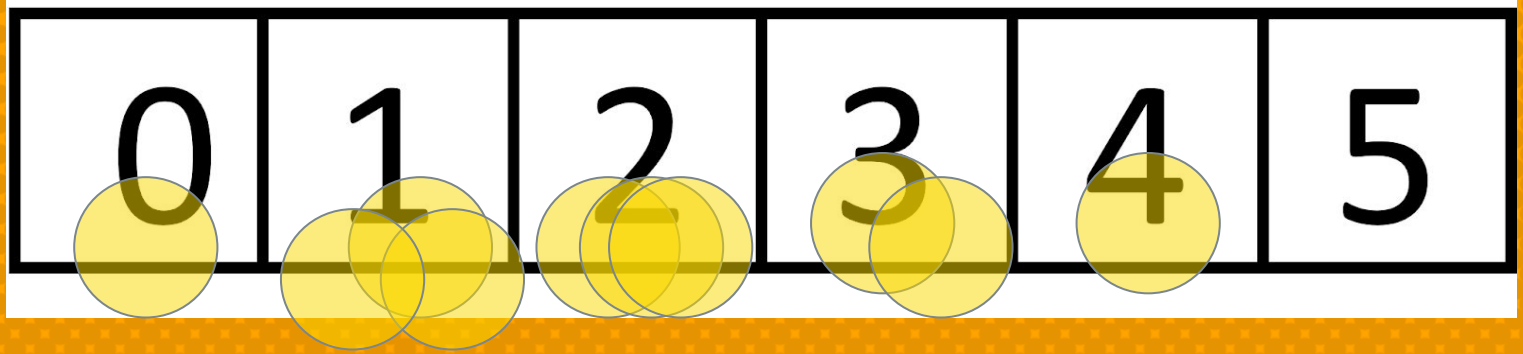
The 2 number cubes are rolled. Each player may remove a counter from the difference of the two number cubes. If no counter is there, none may be removed.

The winner is the first to remove all counters.

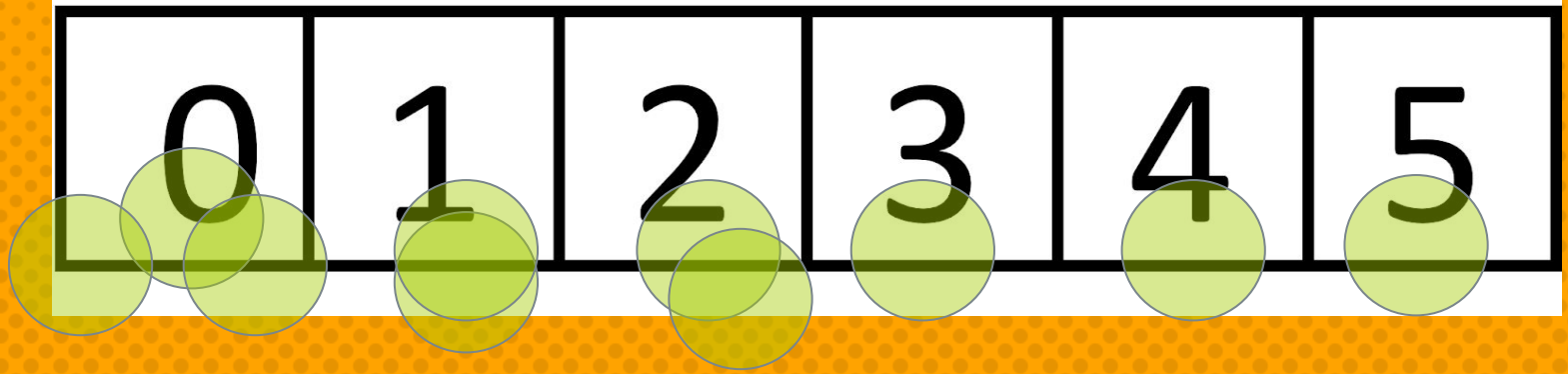
Subtraction Stacks Play Card



Subtraction Stacks Play Card



Subtraction Stacks Play Card



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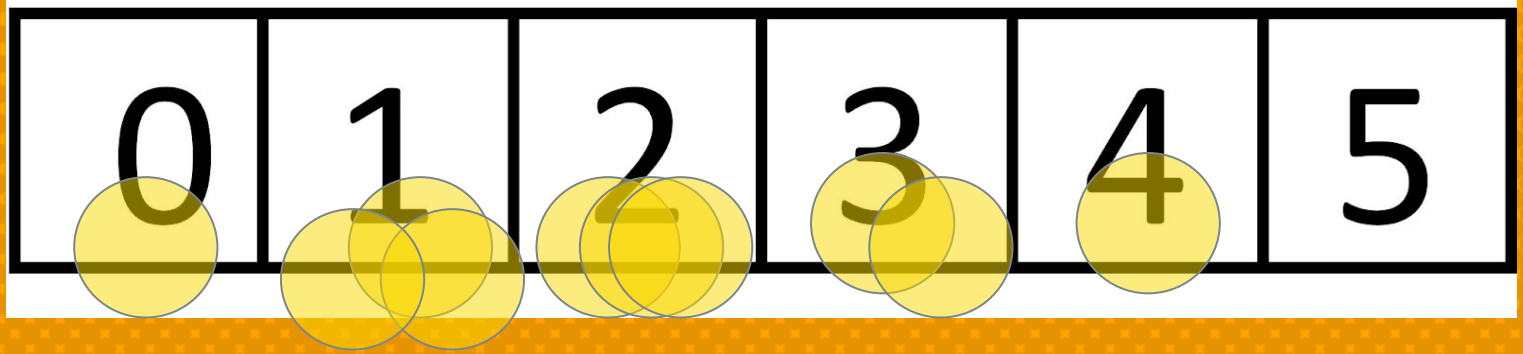

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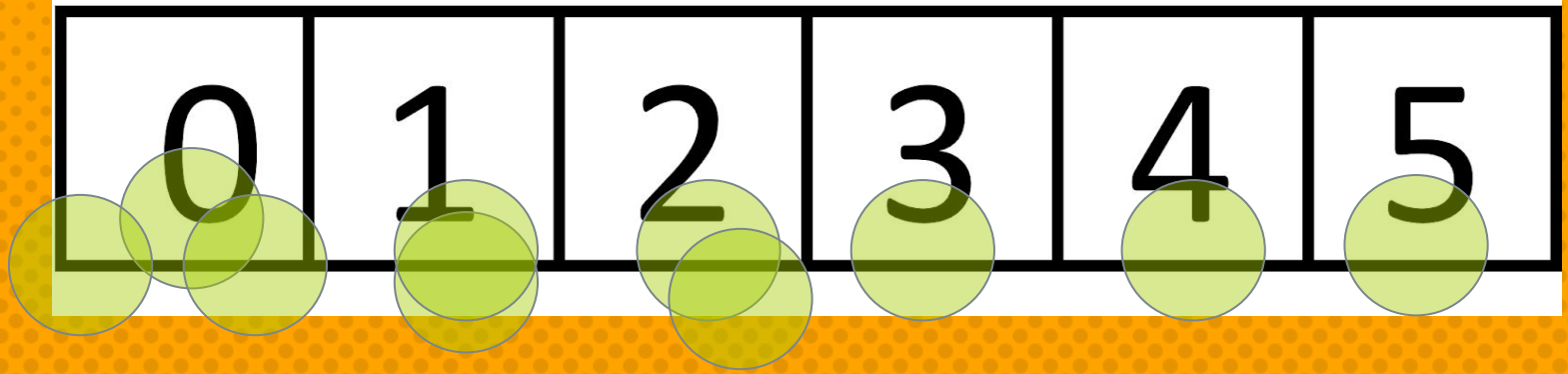

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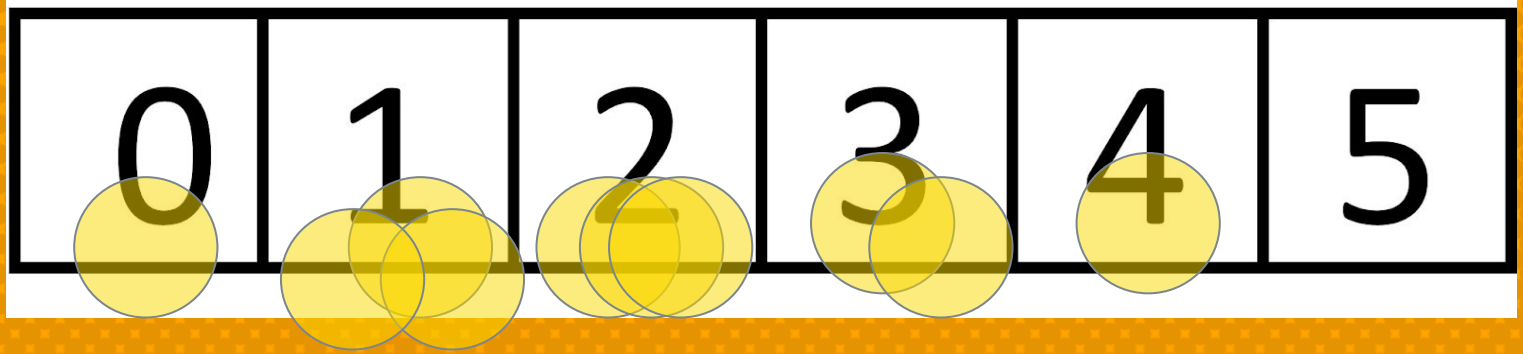

Reflecting on the Game

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- Which **strategies** are supported?
- What makes this game grow in strategy?
- How might the game be **adapted** at this level?
- How might the game be **adapted** for 1st? 2nd?

How is this different from a worksheet?

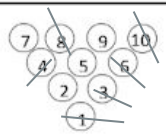
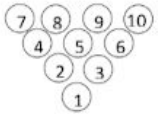
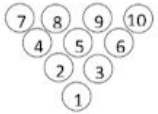
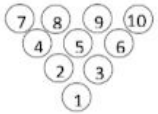
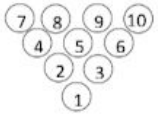
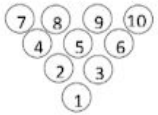
WHEN THEY PLAY GAMES IN A SMALL GROUP

QUESTIONS TO ASK

How did you figure it out?
Can you share how you thought about it in your head?
Is there another way you could figure it out?
If someone didn't know the answer to _____, how would you help them figure it out?

Bowling for numbers

Addition and Subtraction Bowling

Dice Roll	Making Values (what you made and how you made it)	Pins	Score
1, 4, 2,6, 6,3, 5,5	I put 2 and 6 together to make 8 I put 5 and 5 together to make 10		6
			
			
			
			
			

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The goal is to get a higher score each time the game is played.

Addition and Subtraction Bowling

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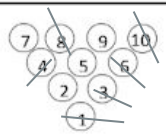
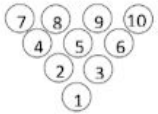
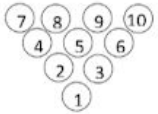
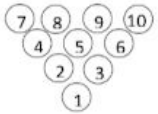
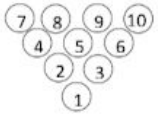
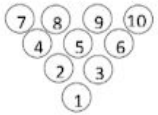
1, 4, 2,6, 6,3, 5,5	I put 2 and 6 together to make 8 I put 5 and 5 together to make 10		6
			
			
			
			
			

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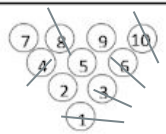
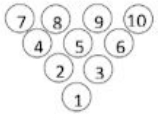
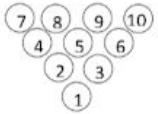
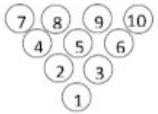
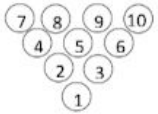
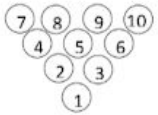
1, 4, 2,6, 6,3, 5,5	I put 2 and 6 together to make 8 I put 5 and 5 together to make 10		6
			
			
			
			
			

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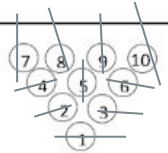
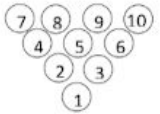
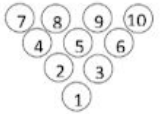
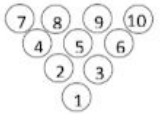
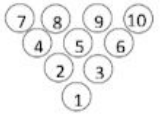
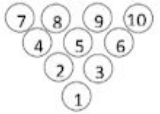
Bowling Addition and Subtraction

Addition and Subtraction Bowling

Dice Roll	Making Values (what you made and how you made it)	Pins	Score
1, 4, 2, 6	1+4=5 2+1=3 4-2=2 6-2=4 2+1+6=9 6+2=8 4+2=6 4-2-1=1 6+4=10 4+2+1=7		MH 10
			
			
			
			
			

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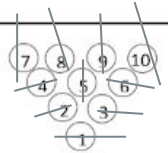
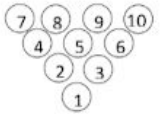
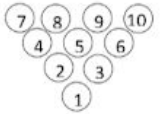
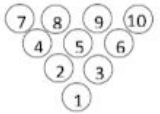
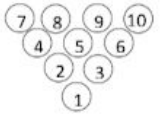
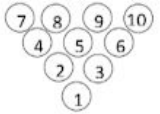
1, 4, 2, 6	1+4=5 2+1=3 4-2=2 6-2=4 2+1+6=9 6+2=8 4+2=6 4-2-1=1 6+4=10 4+2+1=7		MH 10
			
			
			
			
			

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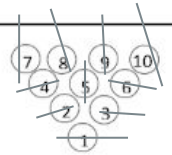
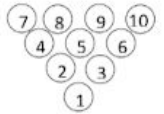
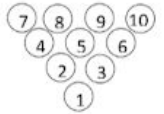
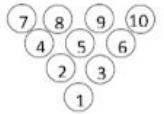
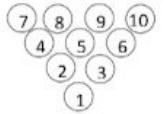
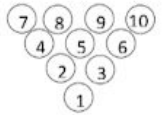
1, 4, 2, 6	1+4=5 2+1=3 4-2=2 6-2=4 2+1+6=9 6+2=8 4+2=6 4-2-1=1 6+4=10 4+2+1=7		MH 10
			
			
			
			
			

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Reflecting on the Game

- Which **concepts** are supported?
- Which **strategies** are supported?
- What makes this game grow in strategy?
- How might the game be **adapted** at this level?
- How might the game be **adapted** for 1st? 2nd?

SQUARE DEAL

19	17	11	12	13
12	14	15	14	11
18	19	16	17	12
19	17	11	12	13
15	10	13	16	14

Player 1 rolls a 10-sided dice (0-9) and that is added to 10. The player selects a square on the game board that matches the sum. For example, rolling a 3 allows the student to select any cell with a 13 on it. Student says aloud, "10 plus 3 equals 13" and places a chip on a 13. Player 2 repeats the process. The goal is to cover four spots that make a square. The winner is the student who can cover the most squares.

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How do your games measure up?

- ✓ Are they engaging?
- ✓ Do they provide opportunities for strategy discussion?
- ✓ Are they sequenced developmentally?
- ✓ Do they allow for differentiation.
- ✓ Which concepts do they support?
- ✓ Which strategy/strategies do they encourage?.

CAUTIONS & CONSIDERATIONS

Collaboration vs Competition

Speed vs Efficiency vs FLUENCY

KNOW YOUR GOAL

Low floor–High Ceiling

CAN I GRADE A GAME?

What is the goal for the grade?

What will the grade communicate?

To whom will the grade communicate?

Will the grade be summative or formative?

What is your big takeaway regarding games that build fluency?
How will this change your instruction?

FAMILY MATH READERS

ACHI, KRAAL, & Turtle Sums (Lo Shu)
https://www.mindresearch.org/mathminds/games

The Lemonade Stand

Ten Black Dots

12 Ways to Get to 11

Ten Friends

Fish Eyes

On the Launch Pad

WE WANT YOUR FEEDBACK!

MORE GAMES

COUNT IT KEEP IT

Directions

Version 1
The player grabs a handful of the items in the bag. If the player can count them correctly, the player gets to keep the objects. Players take turns. The goal is to have the largest collection possible.

Version 2
Roll two number cubes. Count the total shown. If the response is correct the player gets to keep those points on a score sheet. Players take turns.
In the next round three number cubes will be used. Count the total shown. If the response is correct the player gets to keep those points on a score sheet.
Each round increases the number of number cubes used.

Make 5 or Make 10

Materials:
Two hands

Directions

Using your hands show the child an amount of fingers and state,
“I have this many fingers. How many do you need so that we can make 5”
or
“I have this many fingers. How many do you need so that we can make 10”

Be sure to start with a middle value when you are playing, then after many games have been played move to 1 less than the target number or just 1 finger. After a significant number of games have been played show that you have no fingers. Finally show that you have all the necessary fingers to make the target number.

Memory

1. Working together separate the ten frame cards and the dot cards.
2. Place the ten frame cards in a 2 by 5 array and the dot cards in a separate 2 by 5 array.
3. Take turns:
    a. Turn over a card from the dot card array and report the number of dots on it.
    b. Use math talk to explain to your partner how you figured out how many dots are on the card
    c. Turn over a card from the ten frame array and report the number of dots on it.
    d. Use math talk to explain to your partner how you figured out how many dots are on the card.
    e. If quantities match take the two cards and place in your pile.
    f. If quantities do not match let the other player see the two cards before turning them back over.
4. Play until all the ten frame cards have been matched to the dot cards.
5. The winner is the player with the most cards.

WHAT'S MY NUMBER?

Materials: Paper, Pencil

Directions:
A team selects a number within the specified range and writes it on a piece of paper. Clues are then created by the team and given to the other team to guess the number.

★ When clues are given, encourage players to use mathematical terms within their vocabulary, e.g. odd, even, digits, larger than, smaller than, prime, composite, multiples, divisible by.

Examples:
What's My Number? I am odd. I am larger than 10 and smaller than 20. One of my digits is a 5.

I have 2 digits. One is an odd number and one is and even number. The sum of my digits is 6. I am divisible by 5.

I am larger than 50 and less than 60. I am even. I am divisible by 3.

I am less than 30. I am prime. One of my digits is a 7.

BREAK THE TOWER

Materials

Linking cubes, Number cube, Numeral cards, Recording sheet, Score card

Player 1 draws a numeral card and builds a single color tower to make the value shown on the card.
Player 2 has to roll a number cube. That will tell the child how many towers they must use to make the same value.
Player 1 verifies that Player 2 accurately broke the tower.
Both players record the equation on their equation sheet.

E.g., Player 1 draws the numeral card “17”, and builds a red tower of 17 cubes.
Player 2 rolls a 5. Player 2 makes a tower of 2 blue, 5 green, 3 red, 2 black, and 5 orange.
Player 1 verifies that the towers sum to 17.
Player 1 and 2 record the following on their recording sheet: 17 = 2+5+2+5+3 (or some sequence of the addends they choose)

MARBLE MANIA

Roll two number cubes. Use addition or subtraction to make a number that I can cover on the board.
If I cannot use my number cubes to make any of the numbers left on the board, I must put a marble in a bucket (we can only put 1 marble in each bucket). I win if I cover my board before all of my marble buckets are full.

Whole Class version: Each child has their own board. We all celebrate when a board is filled. Then we start over.

Center version: 2 players work together to play two other players. The pairs work on one game board. We all celebrate when a board gets filled and then we start over.

READ MY MIND (MAKE TEN VERSION)

Materials:
Deck of cards with face cards removed

Directions:
Place the deck of cards facedown.

Player 1 draws a card, and without looking at it, puts it up to their forehead so that Player 2 can see it.

Player 2 says the number that will make 10 when added to the number on the card. For example, if the number showing on the card is 7, Player 2 says “3”.

Player 1 figures out the number that is on their card by subtracting 3 from 10 or by just knowing the partner to 10.

TEN FRAME HOW MANY MORE

In grade k use the five dot frames.

In grade 1 use the ten dot frames.

In grade 2 and 3 use numeral cards. Students will start with either a ten or hundred card down, then add another card/cards depending on intensification.

How to play:

Stack cards face up.

1- Students will attempt to identify the quantity of the card.

2- Students will identify how many more are needed -

Grade K- to make 5 (ie: I see 3 dots. I need 2 more to make 5)
Grade 1- to make 10 (ie: I see 7 dots. I need 3 more to make 10)
Grade 2- to make to the next tens or to next hundreds (ie: I have 29. I need 1 more to make 30 OR I have 122. I need 78 to make 200. OR I need 8 to make 130)

[For grade 2 and 3, they will need a partner to verify their answers because the number of possibilities are immense. Students can identify and build the amount on a number track OR utilize other manipulatives.]

TEN FRAME HOW MANY LESS

In grade k use the ten frames. In grade 1 use the 20 frames.

In grade 2 and 3 use numeral cards. Students will start with either a ten or hundred card down, then add another card/cards depending on intensification.

How to play:

Stack cards face up.

1- Students will attempt to identify the quantity of the card.

2- Students will identify how many less are needed -

Grade K- to make 5 (ie: I see 7 dots. I need 2 less to make 5)

Grade 1- to make 10 (ie: I see 19 dots, I need 9 less to make 10)

Grade 2- to make to the next tens or to next hundreds (ie: I have 29. I need 9 less to make 20) or (I have 136, I need 36 less to make 100)

[For grade 2 and 3, we suggest that their partner verify the number and the amount less each time. Students can identify and build the amount on a number track, open number line, OR utilize other manipulatives.]