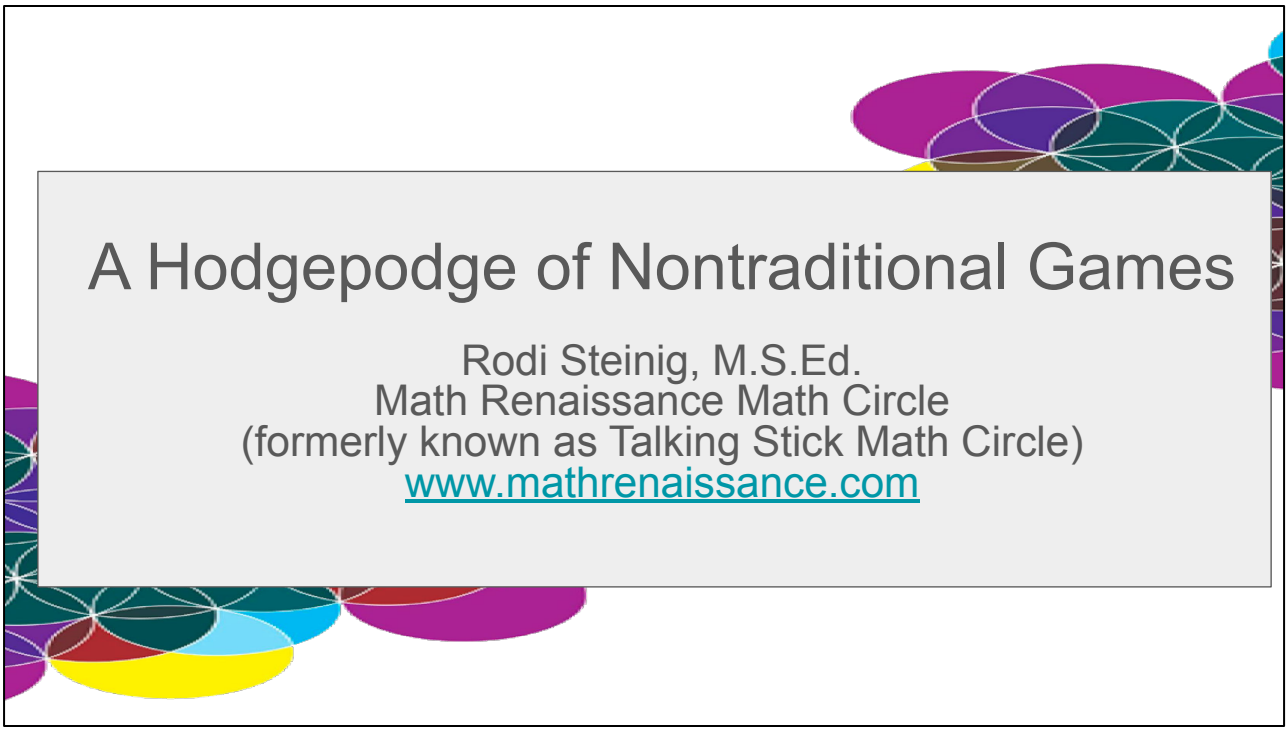
A Hodgepodge of Nontraditional Games
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(formerly known as Talking Stick Math Circle)
www.mathrenaissance.com

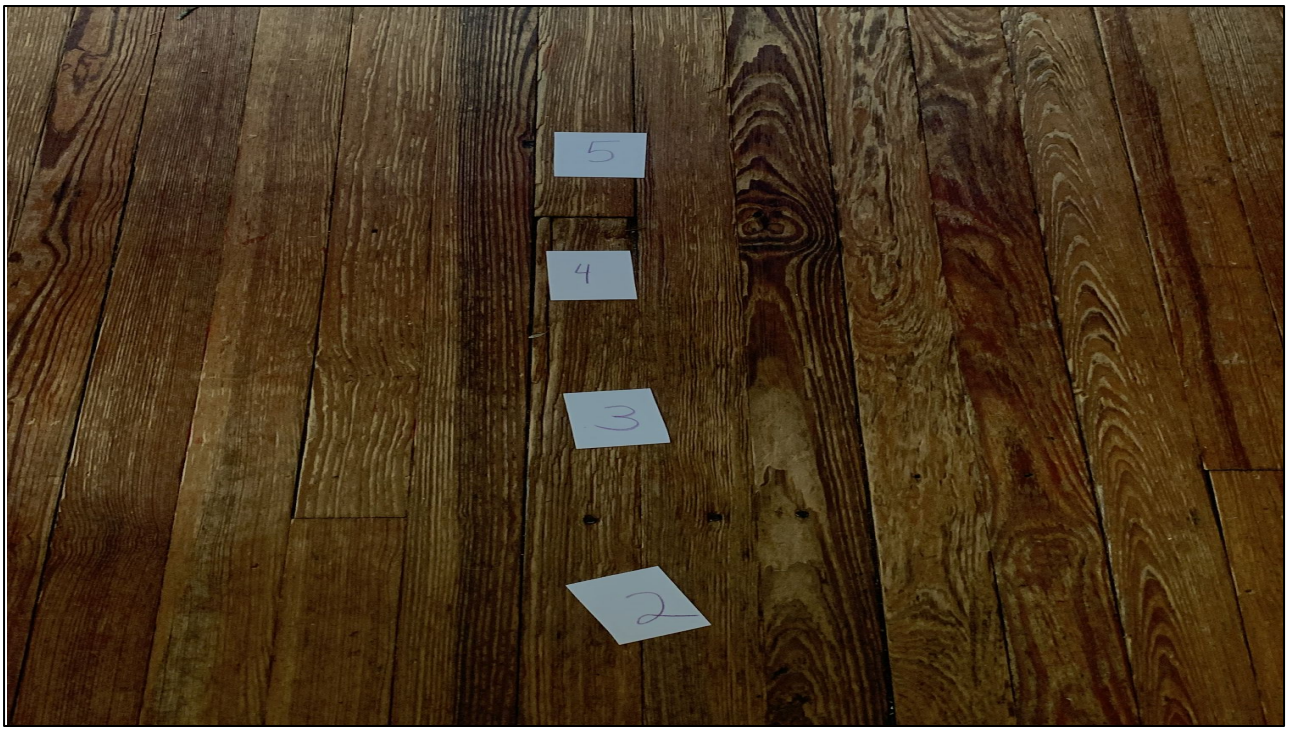
Abstract

Merriam Webster's definitions of games include the terms "rules," "strategy," "struggle," "procedure," "diversion," and "amusement." **In Math Circles, how can we play games that are cooperative? How can we use role-playing? How can we entice reluctant students into competitive games? What games can we play with the youngest of students? What games can be used to help students focus and build frustration tolerance? How can we add complexity to classic games to facilitate deeper mathematical explorations?** In this session, we'll play "Would You Rather," "Math Lawyer," "Odd One Out," "Knights and Liars with Puppets," "The Need for Numbers," "Mathematician Cards," "Math Red Light Green Light," "Mother May I Addition," "Opposite Simon Says," and "How Is this Math?" What do all these games have in common? Each involves strategies for success and meaningful mathematical thinking. Audience participation is encouraged but not required!

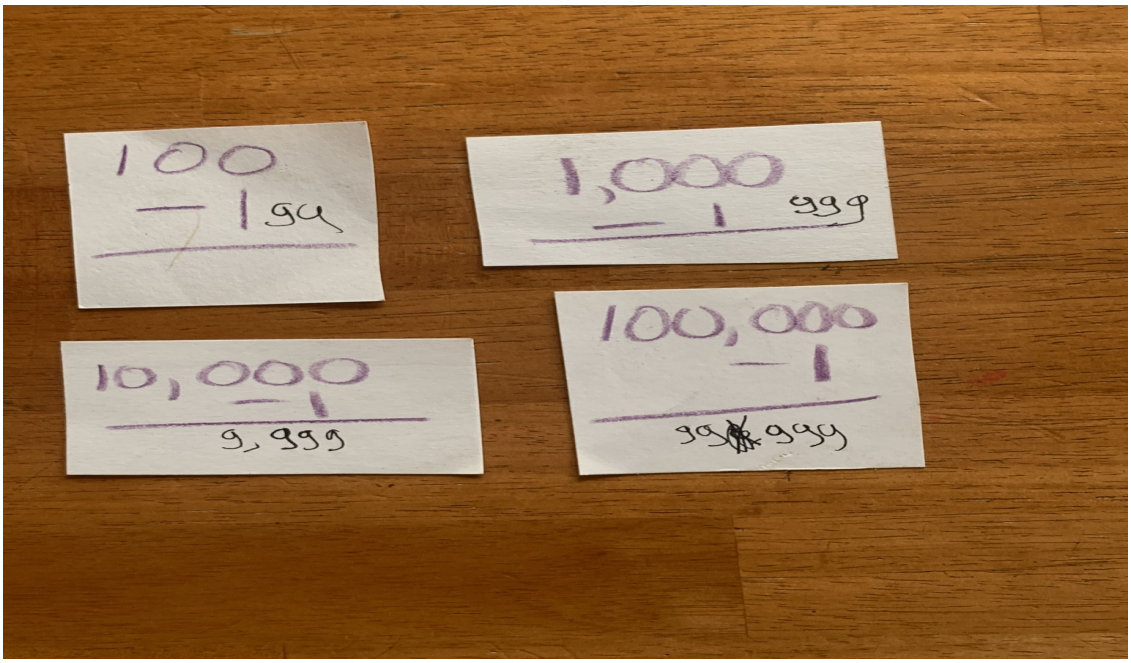
GAME: Math Squares

Math Buddies, Girls' Math Circle, Ages 9-10

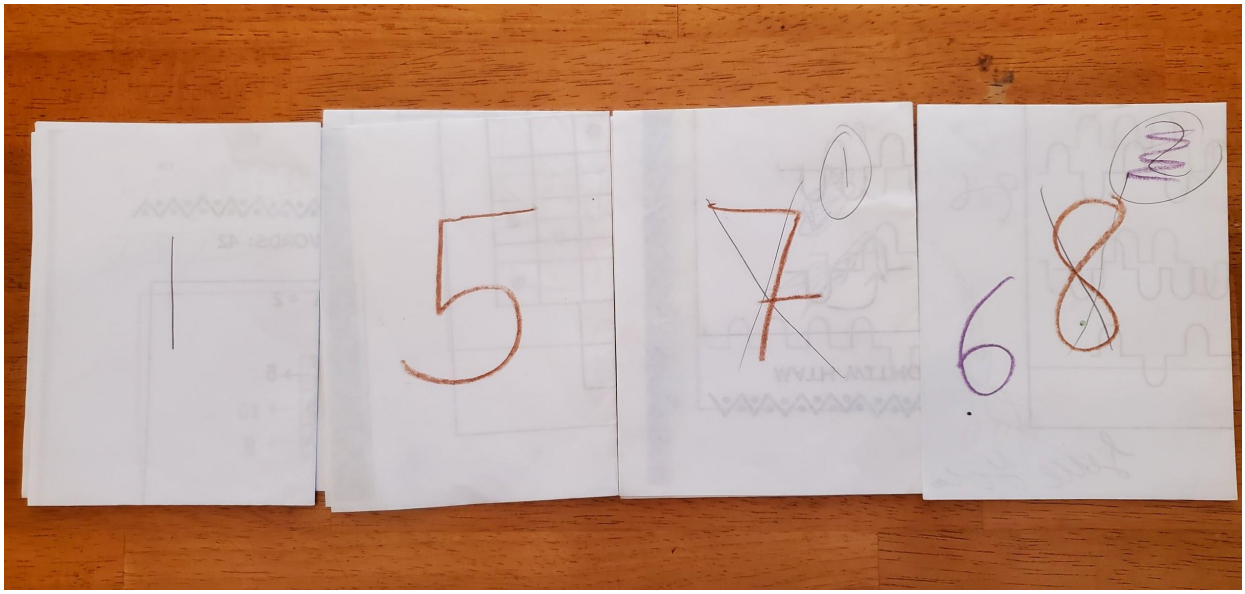
These students invented, tested, and continually developed this game - reluctant math learners.



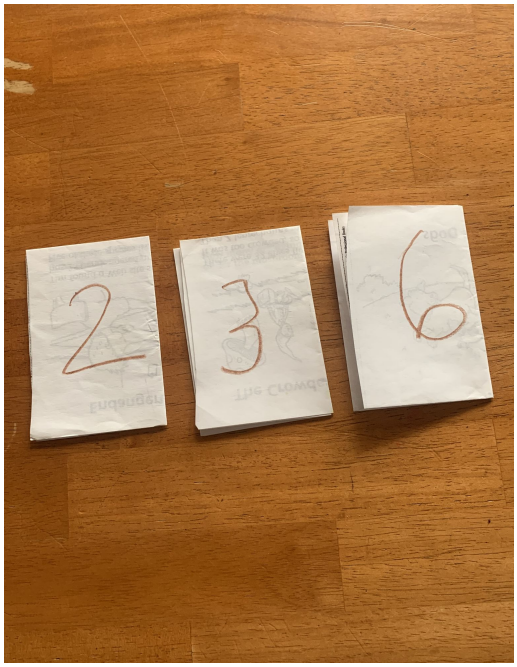
Students asked me to put a math problem on the back of each numbered square. They stand together on #1, uncover it, solve it together, then hold hands as a team and jump to #2. Goal: solve them all before the parents come to pick them up.

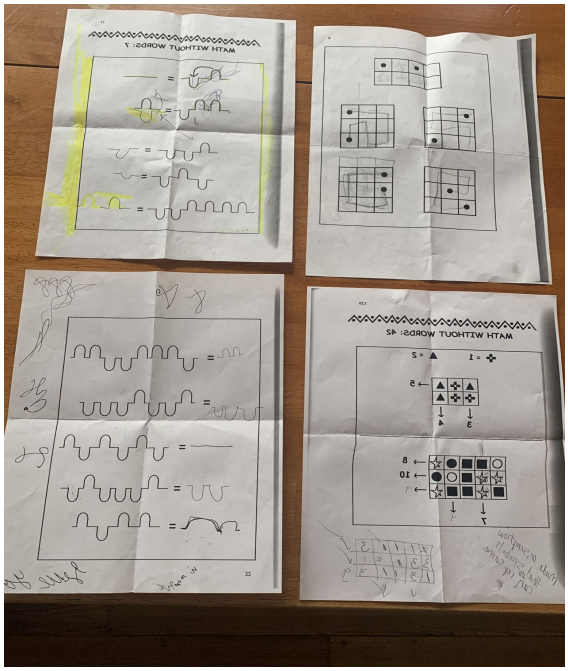


First time we played - after having done Exploding Dots.

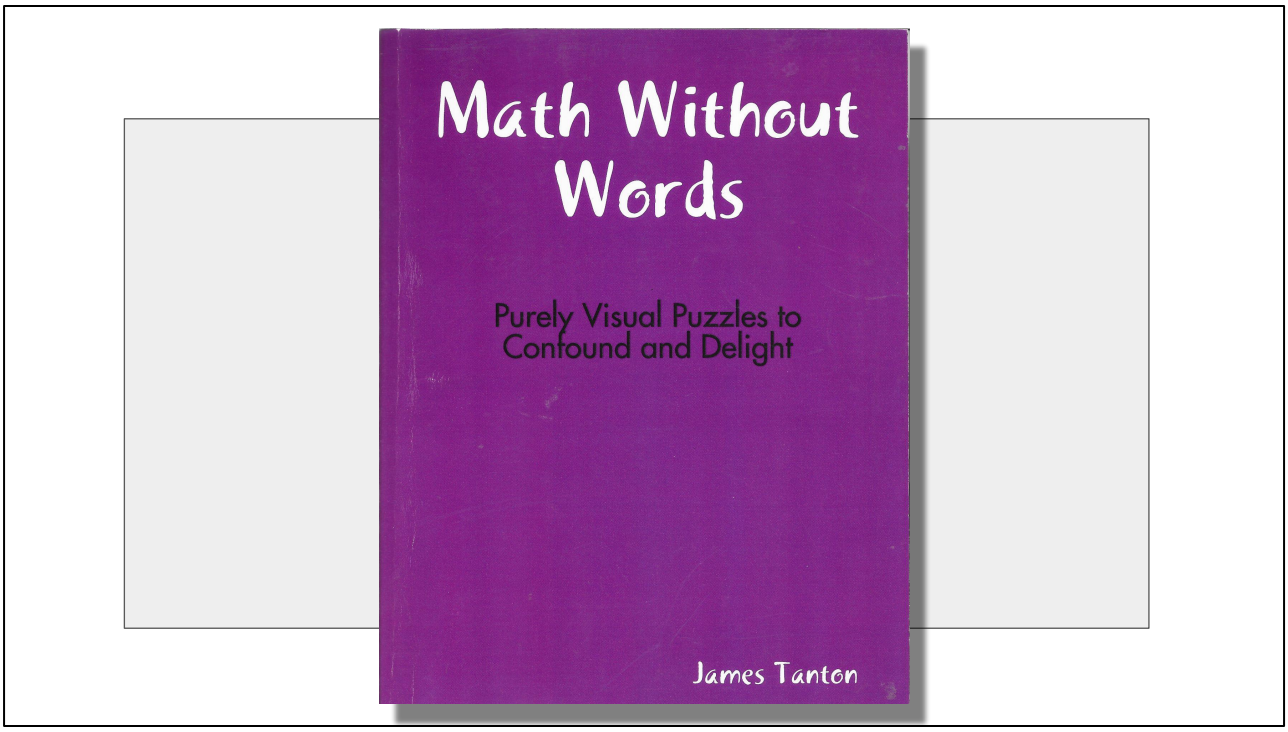


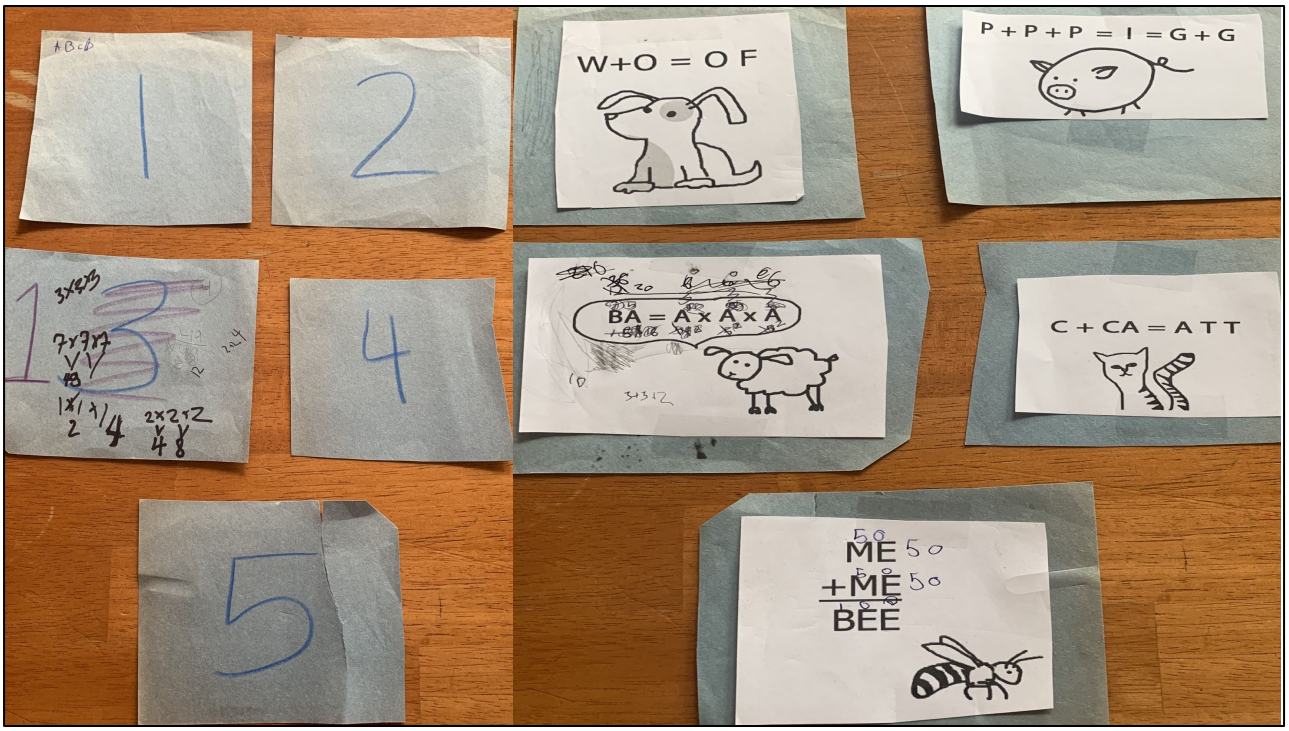
sI had to keep changing up the order of the squares to have the right amount of time to solve a few before parents arrived for pick-up.





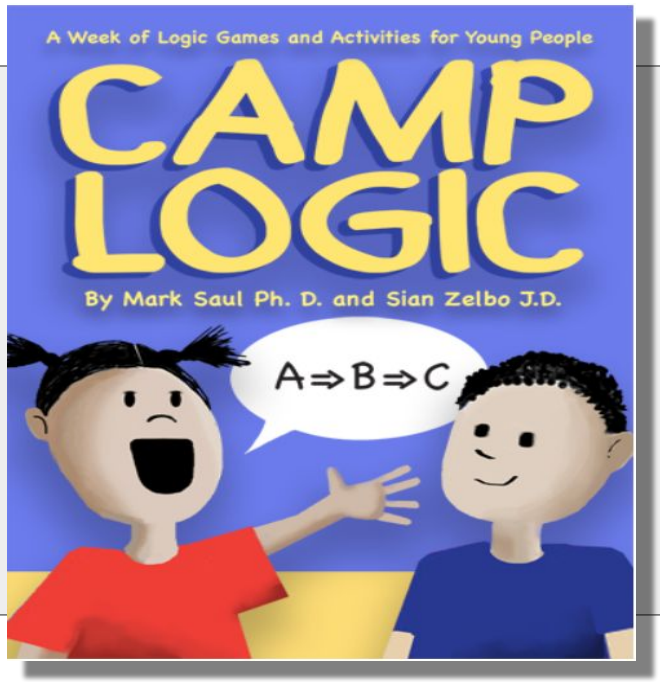
Second time doing the game. We had tried these problems from Math Without Words a few weeks before but the students were too intimidated to persevere. Now in the context of the game they tried all of them.

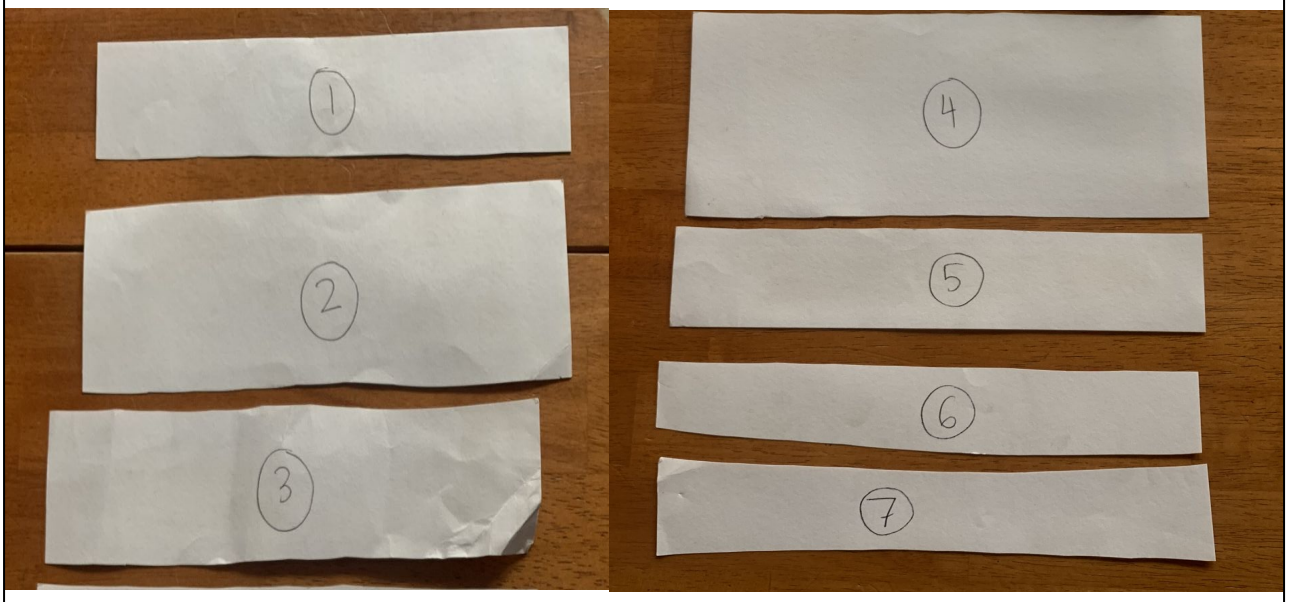

Math Without Words
Purely Visual Puzzles to Confound and Delight
James Tanton



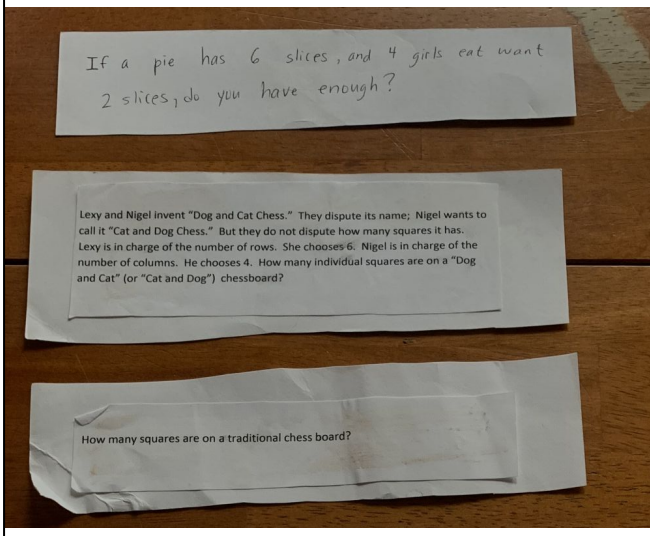
We had done Cryptarithms before to mixes results. One student loved them, one was meh, and the others strongly disliked. Now, in the third week of the game, students happily worked together to solve them. I think it's because I wasn't there - I left the room - maybe the students had more courage to take risks in a game without an adult present. (Even though when present I was uninvolved, I still think it factored in.)

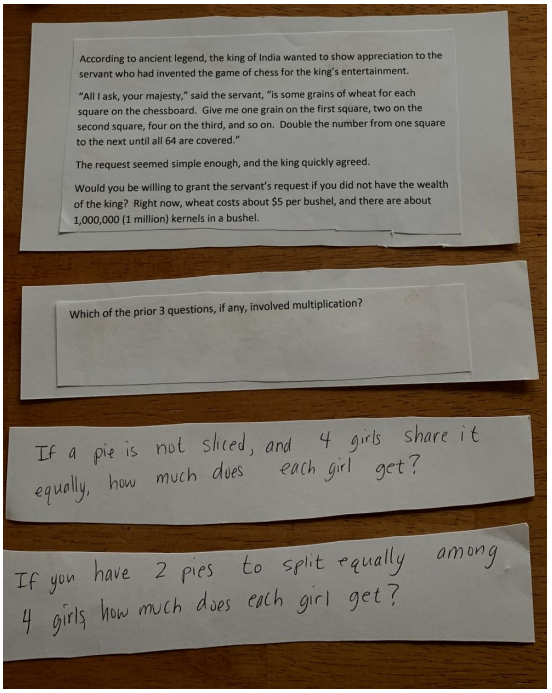
Cryptarithms





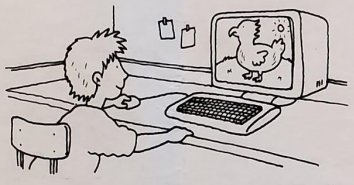
Week 4 - game evolved - I started mixing topics, not just one topic.





Email me if you can't read these - I can type them into a Google doc.

Endangered Species



Tim found a Web site showing that California has 254 endangered animal species. Five of these species live near Tim.

How many of these species don't live near Tim?

_____

11

Mei Mei's Dogs

Mei Mei has four dogs:
Rags weighs 53 pounds.
Shadow weighs 95 pounds.
Red weighs 27 pounds.
Tuff weighs 67 pounds.

Use subtraction to fill in the dog names below:

_____ **weighs 28 pounds more**

than _____.

10

The Crowded Mushroom

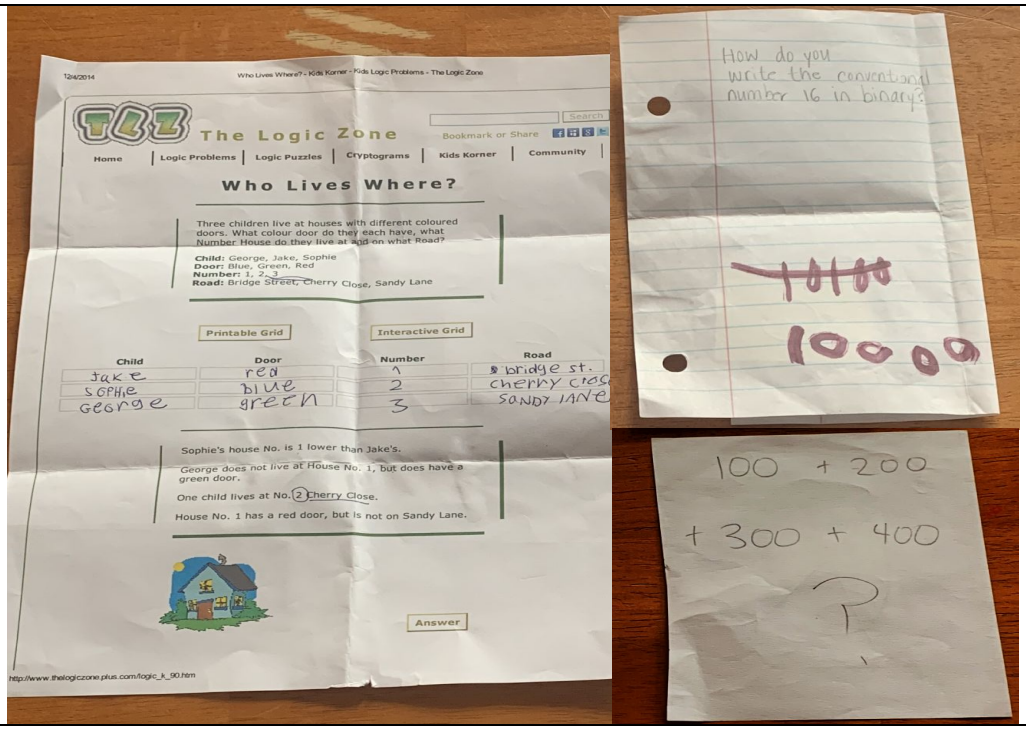
There were 32 elves living under a mushroom.
It was too crowded, so 13 moved out.
Then 7 leprechauns moved in.

How many are living under the mushroom now?

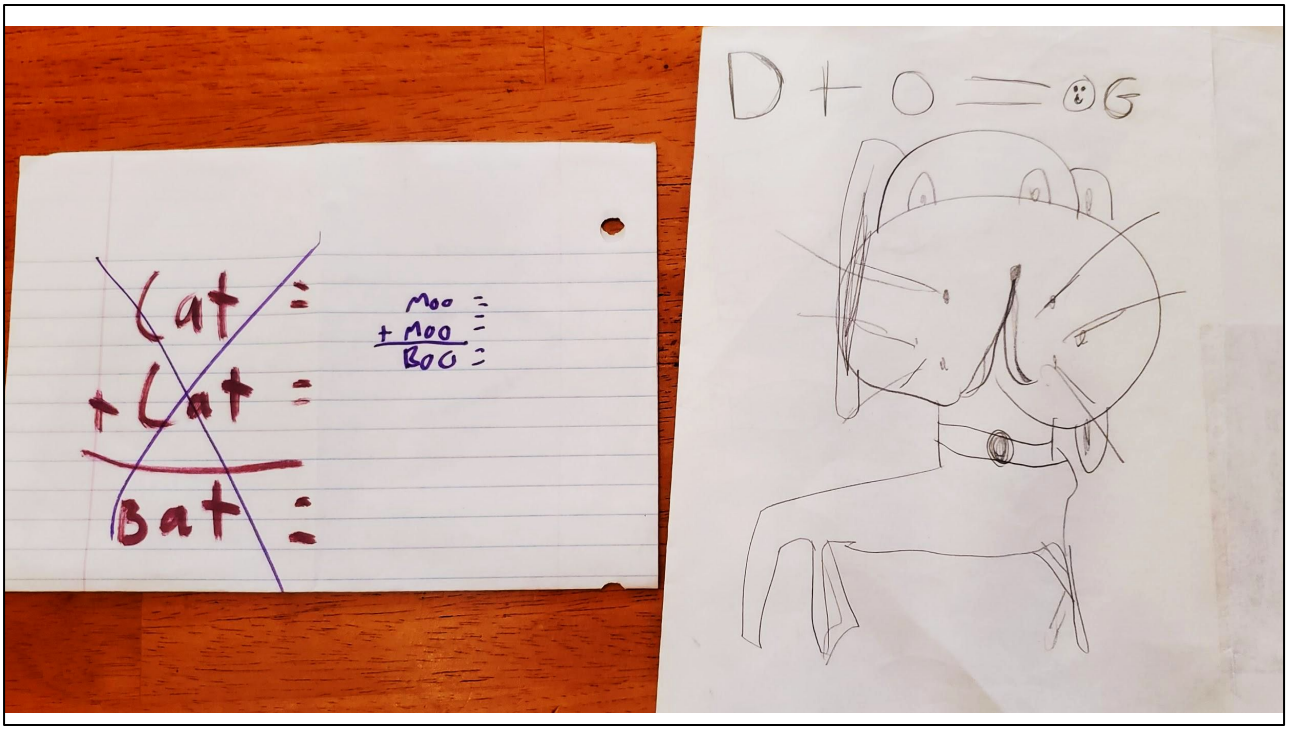
_____

3

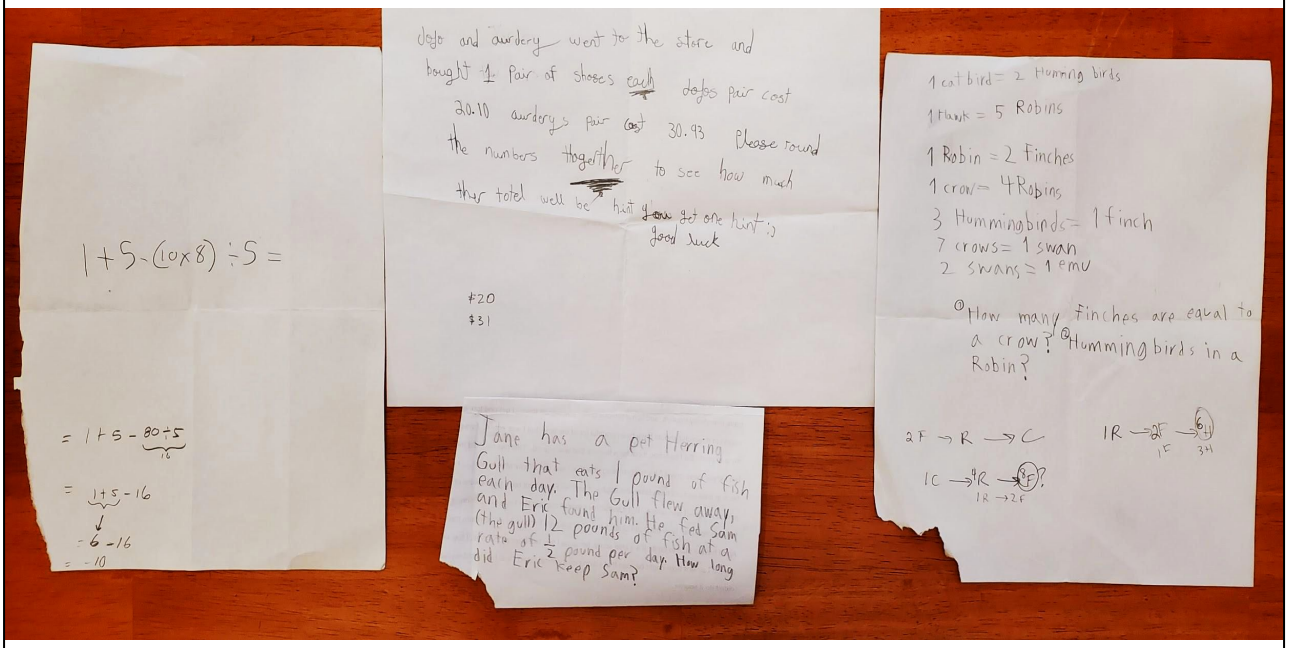
Week 5 - further evolution of the game - one of the student copied some pages in a book she had at home. She asked me to fold them up and use them for this week's round of Math Squares.



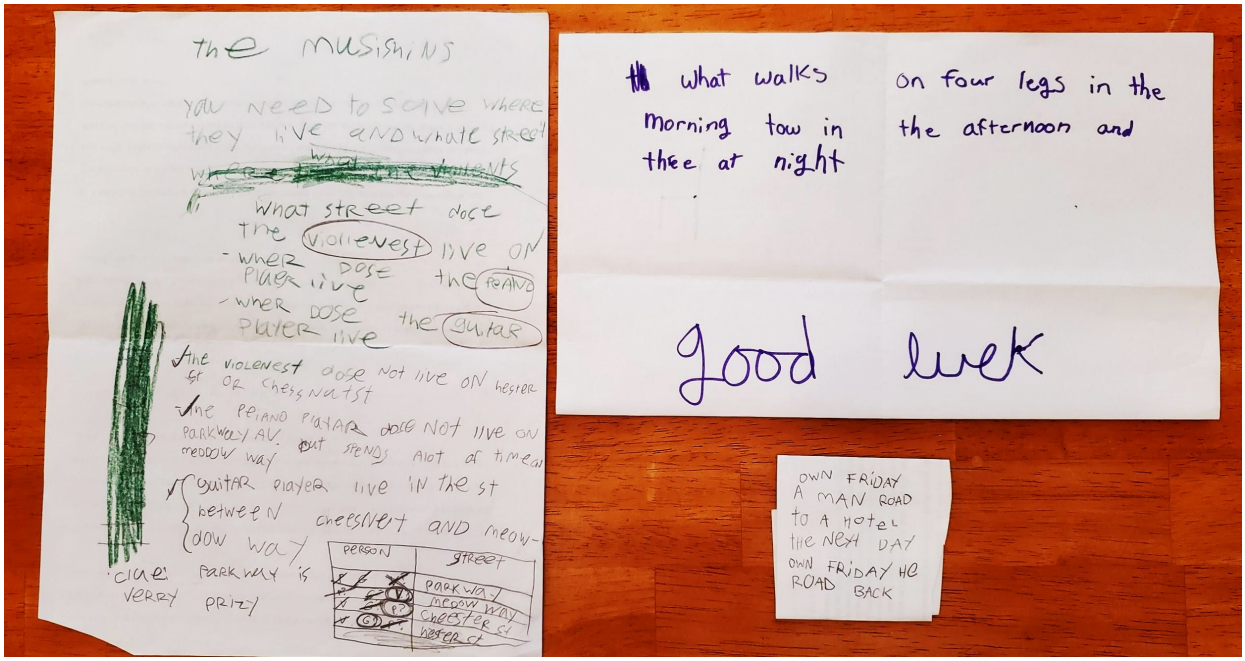
Week 6 - game evolved further - students wanted to end with an easy problem, not hard, so the problem in the bottom right corner was the last one.



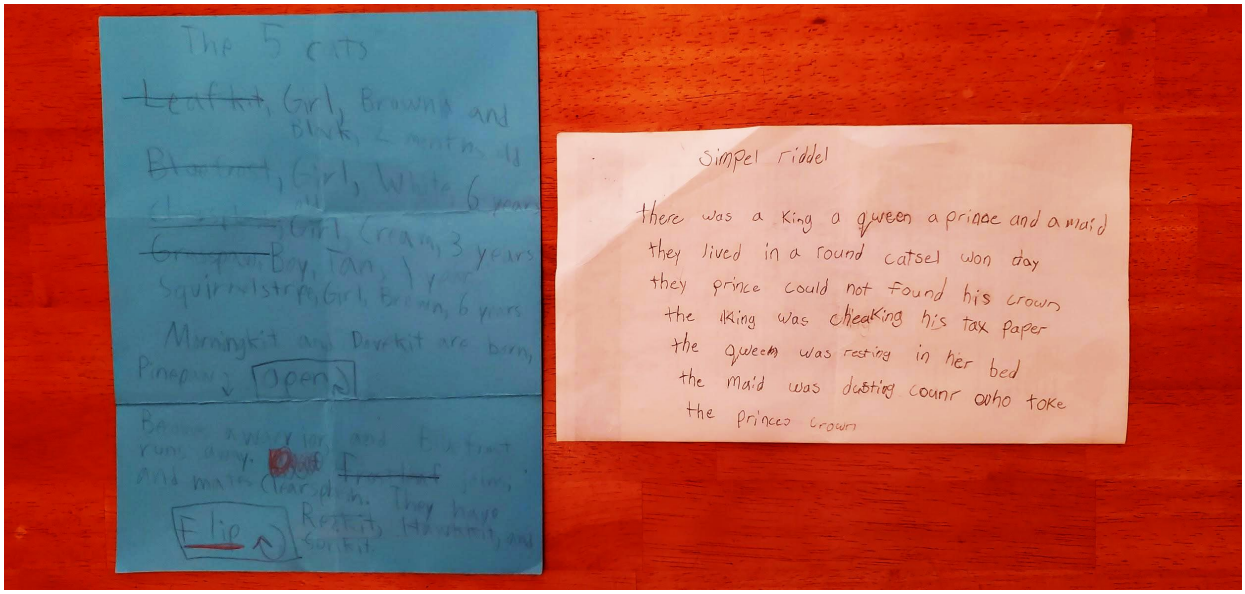
Week 7 - huge change in the game - the students told me that from now on they would write the problems for the Math Squares and that I and their parents were to solve them. I love that they chose Cryptarithms for their first topic - a topic that at their first exposure that had not embraced.



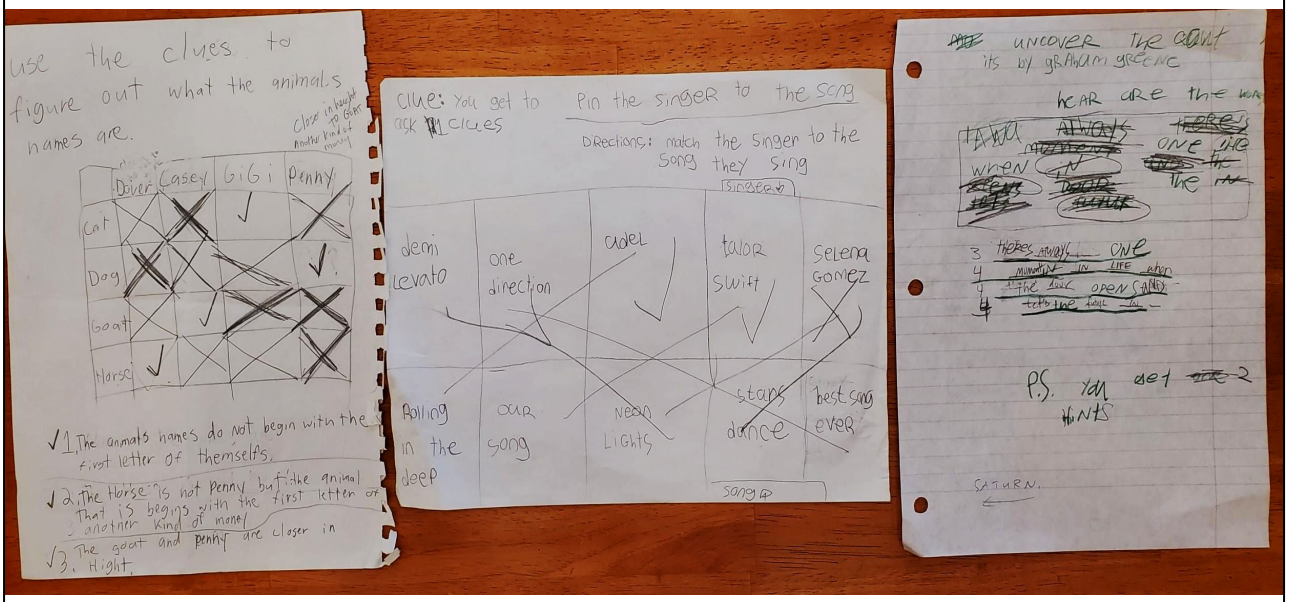
Week 7 - students started writing word problem. They asked their parents to come for pick-up earlier to have more time to participate in the game.



Week 8 - they added in some riddles. And started wishing us luck and offering hints and other support. They really wanted to set us up for success.



Week 9 - the problems become more complex.



Week 10 - our final session of theyear - the students created tables for organizing info (all their own ideas, of course). The game was a huge hit - I think because students invented it, cooperated, adapted it over time - total ownership!.

Some Categories of Goals

- Focusing
- Conjecturing
- Embodied mathematics
- Role playing
- Strategy

Math Squares was a huge motivator - it got me thinking about other purposed games serve in my Math Circle.

GAME: Mathematician Cards

I've used a lot of focusing games at the Talking Stick Math Circle. These students were doing a different activity - some had wandered away - I set up a round of Mathematician Cards to refocus the grou. Here I was about to call everyone back together at the white table. (I also use this game sometimes as a warmup focusing game at the start of the session.)

Mathematician Cards: Variations on Rules

PICK ONE CARD ON YOUR TURN:

- If today is that person's birthday, the game ends.

PICK TWO CARDS ON YOUR TURN:

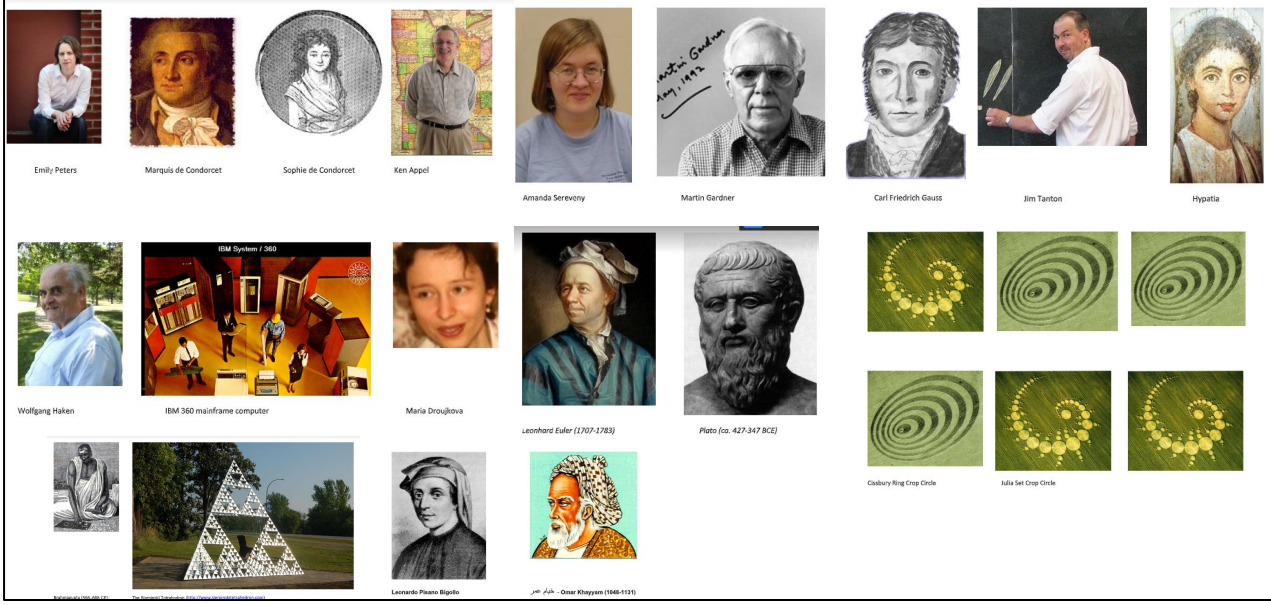
- If both cards are mathematicians, you keep the cards.

  -OR-

- If both cards reveal LIVING mathematicians, you keep the cards.

1) I did the first version on Omar Khayyam's birthday. When a student got his card, we stopped playing the game and talked about some math history.
2) In the second version, there needs to be at least a few cards of something that is not a mathematician. Question: can a computer be a mathematician?
3) Students always tell me that mathematicians are dead, white, and male. The third version shakes up this assumption.

Version 1.0 (2011)



When I first started doing this game in 2011, the cards didn't allow all of my students to "see themselves in the curriculum" (to quote Dr. Rochelle Gutierrez).

Version 2.0 (2019)






After I heard Dr. Gutierrez talk at MathFest 2019 (“What’s at Stake in Rehumanizing Mathematics?”) I realized i needed to put some new cards in my deck.

Mathematician Cards - ALL OF THEM (so far)

Every card is connected to some mathematical activity that we do in Math Circle.

Some Other Focusing Games

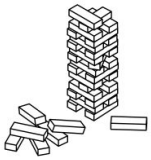
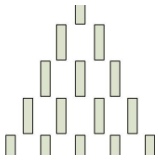
Pick Up Stix 	Jenga 
NIM 	Tens Concentration 

Image Attributions: The Noun Project

I usually use these games as students come into the classroom. I stop the activity before it's done to avoid competition. Or I have the students as a group play against me or my student assistant. We also sometimes play the "Takeaway Game," in which I place a bunch of random objects on a tray, ask students to remember what's there, secretly remove one, and ask what's missing.

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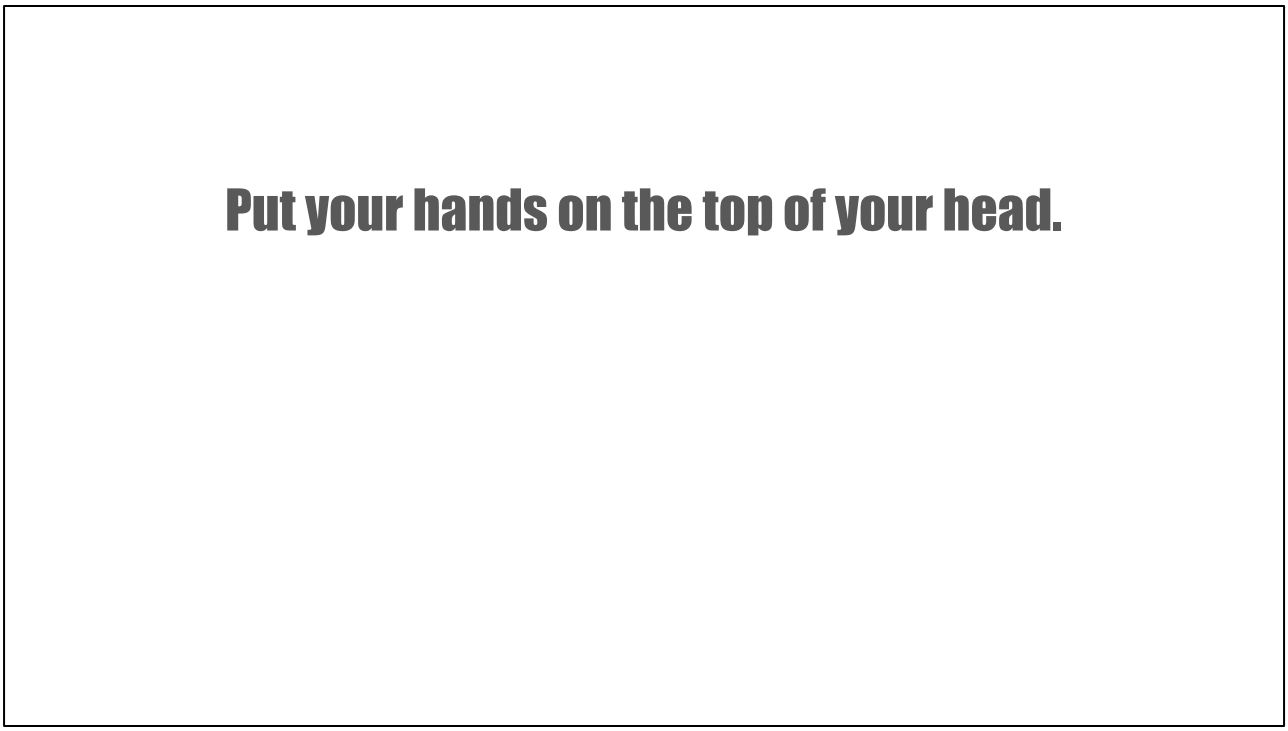
GAME: Opposite Simon Says

I'll be Simon. Do what I say only if I preface the command with the phrase "Simon Says."



I didn’t say “Simon Says!” If you did put your hands there, you shouldn’t have.

Simon says, “Put your hands on the top of your head.”

I didn’t say

Put your hands back where they were.

Simon says, “Put your hands back where they were.”

Simon says, “Reach your arms to the sky.”

Simon says “Do the opposite of reaching your arms to the sky.”

What is the opposite of this command? Reach to the ground? Be still and don’t reach? Do some things have multiple opposites?

Simon says, “Touch something that’s green.”

Simon says, "Do the opposite of touching something that's green."

Is there an opposite of touching? Of green? Does everything have an opposite?

Simon says, “Stand on your left foot.”

Simon says, “Do the opposite of stand on your left foot.”

LET’S TALK ABOUT COMMANDS NOW.
ARE SOME COMMANDS ACTUALLY TWO COMMANDS EMBEDDED INTO ONE?
ARE THERE COMPOUND COMMANDS, LIKE COMPOUND FUNCTIONS?
ARE FUNCTIONS COMMANDS?
ARE NEGATIONS AND INVERSES THE EXACT SAME THING AS OPPOSITES?

OPPOSITE SIMON SAYS: Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

http://www.corestandards.org/Math/Content/1/introduction/

I think we engage in at least 6 of these Common Core standards for first grade mathematical practices in this game.

GAME: Math Red Light Green Light

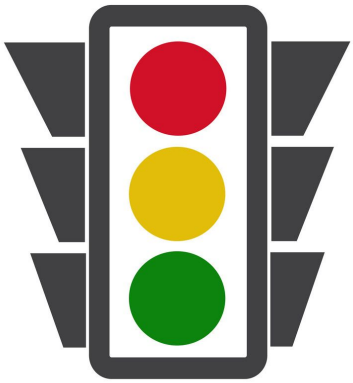
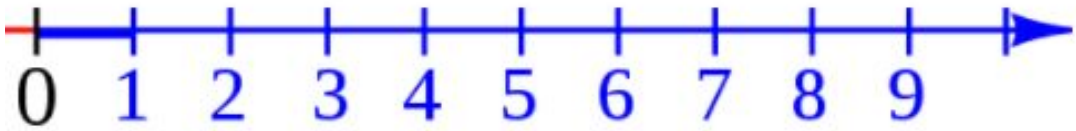


Image Attribution:: vectorstock.com

Let’s play - When I say “Green light” I turn my back on you. You can run halfway to the finish line. When I say “Red Light” I turn back and face you and if anyone is still moving, you go back to the starting line. If you go more than halfway of your remaining distance to the finish line, you go back to the starting line. Whoever gets to the finish line first wins. (There’s a punch line to this game, so you may only be able to play it once.)

GAME: Mother May I Addition (sidewalk chalk)

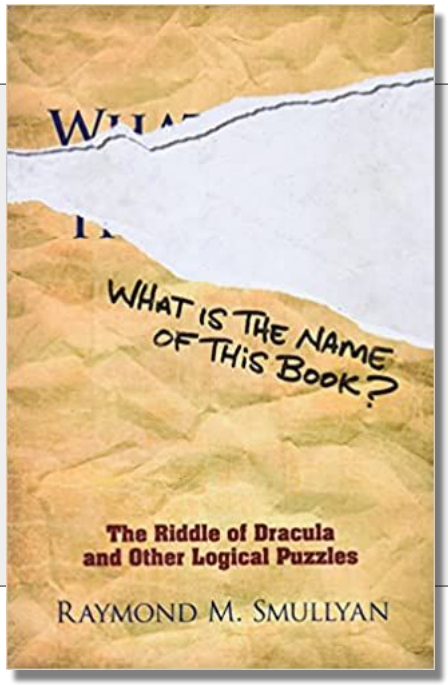


https://en.wikipedia.org/wiki/Number_line

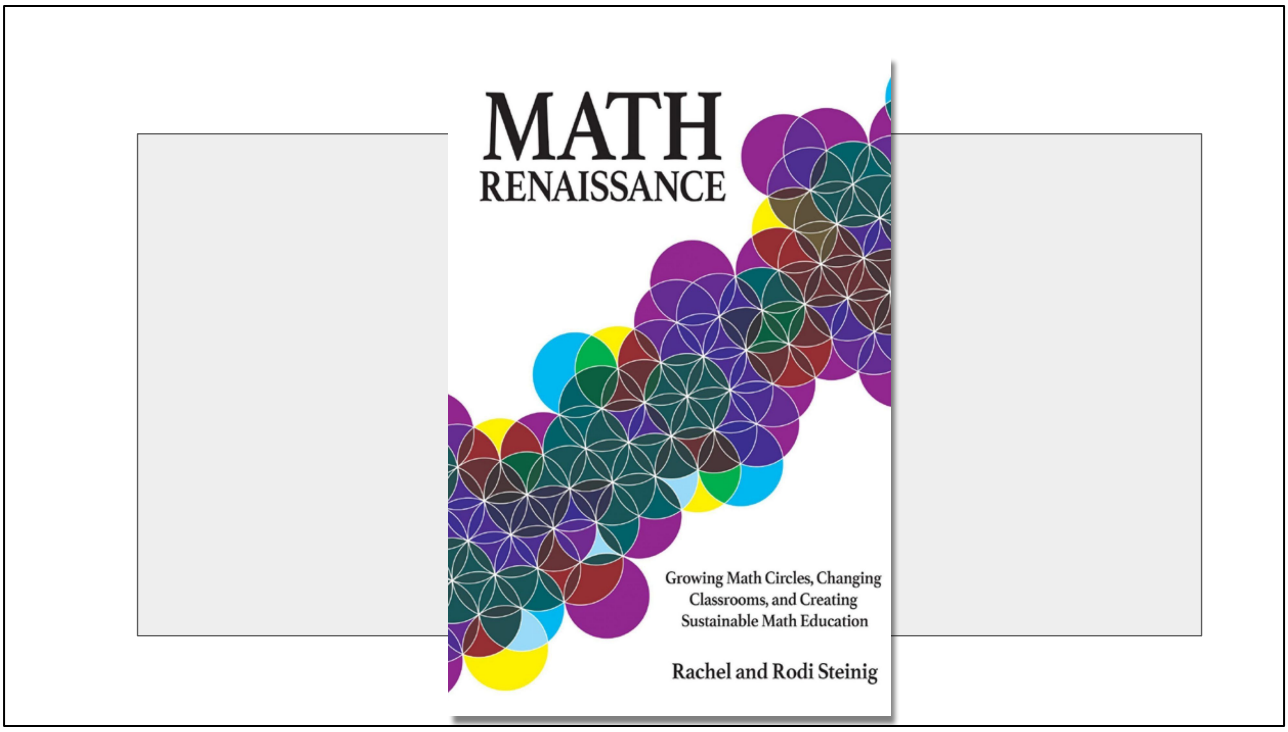
MORE EMBODIED MATHEMATICS - a combination of the games “Mother May I” and Sidewalk Chalk Addition.
“MOVE FORWARD 3 PLACES. MOVE BACKWARDS 5 SPACES” (BUT STILL FACE FORWARD.)
CAN RAMP IT UP WITH FACING THE OTHER WAY FOR SUBTRACTING (VERSUS ADDING NEGATIVES)

GAME: Knights and Liars (Knaves) with Puppets

“Waggy do you eat meat?” (role playing, conjecturing, strategy game) - puppets adds a layer of complexity to the classic game.



The game Knights and Knaves is in this book.



This book describes in details playing Knights and Knaves/Liars with puppets - extending the game into formal logic concepts such as negation, inverse, converse, etc.

How Is this Math? (a.k.a Is there Math in Everything?)

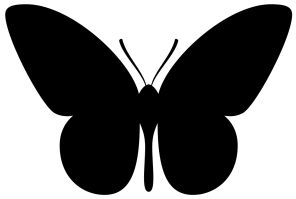
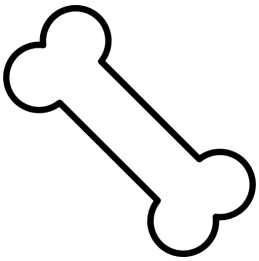
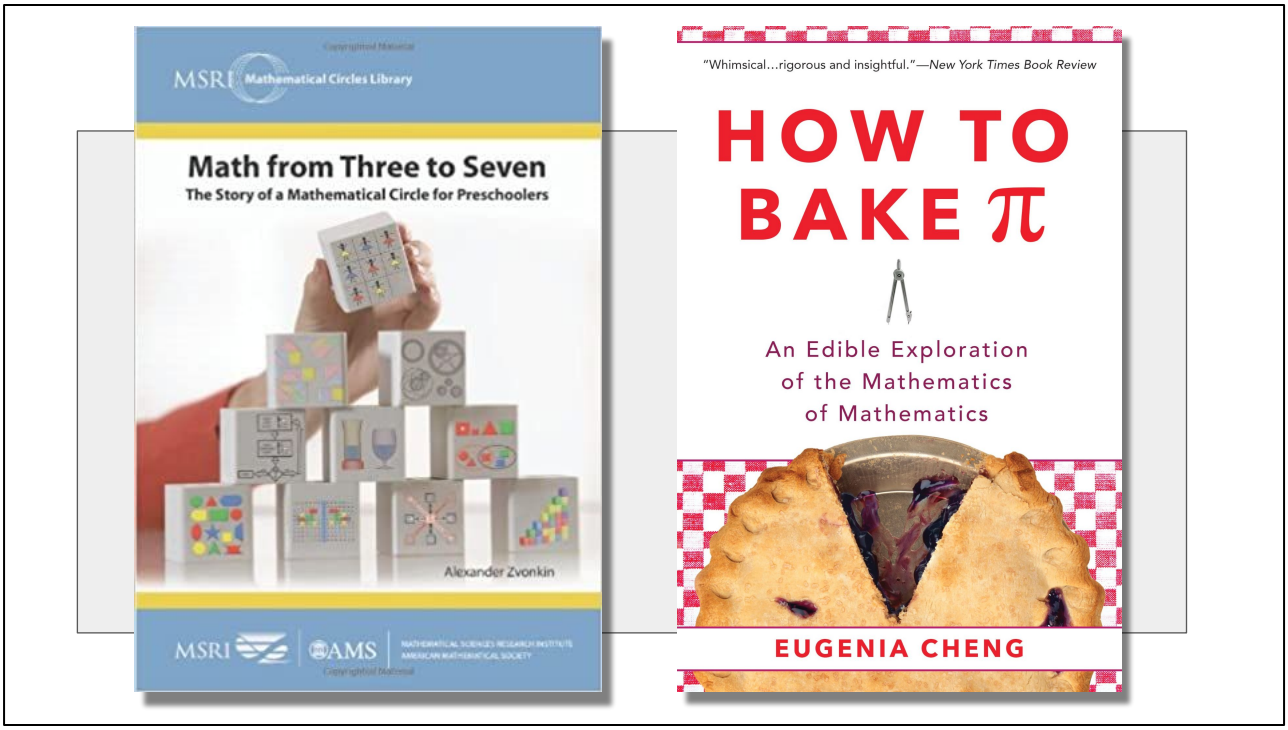




Image Attributions:
The Noun Project
FlatIcon

CREATIVE GAME, THINKING GAME - detailed in this blog post:
https://mathrenaissance.com/meta-pedagogy/

Odd One Out

CONTEXT MATTERS. The Green pentomino is linear so it must be the odd one out. Green is not a primary color. Red has no symmetry. CHALLENGE: how could the yellow or blue be the odd one out? (Students challenge each other with their own set-ups.)

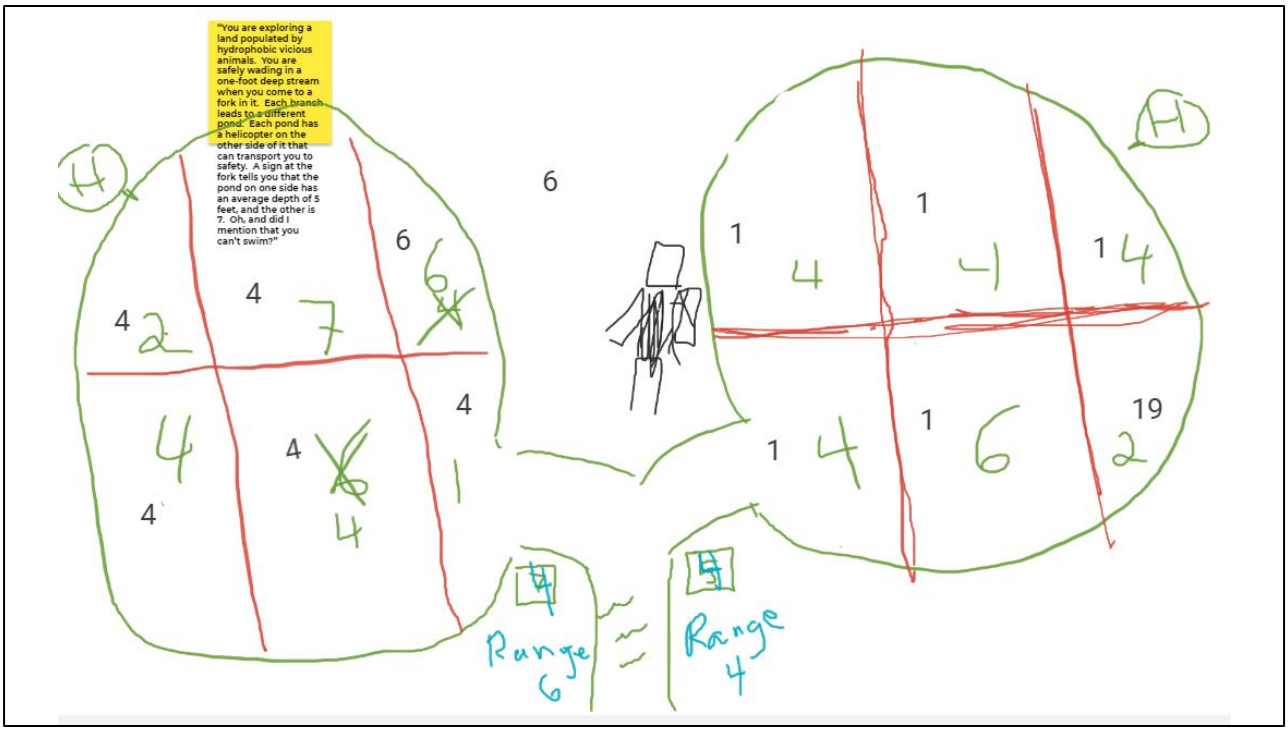


Both these books have good info about Odd One Out.

Would You Rather?

You are exploring a land populated by hydrophobic vicious animals. You are safely wading in a one-foot deep stream when you come to a fork in it. Each branch leads to a different pond. Each pond has a helicopter on the other side of it that can transport you to safety. A sign at the fork tells you that the pond on one side has an average depth of 5 feet, and the other is 7. Oh, and did I mention that you can't swim?

"Would you rather wade through the pond with the 5 foot sign or the pond with the 7 foot sign?"



I like to expand this problem with talk about range, not just average, to make the distinction between measures of central tendency versus dispersion. This is some work students did in a recent virtual Math Circle.

GAME: Math Lawyer

“A square and a rectangle are the same thing.”

Lots of role playing - defendant, prosecutor, judge…. (a conjecture goes on trial)

GAME: Math Lawyer

“A square and a rectangle are the same thing.”

“Diameter as a concept is unnecessary, since it’s just a function of the radius.”

Multiple groups of students have invented this game. In both of these shown, students came up with the statements to put on trial.

GAME: The Need for Numbers




Image attributions:
The Noun Project
PNG Wing

Role-playing math game
The basics of this game:
https://mathrenaissance.com/role-playing-the-need-for-numbers/
Spreading the game out over 5 weeks:
https://mathrenaissance.com/embodied-mathematics/

The Need for Numbers: Ramping up the Difficulty

Week 1: no numbers allowed

Week 2: no numbers, no pictures

Week 3: no numbers, no pictures, no names of shapes

Week 4: no numbers, no pictures, no names of shapes, no comparison words, no approximations

Week 5: all of the above allowed (phew!)

STUDENT DEBATES: IS “A” A NUMBER? IS ONE A NUMBER? IS A WORD LIKE HERD AN IMPLIED NUMBER? Point? Line? Few? Side? Shape? Herd?
(ramped up newer version from my students)

CONJECTURING GAMES

What's the rule, the function, the thing being defined...

- Euclidian Definitions
- Fruit Vendor (http://mathmaniacs.org/lessons/fsm/index.html)
- Function Machines

Euclidian Definitions: read a definition from Euclid's Elements. The students have to figure out what geometric concept is being defined. (And see if they can come up with their own definitions.) Fruit Vendor is a game about Finite State Machines. It is a LOT of fun to act it out - we did this in a virtual course. I wrote about Function Machines extensively in the book Math Renaissance.

Some strategy games that can be played cooperatively

Blokus	Backgammon*	Go
		

* Image Attribution: Shutterstock

I've played these games with students against me. When I had students play Go in pairs (on the right, above) it didn't go so well. But when we all played it together it was a hit.


Thank you!
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www.mathrenaissance.com
Contact form is on the website