

Games & Me

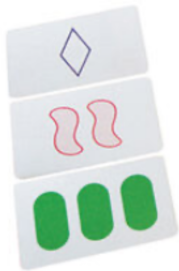
- I grew up playing games - home, car, playground
 - game nights & groups - playing & playtesting
- So so did my kids
- MSB - curriculum?
- More intentional - concentration/memory games for language, art, etc.
- ConcenFraction & PriMemory - additional strategy & interaction

I ❤️ 🎮

Games Class for Homeschoolers

Who Don't Like Math

- No visible numbers - colors, shapes - logic, geometry
- SET, Qwirkle, Logicon, ...



Game Design Camp

- Game Theory - Prisoner's Dilemma, Probability, Graphs; Isomorphism
- Game Design - goals, obstacles, interactions, theme, objects, rules
- Play games, Design & Create games, Playtest each other's
- Only camp extended - twice

Laugh-A-Rade

Chance for Chess

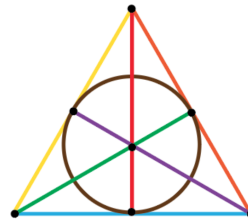
♣ ♦ **Suit Yourself** ♥ ♠

Battle Chips

Chip Attack

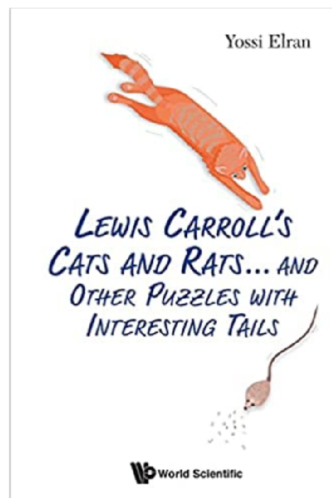
Roles of Games in Math Circles

- Sometimes the topic is the game play - Nim, Queen's Move
 - predicting the outcome, patterns of winning positions, strategies
- Sometimes it's about the underlying structure of the cards - SET, Spot it!
 - analyze, combinatorics
 - \mathbb{Z}_3^4 , finite projective plane



From Magic to Games

MatheMagics



Game Design

New goal: start every math circle with a related game

Arrival Activity at Math Circle

Short 2-Person Game

Method

- Pair up as arrive
- If odd #, I play until next person arrives
- Sometimes have earlier pairs split up and explain to later arrivals
- Can choose to watch a pair instead – get role of keeping score, checking validity, ...
- When appropriate, suggest playing cooperatively

Arrival Activity at Math Circle

Short 2-Person Game

Advantages

- Get involved as soon as walk in
- Start gaining insight into topic
- Late arrivals are fine
- Interaction almost required
- Shyer kids immediately have someone to talk to and not too many people
- Fun, exciting, ...

Arrival Activity at Math Circle

Short 2-Person Game

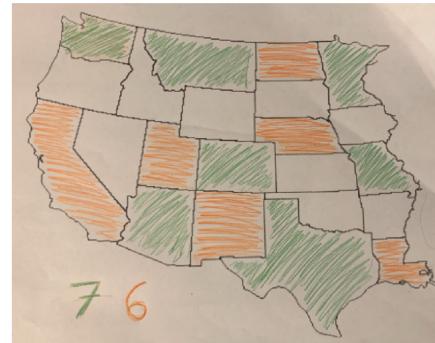
Disadvantages

- Fostering competition
- Can be too engaging!

Gamifying Classic Math Circle Activities

Map Coloring

- each person has 1 or 2 colors
- both people have 2 or 3 or 4 or 5 colors
- winner is the last colorer



Note this cannot be extended to a 4-coloring

Gamifying Classic Math Circle Activities

Ramsey Theory

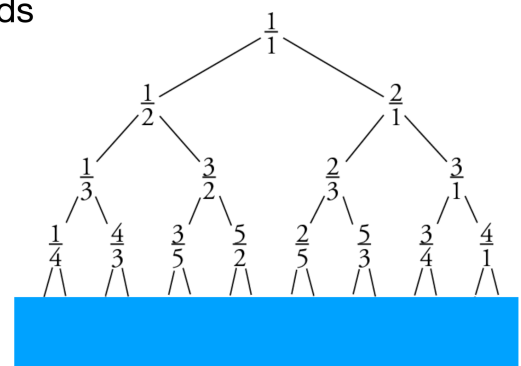
- connect 6/5 dots trying to make/avoid a triangle in your color
- high school: more dots, more colors,
make monochromatic quadrilateral
- checking (ties on 6), collaborate to avoid (on 6)



Gamifying Classic Math Circle Activities


Calkin-Wilf tree

- each small card deck has fractions in first 4 rows
- go-fish or rummy style - goal is to get rid of cards
- put down binary subtrees of the form $\frac{N}{N+D}$ $\frac{N}{D}$ $\frac{N+D}{D}$
- variation - can add to others'



Whenever there's an activity involving repeatedly placing or removing things until a condition is met, it can be turned into a 2-person game by alternating the moves with the winner being the one who made the last move.

This one is a JRMF activity inspired by Greisy Winicki-Landman



Julia Robinson
Mathematics Festival


Prime Cubes Instructions

Objective


- The winner is the last player to place a number on the cube while following the rules.

Rules


- Players take turns placing one of the numbers from 1-8 on the vertices of a cube.
- Players do not need to place numbers in numerical order, e.g. Player 1 can start with 3.
- A number cannot be used more than once.
- If an edge connects two numbers, their sum must be prime.



Player 2 **cannot** place the 4 on the green vertex because $6 + 4 = 10$, which is not a prime number.



Player 2 **can** place the 4 on the orange vertex because $1 + 4 = 5$ and $3 + 4 = 7$, both of which are prime numbers.



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Thank You

Skona@SBFamilySchool.com