Maths for Funsies

Playful Classroom Activities for Mathematical Exploration

Axel Brandt

NKU NORTHERN KENTUCKY UNIVERSITY

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Slides at: sap-pho.nku.edu/ brandta2/docs/kcm2020.pdf

When did you know you liked maths?

Why did you?

Number Babble

Reciting π Alternatives

3-to-6-digit No Remainder

2-digit Cubed

9^{th} Digit

Barcode Scanner

The Maths

$$ABCABC = ABC000 + ABC = (1000 + 1) \cdot ABC = 1001 \cdot ABC = 7 \cdot 11 \cdot 13 \cdot ABC$$

$$(AB)^3 = (10 \cdot A + B)^3 = 1,000A^3 + 3 \cdot 100 \cdot A^2 \cdot B + 3 \cdot 10 \cdot A \cdot B^2 + B^3$$

$$Pr(9 \mid \prod d_i) > 0 \text{ implies } 9 \mid \sum d_i$$

$$10 \mid 3d_1 + d_2 + 3d_3 + d_4 + \cdots + 3d_{11} + d_{12}$$

Number Babble

Birthday Mindreading

Card 4				Card 3				Card 2				Card 1				Card 0			
16	17	18	19	8	9	10	11	4	5	6	7	2	3	6	7	1	3	5	7
20	21	22	23	12	13	14	15	12	13	14	15	10	11	14	15	9	11	13	15
24	25	26	27	24	25	26	27	20	21	22	23	18	19	22	23	17	19	21	23
28	29	30	31	28	29	30	31	28	29	30	31	26	27	30	31	25	27	29	31

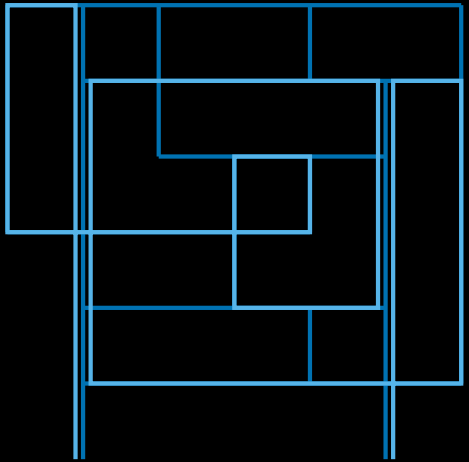
The Maths

Binary Number System: $2^4 + 2^3 + 2^2 + 2^1 + 2^0$

Spatial Reasoning

No left turn!

More floor mazes:
jrmf.org/activities



Spatial Reasoning

Picture Hanging

Picture falls if 1 nail removed

Rope Handcuffs

Mental Model

Impossible?

Logic

Reassess Model

MatheMagic

Rope Trick Topology

The Twisted Tailor

The Blind Barkeep

Tic-Tac-Whoa

O	X	O
O	X	X
X	O	X

Tic-Tac-Whoa!

Refresh memory by playing a few games of tic-tac-toe.

Students discuss their strategy and how successful it is.

Conversation about ways of knowing

1: What is one way to measure the "strength" of a square?

2: Under your measure, how strong is each square?

3: Do any squares have the same strength?

4: Can you explain why this would be the case?

Tic-Tac-Whoa!

Place Ace through 9 between two players.

Players alternate turns picking a card to put in their hand.

Winner: first to have a hand that contains 3 cards that sum to 15

Player 1	1					6	7	8	
	1	2	3	4	5	6	7	8	9
Player 2		2	3		5				

Tic-Tac-Whoa!

Gain experience by playing a few games of 3-to-15.

Students discuss their strategy and how successful it is.

Revisit conversation about ways of knowing

5: What is one way to measure the "strength" of a card?

6: Under your measure, how strong is each card?

7: Do any cards have the same strength?

8: Compare your answers for 2-3 and 6-7. What do you notice?

Tic-Tac-Whoa!

8	3	4
1	5	9
6	7	2

Extensions

Magic Squares

Isomorphisms

Prove no winning strategy

Explore variations of rule changes
e.g. 3 in a row loses

Predict result of tic-tac-toe game

Classroom Activities

Surface Area, Volume, and Mammalian Heart Rates

measure body parts in inches

calculate $120 \times \frac{SA}{V}$

compare to resting heart rate

Will the Zombie Virus Get You?

simulate spread of zombie outbreak via linear, exponential, and dice roll models

Greedy Pig

dice roll game played in rounds

while standing up, accumulate points unless `bad' number rolled

Combinatorial Game: One Pile (AKA Subtraction Games)

Place a small handfull of stones between two players.

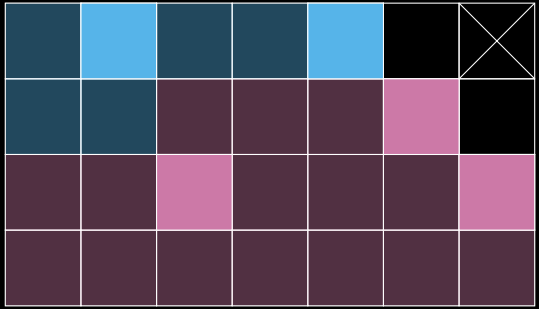
Each turn, a player takes 1, 2, or 3 stones from the pile.

Winner: whoever takes the last stone(s)

Combinatorial Game: Chomp

Players alternate turns "chomping" a square out of a rectangular chocolate bar along with any squares to left and down.

Loser: player forced to chomp the top right square (it's poisoned!)



Combinatorial Game: Chomp

Play on small $n \times n$ boards

Prompt students to analyze all moves on partial boards, thinking about subsequent moves

Identify strategy for $n \times n$ boards

Prove player 1 has a winning strategy for Chomp

Extensions

Rectangular boards: $2 \times n$, $3 \times n$, $m \times n$

Classroom Activities

Towers of Hanoi - determine closed form minimum number moves

Utility Sabotage - draw $K_{3,3}$ in the plane

Knight's Tour - chess knight land all squares once

Number Building - n^{th} digit is # times $n-1$ is used as a digit

Coins in the Dark - split pile of n coins with $\frac{n}{2}$ heads into 2 piles with same # heads in each pile

Cryptography - shift and block ciphers

SuperPermutations - efficiently binge TV series

In Progress - Voting Methods

Thank These People!

MathsBusking.com
- Rope Handcuffs
- 2-digit Cubes
- Binary Mindreading
- Divine Remainder
- Subtraction Games
- Emergency Pentagon

Stand Up Maths on YouTube
- 2-digit Cubes
- 9-digit Product

ArtOfMathematics.org
- IBL Activities

CU Denver STEM Clubs
- Combinatorial Games
- Greedy Pig
- Mammalian Heart Rates
- Zombie Virus

Rope Tricks
- Allison Henrich @ Seattle Univ
- Book by Karl Fulves

Tic-Tac-Toe
- Main St Math @ Davidson Coll

Slides at:
http://sappho.nku.edu/~brandta2/docs/kcm2020.pdf

Interested in Classroom Visits? Email me at:

brandta2@nku.edu

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