Math, Magic, Puzzles, and Games Presentation

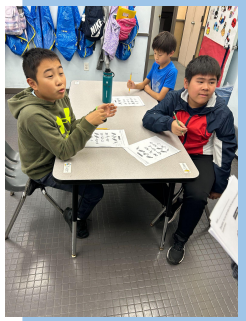
Madison Singlak, Shivani Howe, Alissa Agnelli

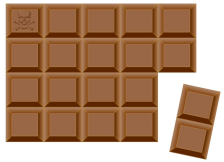
ACCESS Chinatown Service Learning 2023

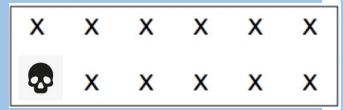
Visit 1

Chomp

Chomp is a two-player strategy game where each player chooses an "x" or a block, which they "eat" along with all the blocks above and to the right of it.







The game ends when one player loses by being forced to "eat" the poisonous block at the bottom left corner of the board. Depending on the size of the board, various strategies exist that will always let you win the game!

Visit 2

Card Tricks

9-Card Liar Trick

1. Deal 3 piles of 3 cards
2. Pick up 1 pile and ask player to look at (and remember) bottom card
3. Place the pile on top of the other 2 piles
4. "Spell" a card (but lie), and place the rest of the pile on top after spelling each word
5. Reveal the card by spelling "truth"

The Trick: after spelling the card value, "of," and card suit (ex: "ace" "of" "spades"), the chosen card always ends up right in the middle of the packet (the fifth position from the top)

21-Card Trick

1. Deal 21 cards into 3 piles of 7
2. Ask player to select a card and indicate which pile it is in
3. Pick up cards, with indicated column of cards in the middle, and deal them into 3 columns again
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The Trick: after three circuits, their card will be the 11th card from the top (meaning it will be in the center of the middle column)

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Hexaflexagons

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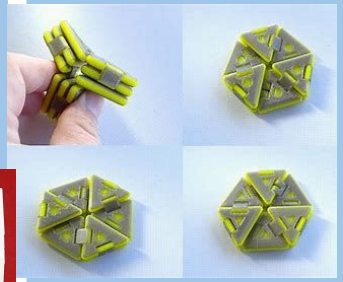

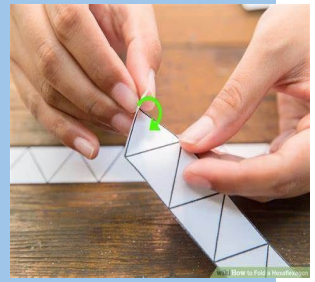

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MATH, MAGIC, PUZZLES, & GAMES

By: Pruthvi, Lauren, Riya, Afnan, and Ved

BOYS & GIRLS CLUB OF DORCHESTER

GAME GAME TIC TAC TOE

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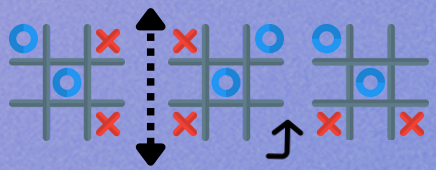

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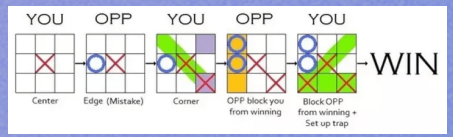
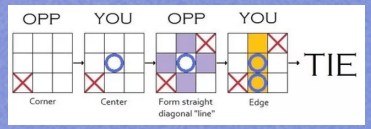


Conversely, when playing second, students aim to force a tie. If the first player starts with an X in a corner, the second player responds with an O in the middle and subsequently on an edge. For the rest of the game, the player must simply block their opponent in order to guarantee a draw.



PUZZLE PUZZLE SET

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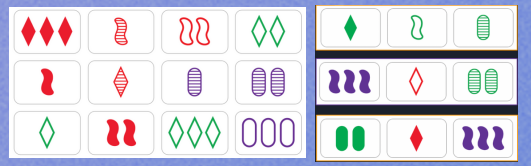

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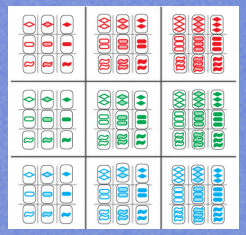

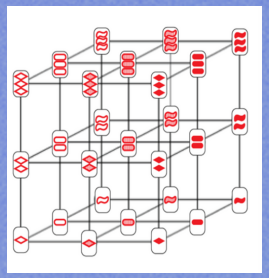

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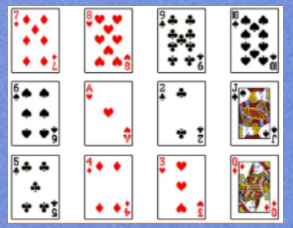

Students choose any card from the arrangement of 12 cards, and then repeatedly move around the board based on their card's value, but they all land on the same card!

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Madison, Ellie, Will, Sara - Fall 2023

Graph Theory + Transversable Paths

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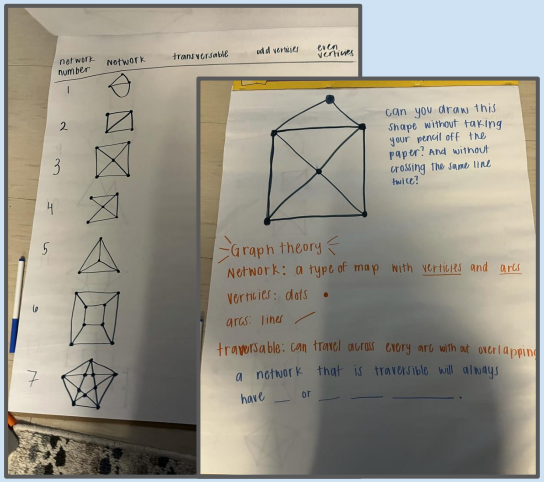

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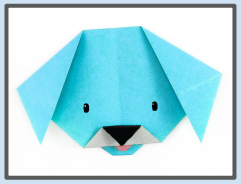

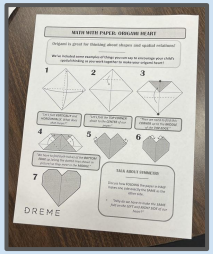

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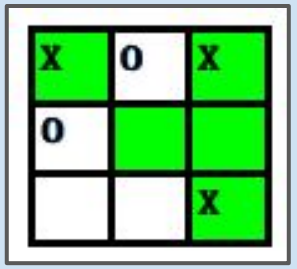

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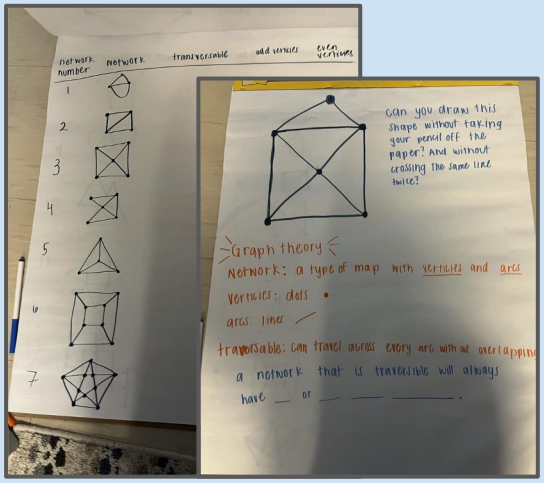

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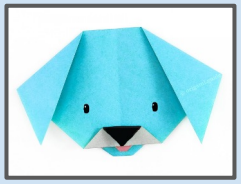

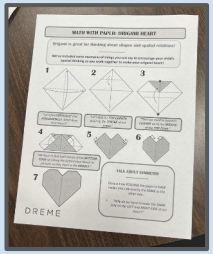

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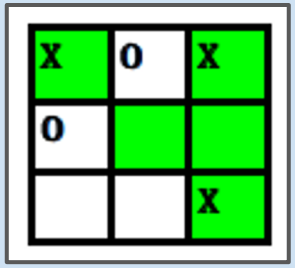

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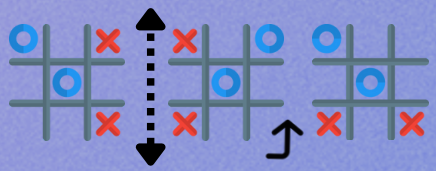

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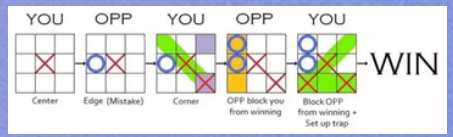

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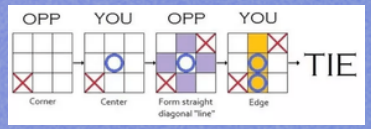

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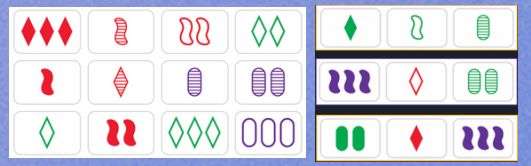

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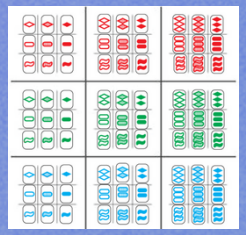

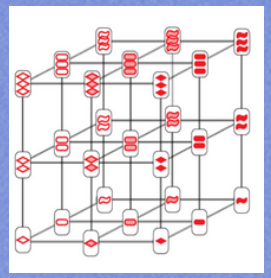

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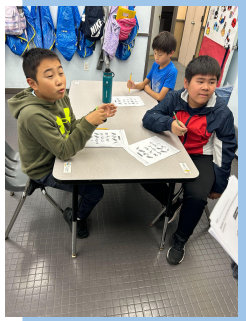

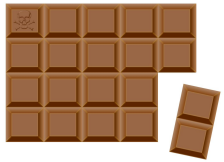

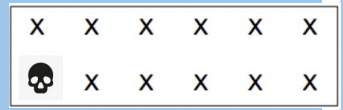

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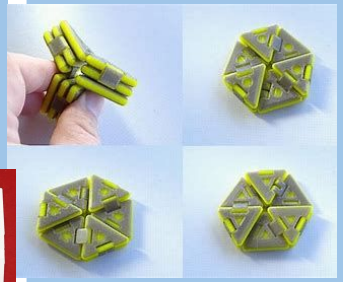

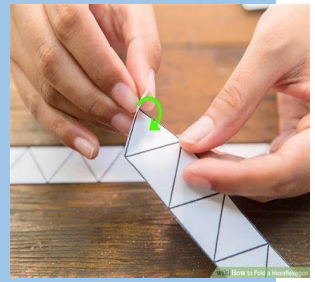

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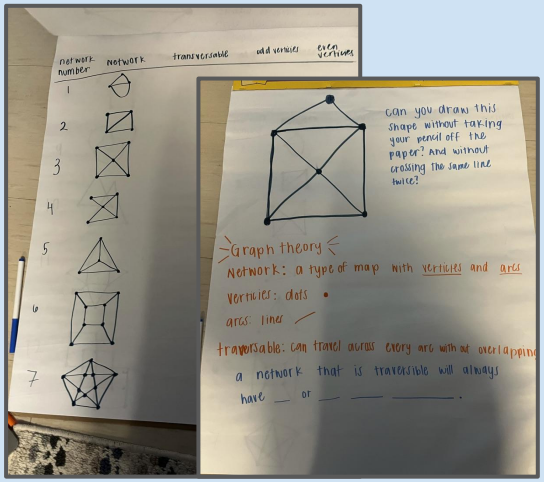

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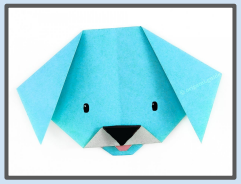

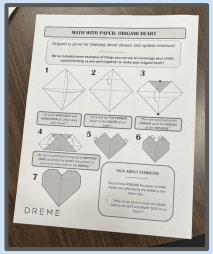

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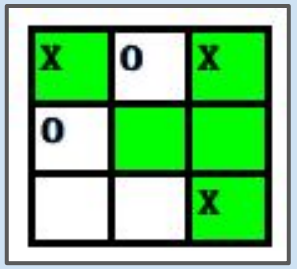

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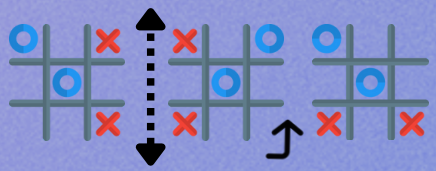
Students learn to recognize the symmetrical properties of a tic-tac-toe board, leveraging this understanding to create strategic combinations that enhance their chances of victory or a draw. By employing principles of symmetry within the context of combinations, players develop a nuanced approach that maximizes control over the board and influences the outcome of the game. This knowledge guides their decisions based on whether they play first or second.



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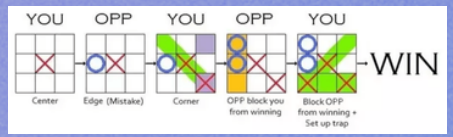

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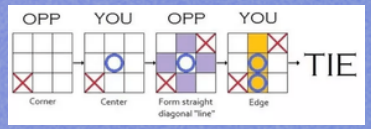

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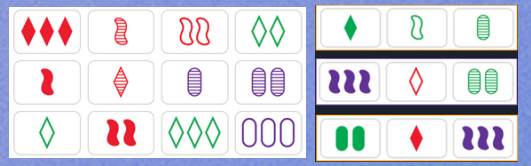

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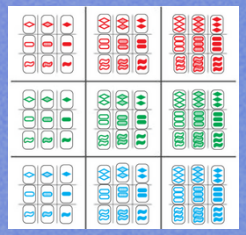

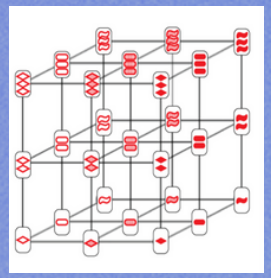

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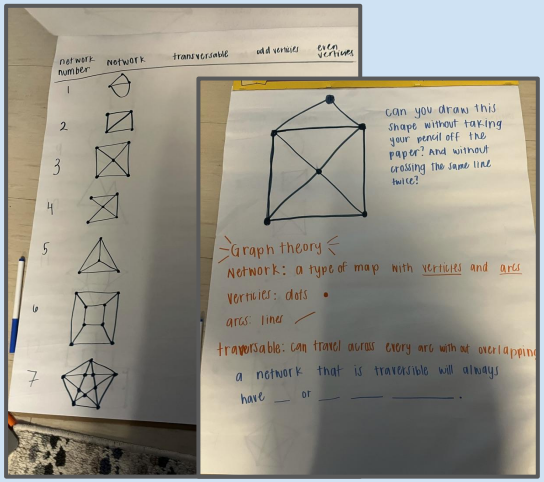
Math, Magic, Puzzles & Games -- Service Learning with St. Stephen's Youth Group

Madison, Ellie, Will, Sara - Fall 2023

Graph Theory + Transversable Paths

As an introduction to graph theory, we asked the students to draw a shape without taking their pencil off the page and only going over each line one. A network is a type of map with vertices and arcs. If it is trandgersible, that means one can travel across every arc without overlapping. A network that is transversable will always have <u>0 or 2 odd vertices.</u>

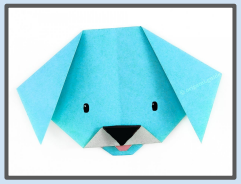


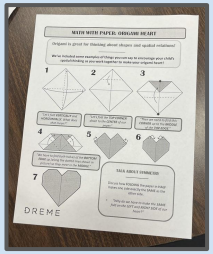
Anchor Charts to display in the classroom.

Origami

Origami is a great example of the intersection between math and crafts. Origami has been formalized by mathematicians into a series of geometric "axioms," or rules, that essentially tell you when you fold a piece of paper, there are a certain number of things that can happen. For instance, one axiom states that if you have two points on a piece of paper, you can *always* fold one onto the other.

While the axioms of origami may be a little complicated, even the younger children can understand origami intuitively. We spent some time demonstrating the first two axioms, and then guided the kids through folding various shapes, such as a heart and a dog.

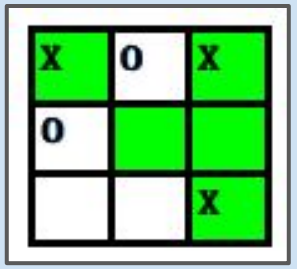




Tic-Tac-Toe & Optimal Strategies

Everyone knows and loves classic tic-tac-toe. Tic-tac-toe has a very simple **optimal strategy.** An optimal strategy is a set of steps one can follow to win a game. Tic-tac-toe's optimal strategy, according to the National Museum of Mathematics' Alyssa Choi is the Fork Strategy. An example is shown below.

(*An example of the fork strategy by Alyssa Choi,* shown right)



With other varieties of tic-tac-toe, however, optimal strategies become far more complicated. *How do mathematicians find the optimal strategy for a game* was a question frequenting the minds of the kids we presented to.

MATH, MAGIC, PUZZLES, & GAMES

By: Pruthvi, Lauren, Riya, Afnan, and Ved

BOYS & GIRLS CLUB OF DORCHESTER

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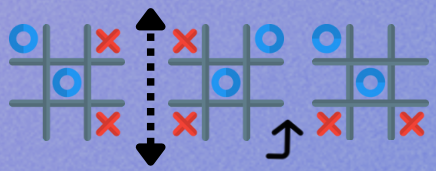

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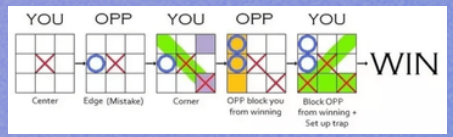

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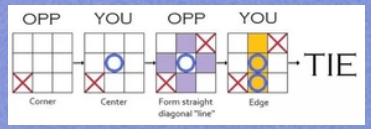

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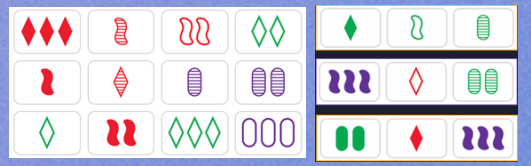

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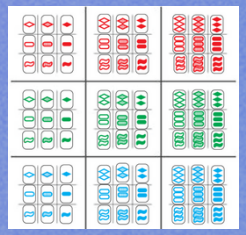

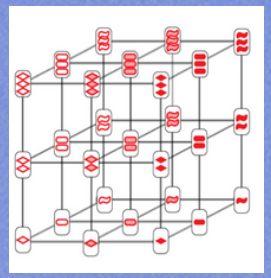

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Math, Magic, Games, and Puzzles Presentation

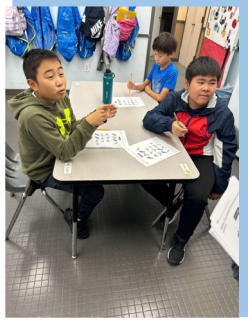
Madison Singlak, Shivani Howe, Alissa Agnelli

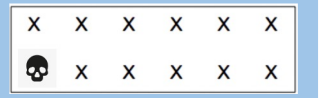
ACCESS in Chinatown Service Learning 2023

Visit 1

Chomp

The game Chomp is a two-player strategy game where each player chooses an "x" or a block, which they "eat" along with all the blocks above and to the right of it. The game ends when one player loses by being forced to eat the poisonous block at the bottom left corner of the board. Depending on the size of the board, various strategies exist that will always let you win the game!





Visit 2

Card Tricks

9-Card Liar Trick

1. Deal 3 piles of 3 cards
2. Pick up 1 pile and ask player to look at (and remember) bottom card
3. Place the pile on top of the other 2 piles
4. "Spell" a card (but lie), and place the rest of the pile on top after spelling each word
5. Reveal the card by spelling "truth"

The Trick: after spelling the card value, "of," and card suit ("ace" ", the chosen card always ends up right in the middle of the packet (the fifth position from the top)

21-Card Trick

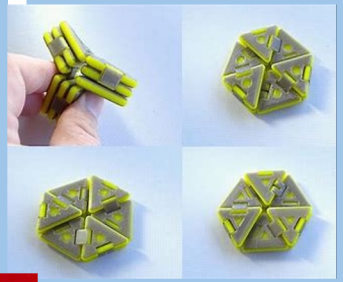
1. Deal 21 cards into 3 piles of 7
2. Ask player to select a card and indicate which pile it is in
3. Pick up cards, with indicated column of cards in the middle, and deal them into 3 columns again
4. Repeat twice

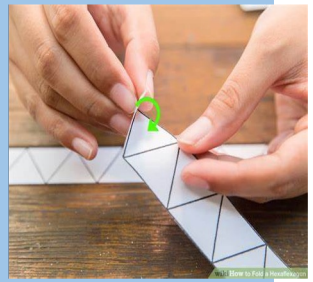
The Trick: after three circuits, their card will be the 11th card from the top (meaning it will be in the center of the middle column)

Visit 3

Hexaflexagons

Through the folding of paper, kids were able to make their own hexaflexagons and design them.





These are made by cutting out strips of paper, which are then folded and through flexing the shape reveals faces that were on different sides.

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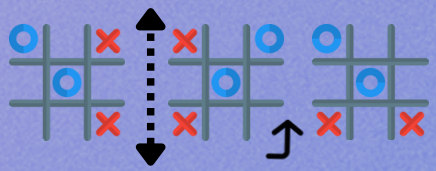

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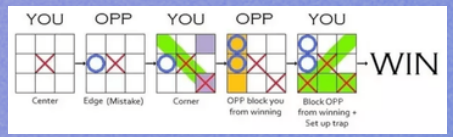

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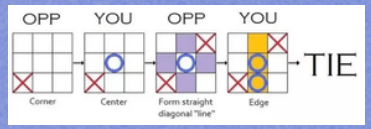

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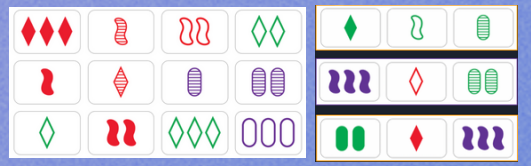

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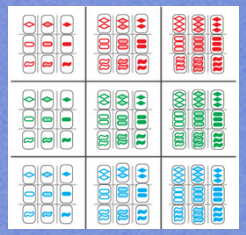

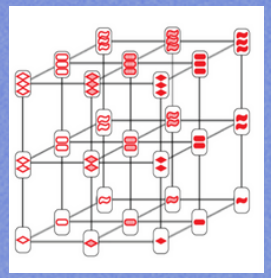

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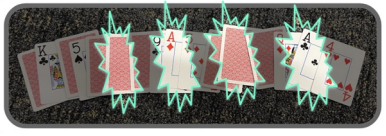
Math, Magic, Puzzles, and Games at St Stephen's Youth Program

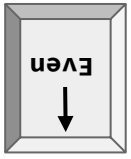
Emily Ryan, Justin Wang, Vincent Demaisip

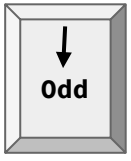
Four-of-a-kind trick

- Using the Hummer shuffle to create the illusion of mixing the cards up using parity!

- Flipping over the top two cards and cutting maintains the relative parities and orientations of the four-of-a-kind.
- After "shuffling", we showed that the four-of-a-kind they chose was shown face-up when all the other cards were face-down.

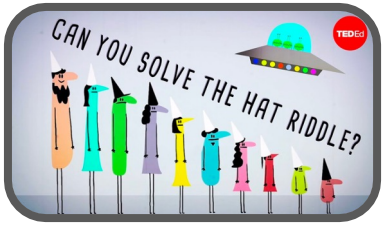




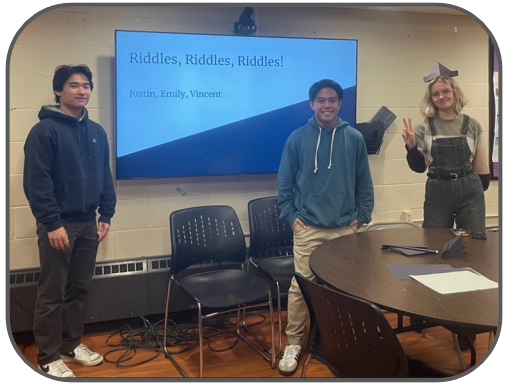


Alien Hat Riddle

- 10 people are kidnapped and put into a single-file line facing forward in size order (all have black or white hat)

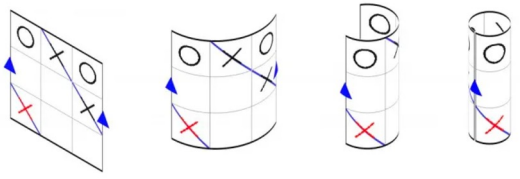


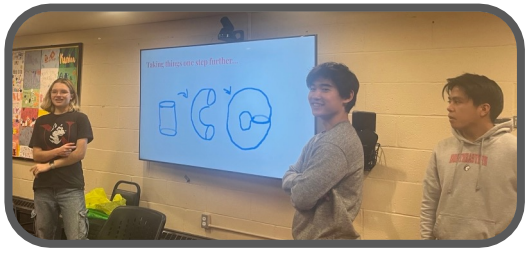
- Each person has to guess the color of their own hat using the words "black" or "white"!
- The kids solved the riddle by saying the color of the hat in front of them based on its parity in relation to their own hat's color.

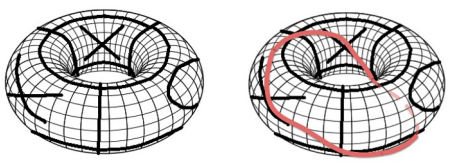


Topological Tic-Tac-Toe

- Taking Tic-Tac-Toe beyond the plane by mapping the board onto a cylinder and then a torus—no more ties!
- Normal planar Tic-Tac-Toe is boxed in by four edges, but each transformation makes the game's playspace more and more







Math, Magic, Puzzles, & Games

Aditi Swamy, Aidan Stovin, Shirleen Zheng

CASTLE SQUARE TENANTS ORGANIZATION

Nim Day

21 Additive Nim: All the kids stood in a circle. We started with the number 1 and each kid took turns adding either 1, 2, or 3 onto the previous number. Whoever got to 21 or higher was out! This was repeated until there was only 1 person left.

Classic One Pile Nim: The kids split up into smaller groups of 2 or 3. Each group was given 11 pieces of candy. The kids in a group took turns taking either 1, 2, or 3 pieces of candy. Whoever took the last piece of candy LOST!

Card Tricks

15 Card Trick: 15 cards are dealt into 3 columns, and the kids choose a card. They say which pile their card is, and the cards are re-dealt. The kids point out what pile the chosen card is in. This is done 3 times, before their chosen card is revealed!

Baby Hummer: The kids are each given 4 cards and are asked to remember the card at the bottom of the pile. They are then asked to do a series of moves and a special type of shuffle called a “hummer shuffle”. Once they fan the cards in their hands, we can point out which card was their card.

Paper Tricks

Trihexflexagon: A special type of paper polygon that can be folded over and over again to reveal 3 different faces. The kids got to make their own trihexaflexagon and decorate them.

Mobius Strip: A three dimensional figure that only has one surface. The kids were able to make a mobius strip by simply twisting and taping a strip of paper.