THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Education
Department of Curriculum & Pedagogy

For Curious and Inquiring Minds .....

Photo credits left and right: *Paul Joseph|UBC Brand and Marketing*

Virtual Family Math Fair

Saturday Feb 20, 2021, 10:00 am - 12:00 noon

Virtual through Zoom with
UBC Faculty of Education Graduate Students and Teacher Candidates

Photo credits above: *Janice Novakowski*

Sat Feb 20, 2021
10:00am-12:00 noon

Hands-on Minds-on
Math Activities for all Ages!

A Compilation

Z. Alikhani, C. Dusdal, & N. Lubenow

ACKNOWLEDGEMENT

We would like to acknowledge that we, the members of UBC's Masters of Education in Mathematics Education: Teaching and Learning Mathematics in Community, are grateful to live and work on the traditional, unceded territories of the following Indigenous Peoples, who have been living on this land since time immemorial:

Syilx, xʷməθkʷəy̓əm, Se̓l̓íl̓witulh, Sḵwx̱wú7mesh, Katzie, Stó:lō, Kwikwetlem, Kwantlen, Matsqui, Semiahmoo, Tsawwassen, Tk'emlúps te Secwe̓pemc, Sinixt, Interior Salish, Ktunaxa, Okanagan Syilx, Gitxsan, Ts'msyen, Lhtako Dené, and Williams Treaties First Nations: Chippewas of Beausoleil, Georgina Island, and Rama, and the Mississaugas of Alderville, Curve Lake, Hiawatha, and Scugog Island.


Gulf of Alaska
ALBERTA
BRITISH
COLUMBIA

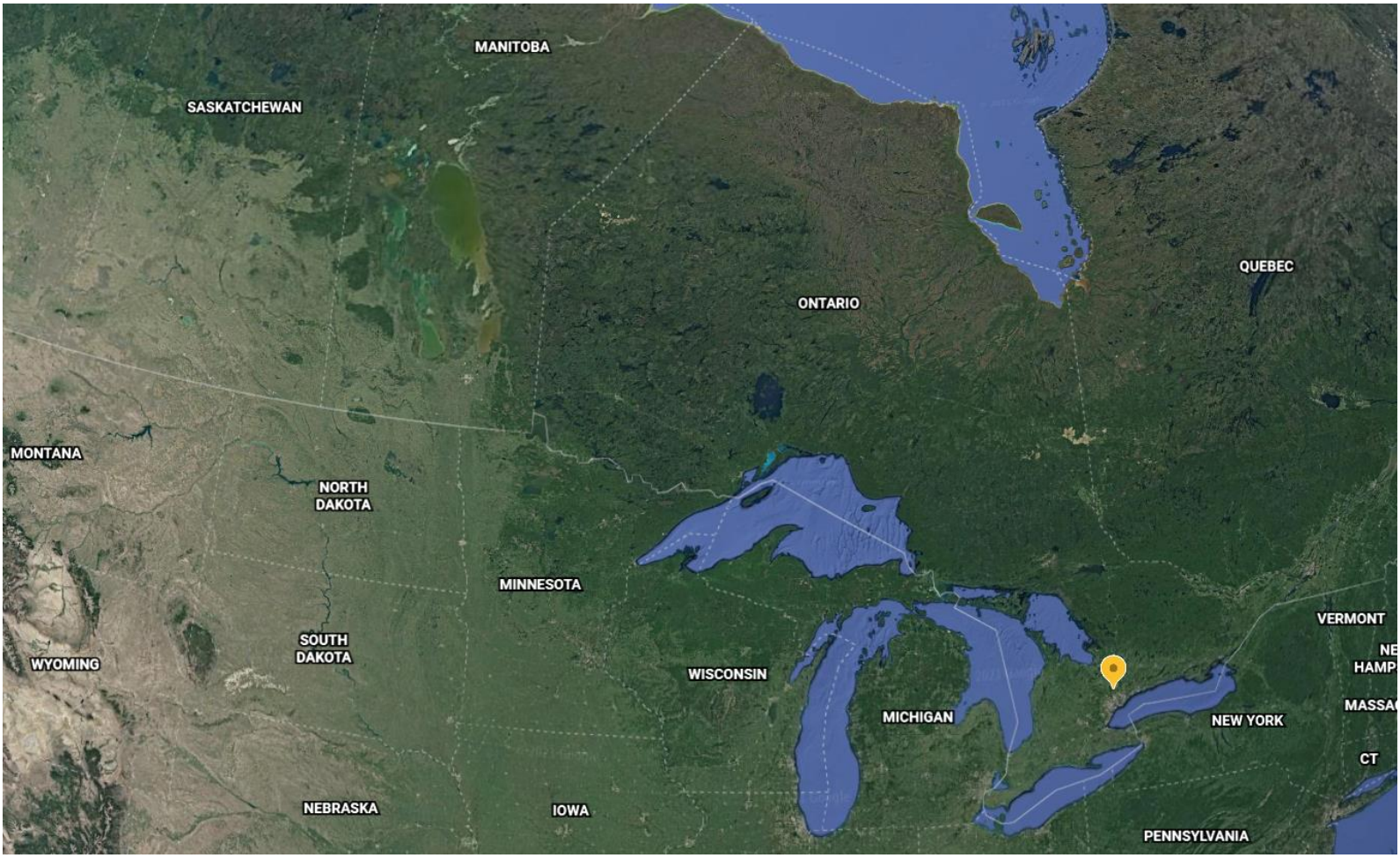

MANITOBA
SASKATCHEWAN
QUEBEC
ONTARIO
MONTANA
NORTH
DAKOTA
MINNESOTA
VERMONT
SOUTH
DAKOTA
WYOMING
WISCONSIN
MICHIGAN
NEW YORK
CT
NEBRASKA
IOWA
PENNSYLVANIA

TABLE OF CONTENTS

"Everyone has promise in mathematics."

Francis Su-
Mathematics for Human Flourishing

INTRODUCTION

The University of British Columbia's graduate cohort in mathematics education organized our first Virtual Family Math Fair. Held on a Saturday morning in February 2021, the event grew out of a cohort course focused on teaching and learning mathematics in community. Graduate students invited families, children and youth, to attend sessions they facilitated along with faculty, other graduate students, and teacher education candidates through Zoom.

Over 300 families, with more than 500 children mainly from across Canada with some in the United States, registered and participated in the event. Ten concurrent sessions– 40 sessions in total – engaged children from early years to teen years with their families to explore the beauty and wonder of mathematics.

Sessions included: logic puzzles, exploring fractions with Lego blocks, Tik Tok-inspired pattern dance parties, toothpick transformation puzzles, playing with pentominoes, making and exploring hexaflexagons, paper folding puppies, exploring triangles and building with cardboard, magic numbers, card games and much more!

This document is a collection of tasks offered at this Virtual Family Math Fair. Please browse through these pages to discover enriched math activities for families or classrooms. We hope this document inspires you and your family to explore the possibilities mathematics offers for bringing us together. We hope you have hours of fun learning math by choosing and using the activities included in this document.

"Mathematics is the science of patterns and the art of engaging the meaning of those patterns."

Francis Su-
Mathematics for Human Flourishing

Tik Tok Inspired Dance Party: Will Mathematicians Make The Next Viral Dance Trend?

By Mahima Lamba and Joy Fast

Level:
Pre-Kindergarten/Kindergarten

Concepts: Patterning, Number Sense

Materials:
Collect to show everyday objects featuring patterns
Select upbeat music with a strong beat and minimal lyrics - make sure children have access to adequate space to move

We love:  Dandelion
by Galantis JVKE **or**  Good to Go
by A Tribe Called Red

Introduction: "I see patterns everywhere!"
Show children patterns on everyday objects to focus their thinking. We used socks, seasonal decorations, picture books and other household items that show patterns.

Essential Questions:
Ask the children:
What is a pattern?
Where do we find patterns?

Hook: Show a Tik Tok dance!
We made our own! Children will delight in thinking their teacher or family member is famous!

"Anyone can be famous with the right moves!"
"I wonder, can the children show us some cool moves?"

Turn on the music to dance around and watch the children's movements. Use some of their moves in your examples to generate dances.
Make sure to observe and name some cool moves. Examples include: stomp, turn around, wait, corvette corvette, the woah.

Use a combination of dance moves shown by the children to make a dance of 3-4 moves in length to provide an example to the children of how to make a dance with patterns. Also show a non-example and show children how to repeat the moves to make a pattern.

Let's Make a Dance!
Example:

Let's open the door to the right, open the door to the left, wait, corvette-corvette - what do you think?

It looks cool, but it's not a pattern yet!

To make this dance a pattern, repeat the moves again and again!
Take a moment to experience the pattern of moves set to the music and dance all together!

Time to Create!
Ask children to make a combination of at least 3 dance moves that repeat to create their own pattern dance. Then ask for volunteers to share their dance with the group!

Translating Patterns
As the children perform their dances, highlight the patterns in the moves using colourful cards.

"I can see the pattern ad show it using colours!" 

We showed that although we were using movements, we can create the same pattern using colours to represent the dance moves. We used this example to extend thinking about patterns so we could build meaning together.

Sharing Ideas and Making Meaning:
Children, with the help of their families or teachers, can share other ways to make patterns. Some suggested that patterns could be made with letters, colours, different shapes and materials from their homes.

Closing the Activity
We briefly summarized our learnings together.

"We can create a pattern with movements – we can feel patterns! We can also hear patterns and see patterns!"

With our extra time, we shared slides of photographs showcasing patterns in nature such as the scales on a lizard or the stripes on a snail's shell.

Questions for Further Thinking:
What are other materials we can use to make patterns?

What are other ways to make a pattern?

Why do you think we need to repeat the steps in our dance?

How did the pattern make it easy to learn our dance?

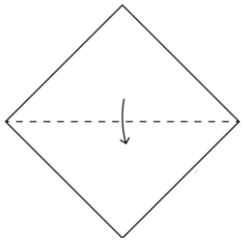
Fun with Paper Folding and Learning Math

By Zaman Alikhani

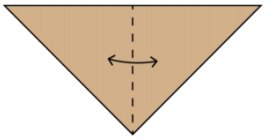
Grade Level: Elementary (Grades 3-6)

Core Concepts: Patterning, Geometry and Measurement, Spatial Relations

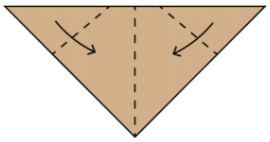
1. Dog Origami



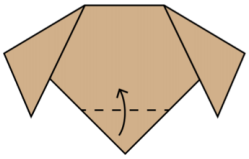
Fold in half



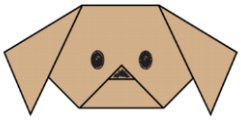
Fold in half to make a line and unfold.



Fold down the two corners to make the dog's ears



Fold up to form the nose.



Draw the eyes and shade the nose

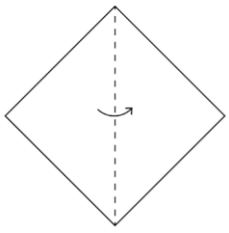
Questions:

1. What shape are the dog's ears and nose?
2. How many different shapes do you see?

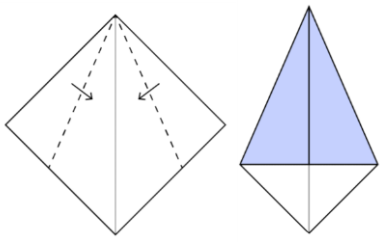
From:

https://dreme.stanford.edu/news/math-paper-fold-some-math-your-day

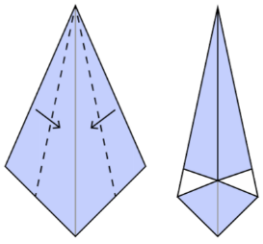
2. Swan Origami



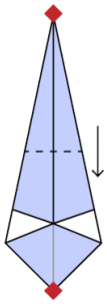
Fold in half. Crease and unfold



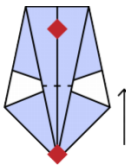
Fold by bringing the two edges to meet at the center.



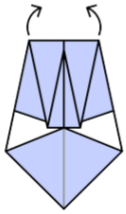
Flip over. Fold the long edges to meet at the center.



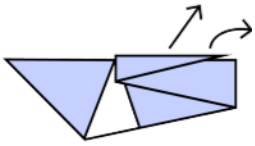
Fold by bringing the top point to the bottom point.



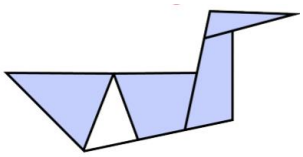
Fold the upper layer to form the head of the swan.



Press at the two edges so the center line moves up



Left the head and the neck up



Adjust the neck as you like.

Questions

1. What kind of triangles you see?
2. Every time you fold the shape and the two halves are the same, what do you think that is?

From: https://dreme.stanford.edu/news/math-paper-fold-some-math-your-day

3. Origami Box

Making an origami box is another simple paper folding activity. Such activities can help with visualizing some important mathematical concepts in geometry, algebra, calculus, and topology. It is interesting to unfold an origami object, such as a box, and look at the crease pattern.

An origami box and its crease pattern.

For step-by-step instructions on how to make an origami box, you may want to use the following link to a YouTube video: https://www.youtube.com/watch?v=Cd5Z8hmcb10

"Exploration and understanding are at the heart of what it means to do mathematics."

Francis Su-
Mathematics for Human Flourishing

3-Digit Dare: Can You Go Higher?

Reimagined by Natalie Lubenow

Level: Elementary (Grades 3 to 7)

Concepts: Number Sense & Probability

Materials: ace (1) – 9 in each suit from a standard deck of cards (36 cards after removing 10s, Face Cards, and Jokers) / alternate card decks may also be used e.g. UNO (use 0-9)

Players: 2-6 (more players? use additional card decks)





How to Play

1. Shuffle the cards and then spread them out face down on the table to create a picking pond.
2. Each player chooses 3 cards.
3. Arrange your cards to make the largest, 3-digit number possible.
4. Decide whether to keep your cards, swap 1 card, or swap 3 cards.
5. If you want to swap: Remove your 1 or 3 cards and mix it/them back into the picking pond. Choose 1 or 3 new cards from the picking pond and then make your new number.
6. After all players have had a turn to adjust their hand, players show their cards and read their number aloud. The greatest 3-digit number wins.

Exploration, Meaning, & Reflection

I wonder…

Have I made the greatest number I can with my cards?
Is my number big enough to win the game? Can I go higher?
Does it make more sense to swap 0, 1, or 3 cards? Why?
Can I think of a strategy to help me decide what to do?
What can I learn from my previous choices? Will that information help me now? Why?
Did my swap increase or decrease my number?

Other Ways to Play

1. The player with the greatest number in a round takes the other players' cards. Play until there are no cards left.
2. No swaps allowed.

3. Take a card from another player's hand (without looking at what card you are picking). That player then takes a card from a different player or chooses one from the picking pile.
4. Use more than one deck of cards.
5. Create smaller, larger, or decimal numbers (e.g. 2-digit, 4-digit, hundredth place, …).
6. Solitaire: Try to beat your Personal Best (PB).
7. Each player uses their own deck to play remotely with a friend or family member.

Extensions & Discussion Question Examples
How did you decide whether to keep or swap?
Did taking a risk work out in this round? Why?
Do you have a strategy for playing this game?
Did you use the same strategy for every round? Why?
Estimate/calculate the difference between the highest and lowest numbers in the round.
How does your 3-digit number compare to the winning number?
What was your personal best (PB) from all of the rounds?
What was the greatest number created in the game?
How does your PB compare to the highest score in today's game?
Write down your number for each round. At the end of the game, arrange your numbers from least to greatest or greatest to least.
What is your number range for today's game?

Resources
https://www.mathcoachscorner.com/2016/08/triple-digit-dare-engaging-place-value-game/
*This blog post was the inspiration for the game I presented at our Virtual Family Math Fair.
https://www.weareteachers.com/math-card-games/
www.fatherly.com/play/the-best-card-games-for-kids/
https://www.kidspot.com.au/things-to-do/kids-games/indoor-play/snap-12-classic-card-games-to-teach-the-kids/news-story/1d153893aee53908749c1377c588928c

Four 4s: Explore making the numbers 1 to 20 with only four 4s and different operations.

Compiled by Sandra Fox

Level: Grades 3 and Up

Concepts: Number Sense, Computational Fluency

The Problem

It has been proposed that all whole numbers to infinity can be represented by four 4s and different operations.

Explore how this can be done for the numbers 1 to 20.

Materials

Scrap paper and pencils, pens, etc. **Useful Math Concepts**

Order of operations

- Anything inside brackets first (following the order of operations inside the brackets as well)
- Exponents next
- Then multiplication and division from left to right
- Finally, addition and subtraction from left to right

Factorial !

! means to multiply the number by each number below it in succession

$4! = 4 \times 3 \times 2 \times 1$

Square Root

The square root of a given number is a number that when squared, equals the given number.

$\sqrt{4} = 2$ (because $2x2 = 4$ or $2^2 = 4$)

Playing with the Four 4s problem develops:

- understanding that numbers can be composed in many ways; flexibility with numbers
- understanding of mathematical rules and concepts
- skills in representing mathematical thinking symbolically

Extensions

Find ways to make the numbers 1-50 or 1-100. (Hint: you will need some other operations for some numbers.)

Can you do the same with five 5s? How about six 6s?

The Four 4s problem has been around since at least the late 1800s.

One source for this problem is: https://www.youcubed.org/tasks/the four-4s/

Interesting Video Here is a video from Numberphile that shows how four 4s can be used to make numbers all the way to infinity!
https://www.youtube.com/watch?v=N oo4lN-vSvw

"Just by noticing the pattern and asking the question why?, you are engaging in mathematical play."

Francis Su-
Mathematics for Human Flourishing

Tricky Triangles: Paper-cut activity that examines the relationships of angles of triangles and other polygons.

By Pushpa Nagarajan and Andrea Marsh

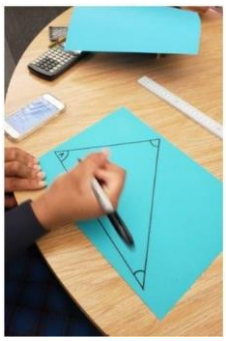
Level: Senior Grades

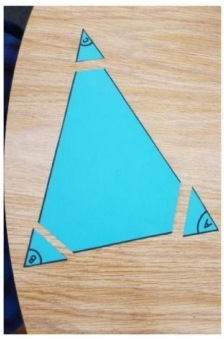
Concepts: Geometry and Measurement, Problem Solving

Materials: Construction paper or cardstock (different colours)/scissors/pen or pencil/ruler/coloured pencils/glue or tape

Interior Angles Procedure:

1. Sketch a triangle on a piece of paper. This can be any size or type. Do you know of any specific types of triangles?
2. Mark the angles inside the triangle as A, B, C. As shown in the diagram. You can colour these three angles with different colours.
3. Cut out the triangle first and then cut out or tear off the three coloured angles.
4. On a second piece of paper, arrange the three angles on a line. How do they fit? What do you now about the angle of a straight line?
5. Complete a second triangle (different size and shape from the first) and see how the angles fit.



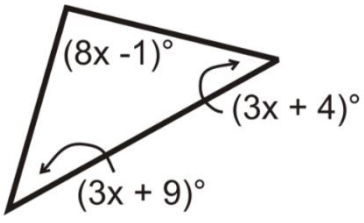


The triangle sum theorem states that all angles in a triangle add to ____. [If you have a protractor use it to measure the angles and verify, they add up to this amount]

Triangle Puzzles

1. Two interior angles of a triangle measure 50° and 70°. What is the third interior angle of the triangle?

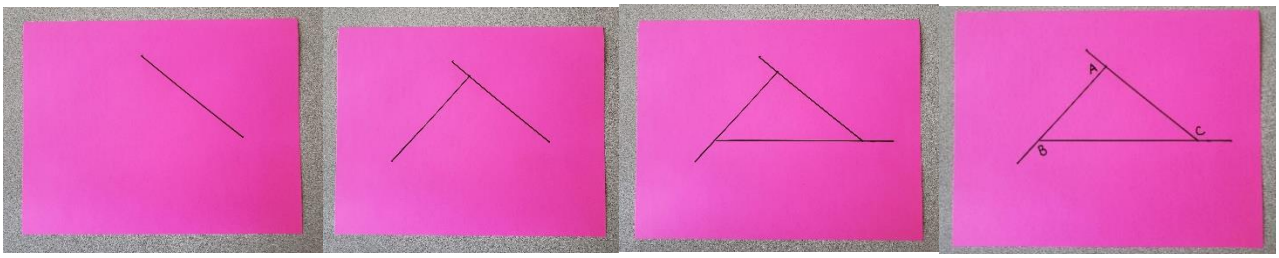
2. Find the value of x and the measure of each angle.



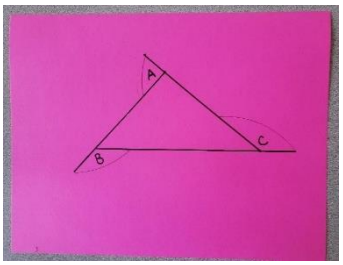
What about the *exterior* angles in a triangle?

Exterior Angles Procedure:

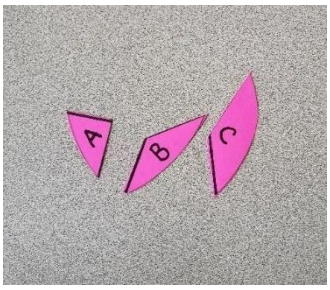
1. Sketch a triangle on a piece of paper and be sure to extend the lines.



2. Mark the angles between the triangle and the line as A, B, and C as shown.



3. Draw in the arcs of each angle. You can colour in the arcs.



4. Cut out all the arcs and arrange the three arcs. What shape does it form? How many degrees does this add to?

Hexaflexagons

By Jen Barbour and Jen Whiffen

Level: Elementary Grades

Concepts: Geometry and Measurement, Problem Solving

When making a hexaflexagon, take your time and enjoy the journey. For this exploration you will need a sheet of note paper (8.5 x 11) cut lengthwise into approximately 2 cm strips, a ruler and a protractor, a glue stick or tape, a pencil and something with which to colour.

Exploration 1: The V-Shape

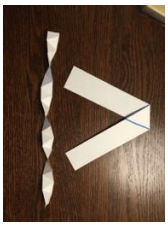
Let's do some experimenting with those strips of paper!
- Fold 1 strip of paper so that it makes a V-shape.
- Next, hold your V up to a light source. A window or a lamp works well. What sort of shape do you notice? Use a pencil to carefully trace around the shape.
- Measure the sides and the angles. What do you notice? Record your ideas.

There are four possible triangles you might have created: an **isosceles triangle,** an **equilateral triangle**, a **right angle triangle** and a **scalene triangle**.
- Which one did you create? How do you know?
- Play around with your other strips of paper. Can you make all four kinds of triangles?
- Is it even possible to make all four? Record your findings.

Use your protractor to measure the angle that sits inside the bottom of your V-shape.
-Can you predict what sort of triangle you made just by measuring this angle?

Exploration 2: Folding Congruent Triangles

In order to make a hexaflexagon, you need to fold a line of triangles that are all the same shape and size (congruent). However, what kind of triangles are the best for this? Try working with an isosceles, right-angle, equilateral, and scalene triangle.



-Fold your paper strip so that you end up with a line of congruent triangles. Use a back-and-forth fold instead of a rolling fold.
-Is it possible to fold all of them? Which ones seem to work best and why?
-When you unfold your stacks of folded triangles, what do you notice? Pay close attention to how they unfold and what they look like.

If you find the folding problematic, try the template at this website: Click here

Exploration 3: Creating Shapes from Lines of Triangles

You will likely have noticed that two triangles result in a pretty satisfying line of congruent triangles: the right-angle triangle and the equilateral triangle. Play with these lines of triangles to see what kind of shapes we can make!

-What kinds of shapes result from folding lines of right-angle triangles?
-What kinds of shapes result from folding lines of equilateral triangles?

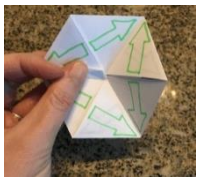
Encourage students to test for different polygons and lines! Here are a few examples:

Exploration 4: Making the Hexagon

By now, you have likely figured out that equilateral triangle is the key to making hexagons! To make a starter flexagon, you will need a line of 9 equilateral triangles in a row.
Play around and see if you can make a hexagon. You will notice 1 extra triangle left over. Fold this one over and glue or tape it down. You should have a nice stable hexagon with no major gaps. Now you are going to make sure your hexagon is flexible along all fold lines. Fold it along every line forward and back to make sure it is good and flexible.

You should be ready to pinch your hexagon so that you make a three-pointed star. Gently open the top of the 'star'. Open it all the way. You will see...another hexagon! Pinch it to make another tree shape and repeat.





Exploration 5: Playing with Designs

Grab some pencils or markers and start to colour your hexagon. Colour both sides a different colour. Add some extra designs if you like.
-Pinch and open your hexagon now. What do you notice?
-When you have coloured all possible surfaces of your hexagon, you can even unfold it to see what happens. Before you do it, make a prediction: what do you think it will look like?
-Make more hexaflexagons! Create different kinds of designs! Play and experiment. What do you notice?

Finally:

Challenge yourself! Can you make a double hexaflexagon that shows six possible designs instead of three? What about a triple? Is it even possible? What happens when you try?

Task adapted from and inspired by:

How to fold a hexaflexagon. (2020, Sept. 6). In *Wikihow*). https://www.wikihow.com/Fold-a-Hexaflexagon
Vihart. (2017). *How to make a hexaflexagon: A definitive guide.* [Video]. YouTube. https://www.youtube.com/watch?v=Svq2Kscmmwc

Teetering Toothpick Towers: Creative building challenge to design the tallest toothpick tower

By Stella Hsu and Christina Reis

Level: All Grades

Concepts: Geometry and Measurement, Problem Solving

Downloadable/Viewable PowerPoint: http://bit.ly/toothpicktowers

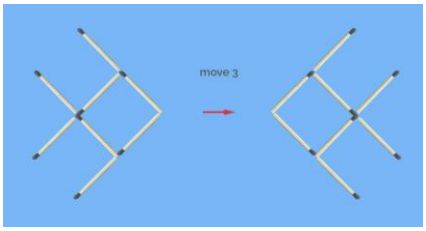
Objective: A creative building challenge to design the tallest toothpick tower. What geometric shape supports, stabilizes, and stiffens structures?

Materials: 30 Toothpicks, Play-Doh (or sticky tack, tape, etc.), measuring tape or ruler (needs to include cm).

Background Information: This activity integrates design components of STEM and the application of math concepts (geometry and measurement). Students have the opportunity to exercise creative thinking skills by designing a free-standing structure from toothpicks, critically assess real-life structures, and then analyze the similarities and differences of buildings in real life to their own designs. Last but not least, they are encouraged to reflect on ways to improve their design and to make observations in their local communities.

Starter/ Warm-Up Activity: Toothpick Fish

Build the toothpick fish and try to determine how the fish can change direction by simply moving only 3 toothpicks.



Adapted from: Chaudhuri, Atunu (2017). "Matchstick Puzzle: Turn around the fish by 3 moves". SureSolv. https://suresolv.com/brain-teaser/ matchstick- puzzle-turn-around-fish-3-moves

Teetering Toothpick Tower Challenge: Using only 30 toothpicks, build the tallest free-standing structure. Play-Doh is used as a connector between the toothpicks. Students are given 10 minutes to build (this can be adjusted depending on the total time allotment). When completed, measure the total height in centimeters to the nearest tenths (1 decimal place).

Discussion Question: Be a detective! Review the following images, what geometric shape(s) stand out? What shapes do you notice in all of the structures? *NOTE: Images below are for reference only. Please see PowerPoint/Google Slides for more detailed versions.*

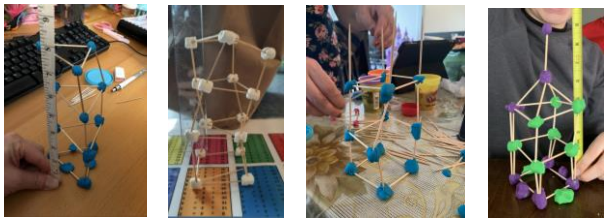
Solution: Triangles

Explanation: Triangles are the strongest geometry shape when it comes to architecture and are commonly used in the design of buildings (Ramos). They stabilize, stiffen and support structures (Design Squad Global). When building materials are used to form a triangle, the design has a heavy base and the vertex (or apex) on the top is capable of handling weight because of how the energy is distributed throughout the triangle. The three legs of a triangle define one and only one triangle. If all three sides are made of a rigid material, the angles are fixed and cannot get larger or smaller without breaking at the joints, unlike a rectangle, for example, which can turn into a parallelogram and even collapse totally (Ramos).

Reflection: Does your own building structure contain triangles? Are there parts that could have had toothpicks added to form a triangle? How would you have done this activity differently now knowing what you know about triangles?

Extension: Explore structures and architects in your local community. What other geometric shapes do you see? Which type of triangles are more commonly seen?

Examples:



Images are submitted by participants during the February 20th Virtual Math Fair.

Resources:

Design Squad Global. 2017. "Strong Structures with Triangles". *WGBH Boston.* YouTube. https://www.youtube.com/watch?v=mBHJtWbsiaA&feature=emb_logo

Lekcyje. "Shapes: How Do Shapes Affect Architecture?" Stadium Jezykow Obcych. https://www.sjo.pw.edu.pl/biuro1/LekcjeTechn/Shapes.doc#:~:text=The%20equilateral%20triangle%20is%20by,Complex%20of%20Giza%20in%20Egypt.

Ramos, Nicholas. 2018. *Triangles Used in Architecture.* Sciencing. https://sciencing.com/triangles -used-in-architecture-12084289.html

"One of the best ways to claim your heritage in mathematics is to find a game of strategy from your own cultural history and embrace the kind of thinking the game requires."

Francis Su-

Mathematics for Human Flourishing

Solitaire Chess: Learn Your Moves!

By April Jung and Jessica Bella

Level: Intermediate Grades

Concepts: Strategy, Problem Solving, Reasoning

How to Play Solitaire Chess:

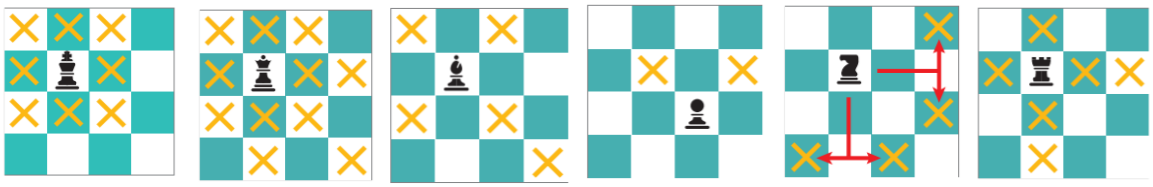
- Move the chess pieces according to the movement rules. Each move must result in a captured piece.
- If you are left with two or more pieces on the challenge card, reset and try again.
- When there is only one piece remaining - YOU WIN!
  *Movements are the same as in standard chess.

Materials:

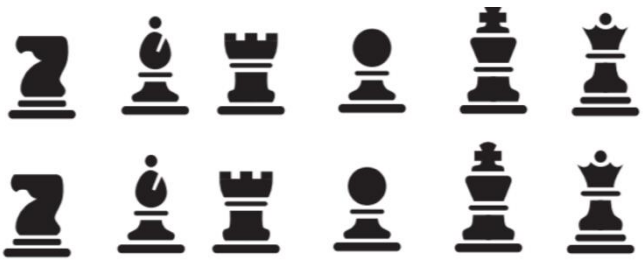
- Chess Pieces individually cut out (at least 2 of each) OR Standard Chess Set pieces
- Level 1 - 4 & Create Your Own Gameboards

How the Pieces Move:

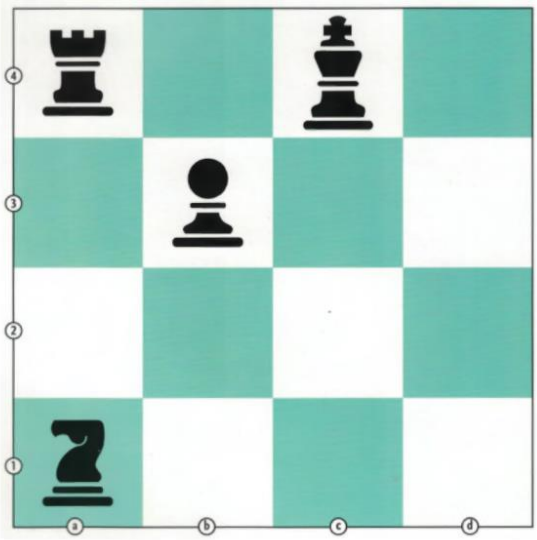
King Queen Bishop Pawn Knight Rook



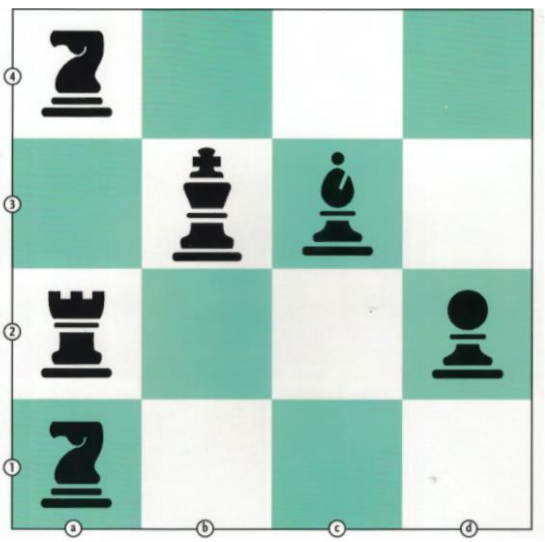
Chess Pieces [Cut Out Individually]



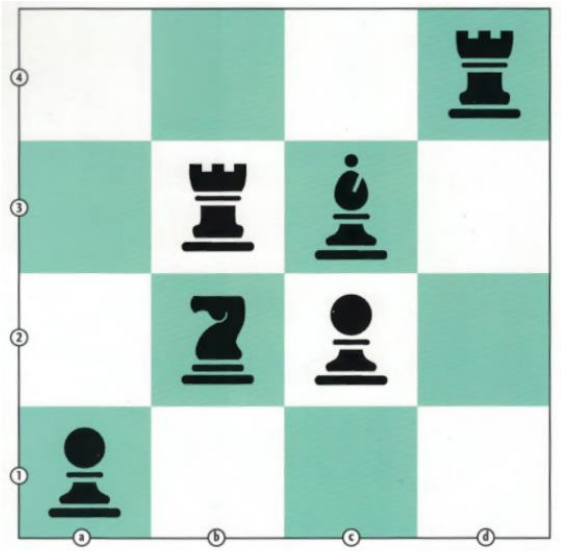
Level 1 Gameboard



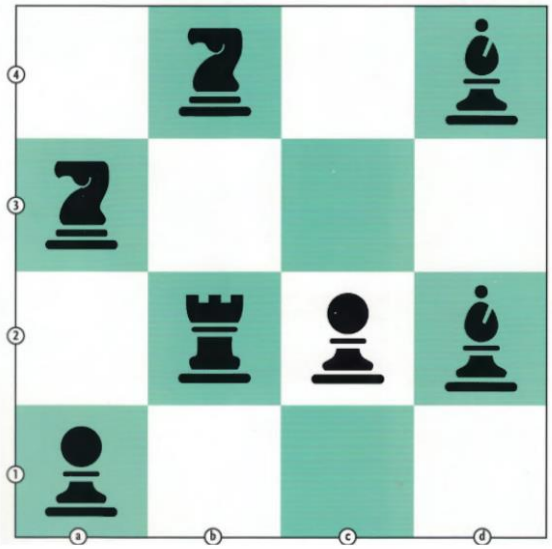
Level 2 Gameboard



Level 3 Gameboard

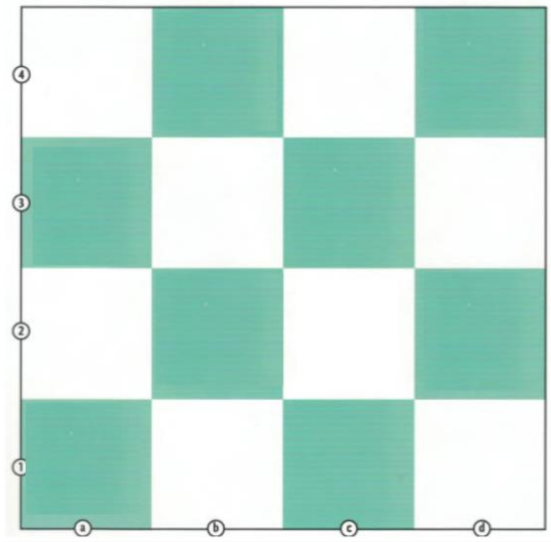


Level 4 Gameboard



Create Your Own

Strategically place the chess pieces of your choosing onto the gameboard provided to create your own game board.



Record Your Movements

Use the below chart to record your moves for each game.

Sequence of Movements: Ex. A2, B4, C3, etc.	

Answer Key

Level 1	Level 2	Level 3	Level 4
A1 - B3 C4 - B3 B3 - A4	D2 - C3 A4 - C3 C3 - A2 B3 - A2 A2 - A1	C3-D4 D4-B2 A1-B2 B3-B2 B2-C2	B2-B4 B4-D4 D4-D2 D2-C2 A3-C2 C2-A1

Photo courtesy of https://www.thinkfun.com/products/brain-fitness-solitaire-chess/

Websites for further explorations with Chess: (Ctrl + Click to activate link)
Solo Chess Online: https://www.chess.com/solo-chess
Play Real Chess Online: https://www.chess.com/play/online
Purchase Solitaire Chess: https://www.thinkfun.com/products/brain-fitness-solitaire-chess/

Acknowledgment:
This task is a game produced by ThinkFun. All copies and game boards shown are from the ThinkFun resource which can be found here: https://www.thinkfun.com/products/brain-fitness-solitaire-chess/

Play to Win with a Game of Nim
Using Math to Find a Winning Strategy

by Kim Bartram and Lana Dyck

Level: All Grades

Concepts: Problem Solving, Number Sense, Strategy

How to Play
There are many variations to playing the game of Nim. Try these rules to start.
Two players have a pile of 15 small objects between them.
The youngest player chooses who will go first.
Each player takes turns removing either 1, 2 or 3 objects from the pile.
The winner is the player who takes the final object from the pile.

Math Thinking
As you play the game, each player can say how many objects they are taking and how many objects are left in the pile. Ask questions like:
Does it matter who goes first?
When can you tell if you are going to win or lose?

Variations
Change the purpose of the game to the winner is the person who does **not** take the last object from the pile.
Change the number of objects in the pile.
Add more players to the game.
Reduce or increase the number of objects a player can remove from the pile.

More Questions
Try some of the variations, compare your experiences and ask more questions.
How does your strategy change?
What do you wonder?
What patterns do you notice?
How can you guarantee you will win?

For further exploration:

https://plus.maths.org/content/play-win-nim
https://nrich.maths.org/1204
https://www.youcubed.org/resources/nim-games-3-12-video/

Tricky Tens

By Charli-Rae Dougherty

Level: All Grades

Concepts: Problem Solving, Number Sense, Strategy

Background Information

Players: 1+ (works best with 1-2)

Time: 5-10 minutes per round

Materials: standard deck of cards, 10s/Js/Qs/Ks & Jokers removed

Required background knowledge:

adding to ten OR ability to count to 10 and use counting on strategy

Suggested Teacher/Parent Use

1. **Explore**: Warm up activity
2. **Play:** Game rules

   (Play the original game before trying alternate versions.)
3. **Think**: Discussion questions

*After learning the game, children can play on their own. If this is the case, the teacher/parent can skip steps one and three at their discretion.

1. Explore

How many combinations of two cards make 10?

What are the different combinations?

(If appropriate, repeat with combinations of three and four cards.)

2. Play

Original Rules and Set-Up: Lay out 20 cards face-up in a rectangle. Remove cards in sets of 2 or 3 or 4 whose numbers add up to 10. Aces count as 1. The goal is to remove all of the cards.

Example turns: 8 and 2 can be removed together.

6 and 3 and A(1) can be removed together.

*Note 1: The combinations used and the order that the cards are removed does make a difference. A set of cards may not be able to be removed with one strategy, but may be possible to remove with a different strategy.

*Note 2: Children who are not fluent with addition can use a counting strategy. If players use a standard deck of cards, children can count the number of symbols on one card, and count-up on another card to find 10. Alternatively, this strategy could be used during the warm-up activity, where pairs can be identified and then written down for reference.

Alternate Rules:

A) Create a draw pile from the remaining cards. Replace removed cards with cards from the draw pile. The game ends when you are out of cards.

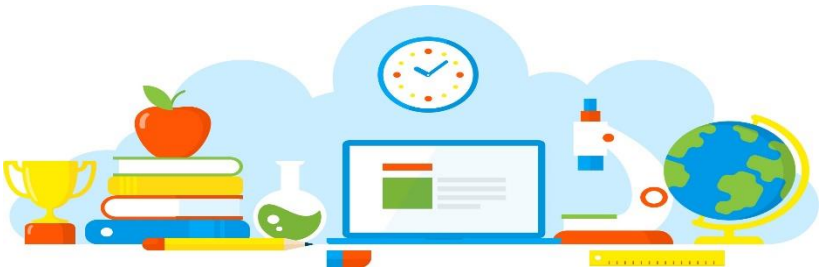
B) Use any operations (+,-,x,/,!) to make 10. (Consider playing to a number other than 10.)

C) Create your own alternate rules.

3. Think

Discussion Questions:

- What strategy did you use when deciding which cards to remove? Do different strategies produce different outcomes?
- What can you learn from this game?
- Is it always possible to clear the cards? What makes a set of cards impossible to clear?
- Will starting with more cards make the game easier or harder? What about starting with fewer cards? Why?
- What happens when you start with an odd number of cards?
- If you're playing with all operations, which goal numbers make the cards easy to clear? Which goal numbers make the cards hard to clear?
- How can you change the rules to make it easier? How can you change the rules to make it harder?
- Inspired by: Maths card game - Total of 10
- https://www.youtube.com/watch?v=SD028NO-ZGc&t



Tapatan : Tic-tac-toe with a Twist
A Three-in-a-Row Strategy Game

By Carol Bob

Level: All Grades

Concepts: Problem Solving, Strategy

Interactive Gameboards on Jamboard:
https://jamboard.google.com/d/1ninL1sRSBffPAQkinOuMX0ATQwVBh82S-IeygAW55zI/viewer

Materials Required:

Paper, marker, two different coloured counters

Core-Competencies:

Critical and reflective thinking
Collaborating
Personal awareness and responsibility

First Peoples Principles of Learning:

Learning involves recognizes the consequences of one's actions

Background:

Tapatan is an abstract strategy game from the Philippines

Directions:

Two players take turns placing one counter at a time on the game board. When all counters are placed on the game board, players take turns moving one counter at a time along any line to the next empty place.

Jumping counters is not permitted.

The first to make three in a row, wins

Discussion Questions:

How could you have solved this challenge differently?

What strategies did you use to make three in a row?

Extensions:

Achi same goal of three in a row with four counters each instead of three counters; played in Ghana, West Africa. Follow this link to learn more: http://pi.math.cornell.edu/~mec/2003-2004/graphtheory/tictactoe/howtoplayttt.html#achi

Picaria is the same game with three in a row but more places to move; played in Puebla nation in New Mexico. Follow this link to learn more: http://mathcentral.uregina.ca/RR/database/RR.09.00/treptau1/game11.html#:~:text=To%20Play%3A,a%20counter%20is%20not%20allowed.

Human Tapatan-two teams of three, chalk to draw a game board on the cement, or a stick to draw the game board in the soil.

Resources

Tapatan rules, downloadable game board: https://regentsctr.uni.edu/ceestem/resources/game/tapatan

Tic-Tac-Toe variations: http://pi.math.cornell.edu/~mec/2003-2004/graphtheory/tictactoe/howtoplayttt.html#achi

Games of Strategy: http://mathcentral.uregina.ca/RR/database/RR.09.00/treptau1/game11.html#:~:text=To%20Play%3A,a%20counter%20is%20not%20allowed.

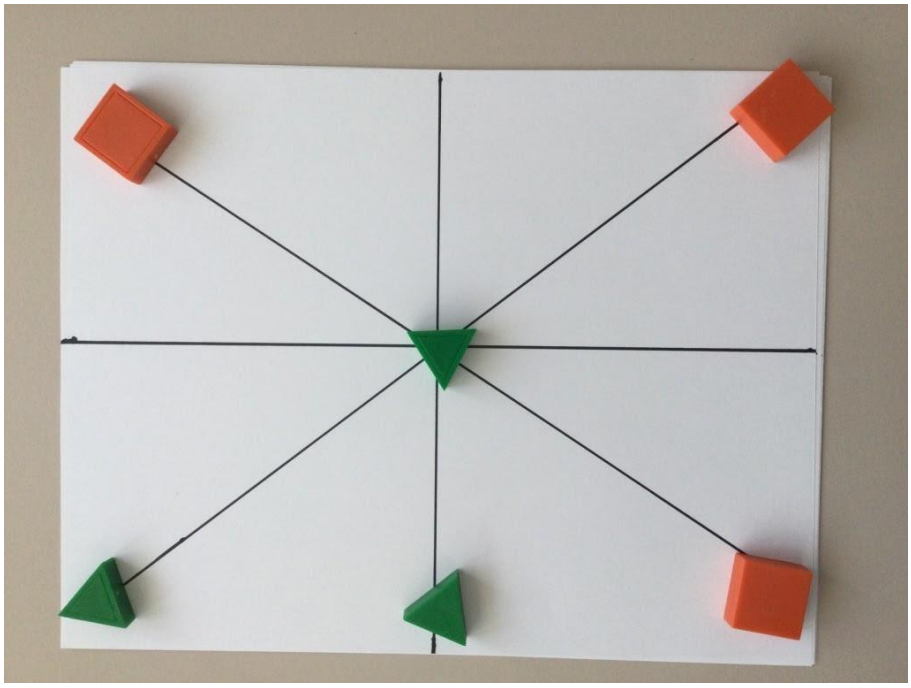


Figure 1 Tapatan game board. Photo by: Carol Bob

"To do mathematics means more than just learning the facts of mathematics - it means seeing oneself as a capable mathematical learner who has the confidence and the habits of mind to tackle new problems."

Francis Su-
Mathematics for Human Flourishing

Logic Puzzles: Try to solve and make your own puzzles.

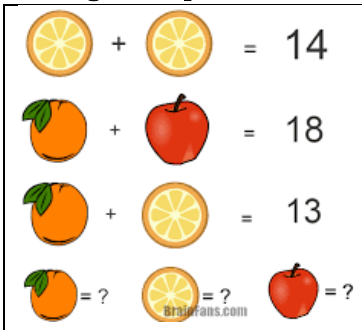
By Maria Ramirez

Level: All Grades

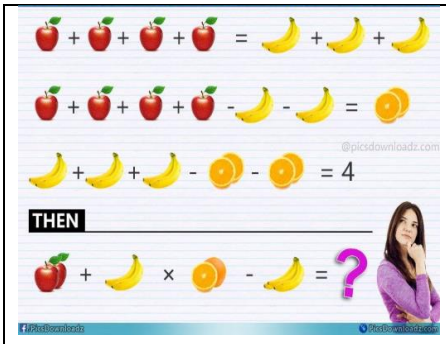
Concept: Problem Solving

Introduction:
In math, we use logic to solve problems. We use clues to help us see patterns to understand the problems better. Let's see if we can solve some logic puzzles using clues.

Solving Examples:

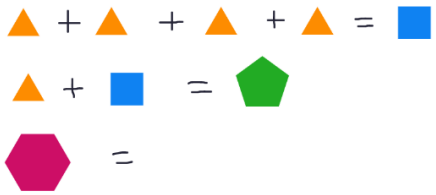
	Ask someone to share how they got their answer. Ask if anyone else gets the same answer using a different way? Answer: Orange slice = 7 Whole orange = 6 Apple =12

Retrieved from https://brainfans.com/

	Ask someone to share how they got their answer. Ask if anyone else gets the same answer using a different way? Some may answer 18. Please ask them to look closely at the oranges and the bananas. Answer: Apple = 3, banana = 2x each banana, orange 2x each orange half 2(3) + 2x2 x 2x3 - 2x3 6 + 24 - 6 = 24

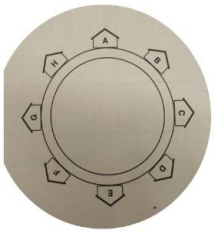
Retrieved from: https://www.pinterest.ca/pin/858639485178457565/

Making our own Puzzles
Go to https://mathigon.org/polypad and model how to make a puzzle

	Try to guess what a hexagon is equal to using triangles, squares and pentagons. There could be many possible answers.

Extension Word Puzzles

Logic puzzles can also be word problems. Here are 3-word puzzles that you can try after the session:



ROUND TOWN

A little town has only one thoroughfare: Circle Street, which traverses around a park. Eight buildings lie along the perimeter including a post office.

LET'S GUESS WHAT THE BUILDINGS ARE, USING CLUES

1. Going counter-clockwise from the town hall (which is in position A) to the church, Circle Street passes the library and exactly two other buildings.

2. The shortest path along Round Road from the hardware store to the museum passes the church

3. The library (which is immediately counterclockwise from the grocery store) is directly across the park from the museum

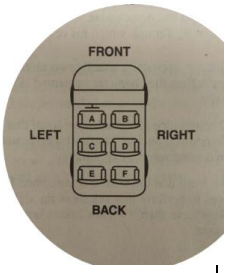
4. The high school isn't directly across the park from the grocery store

SUPER CARPOOLERS

Many superheroes can't fly.

Six superheroes, each of whom has a superhero name and a different secret identity with a first and last name, carpool in a minivan to the crime scene to restore justice and keep the peace.

Guess where each one sits.



1. One superhero's secret identity first name is Calista and one surname is Lewen. One superhero is Silhouette.

2. Denise shuttles her fellow heroes to and from crime scenes as the driver in seat A

3. The hero surnamed Garcia sits to the immediate left of Captain Canada (who is surnamed Nguyen)

4. Mosquito Man's secret identity is Bernard Islington. The incredible Bulk sits immediately behind Arthur but immediately in front of Erna Chan

5. Fred (who sits in front of at least one other superhero) isn't the hero surnamed Jones. Wonder Wombat sits to the immediate left of Ultrasonic

Adapted from Original Logic Problems (ISSN 1533-8274) October 2014 by Penny Press Inc

Mathemagic!

By Danielle Kerbrat

Level: All Grades

Concept: Problem Solving

How to play: Watch it done

1) The magician will lay out 4 cards face up in a row, then place another 4 cards face up in a second row, and repeat until there is a 4 by 4 grid of 16 cards face up as shown. Set the remaining cards aside.

2) A volunteer will be asked to choose a card and identify only the column where the card is located.

3) The magician will collect the cards by column, then lay them out in rows of 4 as before.

4) The volunteer will again be asked to identify the column where their card is located.

5) The magician will name their card.

Why it works:

The magician asks the volunteer to identify the column where the card is located. The magician picks up the cards by column (remembering which column the card was in) then places them back down in rows. This is the equivalent of rotating the grid of cards by 90^0 or switching the rows and columns. (Compare this picture with the one above.)

Now the magician knows what row the card is in. When the volunteer identifies the column the card is in now, the magician is able to use the intersection of the two "columns" to locate the card.

Change it up:

Try this trick with a different sized grid, or by asking for rows instead of columns.

Transforming Toothpicks: Transform One Configuration to Another!

By Grace Point

Level: All Grades

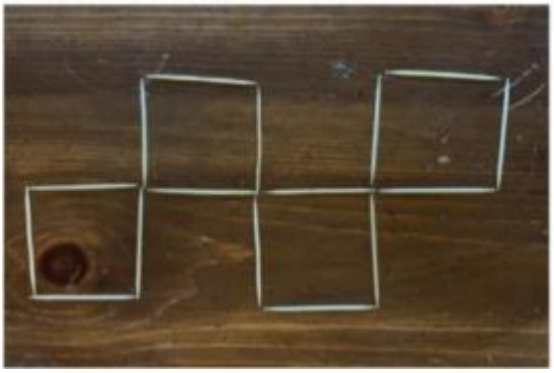
Concepts: Problem Solving, Spatial Relations

Materials: 16 Toothpicks/Matches/Popsicle sticks

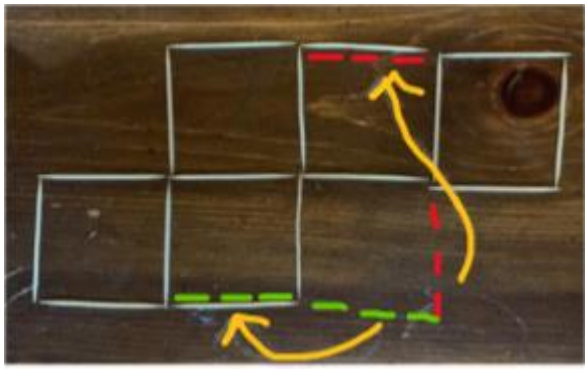
Directions: configure 16 toothpicks on a table in the shape of 4 staggered squares where one corner of each square is touching another.

The challenge: Move only 2 sticks to create 5 squares.

The catch: there cannot be any sticks "poking out," all sticks must be used to complete the 5 new squares.



Solution: Move the farthest toothpick on the bottom row to the top middle space; the bottom farthest toothpick to the left to create adjacent square.



YouTube Link: https://www.youtube.com/watch?v=iR0LTiuj6FA

Lego and Math: Use Lego Blocks to Explore Multiplication, Division and Factors

By Justin Bisson and Lida Espinosa

Level: Elementary Grades

Concepts: Problem Solving, Number Sense, Computational Fluency

Essential Questions:

1. How can I use Lego blocks to represent groupings?
2. How can I connect Lego and groups with the concept of multiplication?

Problem:

Represent groups using Lego blocks from numbers being rolled on two dice.

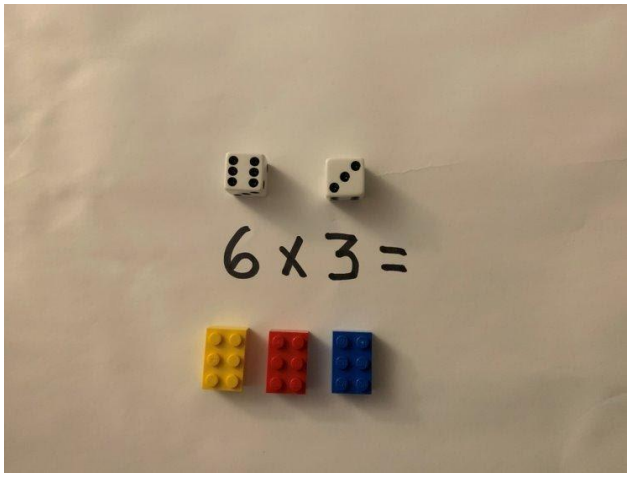
Materials:

- Two six-sided dice
- Lego blocks – random sizes
- Lego plate – any size

Procedure:

1. Roll dice.
2. Look for Lego blocks that represent the groupings.
3. Put Lego blocks on Lego plate.
4. Find another way to show the groupings using different Lego blocks.

Example:



Step 1 – Roll Dice.

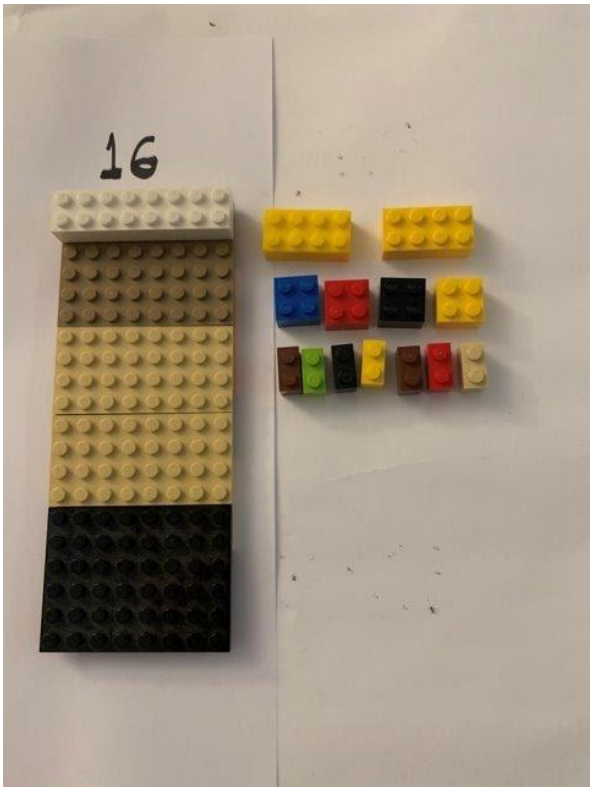
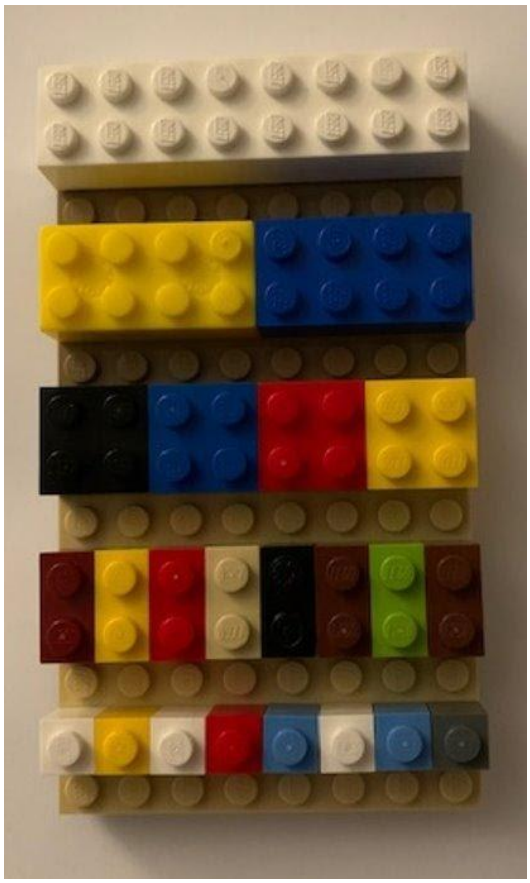
Step 2 – Find 3 groups of 6 Using Lego blocks.

Step 3 – Represent using Lego blocks.

Extension: Find other blocks to represent this situation. How does 6 groups of 3 relate to 3 groups of 6?

Other questions/extensions to consider:

1. Using three dice instead of two and repeat steps 1 to 4 in the procedure.
2. How can you split up a Lego block into groups of different blocks of the same size?

For example, how could you split a Lego block of 16 studs into groups of different groups of the same size? 	Pose a picture that students need to find the mistake if any: Is there anything wrong with this picture?  Answer: Yes – there are only 8 one stud blocks at the bottom and there needs to be 16

3. **Create a game adapted from the resource:**
https://www.youcubed.org/tasks/how-close-to-100/

a. Use two dice to roll the factors.
b. Represent the factors using Lego blocks and place strategically on Lego plate.
c. Players take turns rolling dice and first player to cover entire Lego plate wins!

Triangle Sums Puzzle

By Janelle Findlay

Level: Elementary Grades (Grades 3 and up)

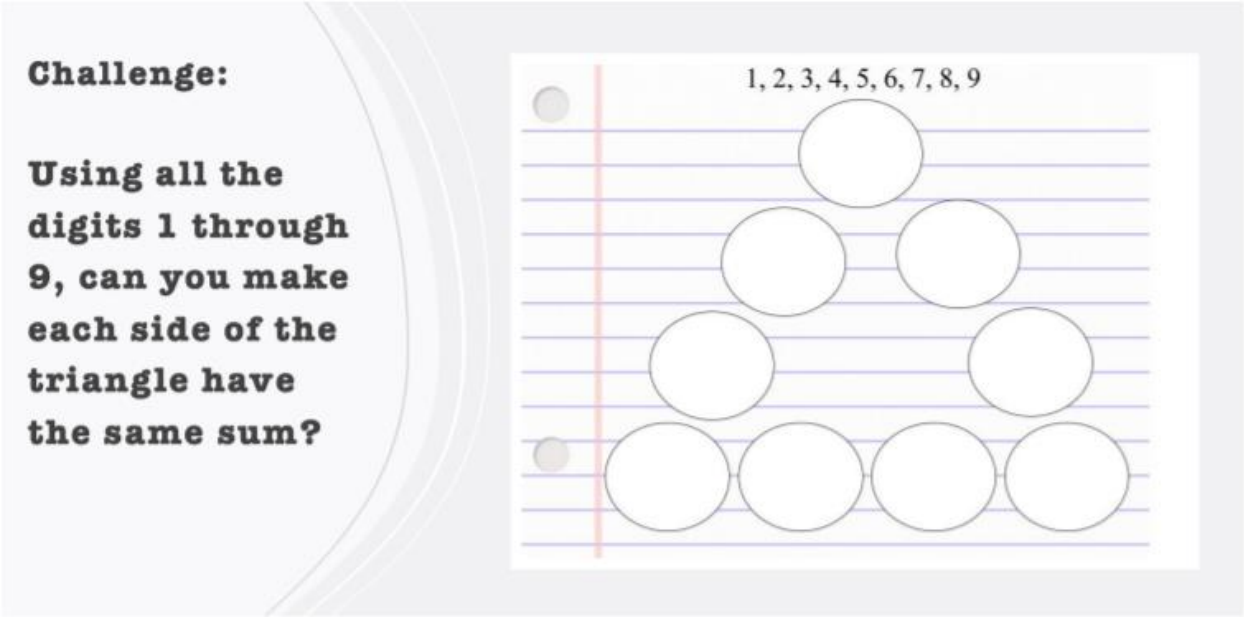
Concepts: Problem Solving, Number Sense, Computational Fluency

Materials:

Pencil and Paper or Whiteboard and Whiteboard Marker

Introduction:

Most three-year olds can recite the first nine digits of our number system. And, the first operation we learn as young children is addition. Let's take these two concepts and explore the beauty that can emerge when we play around with them in puzzle form.



*If a further challenge is desired, have all the digits be negative.

**There is more than one answer, and more than one sum.

Extension Question: If you find a solution that works, what do you notice about the three corner digits?

This question was adapted from: http://www.solving-math-problems.com/math-puzzle-triangle.html

Noggin Joggin': Math Puzzles Game Show
Each question gives your brain a little workout!

By Cassie Dusdal

Level: Intermediate Grades

Concepts: Problem Solving, Number Sense, Patterning

Included are a variety of leveled logic puzzles that work to exercise our understanding of patterns, place value, factors, multiples, fractions, operational fluency and divisibility. Choose a category and away you go! These puzzles can be accessed at the following link: Click here!

Required Materials:
Pencil and paper, or whiteboard and marker

Some questions we might want to ponder before beginning:

- What do the following words mean?:
  - Sum
  - Difference
  - Product
  - Quotient
  - Divisible
  - Numerator and Denominator
- What are some strategies I could use to figure out these questions?
- What is the difference between the phrases like "20 greater" and "20 **times** greater"?

Playing Tips:

- Start at the beginning! The questions might seem easy at first, but they get trickier!
- Don't try to do all of this in your head!
  - Draw it out
  - Try different pencil on paper/marker on whiteboard strategies
  - Use your fingers (maybe even your toes!)
  - Talk it out
  - Work together with a friend or family member
- Have fun!
  - Don't take this too seriously
  - Keep score – but only if it adds to the fun factor!

Photo Reference: American Escape Rooms. (2018-2021). Brain Teasers and Tricks to Better Thinking Minds. https://americanescaperooms.com/blog/post/brain-teasers-and-tricks-to-better-thinking-minds

AFTERWORD

We are grateful to all of the families that accepted our invitation to experience the fun of exploring mathematics with and in community during UBC's first Virtual Family Math Fair. You welcomed us into your homes and joined us in playfully interacting with mathematical concepts from a range of topics.

Parent Feedback:

"We thought the entire program was well organized, user friendly, fun and the instructors gave very good directions…"

"We liked learning new games that we can play again at home and share with our other family members."

"It was nice to have a relaxed atmosphere … I could tell that this environment engaged my daughter."

"Super wonderful event. Our whole family enjoyed it. Thank you so much."

Thank you to the faculty and graduate students enrolled in EDCP 550 Mathematics in Community for organizing the Virtual Family Math Fair. Additional thanks to teacher candidates, faculty, and graduate student volunteers who contributed to the success of this event.

Facilitator Feedback:

"I was delighted to hear children talk about math and say, 'That was fun!' after they completed a task."

"Watching children and adults embrace the opportunity to become math explorers who notice and wonder was an energizing experience for me as a presenter."

"I knew we were doing something good when after the session was over, a child said, "One more!"

Our hope is that these activities from the 2021 UBC Virtual Family Math Fair become *"conversation starters- in the home, in the classroom, or among friends- for how to imagine mathematics in a new way"* (Su, 2020, preface x).

For further family math resources, visit https://dfr.stemnetwork.educ.ubc.ca/

Reference:

Su, F. (2020). *Mathematics for human flourishing*. Yale University Press.

Contributors to UBC's 2021 Virtual Family Math Fair

UBC's first Virtual Family Math Fair was the brainchild of our professor, Dr. Cynthia Nicol, who is an Associate Professor in the Faculty of Education. Dr. Nicol invested countless hours organizing the event and collaborating with contributors. Our cohort is grateful for her support.

Thank you to the faculty, graduate students and teacher candidates:

Zaman	Alikhani
Ann	Anderson
Danielle	Antoniazzi
Will	Ballard
Jennifer	Barbour
Kim	Bartram
Jessica	Bella
Justin	Bisson
Carol	Bob
Leicha	Bragg
Eva	Choi
Charli-Rae	Dougherty
Cassie	Dusdal
Lana	Dyck
Megan	Fan
Joy	Fast
Janelle	Findlay
Katrina	Fograscher
Sandra	Fox
Evelyn	Gakpetor
Lida	Garzon
Carolynne	Hodgson
Stella	Hsu
April	Jung
Sukhwinder	Kaur
Debby	Knoke
Christina	Krause
Peter	Lai
Mahima	Lamba
Michelle	Li
Esther	Lu
Natalie	Lubenow
Andrea	Marsh
Fiona	Meagher
Michael	Myhal
Pushpa	Nagarajan
Sharon	Ng
Cynthia	Nicol
Janice	Novakowski
Grace	Point
Joy	Qiaochu
Maria	Ramirez
Christina	Reis
Lindsay	Reynolds
Jacob	Richardson
Bavoshia	Silas-Bossan
Shawn	Stewart
Jennifer	Whiffin
Kwesi	Yaro

We acknowledge and appreciate the wonderful families who joined us on a Saturday morning to share in our mathematical community. UBC's first Virtual Family Math Fair would not have been possible without their enthusiastic participation!

"Believe that you and every person in your life can flourish in mathematics."

Francis Su-
Mathematics for Human Flourishing