5 Games For Building Logic

Hands on Math

A collection of incredibly awesome math games

Edited by
Emily Dyke and Joe Dyke

"A mind is not a vessel to be filled but a *fire* to be kindled." - Plutarch

Hands-On Math

"Knowing mathematics means being able to use it in purposeful ways. To learn mathematics, students must be engaged in exploring, conjecturing, discovering and thinking rather than only in rote learning of rules and procedures. Mathematics learning is not a spectator sport. When students construct personal knowledge derived from meaningful experiences, they are much more likely to retain and use what they have learned. This fact underlies teachers' new role in providing experiences that help students make sense of mathematics, to view and use it as a tool for reasoning and problem solving."

- Standards for School Mathematics: Executive Summary
National Council of Teachers of Mathematics

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Hands-On Math

A Note to Parents and Teachers

Dear Parents and Teachers,

You are about to see an incredible transformation in your students! The foundation for all learning and success in education is laid by establishing a love of and passion for learning. Math is no different. It all starts with fun!

There are so many games and activities available to teachers and parents to supplement their student's math experiences. However, not all of those games and activities encourage deep, intense logical thinking and rarely are able to be easily adapted and enjoyed and explored by every ability level of math student. We have searched far and wide to collect games that meet the above criteria. We use all of these games on a frequent basis with our very own students and children.

In playing these games please adapt and create new variations and rules that help meet the specific needs of your students. We have had incredible experiences by simply letting our students create nuanced versions of the games, and with our older students we often ask "What rules can we change to make this more challenging?" and they love it!

These games have been specifically included in this book to do three things:

1. Help you identify when your young ones are ready to begin engaging higher level math and move into operations. Look for your student's ability to strategize and to recognize that the outcome of the games is based on superior strategy rather than simple chance. Strategic thinking is the sign of readiness for critically analyzing, problem solving and formal math. Until then, it's all for fun and exposure and to develop a love and passion for math!
2. Develop powerful and unique thinkers. The purpose of mathematics is not to memorize endless rules, procedures or concepts, rather it is to aid us in developing our abilities to logically reason, problem solve and think critically. These are the skills that our students need to be successful in our world, not computation and calculation. These games provide incredible opportunities for our students to think deeply, identify difficult patterns and create brilliant strategies.
3. Supplement your curriculum by providing students with fun, engaging opportunities to practice in place of mundane worksheets. Your students will actually enjoy mastering their math facts with these games rather than by simply memorizing them with flash cards, especially if you couple their practice with using manipulatives to demonstrate the operations and thinking in a visual and physical manner.

The key to maximizing the success of these games is allowing your student to think independently and strategize on their own- **YES THIS MEANS DON'T TELL THEM WHAT TO DO OR WHAT THE BEST STRATEGY IS!** They will figure it out!!! They will, through repetition and observation, create incredibly unique and brilliant strategies that will blow your mind and often outwit your best strategies. Our students all have brilliant, unique and powerful minds, our role as their mentors and teachers is not to create their fire; rather it is to provide the kindling and elements to grow their flames into wildfires!

Enjoy!
Joe and Emily

KRYPTO

Focus: Logical Reasoning, Number Sense, Algebra

Prerequisite: Basic Operations (+ - x ÷)

Materials: Deck of UNO cards (or any cards 0-10), paper, pencil

Objective: To use all 5 number cards dealt to you to create the target number turned up from the deck.

How To Play:

1.) Deal 5 cards to each player, and then turn one card from the deck face up. The number on that card is the number each player is trying to "target." (In UNO cards, skips are 10's)
2.) Each player, using any combination of addition, subtraction, multiplication or division, manipulates the five numbers to reach a "target" number on their game board. Each of the five cards must be used once and only once. For example, if the cards read "3, 4, 1, 6, 8" in no particular order, I could reach the target number of 11 by 3 x 4 + 1 – (8 - 6) = 11. There is a way, usually more than one, to reach the target number with any set of five numbers.
3.) The first player to reach the target number yells "Krypto!" and shows their cards and explains the process they took to reach that number.

Follow-up: Discuss your processes, even if you lost. We allow all players to find a krypto before each player reveals how they solved the problem. To decrease difficulty, allow students to use at least 2 but not require all of the cards to be used to reach the target number. For example, if the cards are 2, 4, 8, 8, and 9 and the target number is 4, a young student could use 8-8+4 to reach the target number. To increase difficulty, increase the range of numbers to 1-25. You can, as students become familiar with, include other operations such as squares and square roots or try to be super-human by not moving your 5 cards around but by keeping them in the order they are laid out.

Mastermind

***Focus**:* Logic, Problem Solving

***Prerequisites**: None*

***Materials**:* Partner(s), Cuisenaire rods (other colored counters may work)

***Objective**:* Deduce the hidden selection of rods in as few guesses as possible.

How To Play:

1.) Place the entire set of Cuisenaire rods on the table. A player is chosen as the pattern maker. The rest of the players close their eyes. The pattern maker chooses three Cuisenaire rods (no repeating colors) and hides them from the other players.
2.) The other players open their eyes and present possible solutions to the pattern maker. In this version, each player will present a set of three rods as their guess to the pattern maker.
3.) The pattern maker then tells that player how many rods in the guess match the rods that are hidden. For example, if the pattern maker chose blue, red and yellow rods and the player presents a guess of red, green and brown rods, then the pattern maker would say "You have one correct color."
4.) The player then presents a new guess, using the information gathered in the previous guess and the pattern maker states how many rods in the new guess match the hidden rods.
5.) Play continues until the player correctly identifies all three rods that were hidden, in other words, the pattern maker would say "All three colors are correct." Count how many guesses it takes to find the pattern and this is the player's score.

Variations:

- To increase difficulty increase the number of hidden rods to 4 or 5. For even a higher difficulty, allow repetition of colors. Finally, for super advanced Masterminders require the correct order of the rods. In this final version, the pattern maker would divulge two pieces of information for each guess: 1.) How many colors are correct, and 2.) How many colors are in the right location.
- With multiple players, the players present guesses back and forth, racing to be the first to identify the hidden pattern.

Nimbi

History: A Danish mathematician found that he could figure out how to solve the ancient Chinese game of Nim with a mathematical formula. He worked to create a game that could not be solved with a formula, but with sound logical thinking: a new game experience each time.

Focus: Logical Reasoning

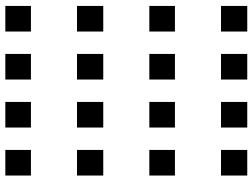
Prerequisites: None

Materials: Partner, 16 markers (toothpicks, beans, rocks, sticks, candy…)

Objective: Force the other partner to take the last marker

How To Play:

1.) Place the markers in four straight rows and four straight columns in this manner:



2.) Take turns. The first player may take any number of markers (from 1-4) from any row or column. The only rule is that the markers need to be adjacent (horizontally or vertically - NOT diagonally adjacent).

3.) The person who takes the last marker loses.

Follow Up: Monitor the number of moves it takes to win the game. After several games, discuss with your student methods/strategies to make the game shorter or longer. What is the least amount of moves needed to win? The most? If needed, start with a 2 x 2 board and discuss these patterns and then build up to a 3 x3 and a 4 x 4. Are there strategies that can be applied across the different sizes? What changes in strategy are there as you change the size of the board?

Poison

Focus: Number Sense, Logical Reasoning, Problem Solving

Prerequisites: Counting

Materials: A partner, counters or beans

Objective: Get your partner to take the last counter/bean

How To Play:

1.) Set out 13 counters/beans.
2.) Take turns.
3.) On their turn, players may take one or two counters/beans. They cannot take zero or more than two per turn.
4.) The player who "gets stuck" taking the last counter/bean loses.

Follow-up: Play several times but don't share any strategies with your students. Allow them to struggle through and hypothesize and test their ideas on their own. Once you see them start to repeat a process, like always leaving the same amount of beans near the end or always taking just one bean, talk to them about it and ask them why they are following that strategy. Then, test it out with them. Try to beat their strategy and encourage them to develop a new one until they find one that works no matter what you throw at them!

Variations:

- Vary the number of counters/beans that are laid out. Use different values of even and odd numbers.
- If you'd really like to go crazy, take more than two beans. For example, allow players to take up to 4 or 5 beans per turn.

The Coyote and The Hares

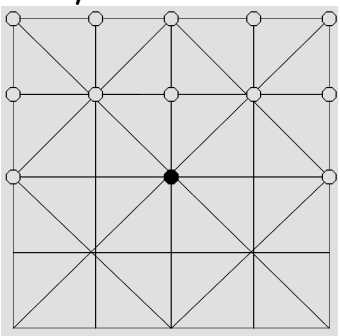
Focus: Logical Reasoning, Problem Solving

Prerequisites: None

Materials: A partner, 12 "hare" markers and 1 "coyote" marker, game board

How To Play:

1.) Arrange the markers as seen in the picture below. One partner is the 12 "hares" and the other player is the single "coyote."



2.) Take turns. Both the coyote and the hares can move one circle at a time, along a line, in any direction, as long as there is an empty circle adjacent to it.
3.) The coyote can capture a hare by jumping over it (along a line to the next circle which must be empty). Multiple jumps during a turn are allowed. Captured hares are removed from the board.
4.) A hare cannot jump over a coyote, but can win if the hares corner the coyote so that he cannot move.
5.) The coyote wins if he captures enough hares so that they cannot corner him.

Follow-up: As you play, perhaps after several games, discuss with your student how many hares is "enough hares so that they cannot corner him?" In other words, what is the minimum number of hares needed for the hares to win? Discuss other observed patterns and thoughts as the game proceeds, such as the coyote having to wait and rely on the hares to make an offensive move in order to make a capture. Who has the advantage in this game? Why? Is there a way for the hares to always win? Or will the coyote inevitably win every game?

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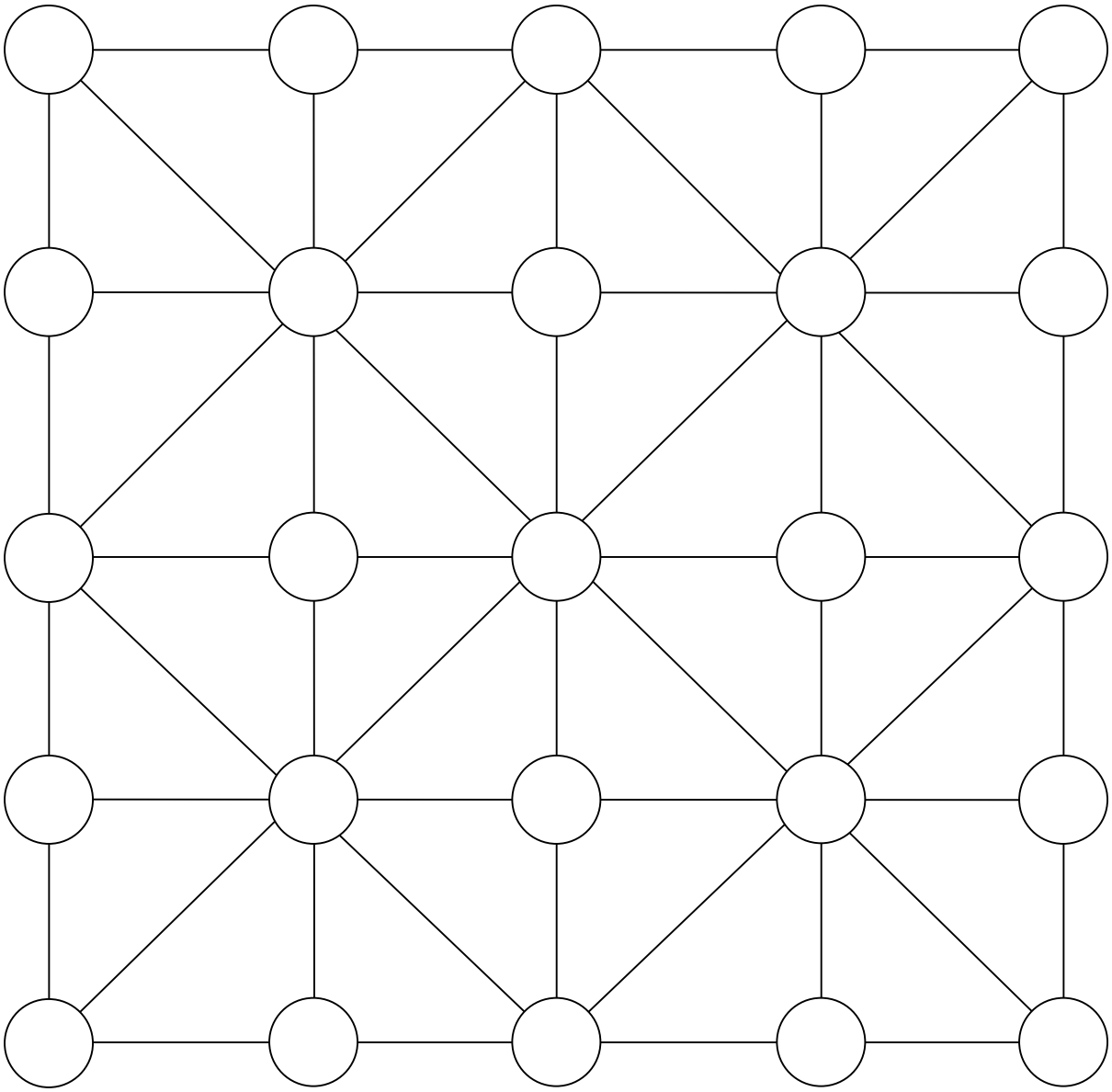
The Coyote and The Hares Game Board



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Other Great Games and Activities That Every Home Should Have

Board Games:

Yahtzee
Master Mind
Chess
Mancala
Checkers
Rage
Uno
Set
Risk
Stratego
Parchisi

Open Source:

(All of these resources can be found for free by doing a search online)

Tangrams
Tic-Tac-Toe
Logic Puzzles
Sudoku
Number Grids
Rosetta Puzzles
Cryptograms