

Encouraging Excitement in Mathematics

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Mathematics is not about numbers, equations, computations, or algorithms: it is about understanding.

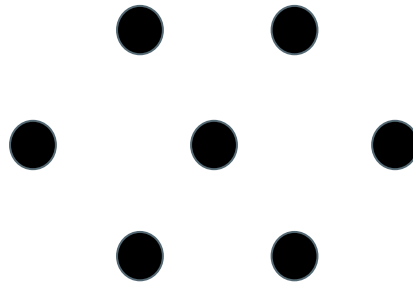
~William Thurston

Objectives

- × Review the shifts in math
- × Explore where to focus our energy for the greatest impact
- × Experience strategies and resources that will encourage excitement in math

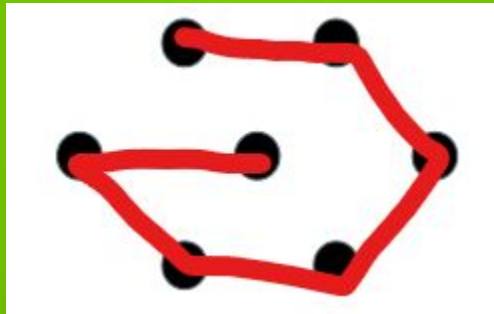
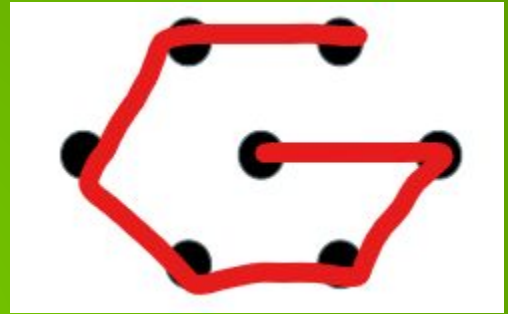
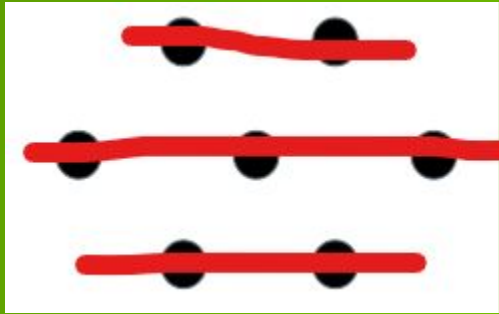
The background is a solid green color with various mathematical symbols scattered across it. These symbols include plus signs (+), multiplication signs (x), squares, and circles, all in a lighter shade of green. The symbols are of different sizes and are positioned at various angles, creating a dynamic and math-themed pattern.

First, let's do
some MATH



Dot Talk

5



$$37 + 38$$

$$\begin{array}{r} 37 \\ + 38 \\ \hline 75 \end{array}$$

$$30 + 30 = 60$$

$$7 + 8 = 15$$

$$\hline 75$$

$$(37+3) \quad (38+2)$$

$$40 + 40 = 80$$

$$3 + 2 = (-) 5$$

$$\textcircled{75}$$

$$37-2$$

$$38-3$$

$$35$$

$$+ 35$$

$$= 70$$

$$2$$

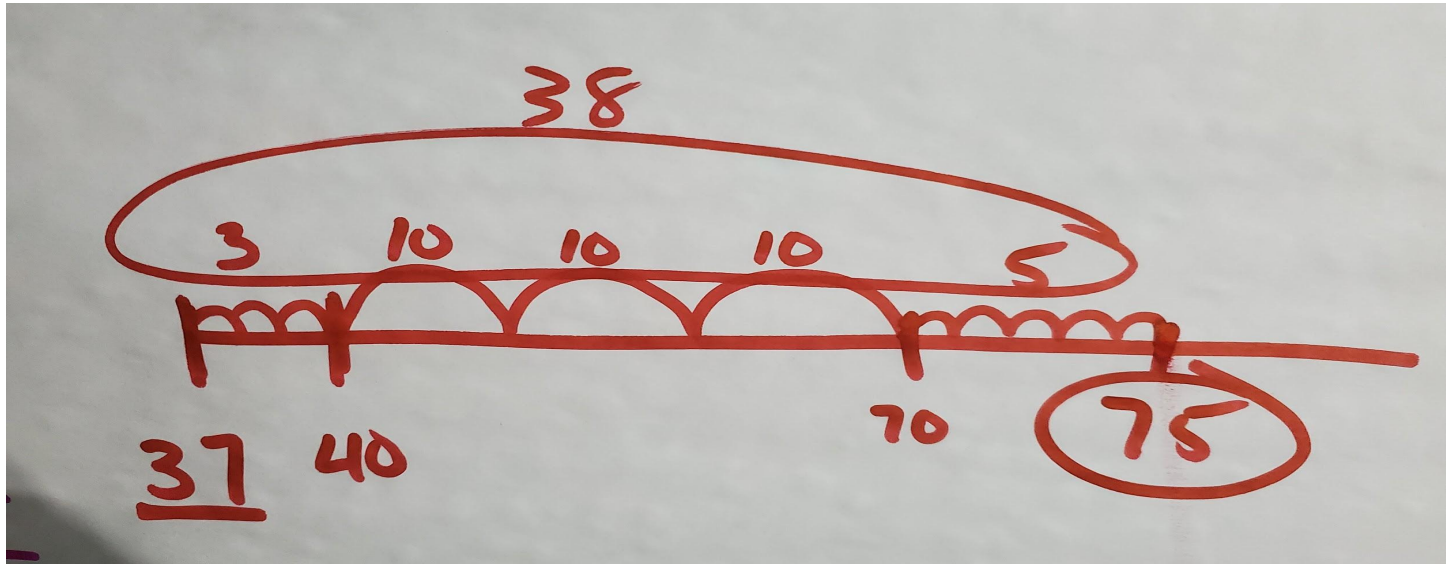
$$+ 3$$

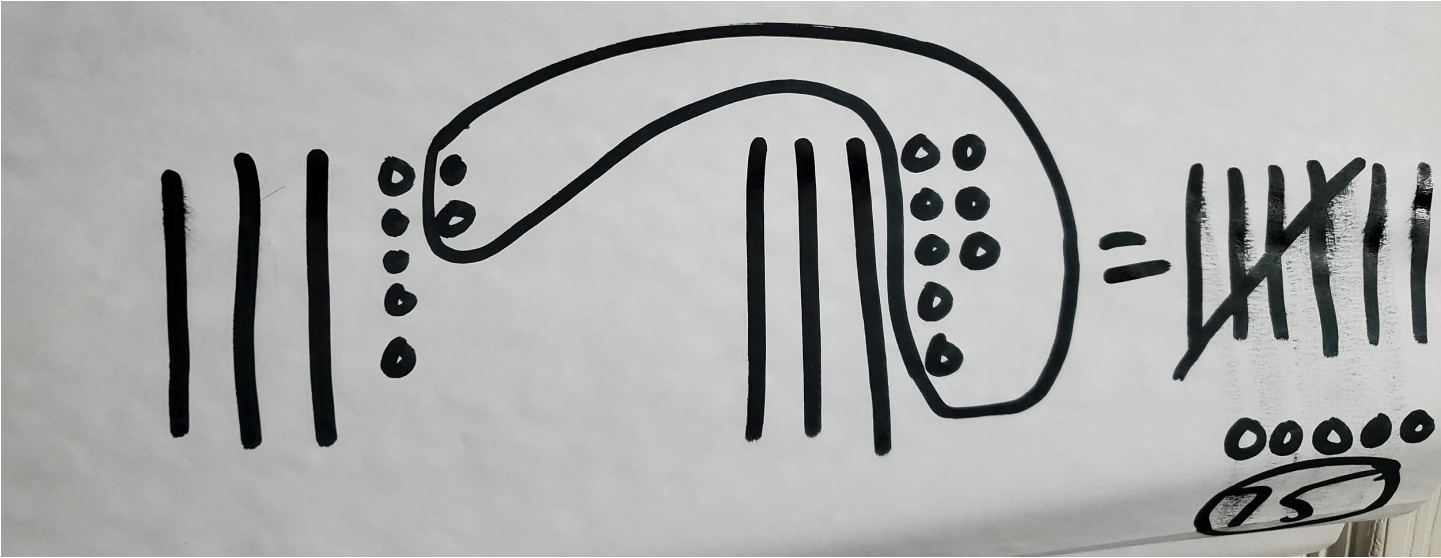
$$= 5$$

$$75$$

$$(37-2) \quad (38+2)$$

$$35 + 40 = 75$$





Steps of a Math Talk:

1. Teacher poses a purposeful problem
2. Students signal when they are ready to give a solution
3. Teacher collects answers orally
4. Students explain or defend their answer
5. Teacher records student strategies
6. Teacher asks questions to facilitate Mathematical Discourse
7. Class comes to consensus

Significant Shifts of the Illinois Learning Standards for Math:

- **Focus**
 - Focusing deeply on major work for the grade
- **Coherence**
 - Linking topics and thinking across grades
- **Rigor**
 - Pursue conceptual understanding, procedural skills and fluency, and application with equal intensity

<http://www.corestandards.org/other-resources/key-shifts-in-mathematics/>

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Climate and Culture for Learning

- Celebrate mathematics as a useful tool in making sense of the world.
- Facilitate productive struggle.
- Recognize there are many different ways to arrive at the solution.
- Create a space where it is safe to make mistakes.

Traditional Math vs Modern Instruction

Traditional

- × I do... We do... You do...

Modern

- × Lots of strategies
- × Deeper understanding
- × Balanced with authentic problem solving

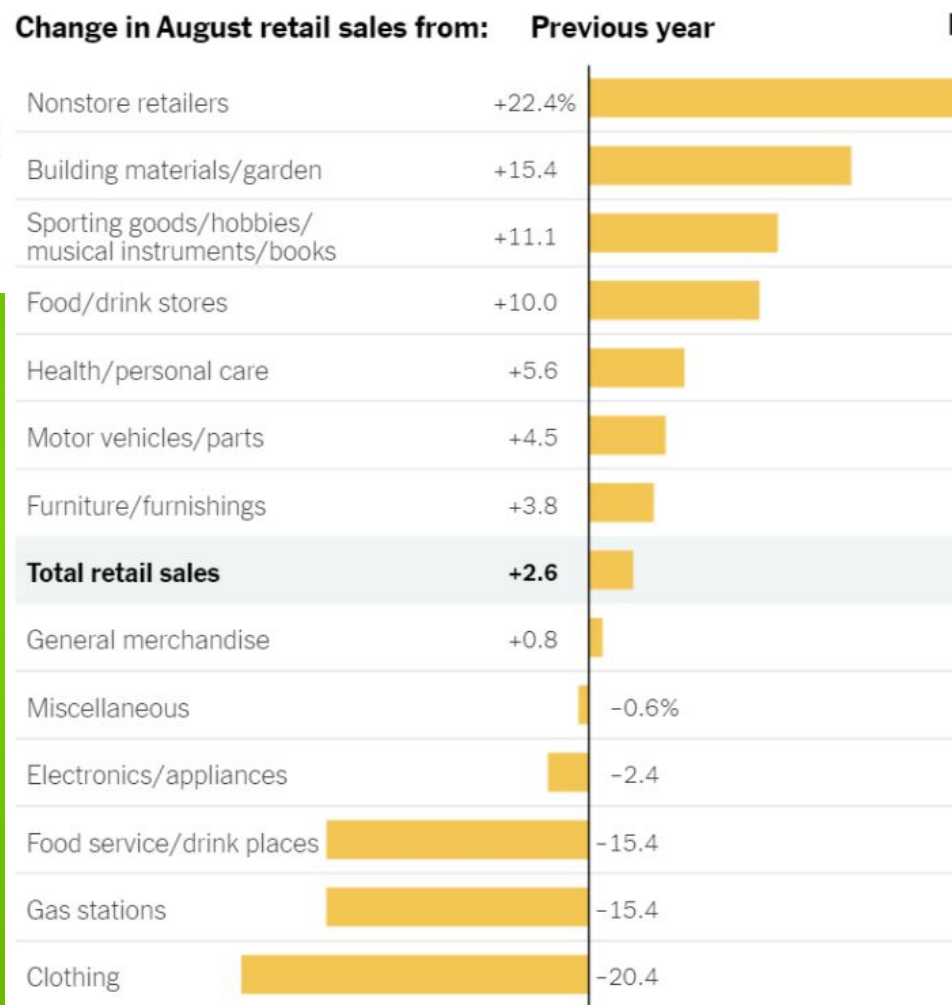
Math as a useful tool...

Capitalize on opportunities when math is useful to make sense of something meaningful to the students.

What's Going On in This Graph? | Consumer Spending During the Pandemic

How has consumer spending in the United States changed during the pandemic?

<https://www.nytimes.com/column/whats-going-on-in-this-graph>



Productive Struggle

- Giving students the end-product of expertise too soon short-cuts the need to find the deep structure that the expertise describes.
- Teachers must help students tolerate the short-term ambiguity of not being told the right answer.

L. Schwartz, Daniel & C. Chase, Catherine & Oppizzo, Marily & Chin, Doris. (2011). Practicing Versus Inventing With Contrasting Cases: The Effects of Telling First on Learning and Transfer. *Journal of Educational Psychology*. 103. 759-775. 10.1037/a0025140.

- How do you know when a student is struggling?
 - What do you do?
 - What can we do better?

A Destructive Struggle

- Leads to frustration.
- Makes learning goals feel hazy and out of reach.
- Feels fruitless.
- Leaves students feeling abandoned and on their own.
- Creates a sense of inadequacy.

Productive Struggle

- Leads to understanding.
- Makes learning goals feel attainable and effort seem worthwhile.
- Yields results.
- Leads students to feelings of empowerment and efficacy.
- Creates a sense of hope.

Praise students for perseverance in problem solving, not for being smart.
They'll be more motivated to face challenging problems.

Don't give easier work to struggling students.
This gives the message that some students can't handle challenging work.

Give students informative feedback and support through questioning.
Provide context to help students course correct toward the solution.

Encourage having a growth mindset.
Remind students that everyone has the ability to be mathematical problem solvers.

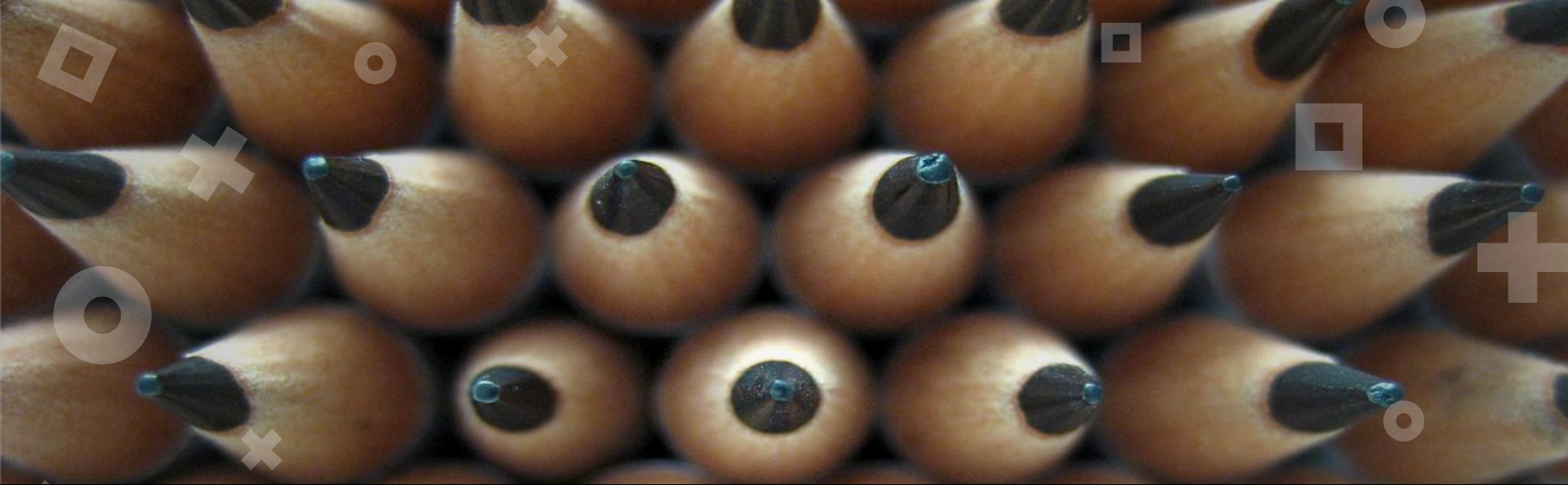
<https://blog.mindresearch.org/blog/productive-struggle-in-math>

Fixed Mindset

- Understanding, proficiency, ability are “set”
- You are good at something or you aren't

Growth Mindset

- Understanding, proficiency, ability are developed regardless of your genes
- You become better at something as you work with it – as you struggle with it



Never touch a student's pencil

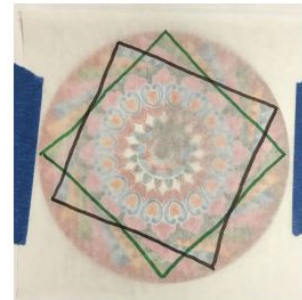
Resources:

- Math Teachers in Action:
www.mathteachersinaction.org
- IL Classrooms in Action:
www.ilclassroomtech.weebly.com
- Math Talks: www.ilteachandtalk.org/

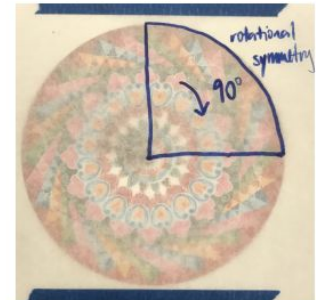
Resources:

YouCubed (<https://www.youcubed.org/>): A website from Jo Boaler, a Stanford University Math Specialist, with links for Teachers, Students, and Administrators. This website contains research, videos, tasks/lessons, and lots more material. Check out [Poly Machines](#) for Grades 1-12. There is also a really awesome [Maths and Art](#) section.

Traditional Costa Rican Oxcart Wheel Painting



Example 1



Example 2

Resources:

Bedtime Math (<http://bedtimemath.org/>): Free, engaging, hands-on math activities



Wee ones: If you slice through a potato and look at the flat side you cut, what shape do you see?

Little kids: If you eat 3 fries with ketchup and 6 without, how many fries do you eat? *Bonus:* If you dip your 2nd French fry in ketchup, then your 5th, then your 8th...which one do you dip next?

Big kids: You can cut about 25 fries from 1 potato. How many potatoes do you need to make 100 fries? *Bonus:* How much taller than that 34-inch French fry are you?

Crazy 8s Club (<https://crazy8s.bedtimemath.org/home/what>): Crazy 8s is an afterschool math club designed to get kids fired up about math. Every week Crazy 8ers build stuff, run and jump, make music, make a mess... all while bonding with new friends over math.

Resources:

Illustrations (<https://illuminations.nctm.org/>): Created by the National Council of Teachers of Mathematics, has lesson, games, and brain teasers. Be sure to check out Krypto.

The image shows a screenshot of the Illustrations website interface. On the left side, there is a vertical navigation menu with four items: "Featured Lesson Plan", "Featured Mobile Game", "Featured Interactive" (highlighted in orange), and "Featured Brain Teaser". The main content area features a farm-themed illustration with a barn, a field, and a bunny. A speech bubble from the bunny says: "Help the bunny eat carrots. How many are there? Tap the digits to enter the number." Below the bunny is a "read more +" button. In the top right corner of the main area, there is a "Featured Interactive" section with the text: "Pre-K-Grade 5: Become confident in facts up to 12×12 using visual models that stress the conceptual aspects of multiplication."

Resources:

Greg Tang's Website (<https://gregtangmath.com/>): This website has great games, puzzles, and suggestions to support mathematical thinking. Some are online while many can be printed. Start with Kakooma and 10-Pin Limbo.

LEVEL 1
ROUND 1

10

Are there fewer tomatoes or mushrooms?

Tomatoes Mushrooms

4 / 30

Time 6x
Hint 3x

Resources:

Mashup puzzles (<https://www.mashupmath.com/freemathpuzzles>): Printable or projectable puzzles to build algebraic reasoning.



A box containing five algebraic puzzles using game-related icons:

$$\begin{aligned} \text{Nintendo Switch} &\times \text{Game Card} = 121 \\ 12 \times \text{Nintendo Switch} &= 132 \\ \text{Game Boy Advance} &= 20 - \text{Game Card} \\ \text{Game Boy Advance} - \text{Game Boy Advance} &= 7 \\ \text{Nintendo Switch} \times \text{Game Boy Advance} &= ? \end{aligned}$$

Resources:

Bump

(<https://www.ccsmathactivities.com/wp-content/uploads/2017/01/BUMP-Instructions.pdf>)

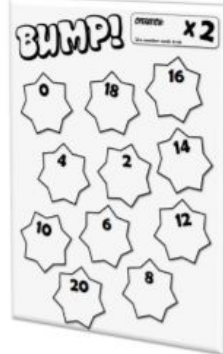
BUMP INSTRUCTIONS

When to use:

BUMP is a great fluency game that can be used for everything from number recognition and simple addition to multiplication facts and even conversions and equalities.

Supplies Needed:

- BUMP board
- Cards or dice according to what students need to practice. (Cards or dice 0-10 are a good start.)
- Two colors of beans or discs to be used as playing pieces.
- Optional: blank ten-frame to track points.



Directions: (For ease of directions, a BUMP board with "x 2" will be used.)

1. Give one BUMP board to each pair of students, along with cards or dice 0-10. Each student also needs his/her own color of beans or discs and a blank ten-frame (optional) to track points.
2. Student 1 draws a card, 0-10 and must multiply it by 2. Student 1 says the equation and puts her color of bean on the product.
 - Student 1: "I drew a 5. Five times 2 is 10. I'm placing my bean on the 10."
3. Student 2 draws a card, and multiplies it by 2. Student 2 says the equation and puts his color of bean on the product.
 - Student 2: "I got a 3. Three times 2 is 6. I'm placing my bean on the 6."
4. Play continues in this fashion. If a student gets the same product again and they already have their own color bean on it, they place another marker there anyway.
 - Student 1: "I got another 5! Five times 2 is 10. I'm placing another bean on the 10."
5. When a student gets a product that contains the OTHER student's bean(s), they get to "BUMP" all their opponent's markers off and place one of theirs on it.
 - Student 2: "Now I got a 5!! Five times 2 is 10! I'm bumping off your two beans and placing my bean on the 10."
 - The bean(s) that get knocked off are points for Student 2 now. If desired, students can organize the beans they get in a blank ten-frame to keep track and reinforce partners to ten.
6. Once a student has 10 of their opponent's beans, the board is cleared and the game starts over.
7. As needed, choose other BUMP boards to keep your students focused on specific skills:

<i>Multiplication 2 – 9</i>	<i>Doubles (draw card 0-10 and double it)</i>
<i>Addition to 10 (roll two 0-5 dice and add together)</i>	<i>Doubles minus 1</i>
<i>Add 10 (draw cards 0-10 and add 10)</i>	<i>Doubles plus 1</i>

See following page for an idea on using BUMP for a problem-solving challenge!

Games using decks of cards:

Name That Number

(<https://everydaymath.uchicago.edu/about/understanding-em/games/name-that-number.html>)

Scholastic Card Games

(<https://www.scholastic.com/teachers/blog-posts/nancy-jang/2017/3-Quick-Math-Games-With-Playing-Cards/>)

Math Engaged Card Games

(<http://mathengaged.org/resources/card-games/>)

Other Great Games that Build Mathematical Thinking:

- SET
- Cribbage
- Quirkle
- Sudoku
- Kenken
- Wittzle
- Rat-a-Tat Cat
- Knockout and Muggins
- Yahtzee
- Chess
- Othello
- Dominoes
- Tri-Ominos

The background is a solid green color with various light green geometric shapes scattered across it. These shapes include squares, circles, and crosses, some of which are slightly rotated or offset from their regular grid positions.

Thank You!



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