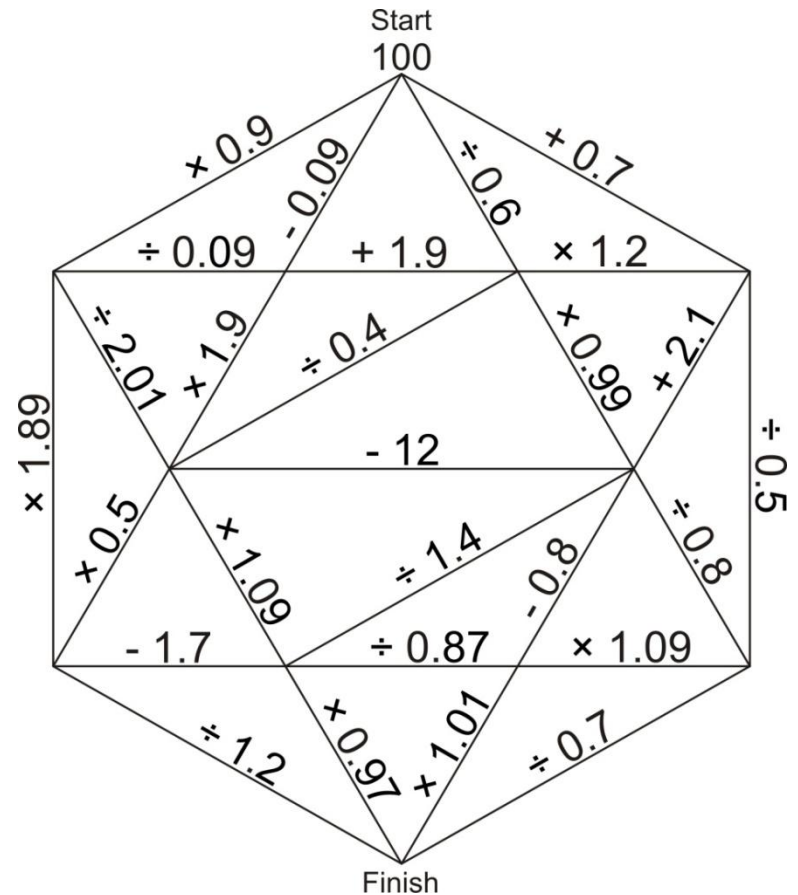


Warm-up: Decimal Maze

- Begin with a value of 100.
- Move down or sideways from **Start** to **Finish**.
- As you cross a segment, perform the indicated operation.
- You may not go up. You may not cross a segment more than once.
- *What is the largest possible value when you reach **Finish**?*



Welcome

23	94	18	13
31	102	26	21
31	102	26	21
40	111	35	30

What'd You Get?

181

Session 181

Whoa!

How does that work?



Engaging and Free Online Resources for Teaching Operations and Fractions

October 26, 2012

Sarah DeLeeuw

sdeleeuw@nctm.org



Standards for Mathematical Practice

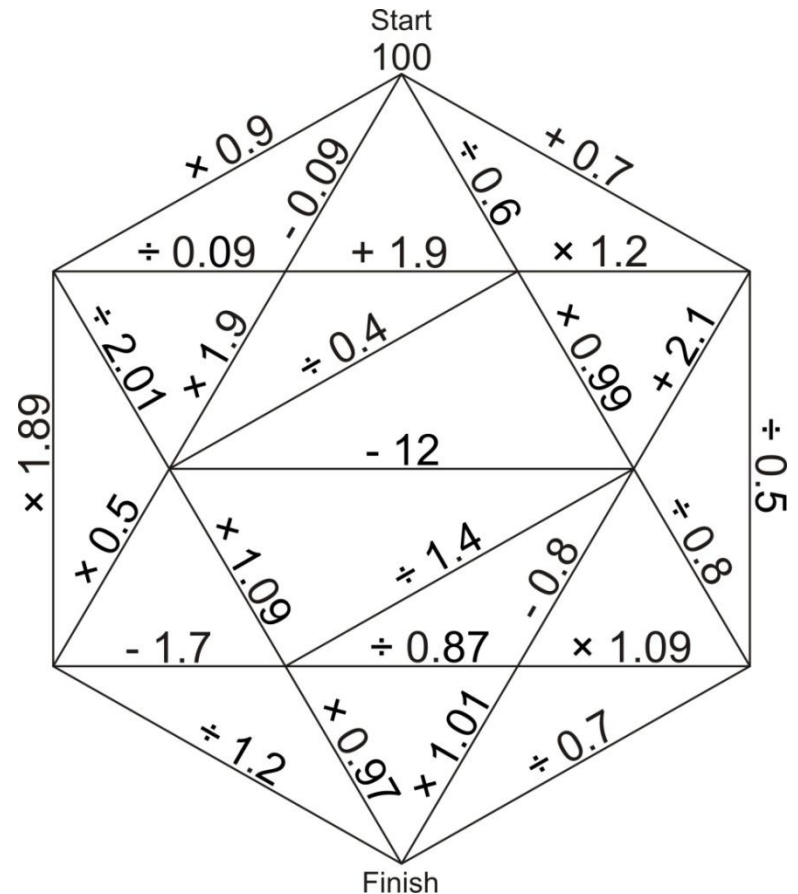
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look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

Reasoning and Sense Making

- It is very important for teachers to lead scholars into the habit of **attending to the process going on in their own minds** while solving questions, and of **explaining how they solve them**. [...] It is next to impossible for a person to direct another's thoughts unless he knows the channel in which they are already flowing.
 - Warren Colburn, *Teaching Arithmetic in the Method of Pestalozzi*, **1830**

Decimal Maze

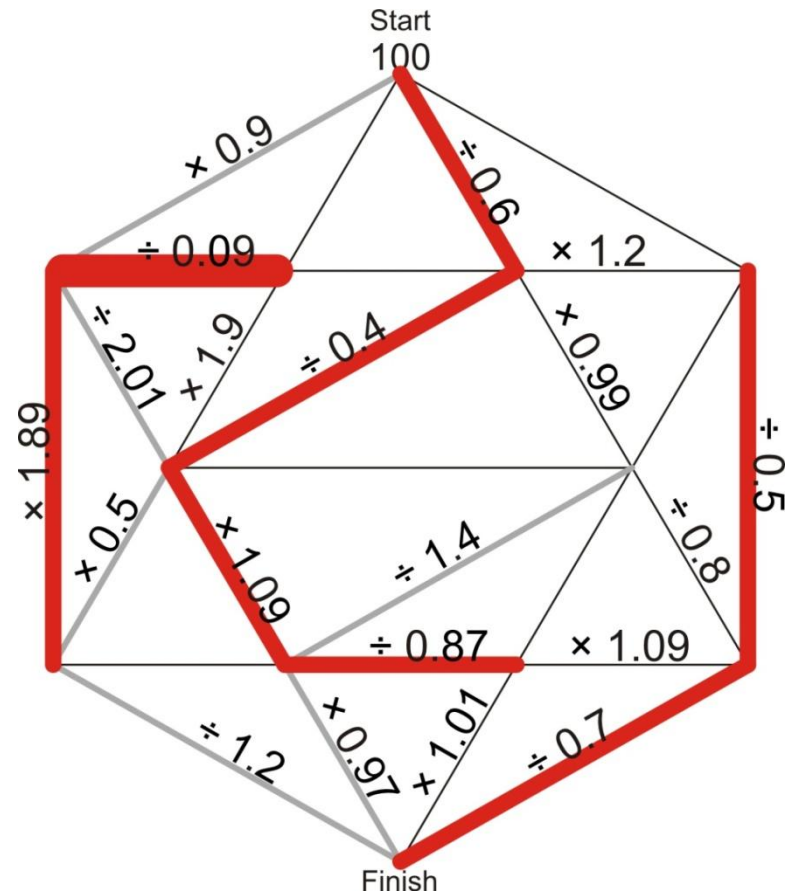
- Begin with a value of 100.
- Move down or sideways from **Start** to **Finish**.
- As you cross a segment, perform the indicated operation.
- You may not go up. You may not cross a segment more than once.
- *What is the largest possible value when you reach **Finish**?*



Decimal Maze

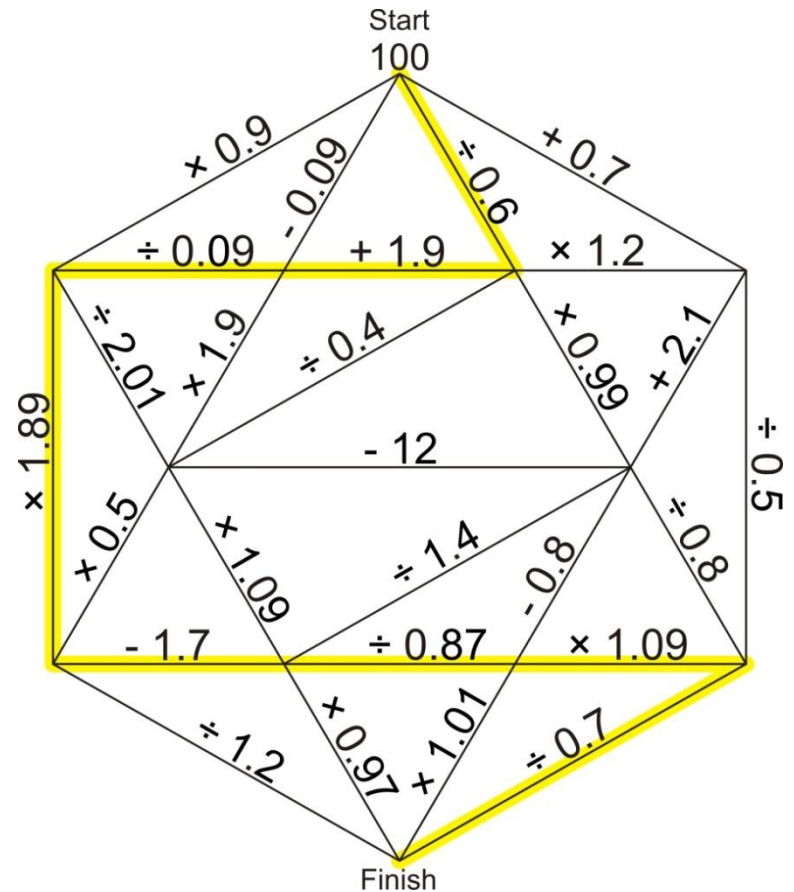
Here's some help:

- The **red lines** are beneficial.
- The **gray lines** are detrimental.
- Addition and subtraction are inconsequential.



Decimal Maze

- Maximum value: **6332**
- Minimum value?
- Finish value closest to 100?
- How many paths from Start to Finish?
- How else might you modify this activity?



Pick-a-Path

Score 24 Target Maximum

move

Click through the maze to boost your score!

Level 1, Puzzle 3

Navigation icons: back, forward, help, pause

Detailed description: This screenshot shows a maze with a purple octopus at the start. A path of orange and yellow lines leads from the octopus to the top-right corner. The score is 24 and the target is 'Maximum'. A 'move' instruction box is at the bottom left.

Pick-a-Path challenge

Choose a level

Level 1

seven levels, each with seven puzzles!

1 2 3 4

5 6 7

Detailed description: This is the 'Pick-a-Path challenge' screen. It features a 'Pick-a-Path challenge' title and a 'Choose a level' prompt. A 'Level 1' button is highlighted with a right arrow. Below are seven numbered buttons (1-7) representing different levels. A text box states 'seven levels, each with seven puzzles!'. Navigation icons are at the bottom.

Score $\frac{3}{2}$ Target 2

explore

powers of 10, fractions, decimals, exponents, more!

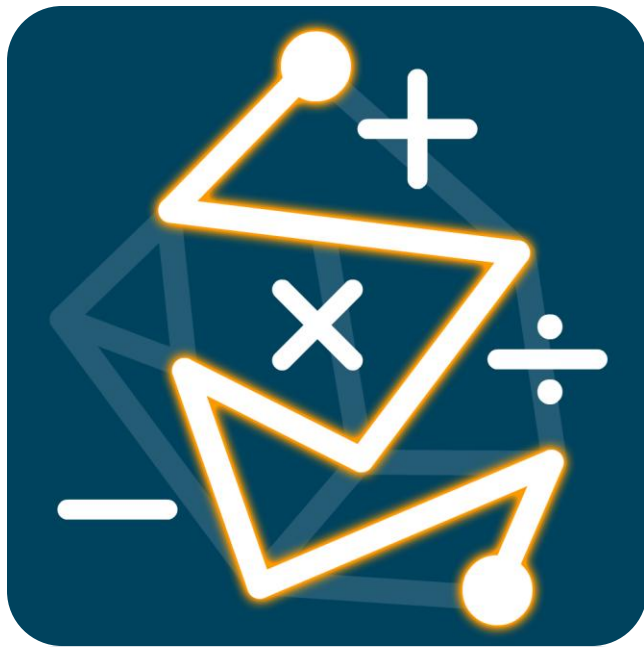
Level 4, Puzzle 4

Navigation icons: back, forward, help, pause

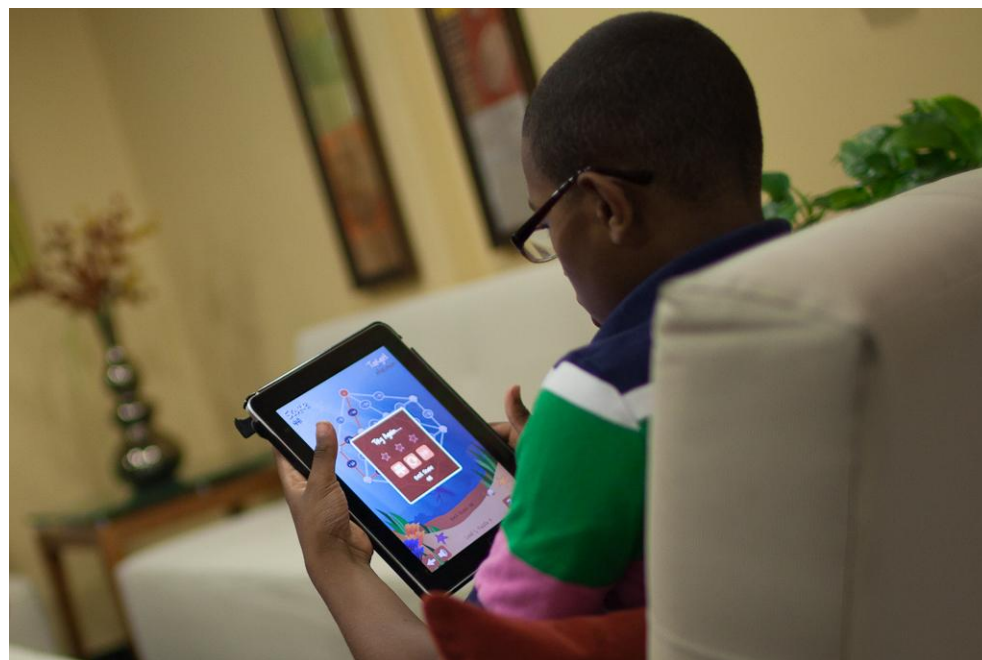
Detailed description: This screenshot shows a maze with a purple octopus at the start. A path of yellow and orange lines leads from the octopus to the top-right corner. The score is $\frac{3}{2}$ and the target is 2. An 'explore' instruction box is at the bottom right. Navigation icons are at the bottom.

Pick-a-Path

- <http://illuminations.nctm.org/pickapath>



Play Anywhere. Learn Everywhere.



Dollar Nim

- Start with a dollar
- Remove any coin:
 - Penny
 - Nickel
 - Dime
 - Quarter
- Player to take the last coin wins



Dollar Nim

- What is the winning strategy for this game?
- How could you modify this game for use with your students?



Extension from NY Times Blog

Since Dollar Nim is played with real money, it makes sense for the participants to keep the change they remove. This confers a reward for removing larger denominations. To offset this, the winner must be given an extra monetary reward. What should be the **minimum** prize money for the two-player game so that no matter what happens, the winner comes out ahead?

Enrichment: Eleven Nim

- Start with a dollar
- Remove any coin:
 - Penny
 - Dime
- Player to take the last coin wins



John Mason, Math 2.0 Listserve

“Just because I play a game, it does not follow that I become aware of what I am doing [or the] underlying mathematical thinking. ...the value of playing a ‘mathematical game’ may lie not in the playing so much as in the reflective consideration of effective and ineffective actions.”

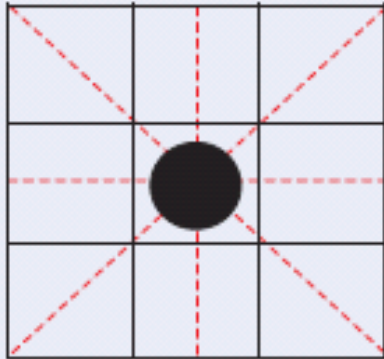
Three C's of Game Play

- Competition
- Collaboration
- Communication

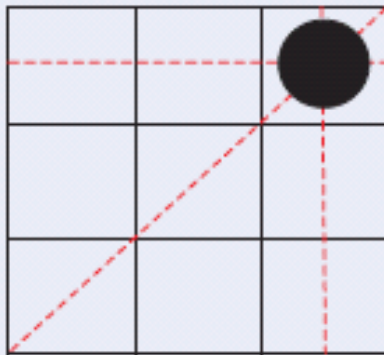
Even one-player games can spark rich discussion of strategy.

Tic Tac Toe

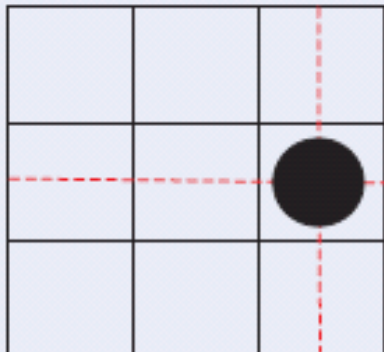
(a) The most advantageous place



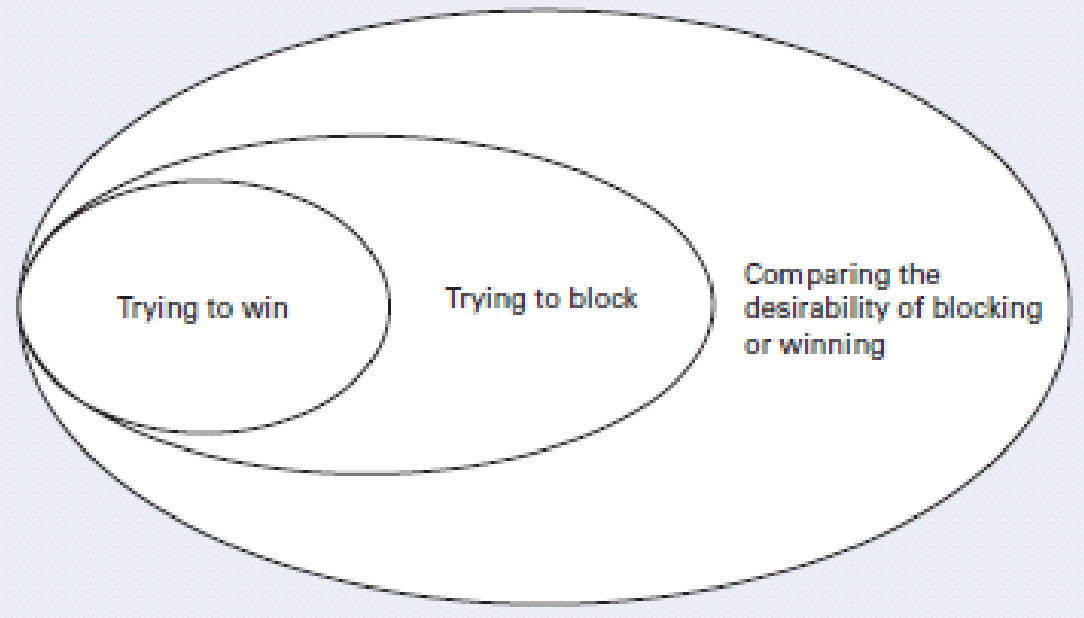
(b) The next most advantageous place



(c) The least advantageous place



The hierarchical development of the three levels



Kamii, C. The Educational Value of Tic-Tac-Toe for Four-to Six-Year-Olds. *Teaching Children Mathematics*, May 2008.

Dig It

calculation nation

Challenge others. Challenge yourself.™

« Back to Play Games

Game Directions



Guest

21913



0



1



1



3



10



Calculation Nation

19748



2



1



2



2



8

Guest

Dirt: 5.57 tons *5,570 points*

Gems: 24 *12,965 points*

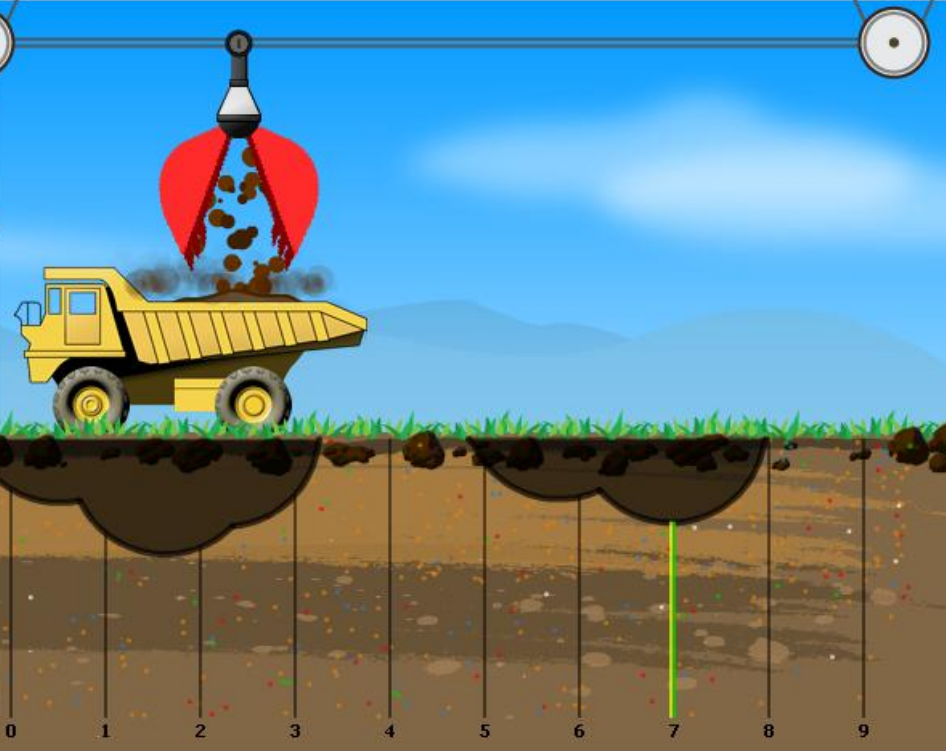
Diamond: 1

Emerald: 1

Sapphire: 3

Ruby: 6

Topaz: 13



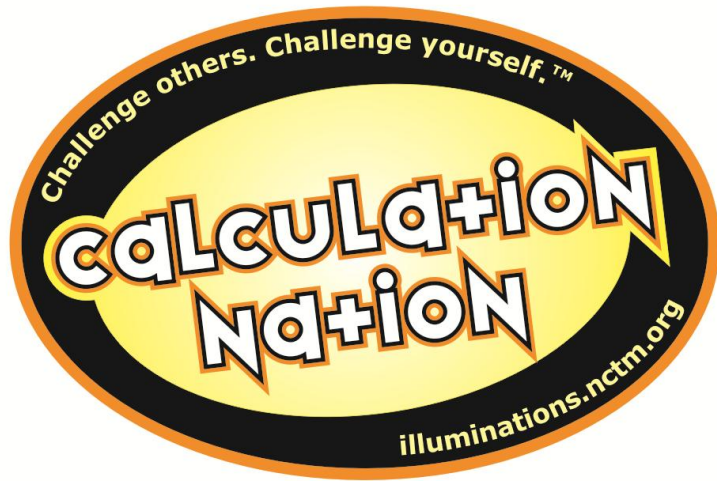
Dig It

- What are the best numbers to try to get?
- What number(s) are easiest to get?
- Which points on the number line can be created in the least number of ways?
- How many fractions can be created with a value less than 1?
- Which digit is the best to get?

Calculation Nation®

- **An online world of math strategy games**
- One- and two-player games:
Challenge others. Challenge yourself.
- Basic registration process:
 - Username
 - Email
 - Password
- Can play games as a guest without registration

Calculation Nation™



Official Launch

April 22, 2009

To Date: 1,209,527 Visitors

September 2012: 1,500 Visitors/Day

Calculation Nation™

- Idea Inspired by Teachers
- Played the “Product Game” Online Using Instant Messenger

Player 1

Player 2

Get 4 in a row by moving the markers to the number line to form products

New Game

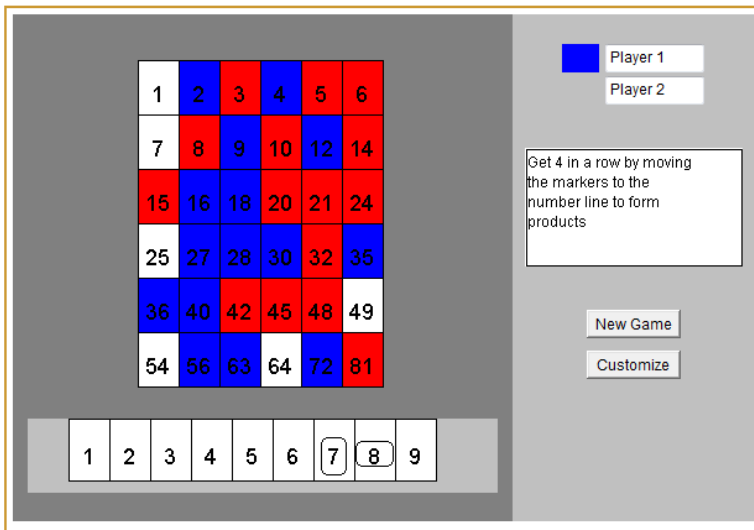
Customize

1	2	3	4	5	6
7	8	9	10	12	14
15	16	18	20	21	24
25	27	28	30	32	35
36	40	42	45	48	49
54	56	63	64	72	81

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

History

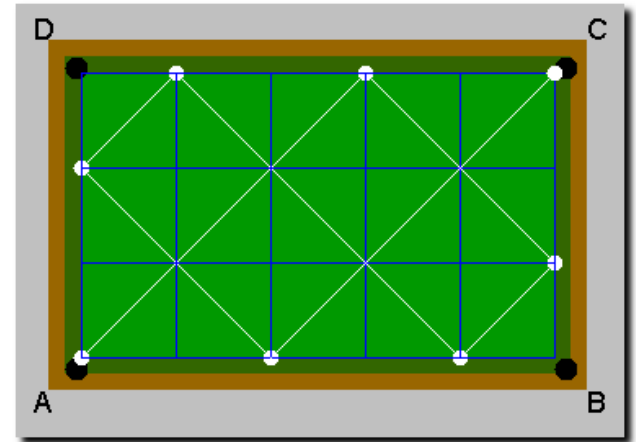
- Two teachers in Wyoming



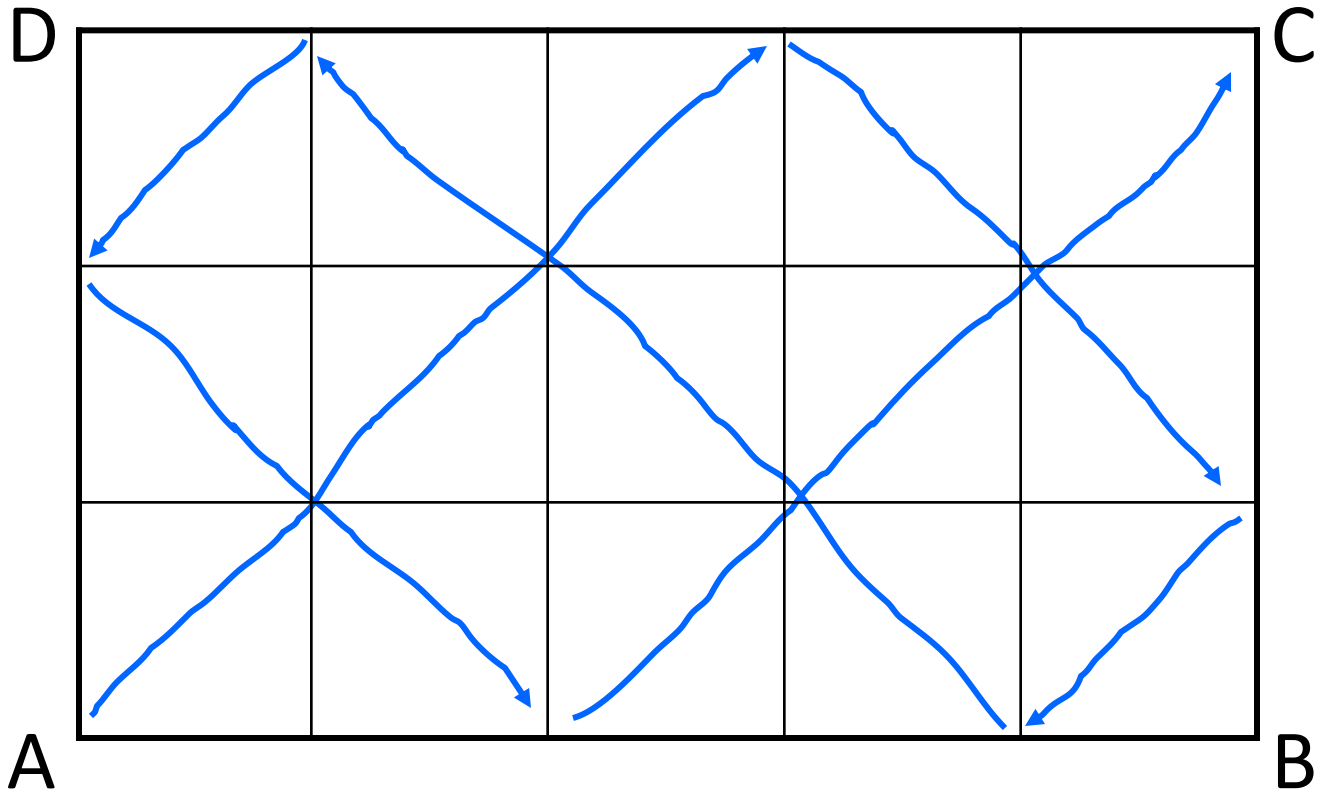
Paper Pool

How to Play Paper Pool

- The ball starts in corner A.
- The ball is **hit** with an imaginary stick so that it travels at a 45° diagonal across the grid.
- If the ball **hits** a side of the table, it bounces off at a 45° angle and continues its travel.
- The ball continues to travel until it **hits** a pocket.

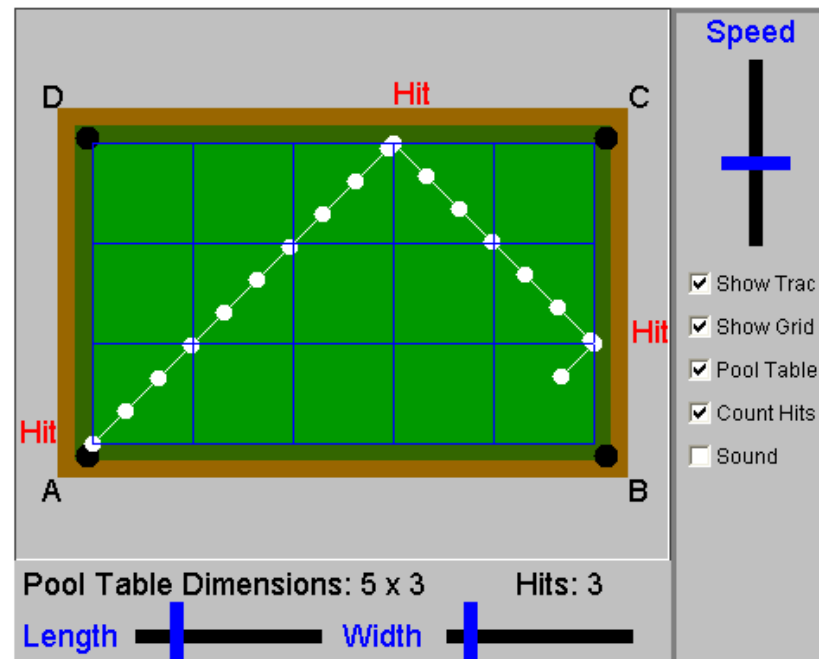


Paper Pool



From Paper Pool...

- Online Version of the Paper Pool Lesson
<http://illuminations.nctm.org/LessonDetail.aspx?ID=U165>




Game Design

- **Other Games:** Do the math, then you can do something fun.
- **Our Games:** Doing the math **IS** something fun.

http://calculationnation.nctm.org

Created by the National Council of Teachers of Mathematics

 ILLUMINATIONS
Resources for Teaching Math

calculation Nation

Challenge others. Challenge yourself.™

Play Games
Challenge Others
Challenge yourself

About Games

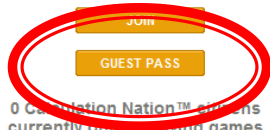
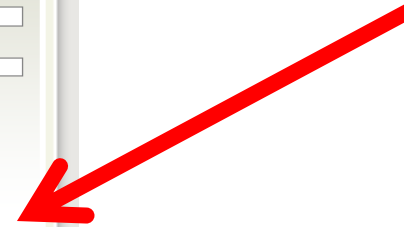
About Calculation Nation

For Parents & Educators

Privacy policy & terms of use | Contact us
National Council of Teachers of Mathematics | Illuminations

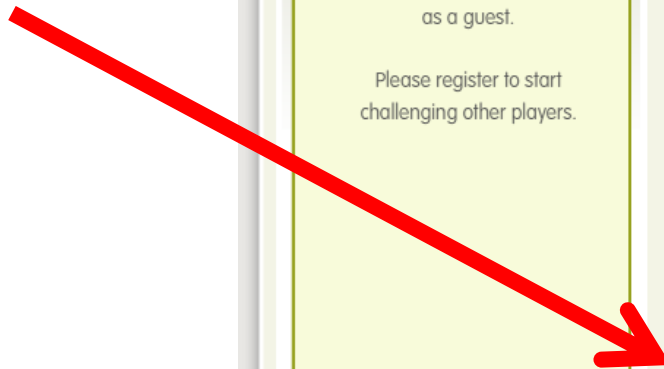
0 Calculation Nation™ citizens currently online playing games

Click here:
“Guest Pass”



Play a Game!

Click here:
“Challenge Yourself”



The screenshot shows the Calculation Nation website interface. At the top, the logo reads "calculation Nation BETA" with the tagline "Challenge others. Challenge yourself.™". To the right is the "ILLUMINATIONS" logo with the tagline "Resources for Teaching Math". Below the logo is a navigation menu with links: "Play Games", "About Games", "About Calculation Nation", "For Parents & Educators", "Passport", "Scorecard", and "News". A purple banner displays "Welcome, Guest" and instructions: "Challenge Others to find an opponent" and "Challenge Yourself to play against the computer". The main content area features a grid of game cards. Each card includes a title, a star rating, and a "Challenge Yourself" button. The "Challenge Yourself" button for the "Times Square" game is circled in red. On the left side, a sidebar contains a "LOGOUT" button and a message: "You are currently logged in as a guest. Please register to start challenging other players."

Ker-Splash

- Choose an expression:

$$17x + 29y + 43$$

$$24x + 22y + 39$$

- The values of x and y are unknown... but you can choose to increase one of them by 1, and decrease the other by 1. Which would you like to increase and which to decrease?
- Now, here are the values: $x = 6$, $y = 4$

Ker-Splash

Your Equation	$x + 1, y - 1$	$x - 1, y + 1$
$17x + 29y + 43$	249	273
$24x + 22y + 39$	273	269

Ker-Splash

calculation Nation

Challenge others. Challenge yourself.™

« Back to Play Games

Game Directions

Round 2 / 5

Combination Area

Combine like terms here

Combine



Calculation Nation

15x	9y	7	

Guest

2x	7y	6	5
+	-2	6y	

+1

+0

Tips for Teaching with Games

- Do not show children how to play at a higher level. Instead, encourage them to do their own thinking.
- Do not reinforce “correct” behaviors or try to correct “wrong” ones.
- Play with individual children whenever possible.

Prime Time

Which is most likely to give an outcome of 4?

- Roll one die
- Roll two die, sum
- Roll two die, difference
- Spinner with four consecutive integers (your choice)
- Flipping n coins, number of heads

Prime Time

Roll one die

$$P(4) = 1/6$$

Prime Time

Roll two die, add

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

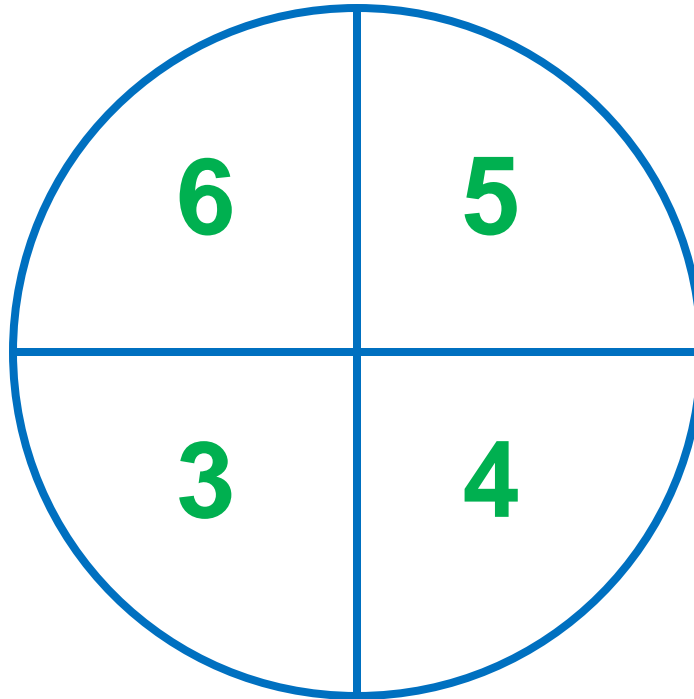
Prime Time

Roll two die, subtract

	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

Prime Time

Spinner with four consecutive integers (your choice)



Prime Time

Flipping n coins, number of heads

n	P(exactly 4 heads)
1	0
2	0
3	0
4	$1/16$
5	$5/32$
6	$15/64$

n	P(exactly 4 heads)
7	$35/128$
8	$70/256$
9	$126/512$
10	$210/1024$
11	$330/2048$
12	$495/4096$

Prime Time

Current Location: 19



Desirable Location: 23

illuminations.nctm.org



Illuminations

The web site currently contains...

- 607 Lessons
- 108 Interactive Tools

On average, 325,000 visitors per month

- August 2004 – 93,371
- March 2012 – 632,910

Illuminations

New in 2012...

- 1 new game for Calculation Nation[®]
- 10 new lessons, *based on Calc Nation games*
- 1 web app
- 3 mobile apps

Illuminations

Click on two cards that you think will match

Games
Face Down

Cards
Numbers 1-6

Players
One

New Game
Reset

two		6	
		5	

Sorry, but that's not a pair. Keep looking!!



www.thinkfinity.org

HOME ACTIVITY INBOX THINGS TO DO BROWSE ▾

Sign In / Register



Places

Resources

Help Center

About Us

Welcome to the New Thinkfinity!

The new home of our award-winning website and online community—offering a broad range of instructional resources from educators and leading educational organizations.

Learn more →

Join us today



What We're Talking About

BLOG POST

EDSITEment's October Newsletter

1 day ago in Community Hub



by joe

DISCUSSION

Re: Tablets are easy to use, easy to break - Do you agree?



by Jane Brown

Thinkfinity Resources



KEYWORDS

STATE STANDARDS

See what standards aligned resources are available by filling out the Keywords or State Standards tab.

Keywords:

Select a Grade:

Thinkfinity

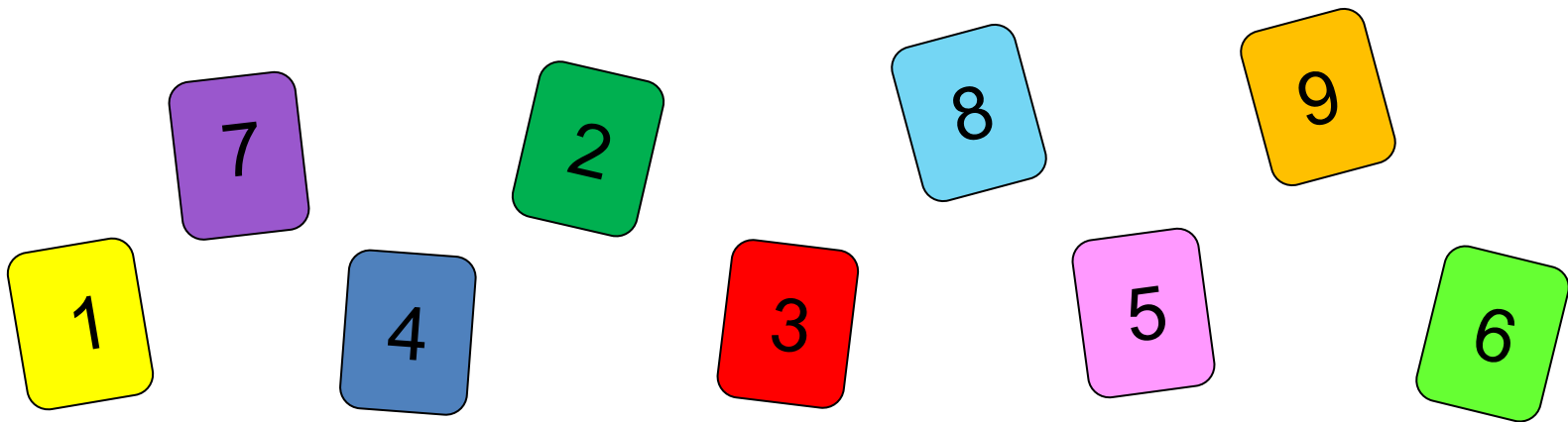
- Provides standards-based content and professional development for K–12 teachers
- Supported by the **Verizon Foundation**
 - NCTM received a three-year, \$1.4M grant for Illuminations
- Consortium of content partners across all disciplines
 - science, arts, humanities, geography, economics, language arts, math, and history

What a constraint!



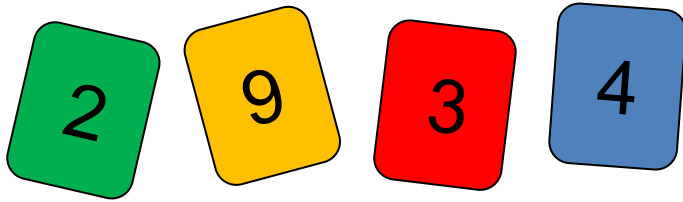
Game of Nine Cards

- **Materials:** Nine cards numbered 1–9
- **Object:** To have any three cards in your hand that add up to 15

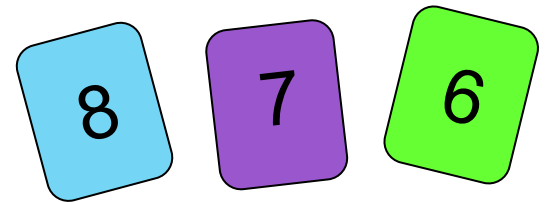


Game of Nine Cards

- Sample Game:



Player 1



Player 2

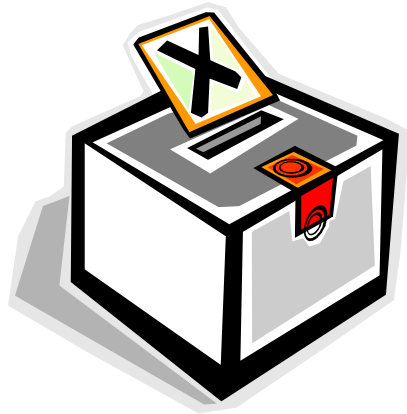
Player 1 Wins: $2 + 9 + 4 = 15$

Game of Nine Cards

Now what?

You Play!

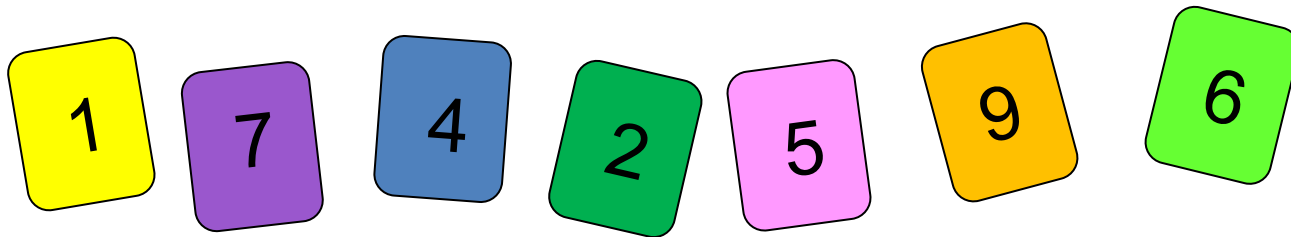
The Basics...



- Who is more likely to win — the first player or the second player? Why?
 - Will someone always win? Lose?
 - What can you do to ensure that you don't lose?
-
- Is there a “best” card to choose?
 - Why do we use a sum of 15?

A Winning Strategy?

- You play first, **pick 8**.
- Your opponent then **chooses 3**.
- What are the **three numbers** that you can choose to ensure a win?



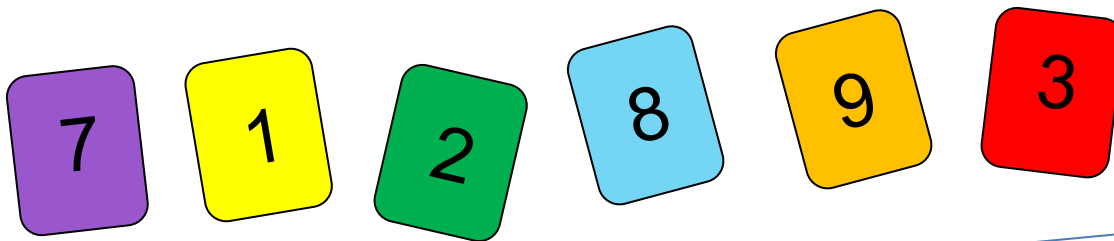
Yours



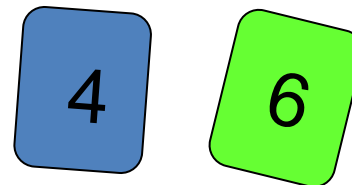
His or Hers

A Winning Strategy?

- Your opponent plays first, **picks 6.**
- You **choose 5.**
- Your opponent **picks 4.**
- Which **two numbers** should you *not* pick?



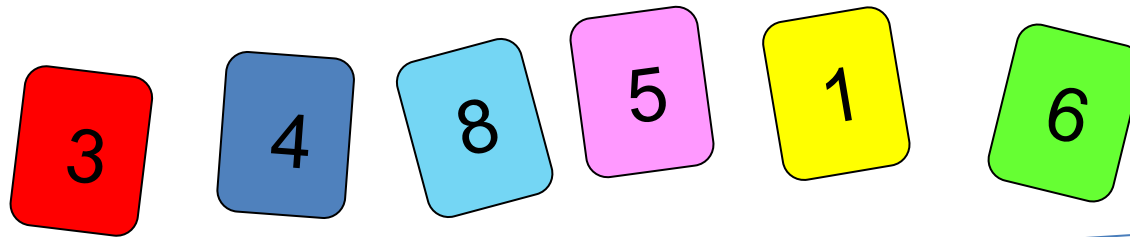
Yours



His or Hers

A Winning Strategy?

- Your opponent plays first, **picks 7**.
- Then you **choose 2**.
- Your opponent **picks 9**.
- Which **three numbers** should you *not* pick?



Yours



His or Hers

More Sophisticated Yet?

- If your opponent plays first and picks an **even** number, what number should you choose to **avoid a loss**?



Another App from Under the Sea

Deep Sea Duel

9 Card

Nice / Easy

Deep Sea Duel
Prepare to Battle Okta!

Choose the number of cards,
Number complexity (Nice to Nasty),
Okta's skill level (Easy to Hard),
and then click Start!

9 card **16 card**

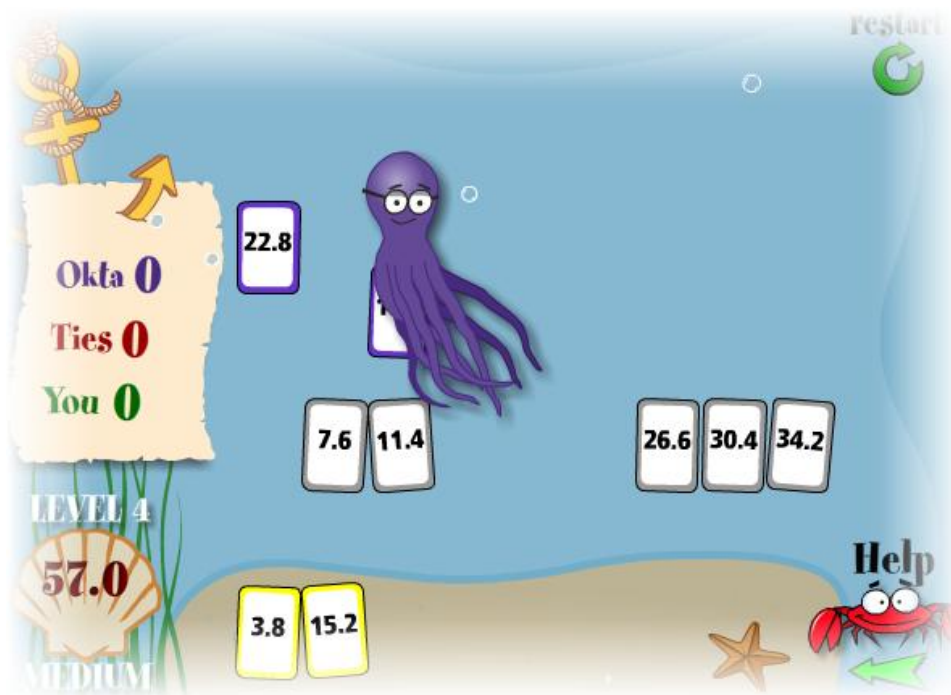
start

Help

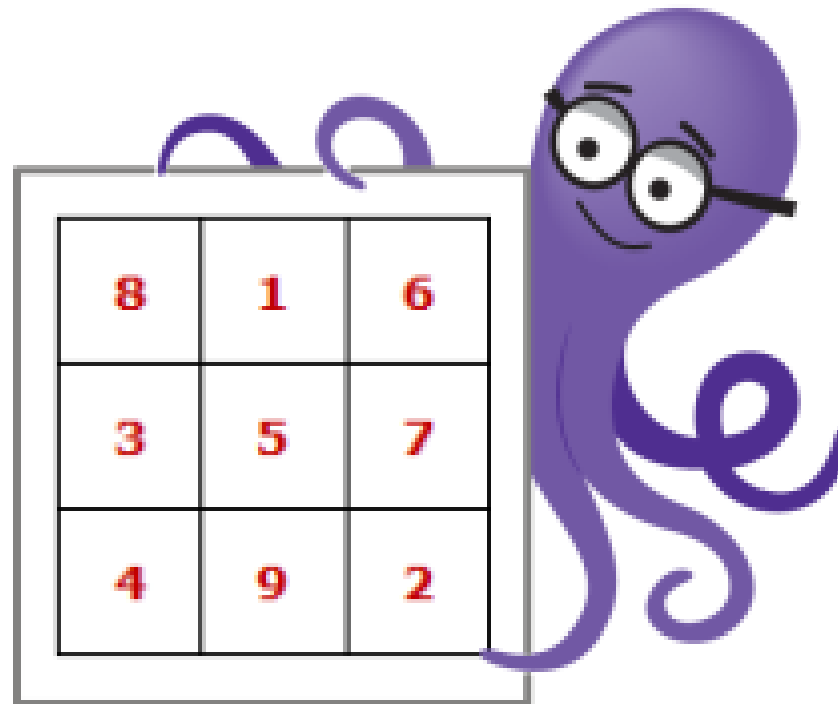
NICE **EASY** **HARD** **NASTY**

Game of Nine Cards

- **Deep Sea Duel** is online!
 - <http://illuminations.nctm.org/deepseaduel>



A Hint from Under the Sea



Modifying the Game of Nine Cards

- Label the nine cards as follows:

5, 12, 19, 26, 33, 40, 47, 54, 61

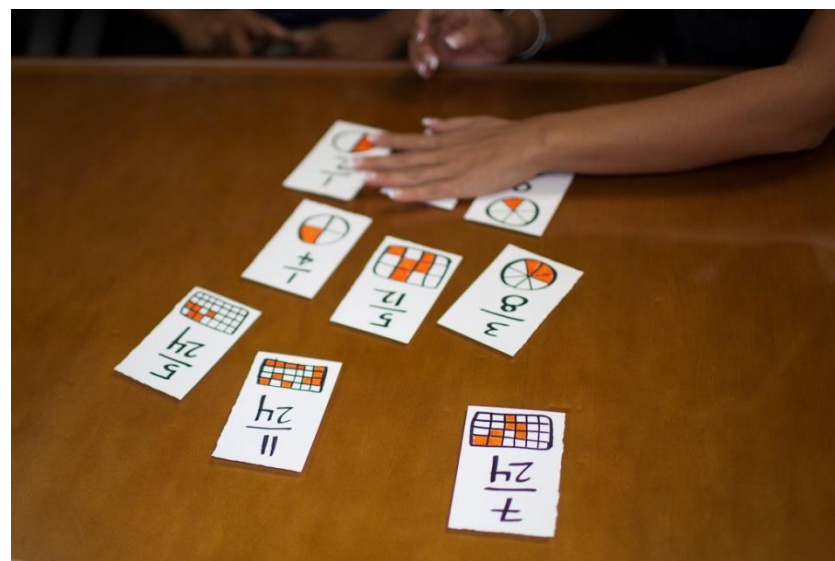
The winner must get three cards that total 99.

Modifying the Game of Nine Cards

- Label your nine cards with fractions:

$$1/6, 5/24, 1/4, 7/24, 1/3, 3/8, \\ 5/12, 11/12, 1/2$$

The winner must get three cards that total 1.



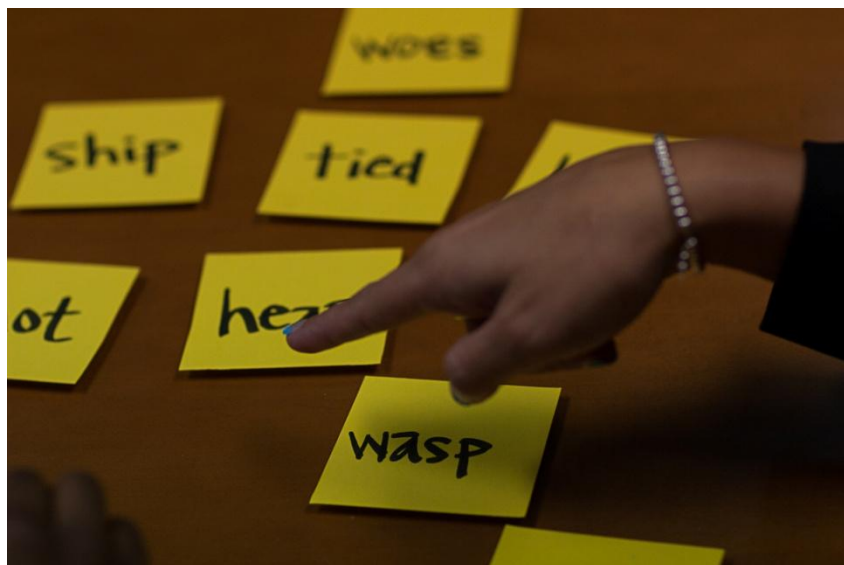
Mahoney, John. What Is the Name of This Game?
Mathematics Teaching in the Middle School, October 2005.

Modifying the Game of Nine Cards

- Use words! Label the cards as follows:

***TIED, HOT, HEAR, TANK, WASP,
WOES, SHIP, HORN, BRIM***

The winner must get three cards that bear the same letter.



Modifying the Game of Nine Cards

- Use exponents!
- Label the nine cards as follows:

$$x, x^2, x^3, \dots, x^9$$

The winner must the *product* get x^{15} .

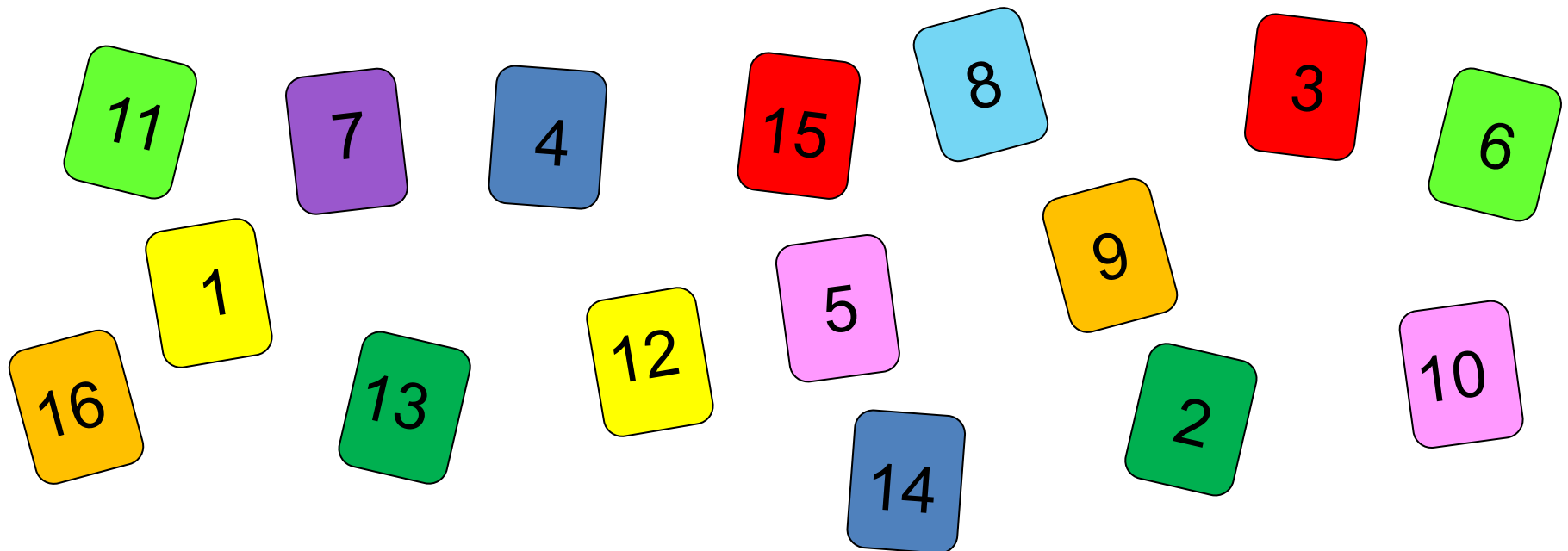
You tell me!

What sum should the winner need to win?



From NINE to SIXTEEN

The winner would use the sum of *four* cards to win.



Another Extension

- The winner is the first player to obtain the sum of exactly 15 from any **TWO OR MORE** cards.
- Does your strategy change? How so?



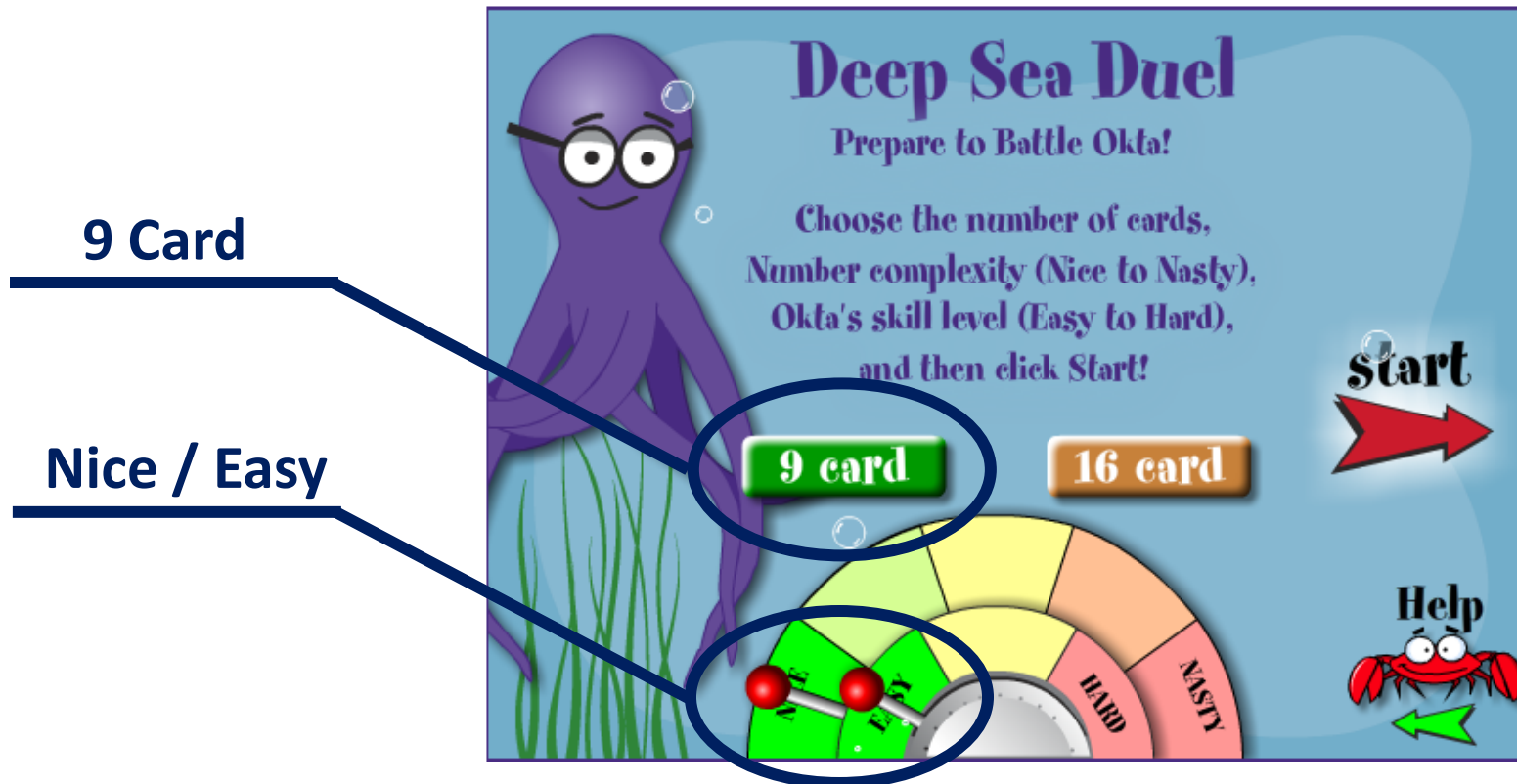
Reminder: What is the Goal?

- How does your strategy from the first version of the game of 9 cards compare to the strategy for these modifications?
- REFLECT: *How* did I come up with these other versions for the game of 9 cards?



Another App from Under the Sea

- <http://illuminations.nctm.org/deepseaduel>



Challenge Okta to Deep Sea Duel on the web.



Options & Modifications in App

Deep Sea Duel
Prepare to Battle Okta!

Choose the number of cards
Number complexity (Nice, Easy, Hard)
and then click Start

9 card 16

NICE EASY HARD

restart

Okta 0
Ties 0
You 0

LEVEL 4
74.8
MEDIUM

2.2	4.4	6.6	8.8	11.0	13.2	15.4	17.6
19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2

Drag card to beach

Help

Learning is fun. Get addicted!

Deep Sea Duel

is FREE online at Illuminations and Google Play and the App Store for phones and tablets.



KenKen®

KenKen®

KenKen is a puzzle game that helps students improve their calculation skills, logical thinking and persistence. The goal is to fill a grid with numbers so that no number appears more than once in any row or column. In addition, the numbers must combine to form a target number using a specific operation. This page is updated with **four new KenKen puzzles daily** and is provided in partnership with Nextoy, LLC.

Instructions

KENKEN
Puzzles That Make You Smarter™

Today's puzzles

- 4x4 (+)
- 4x4 (+-)
- 4x4 (+-x÷)
- 6x6 (+-x÷)

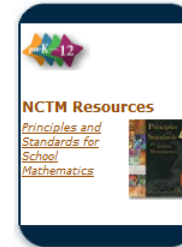
Yesterday's solutions

- 4x4 (+)
- 4x4 (+-)
- 4x4 (+-x÷)
- 6x6 (+-x÷)

For More KENKEN® Puzzles Visit www.kenken.com

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Comment About This Page



illuminations.nctm.org/kenken

An Example



2	12X		
1-		3-	2÷
7+			
3-		6X	

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