Games that Promote Equity and Mathematical Brilliance

in the Upper Elementary Classroom

Louisa Connaughton & Jenna Laib

Intros

Louisa Connaughton
PK-6 Math Specialist
Chestnut Hill, MA

Jenna Laib
K-8 Math Specialist & Coach
Brookline, MA

You're at the right presentation if...

- You are passionate about building equitable classroom communities
- You recognize the value of using games for strategic purposes
- You value and appreciate simplicity

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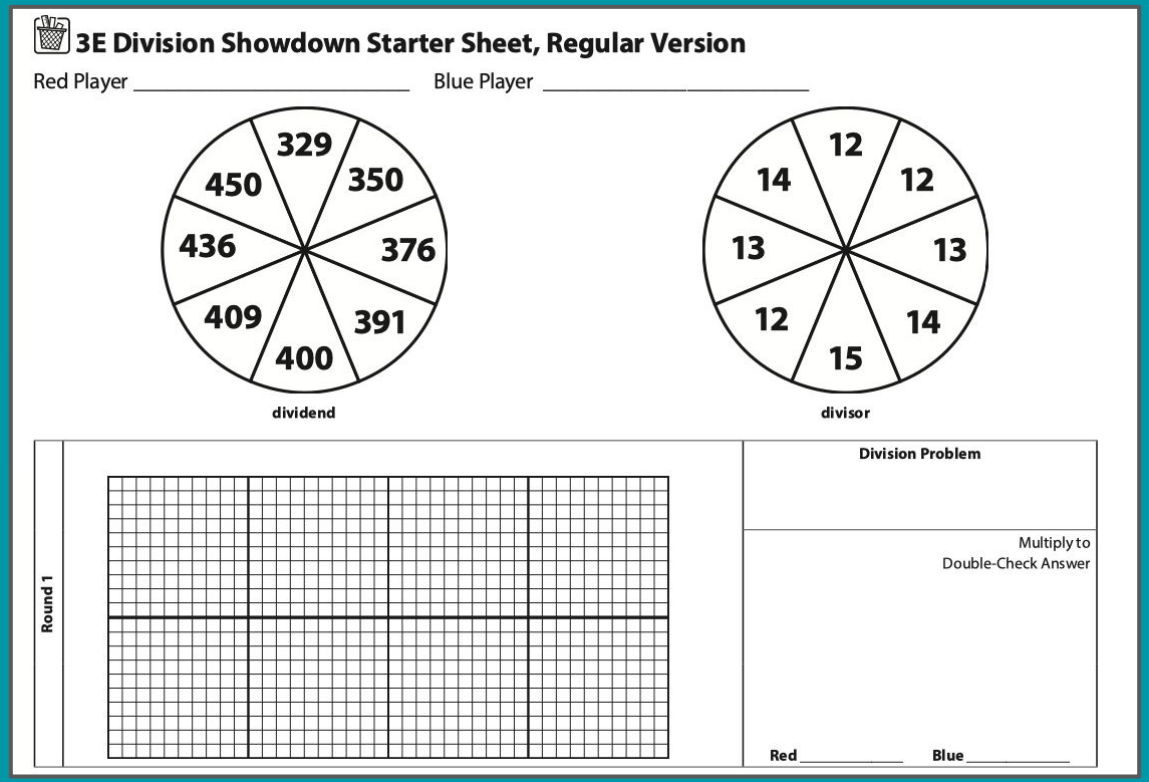
@lpconnaughton @jennalaib

What do you notice? ...wonder?



3E Division Showdown Starter Sheet, Regular Version

Red Player _____ Blue Player _____

Work Place Instructions 3E Division Showdown page 1 of 2

Each pair of players needs

- a 3E Division Showdown Starter Sheet (Regular or Challenge Version) to share
- a 3E Division Showdown Continuation Sheet A to share
- a 3E Division Showdown Continuation Sheet B to share
- 1 spinner overlay
- 1 red and 1 blue colored pencil or markers

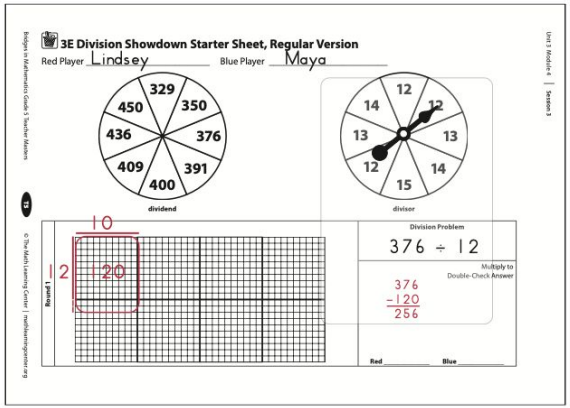
1 Players record their names at the top of the starter sheet, then decide which player will go first and what color each player will use.

2 Player 1 spins the spinners and records a division problem using the two numbers. Then he marks and labels the known dimension (the divisor) on the grid with his or her color.

3 Next, Player 1 loops and labels 10 times the divisor, and records the results in the figuring box to the right of the grid, working in his or her own color.

For example, if the divisor spun was 12, loop and label 12 × 10 on the grid, then mark it by drawing the dimension across the top. Work in the figuring box to subtract 120 from the dividend to see how much is still left.

> ***Lindsey*** *OK, I'm first. I spun 376 and 12, so now I have to write 376 ÷ 12 in the division problem box. Then I have to mark 12 on the side of the grid, and loop and label 10 × 12, which is 120. The last thing I have to do is subtract 120 from 376 so we can see how much we still have. It's 256, and it's your turn now, Maya.*



4 Player 2 takes a turn to loop and label 10 times the divisor using his or her own color, and record the results in the figuring box.

Work Place Instructions 3E Division Showdown page 2 of 2

5 Players take turns looping and labeling 10 times the divisor and recording the results in the figuring box until there isn't enough left of the dividend to subtract 10 times the divisor again.

6 When there isn't enough left to subtract 10 times the divisor anymore, the player whose turn it is gets to subtract as many groups of the divisor as he or she wants.

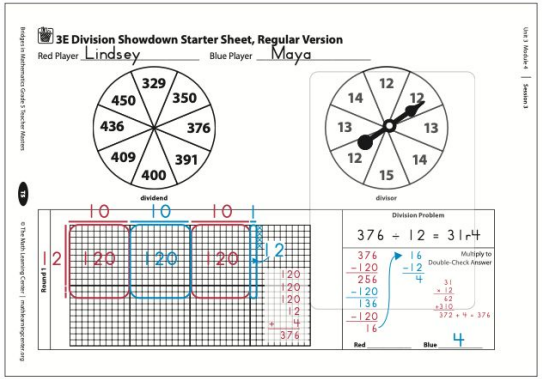
The player should try to remove as many groups as possible, since the player who makes the last removal wins the round.

7 The player who makes the last move must do the following:

- Loop and label the final groups on the grid.
- Subtract the final amount in the figuring box.
- Show the remainder, if there is one, with Xs on the grid.
- Write the answer to the division problem.
- Multiply the quotient times the divisor, and add the remainder if there is one, to double-check the answer.

8 The player who makes the last move scores points equal to the remainder, if there is one. If there is no remainder he scores 1 point for being the last to make a move.

Before the winner of the round can take the points, the other player gets to add up the pieces, including the remainder, on the grid to be sure they total the dividend. If they don't, both players have to find the mistake and fix it.

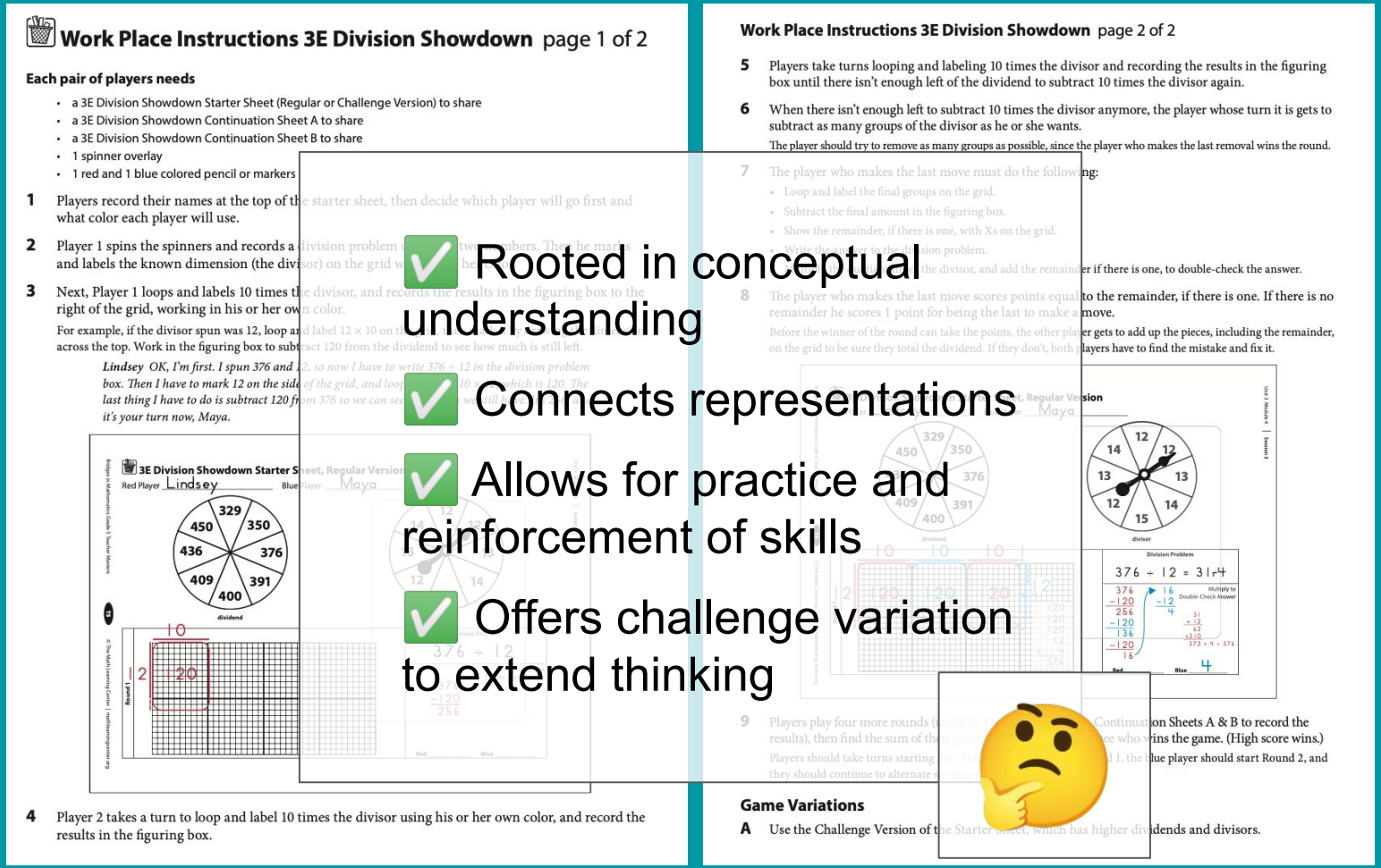


9 Players play four more rounds (using 3E Division Showdown Continuation Sheets A & B to record the results), then find the sum of their points from all 5 rounds to see who wins the game. (High score wins.)

Players should take turns starting first. If the red player started Round 1, the blue player should start Round 2, and they should continue to alternate starting each new round.

Game Variations

A Use the Challenge Version of the Starter Sheet, which has higher dividends and divisors.



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Players should take turns starting first. If [illegible] 1, the blue player should start Round 2, and they should continue to alternate starting [illegible]

Game Variations

A Use the Challenge Version of the Starter Sheet, which has higher dividends and divisors.

✅ Rooted in conceptual understanding

✅ Connects representations

✅ Allows for practice and reinforcement of skills

✅ Offers challenge variation to extend thinking

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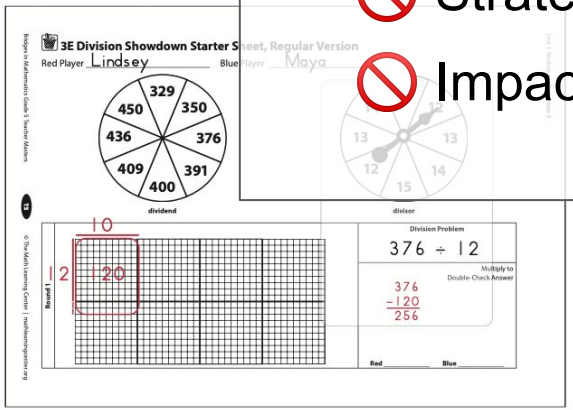

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Time?

Choice?

Strategy?

Impact?

Work Place Instructions 3E Division Showdown page 2 of 2

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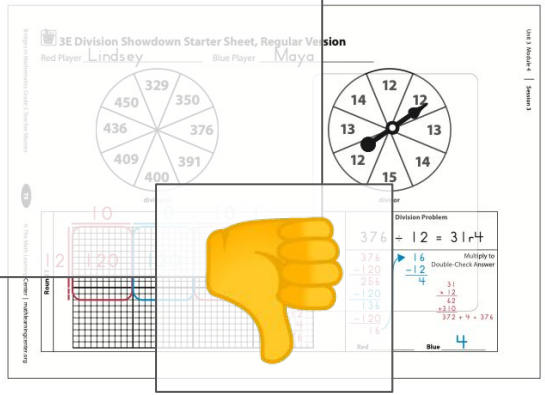

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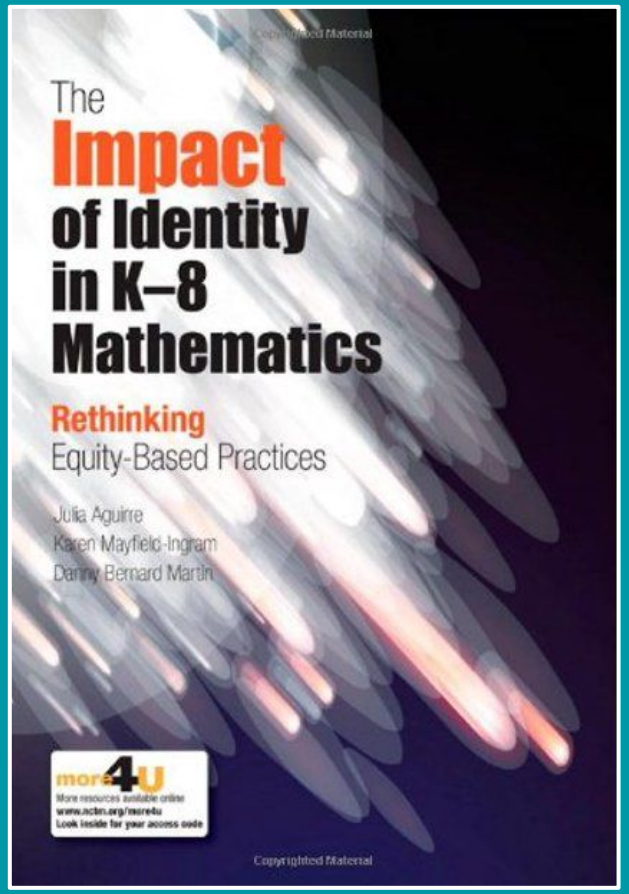

The Impact of Identity in K-8 Mathematics: Rethinking Equity-Based Practices

Julia Aguirre, Karen Mayfield-Ingram, and Danny Bernard Martin

Published by NCTM in 2013

Defining *equity*

"All students, in light of their humanity—their personal experiences, backgrounds, histories, languages, and physical and emotional well-being—must have the opportunity and support to learn rich mathematics that fosters meaning making, empowers decision making, and critiques, challenges, and transforms inequities and injustices."

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5 Equity-Based Teaching Practices

- Going deep with mathematics
- Leveraging multiple mathematical competencies
- Affirming mathematics learners' identities
- Challenging spaces of marginality
- Drawing on multiple resources of knowledge (math, culture, language, family, community)

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Evaluating games with equity in mind

#1 Going deep with mathematics	**Will playing the game deepen mathematical understanding?**
#2 Leveraging multiple mathematical competencies	**Are there multiple entry points?**
#3 Affirming mathematics learners' identities	**Are there multiple ways to participate?**
#4 Challenging spaces of marginality	**Are there multiple ways to be successful?**
#5 Drawing on multiple resources of knowledge	**Is the game simple and accessible?**

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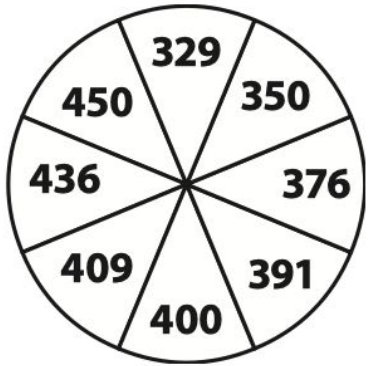
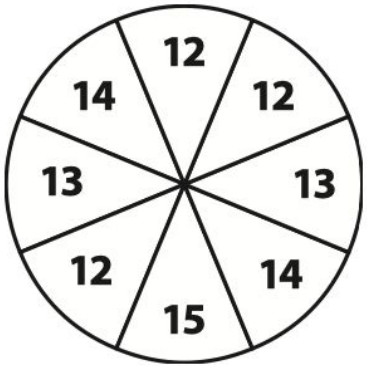


dividend



divisor

Round 1

Division Problem

Multiply to
Double-Check Answer

Red _____ **Blue** _____

Equity and Student Brilliance

- Students feel a sense of belonging when they are:
  - Welcome to share their brilliance
  - Expected to develop their thinking further
  - Learn *with* and *from* others in the room

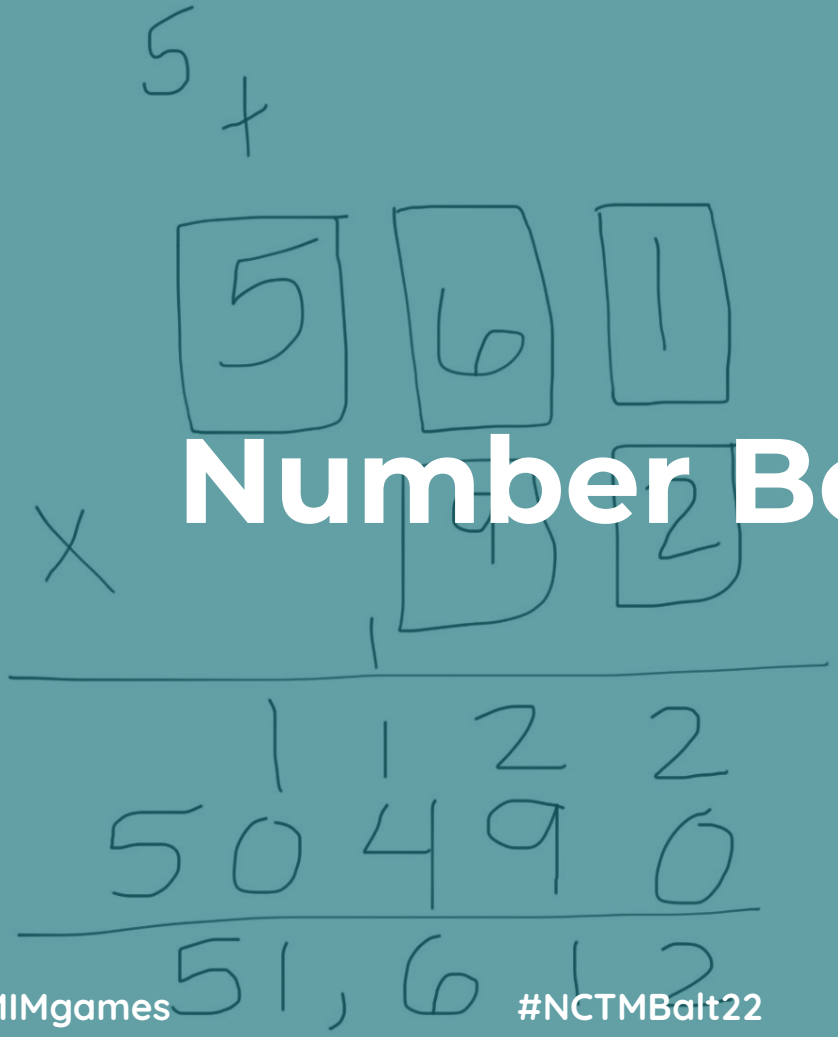
What games promote this kind of environment?

What facilitation moves support this work?

The Games

Number Boxes

The Skip Count Game



Number Boxes

Getting Started: Number Boxes

Materials

- Something to write *with*

- Something to write *on*

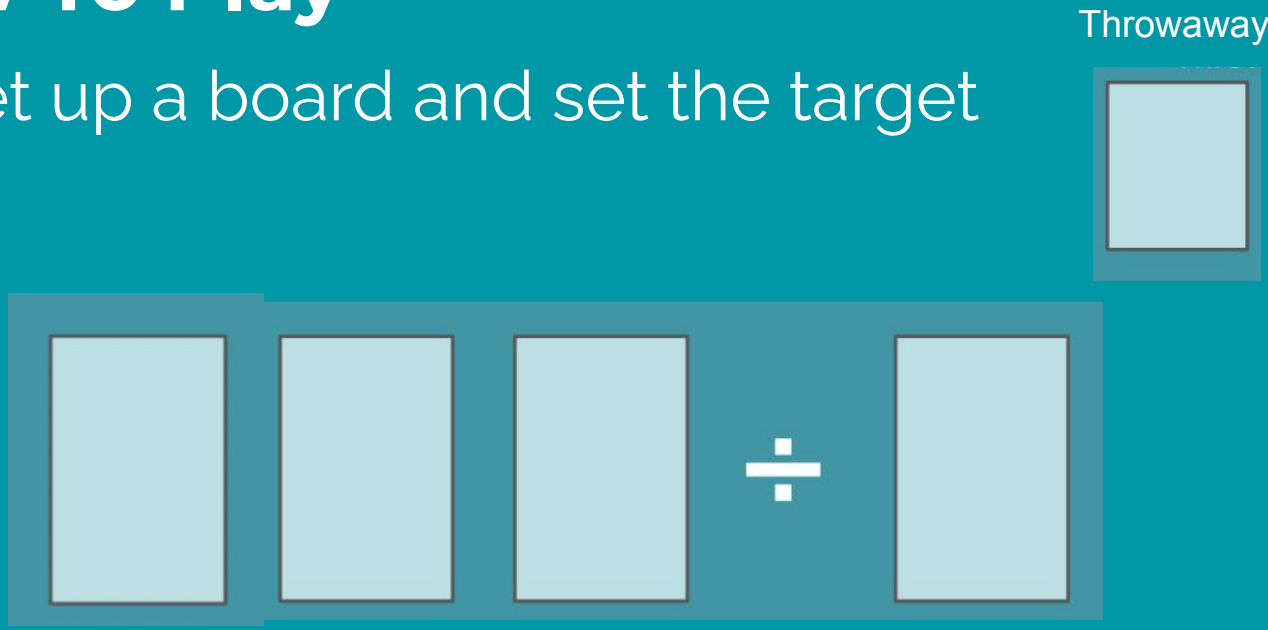
- Something to generate random numbers

A Plan

- Structure of game board
- Target/goal

How To Play

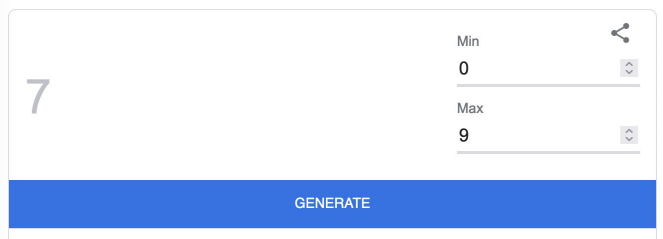
1. Set up a board and set the target

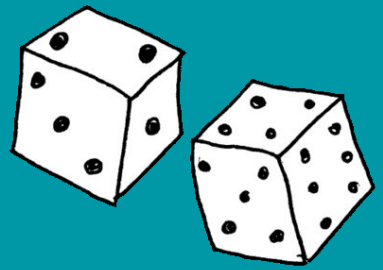


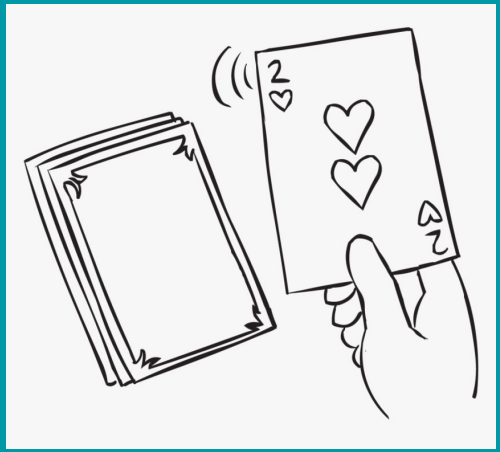
TARGET: Smallest Quotient

How To Play

1. Set up a board and set the target
2. Generate a random digit



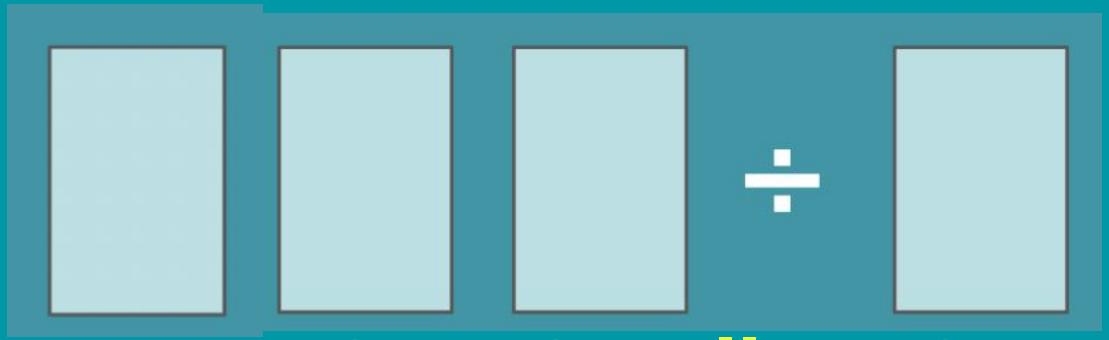




How To Play

1. Set up a board and set the target
2. Generate a random digit
3. Place the digit *(and it can't be moved!)*

Throwaway



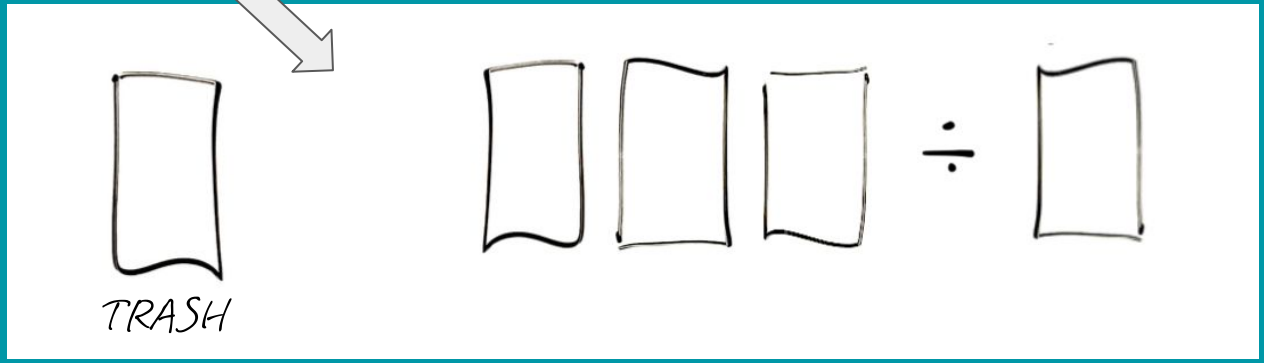
TARGET: Smallest Quotient

How To Play

1. Set up a board and set the target
2. Generate a random digit
3. Place the digit *(and it can't be moved!)*
4. Repeat until all boxes have been filled

How To Play

1. Set up a board and set the target
2. Generate a random digit
3. Place the digit *(and it can't be moved!)*
4. Repeat until all boxes have been filled
5. Calculate, reason, and collaborate



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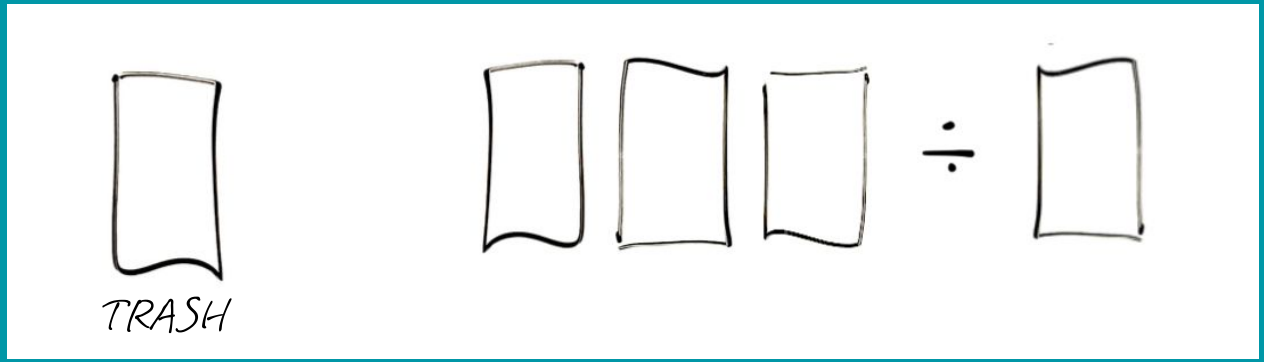

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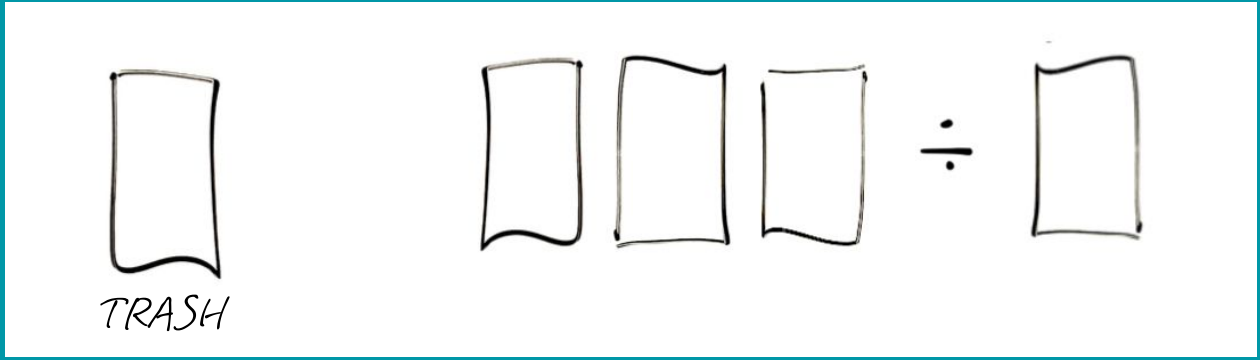

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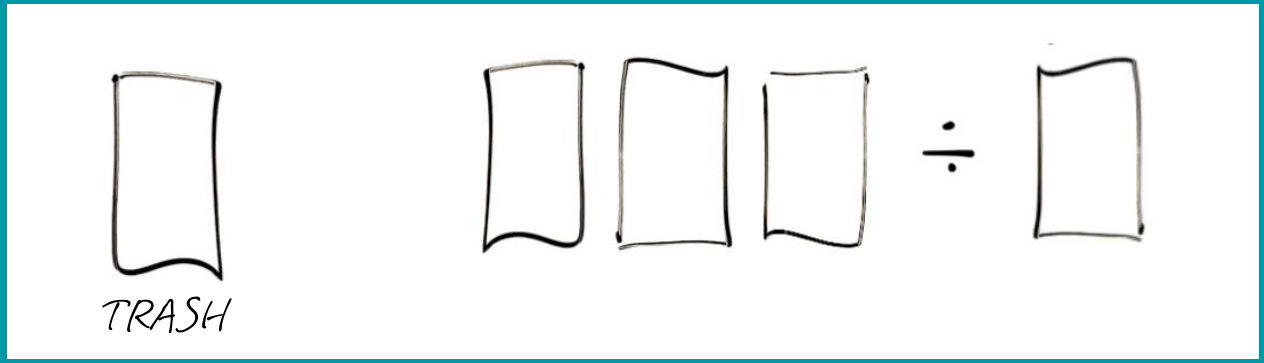

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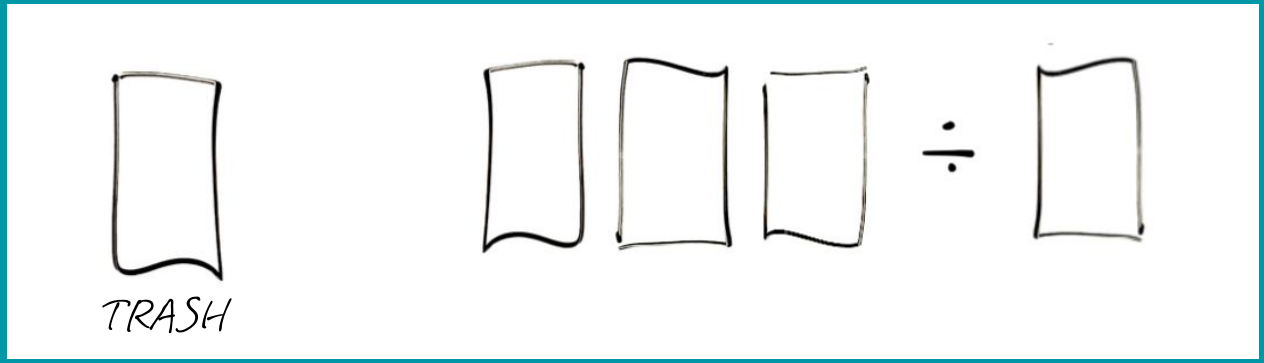

TARGET: Smallest Quotient

How To Play

Possible next games:

1. □□□ ÷ □□ *largest quotient*
2. □□□ ÷ □ *quotient closest to 100*
3. □□.□ ÷ □.□ *smallest quotient*

TARGET: Smallest Quotient

Thank you, Wipebook

wipebook.com/psbma

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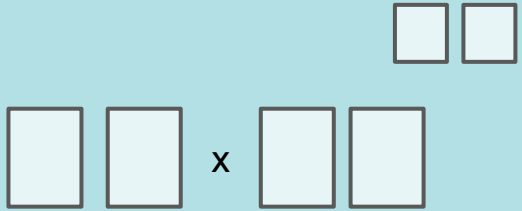
Playing the Game

A

Target: Closest to 1,500

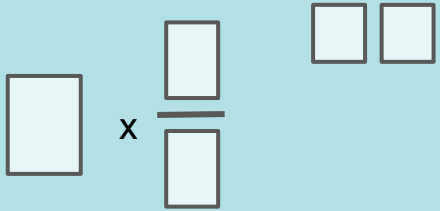


B

Target: Largest Number

C

Target: Smallest Product



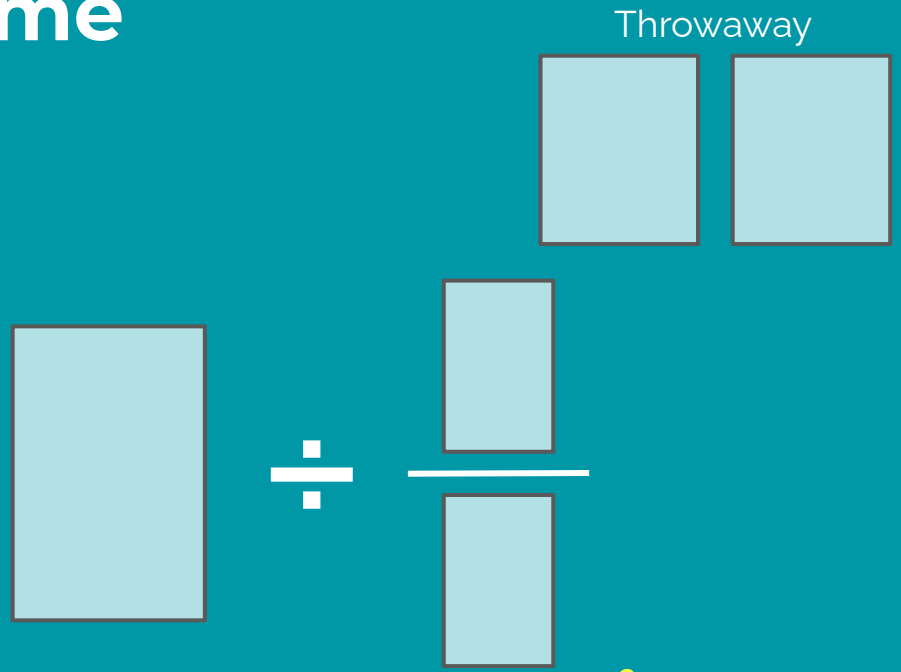
then…

Come up with your own!

- What mathematical content?
- How will you set up the board?
- What will the target or goal be?

Reflect:
What facilitation moves could help uncover student brilliance?

Playing the Game



TARGET: Largest Quotient

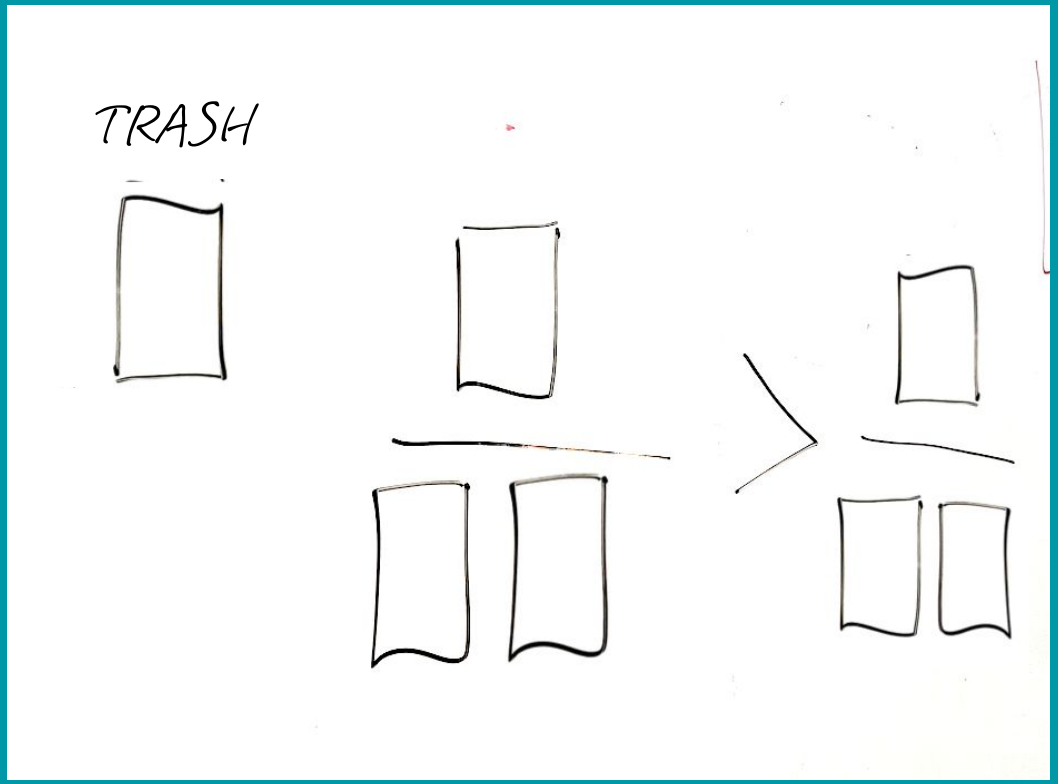
If you tried to plan your own...

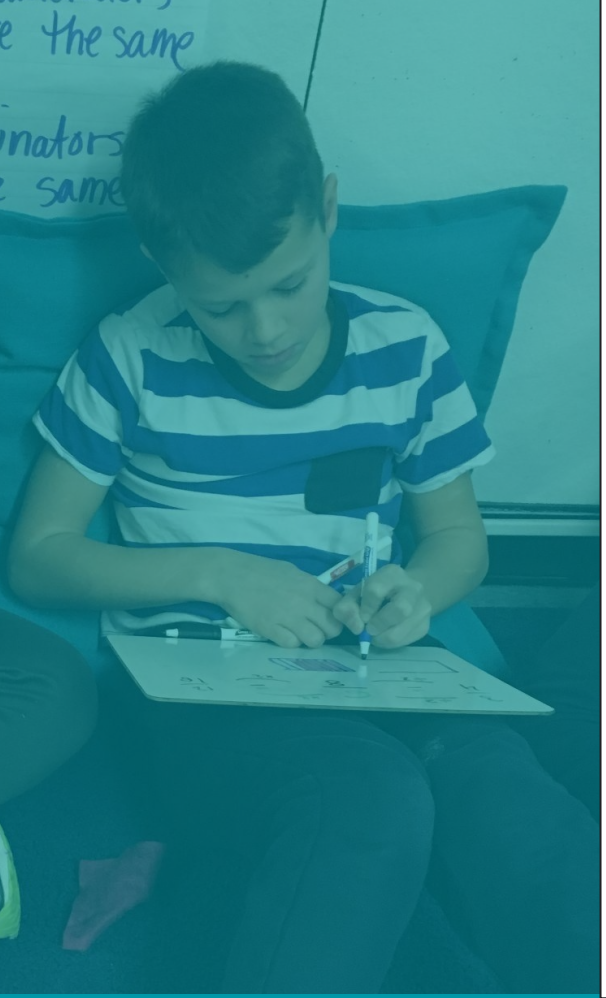
- What worked well?

- What was challenging?

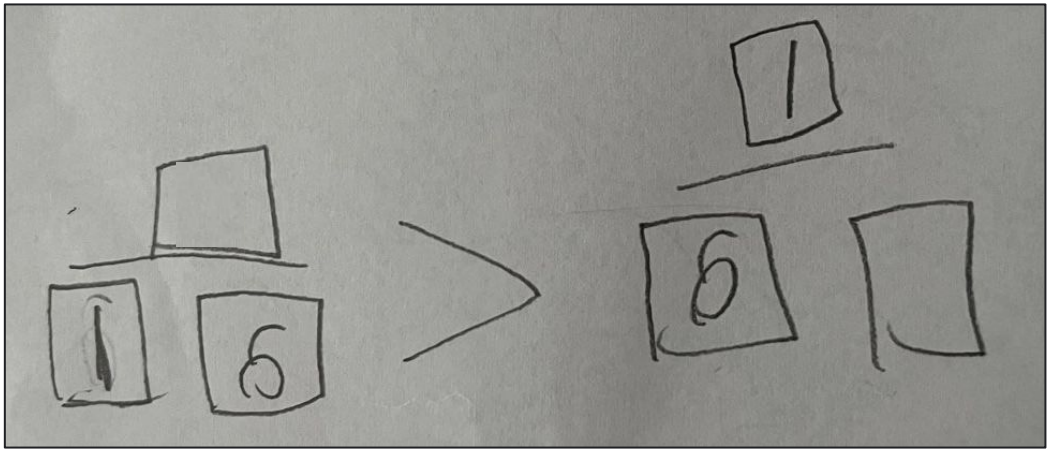
Planning the Structure

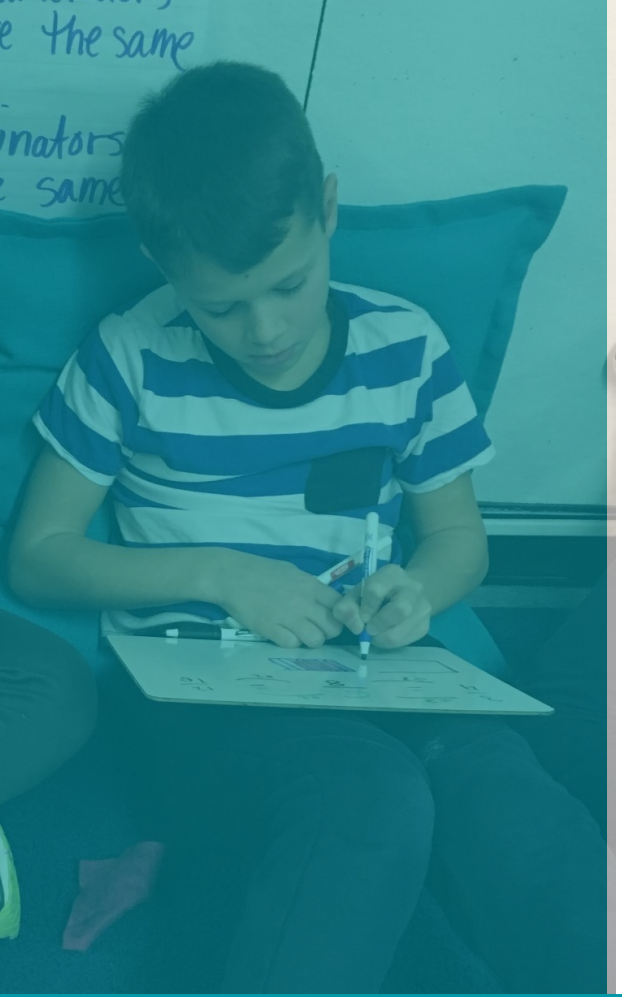
- What mathematical content do you want to focus on?
- What mathematical ideas do you anticipate will surface that you might want to explore?
- What structures (board and target) will maximize your learning goals?


TRASH

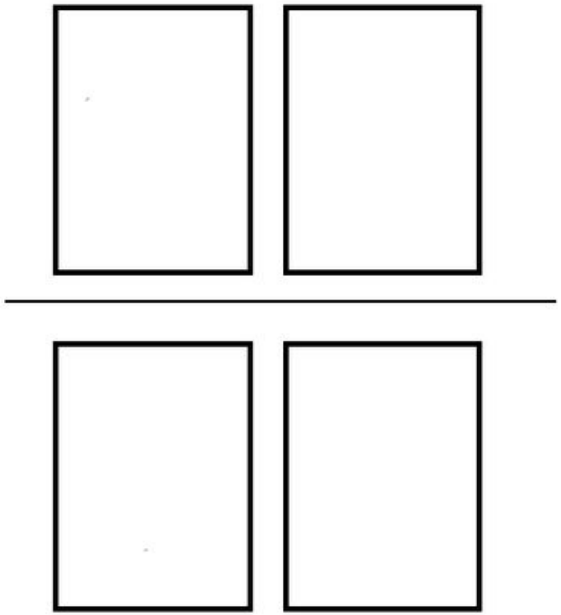


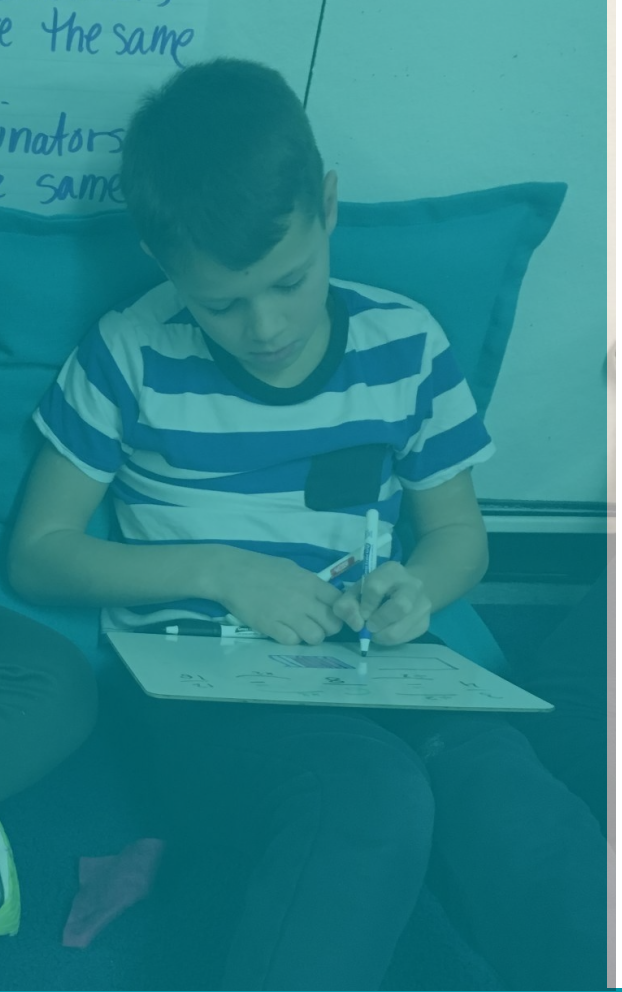
“I already know I won.”



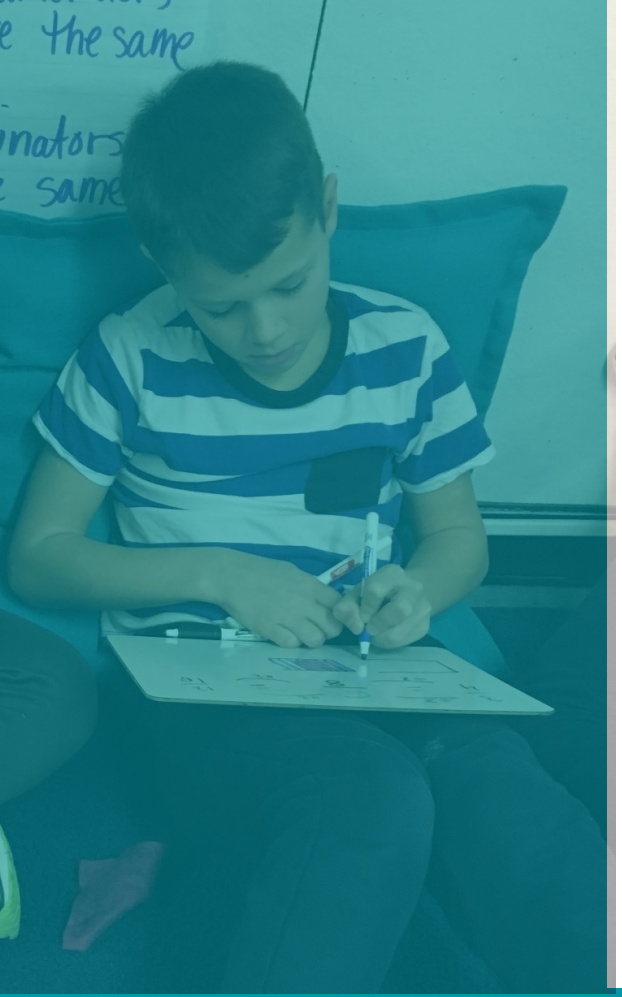


Game 1 - Smallest Fraction



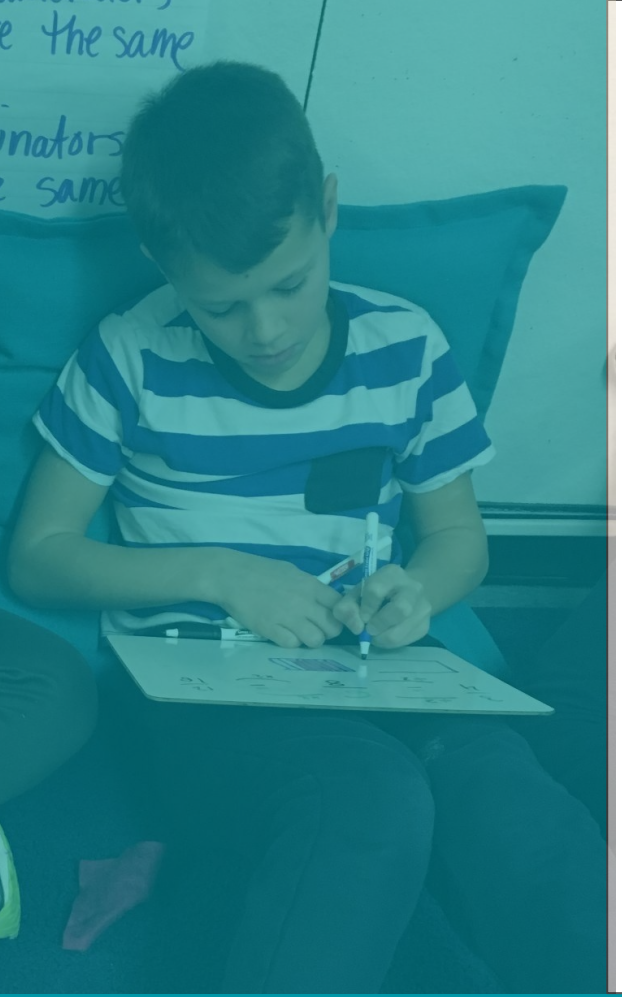


$$\frac{25}{66} \text{ vs } \frac{26}{65}$$



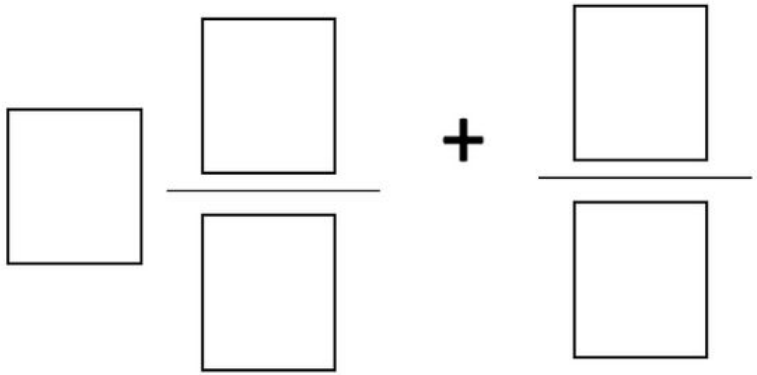
Game 2 - Smallest Sum

$$\frac{\square}{\square} + \frac{\square}{\square}$$



Use each of the digits 2, 3, 4, 5, 6 to fill in the boxes below to create an expression with the **smallest value** possible.

You do not need to solve the problem (but you can if you want!)



Evaluating games with equity in mind

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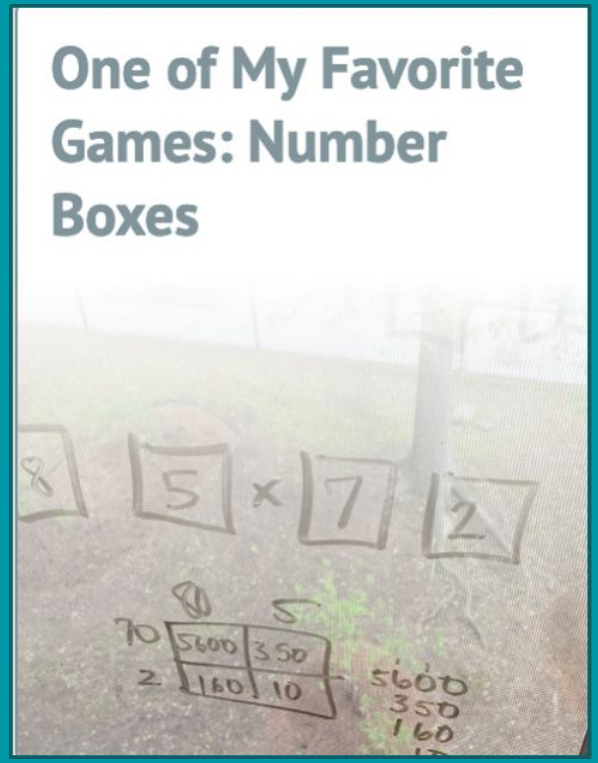
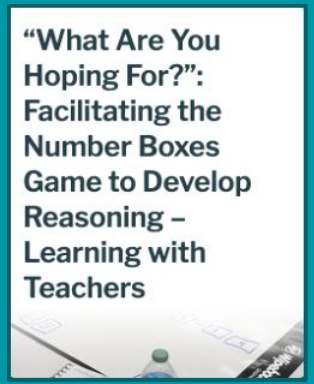
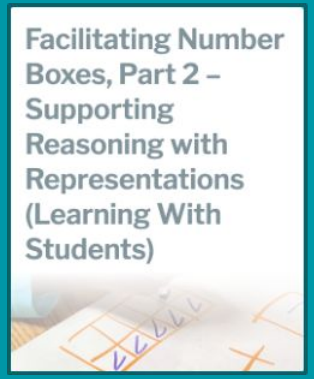
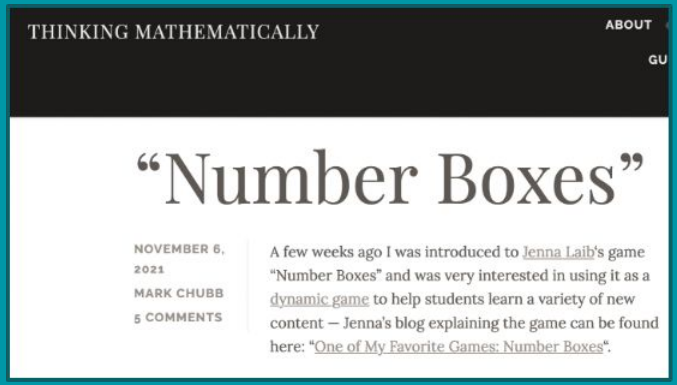
#5 Drawing on multiple resources of knowledge	✅ **Is the game simple and accessible?**

Read More









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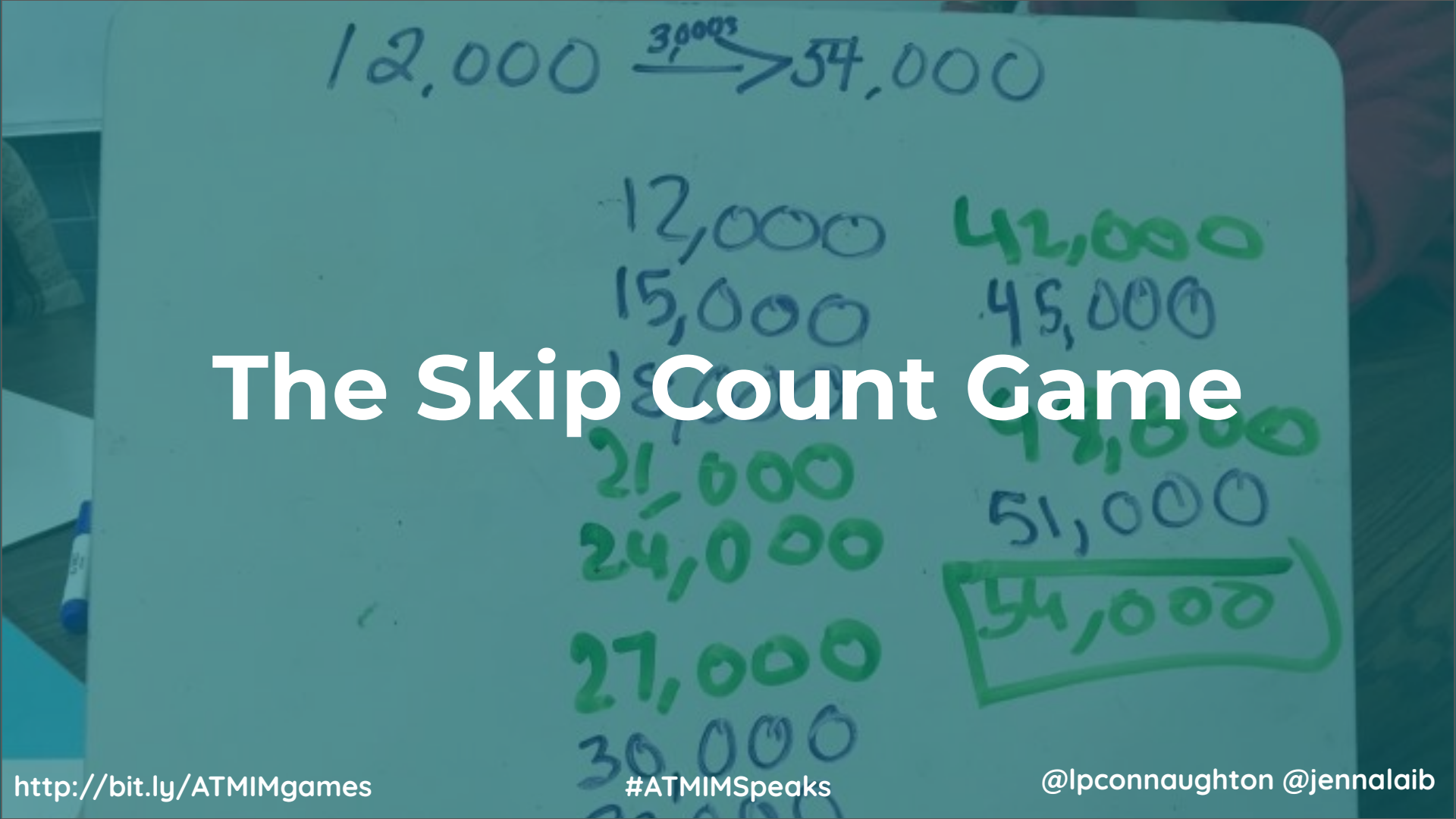

The Skip Count Game

Nim (21 Game)

1	8	15
2	9	16
3	10	17
4	11	18
5	12	19
6	13	20
7	14	

The Skip Count Game

- Players alternate writing 1, 2, or 3 numbers that follow a skip counting pattern.
- Does not need to start at 1, or end at 21
- Can skip count forwards or backwards
  - e.g. 8s, or 125s, or ¼s, etc.
- Player who lands on the ending number wins. 🏆

How To Play the Skip Count Game

Materials

- Something to write *with*

- Something to write *on*

- Plan
  - What to **skip count by**
  - Where to **stop/start**

How To Play the Skip Count Game

Materials

- Something to write *with*

- Something to write *on*

- Plan
  - What to **skip count by**
  - Where to **stop/start**

Directions

- Player 1 starts at starting number, and skip counts 1, 2, or 3 numbers
- Player 2 continues skip counting (1, 2, or 3 numbers)
- Play continues until a player reaches the end
- Player who hits 'end' number wins

402 *Forward by 20s* → **762**

402	542	682
422	562	702
442	582	722
462	602	742
482	622	762
502	642	
522	662	

Playing the Game

A

Start at **355**

Skip count **forwards by 50s**

End at **1255**

B

Start at **¼**

Skip count **forwards by ¼ s**

End at **21/4**

C

Start at **12,000**

Skip count **backwards by 200s**

End at **4,200**

---

then…

Come up with your own!

- What will be the start/end?
- What will you skip count by?
- How many "jumps"?

Reflect:
What facilitation moves could help uncover student brilliance?

If you tried to plan your own...

- What was easy for you to do?

- What was challenging?

Planning the Numbers

- What mathematical structures will emerge?
- Are there patterns you hope students will leverage? If so, what are they?
- How many “turns” should there be?

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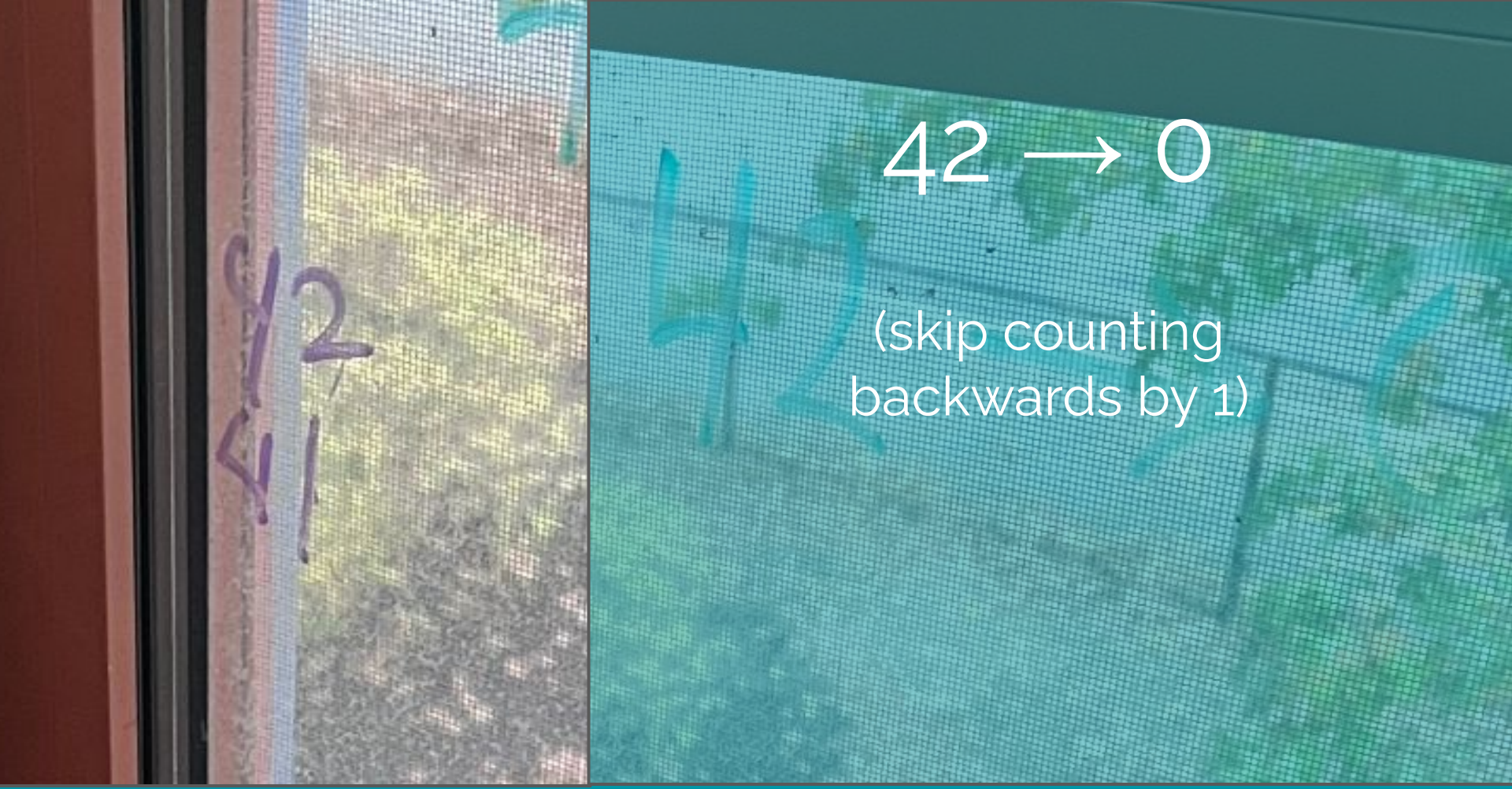
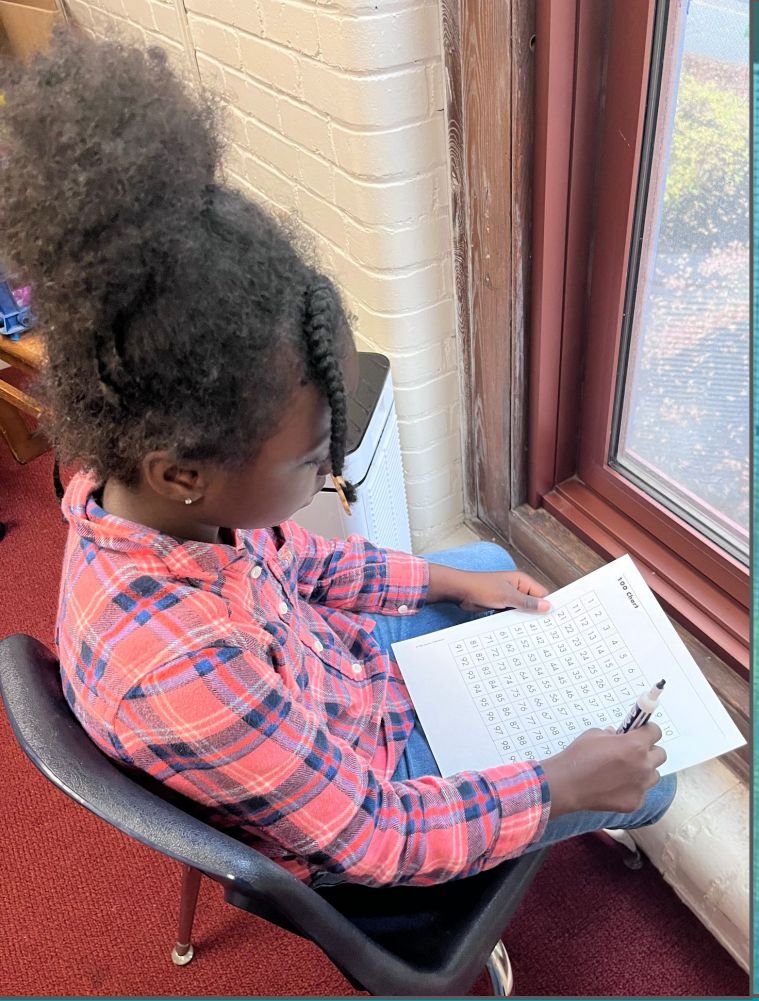
#5 Drawing on multiple resources of knowledge	✅ **Is the game simple and accessible?**

42 → 0

(skip counting backwards by 1)


42 → 0
(skip counting
backwards by 1)



42 → 0

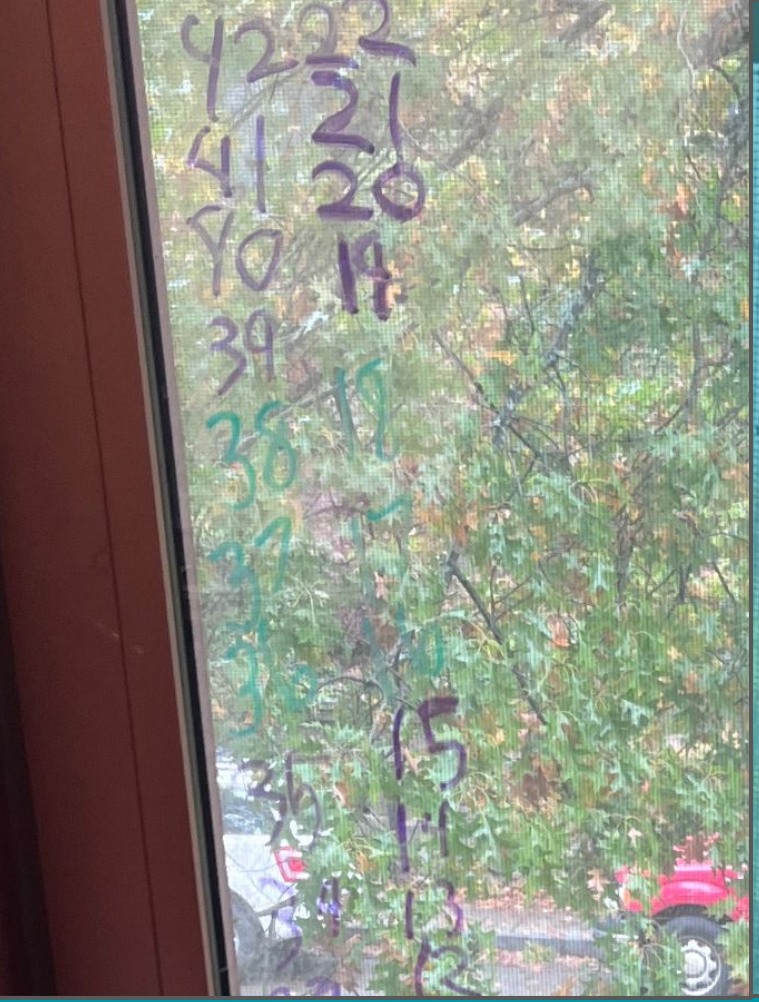
(skip counting backwards by 1)

42 → 0

(skip counting backwards by 1)

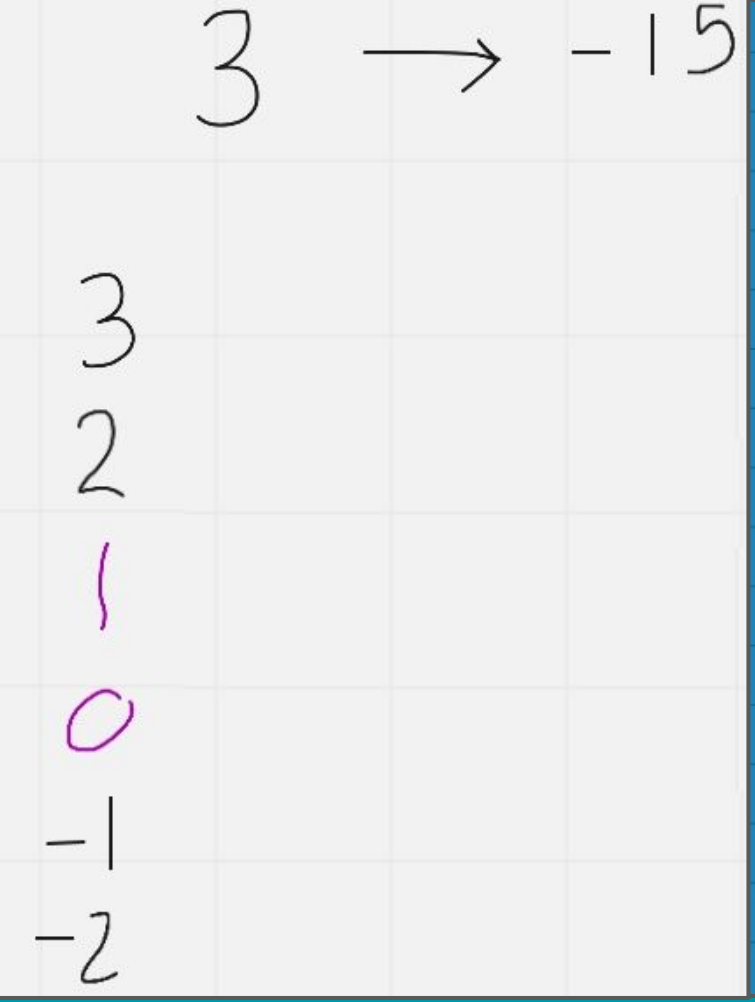
42 → 0

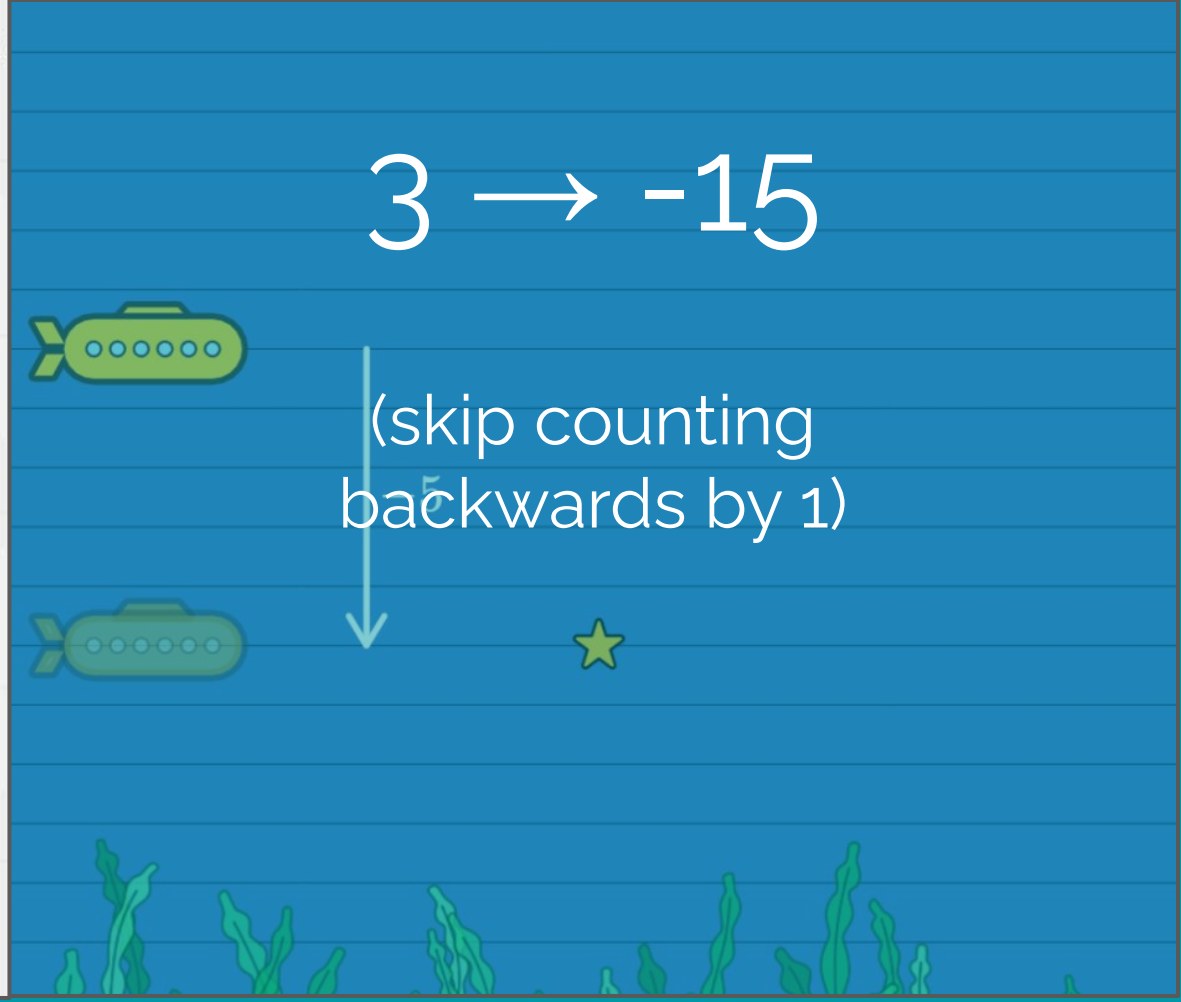
(skip counting backwards by 1)



42 → 0

(skip counting backwards by 1)


3 → -15
3
2
1
0
-1
-2


3 → -15
(skip counting backwards by 1)

3 → -15

3 -4 -12
2 -5 -13
1 -6 -14
0 -7 -15
-1 -8
-2 -9
-3 -10
-11

3 → -15

(skip counting backwards by 1)

6 $\xrightarrow{-2s}$ −24

6 −8 −20

4 −10 −22

2 −12 −24

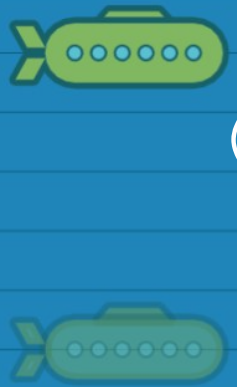
0 −14

−2 −16

−4 −18

−6

6 $\xrightarrow{-2s}$ −24



(skip counting by -2s)

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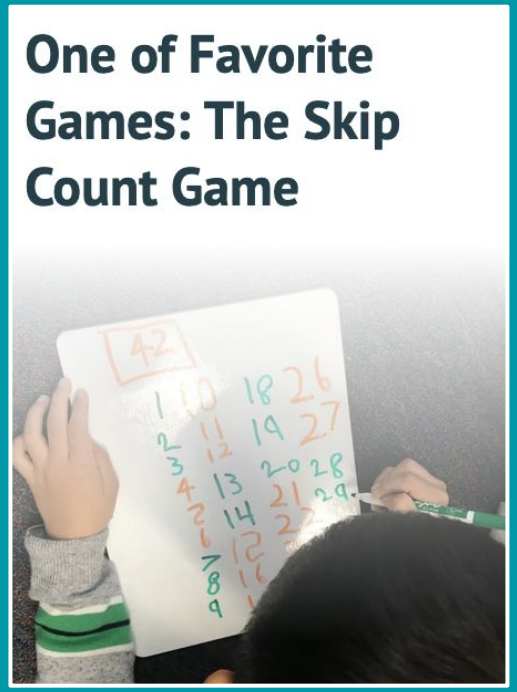

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Standards for Mathematical Practice

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Use repeated reasoning

GAMES

Five Equity-Based Teaching Practices

- Going deep with mathematics
- Leveraging multiple mathematical competencies
- Affirming mathematics learners' identities
- Challenging spaces of marginality
- Drawing on multiple resources of knowledge (math, culture, language, family, community)

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What games promote an equitable environment?

What facilitation moves support this work?

Wipebook

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Thank you!