Problems worth puzzling through

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Writer's cramp saver

- For this presentation: mpi.edc.org/blog
- For more puzzles: solveme.edc.org
- Dialogues: mathpractices.edc.org

Why *"puzzle"* rather than *"solve"*?

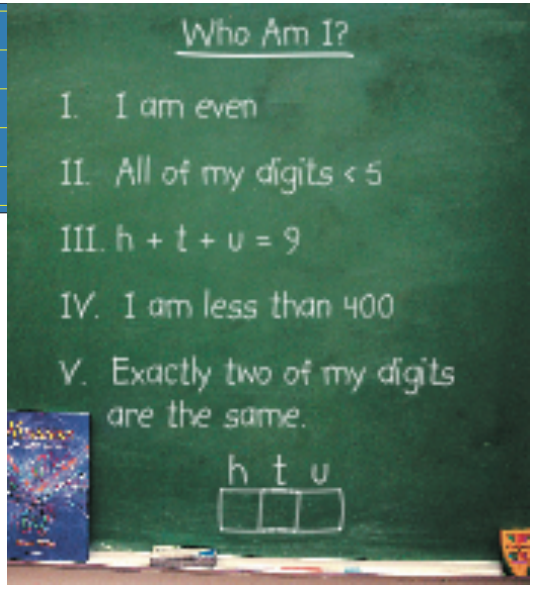
- They're playful? They're fun? ☹
- That's no answer! What's play? What's fun?
- Manageable challenge
- Feels smart (intellectual effort, boredom is punishment)
- *Because it's puzzling*
  - "Problems" are *problems*
  - Puzzles give us permission to think
- And because we're not cats ☺

Why *"puzzle"* rather than *"solve"*?

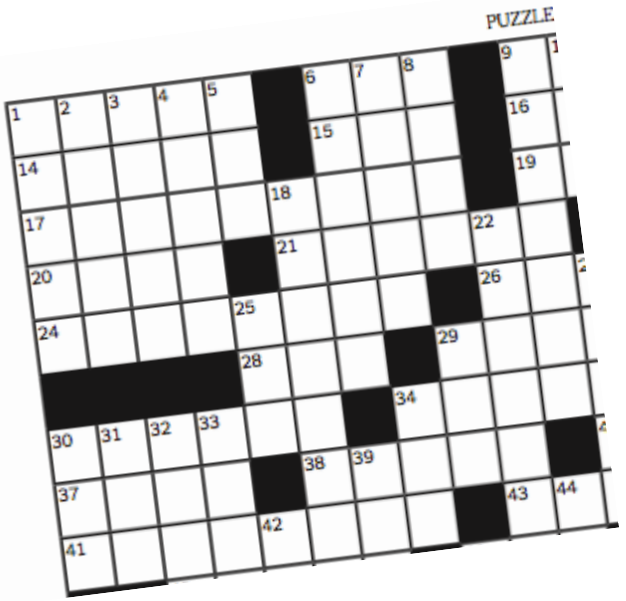
- Brown and Day, 2006: "The difference isn't black and white: stereotype threat and the race gap on Raven's Advanced Progressive Matrices"

- Oversimplified, seeing something as a puzzle rather than as a test improves performance, especially for vulnerable students.

Puzzling things through

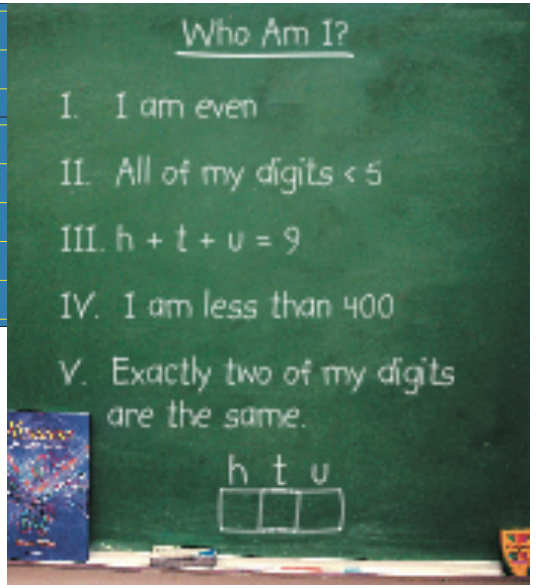


- Part of child's world
- "Pure mathematical thinking" minus the content
- But could carry content, too!



SMP 1

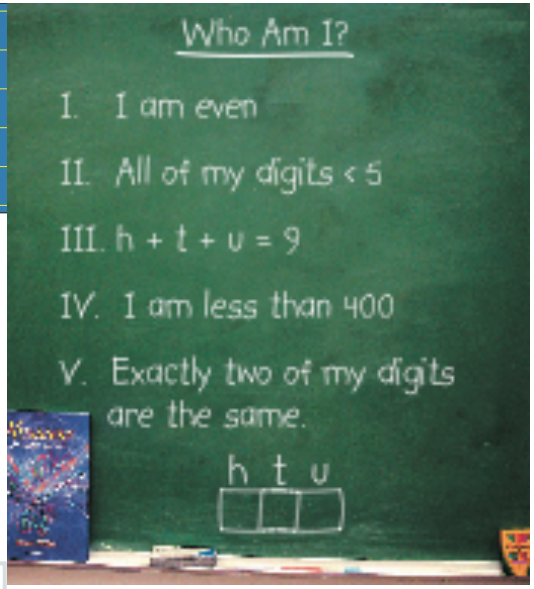
Who Am I? puzzles: constraints and language



- Learning to juggle multiple constraints
- Using mathematical vocabulary
- Using features of numbers and their digits

SMP 1, 6

8 year old detectives!



I. I am even.

II. All of my digits < 5

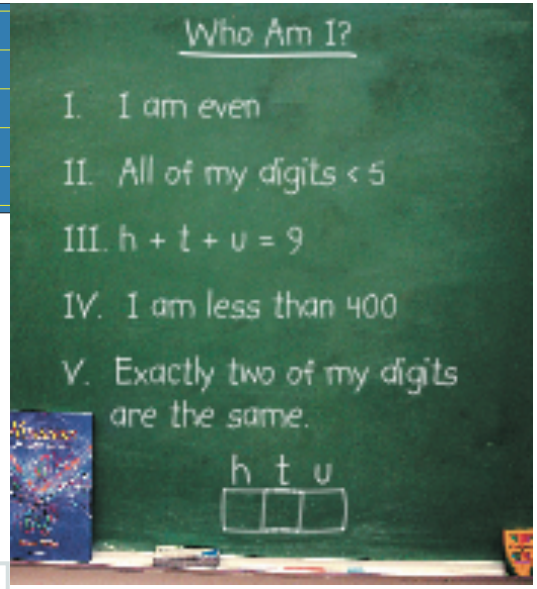
III. $h + t + u = 9$

h	*t*	*u*

	0	0
1	1	~~1~~
2	2	2
3	3	~~3~~
4	4	4
~~5~~	~~5~~	~~5~~
~~6~~	~~6~~	~~6~~
~~7~~	~~7~~	~~7~~
~~8~~	~~8~~	~~8~~
~~9~~	~~9~~	~~9~~

SMP 1

8 year old detectives!



I. I am even.

II. All of my digits < 5

III. $h + t + u = 9$

IV. I am less than 400.

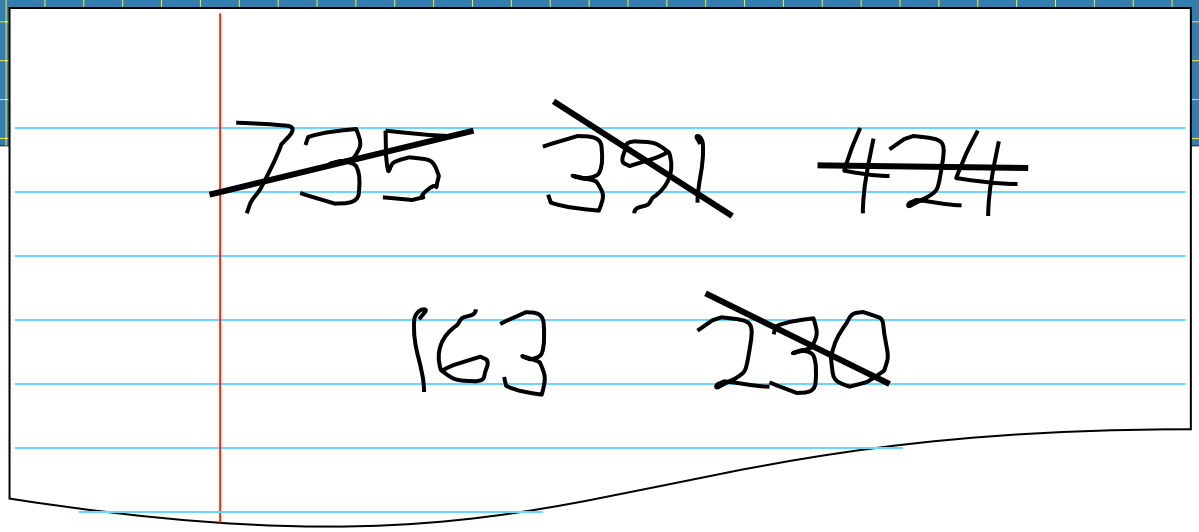
V. Exactly two of my digits are the same.

h	*t*	*u*
1	4	4

~~1,1,7~~
~~2,2,5~~
~~3,3,3~~
4,4,1

	0	0
1	1	~~1~~
2	2	2
3	3	~~3~~
~~4~~	4	4
~~5~~	~~5~~	~~5~~
~~6~~	~~6~~	~~6~~
~~7~~	~~7~~	~~7~~
~~8~~	~~8~~	~~8~~
~~9~~	~~9~~	~~9~~

Bingo



hundreds digit > 6

tens digit is 3, 4, or 5

ones digit < 5

the number is a multiple of 5

the number is even

the tens digit is greater than the hundreds digit

tens digit < ones digit

the ones digit is twice the tens digit

the number is divisible by 3

SMP 1, 3, 6

Make up your own

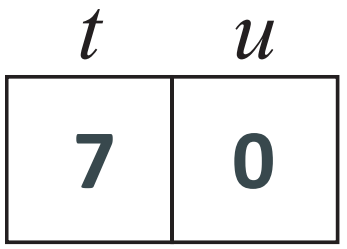
- *Tailor* the puzzles' content and challenge level
- Make them fit *your* students
- We'll start with the Bingo version

SMP 1, 3, 6

Number Bingo: invent your own clues

- Your tens digit is a prime number
- h = u + t
- The digit sum is not a prime number
- Number is not divisible by six
- Number is a perfect square
- A factor is 3
- The number is odd
- The number is a multiple of 4

Who Am I?: invent your own puzzle



- I'm < 100
- I'm a multiple of 10
- I'm even
- My tens place is odd
- The sum of my digits is prime
- I have an even number of factors
- I'm greater than 50

Who Am I? puzzles

- solveme.edc.org

Problems worth solving

- ***All*** **problems that make you better at something are *sort of* worth solving…**

  …but only sort of. No real *satisfaction*

  UNLESS…

We get real satisfaction when…

- The answer matters

  or

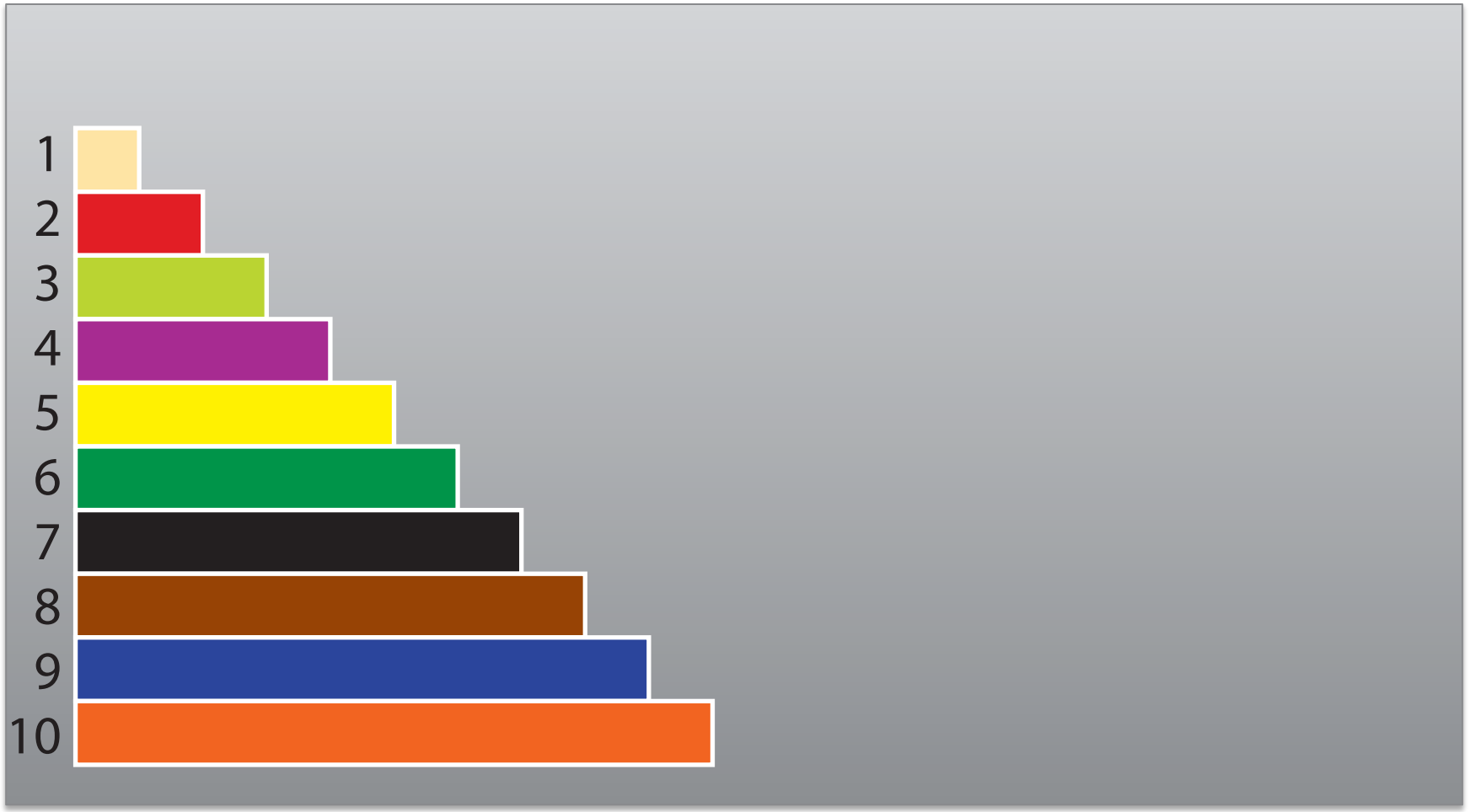
- the process matters

  or

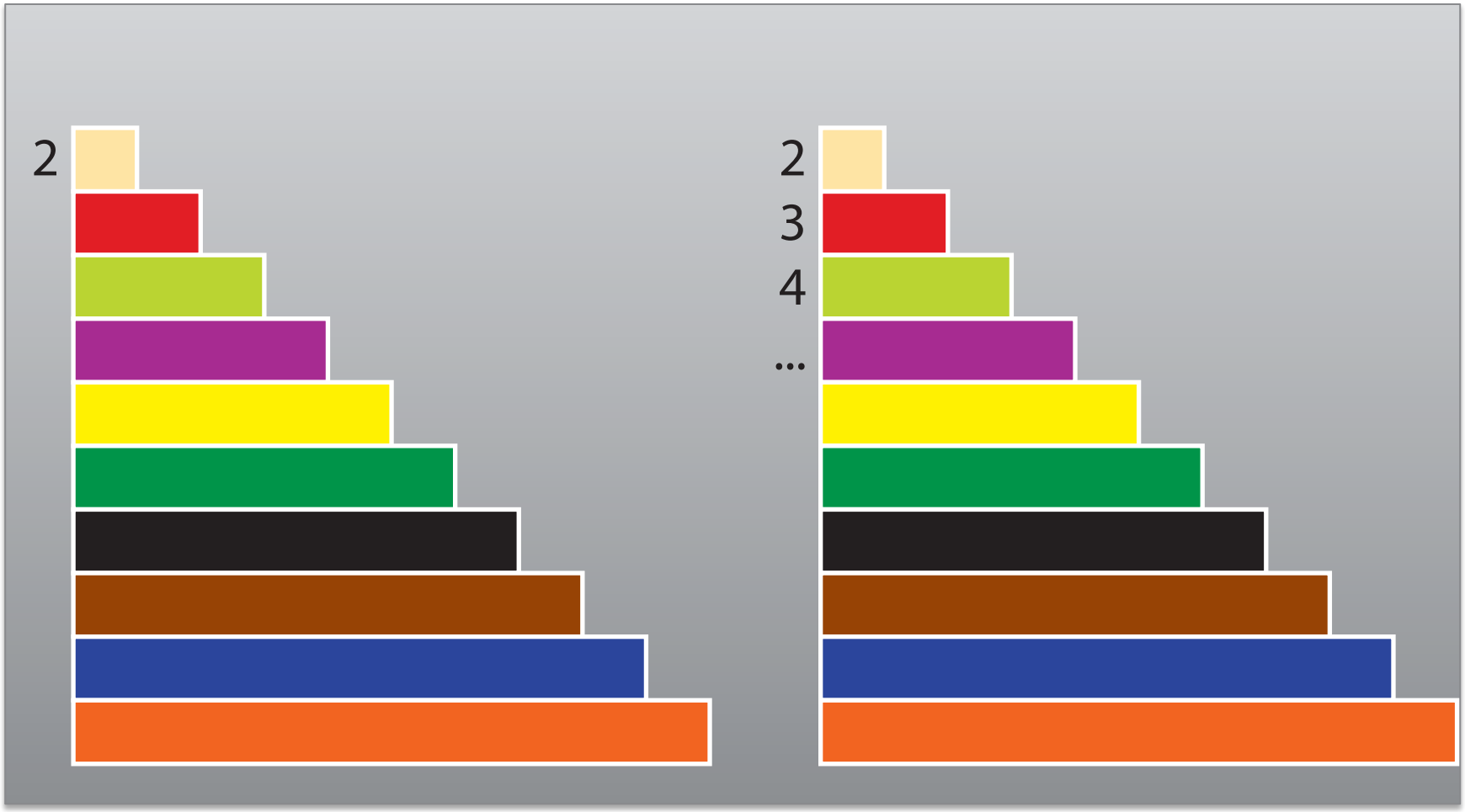
- the problem produces surprise or insight

- The problem *also* needs to serve other goals (skills, whatever) but to *feel worth solving…*

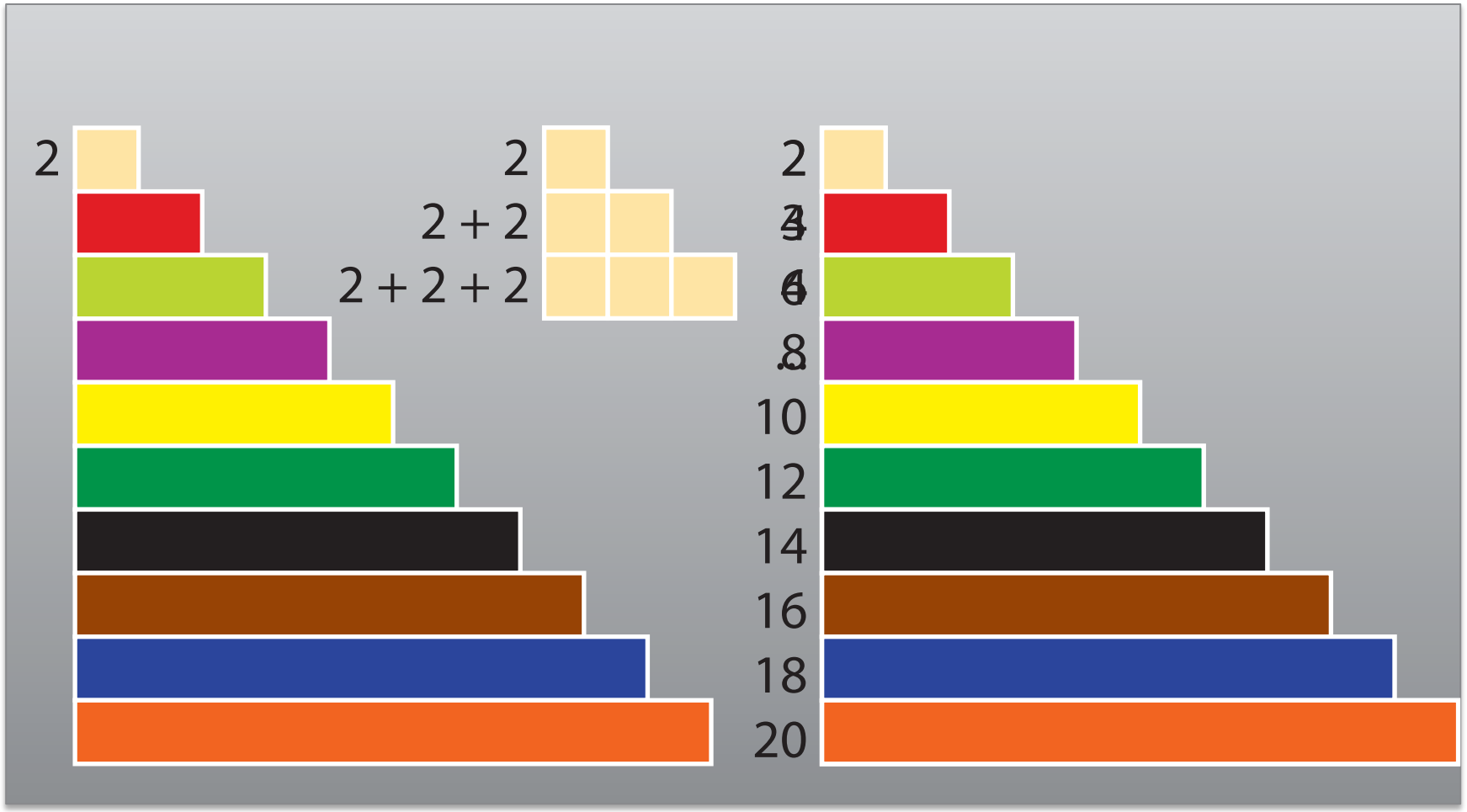
Cuisenaire rod puzzles: multiples & fractions



Cuisenaire rod puzzles: multiples & fractions

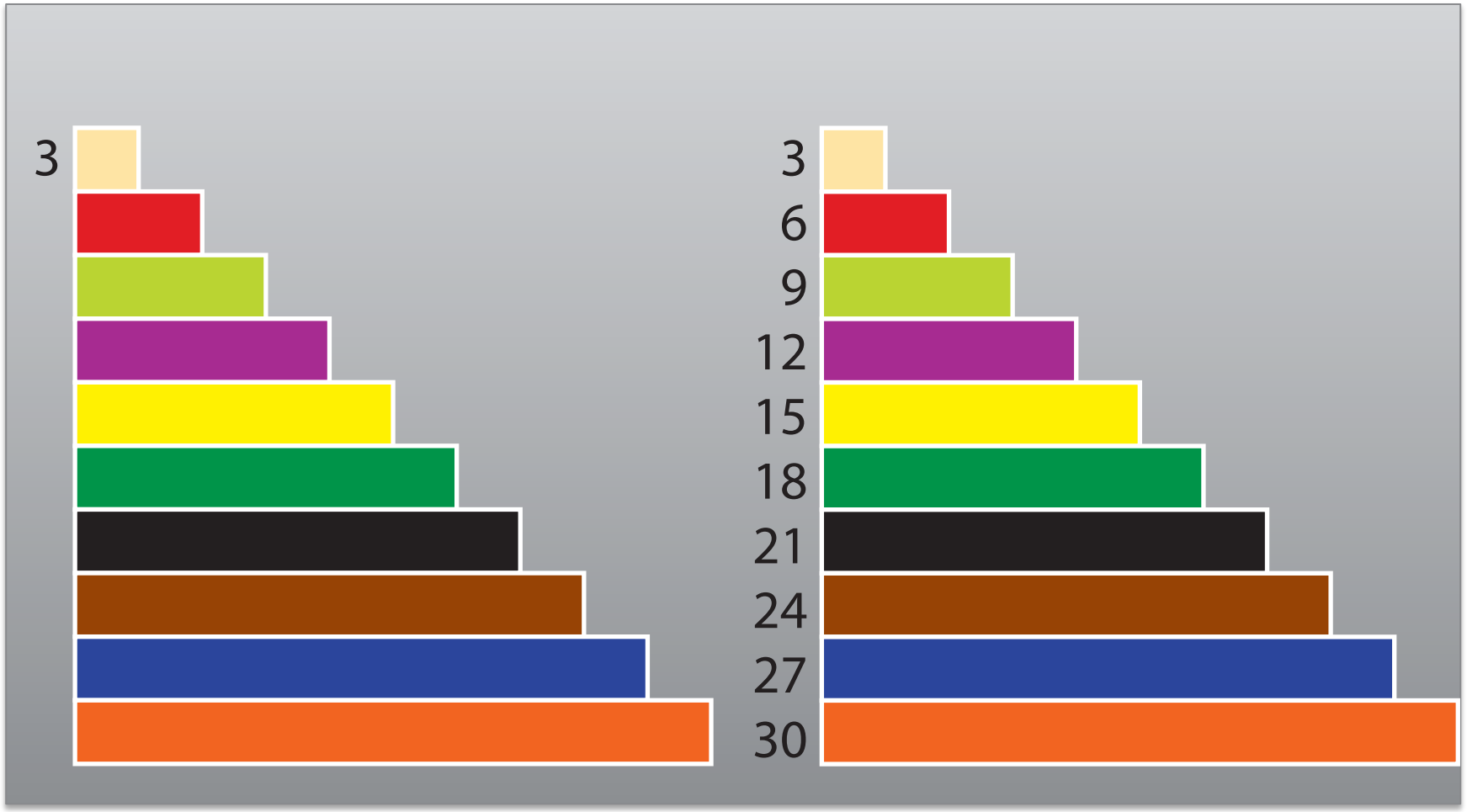


Cuisenaire rod puzzles: multiples & fractions



SMP 7, structure

Cuisenaire rod puzzles: multiples & fractions



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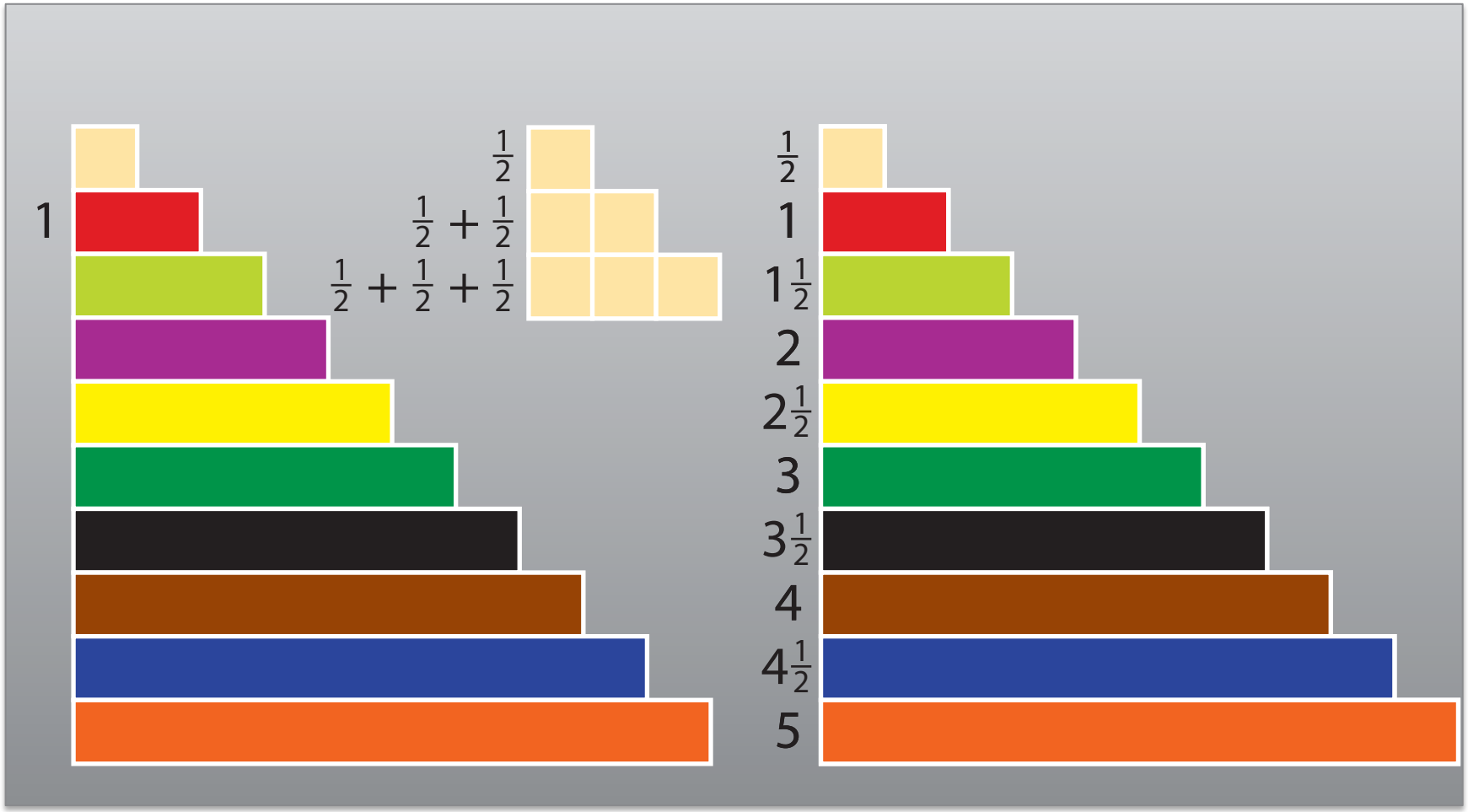

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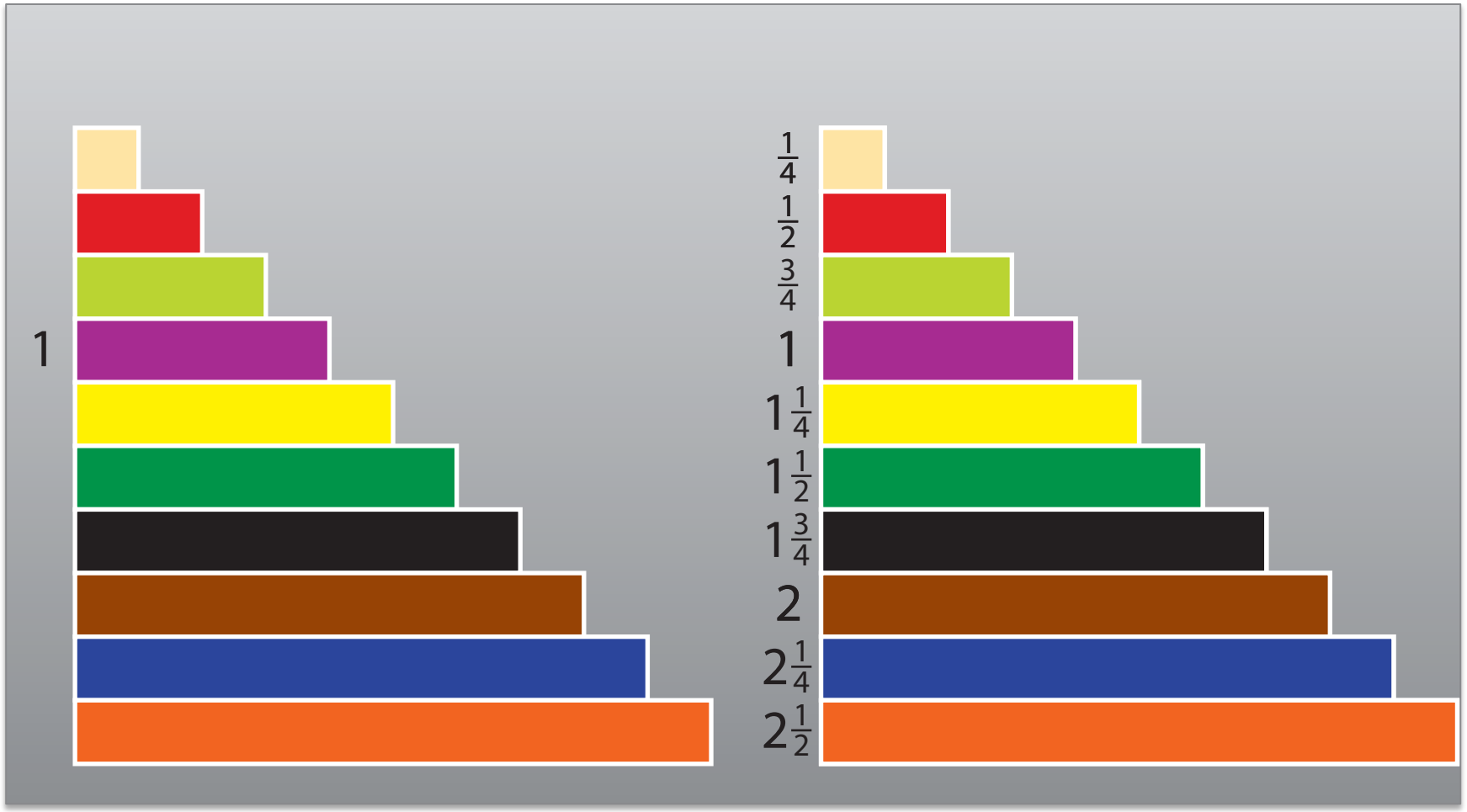

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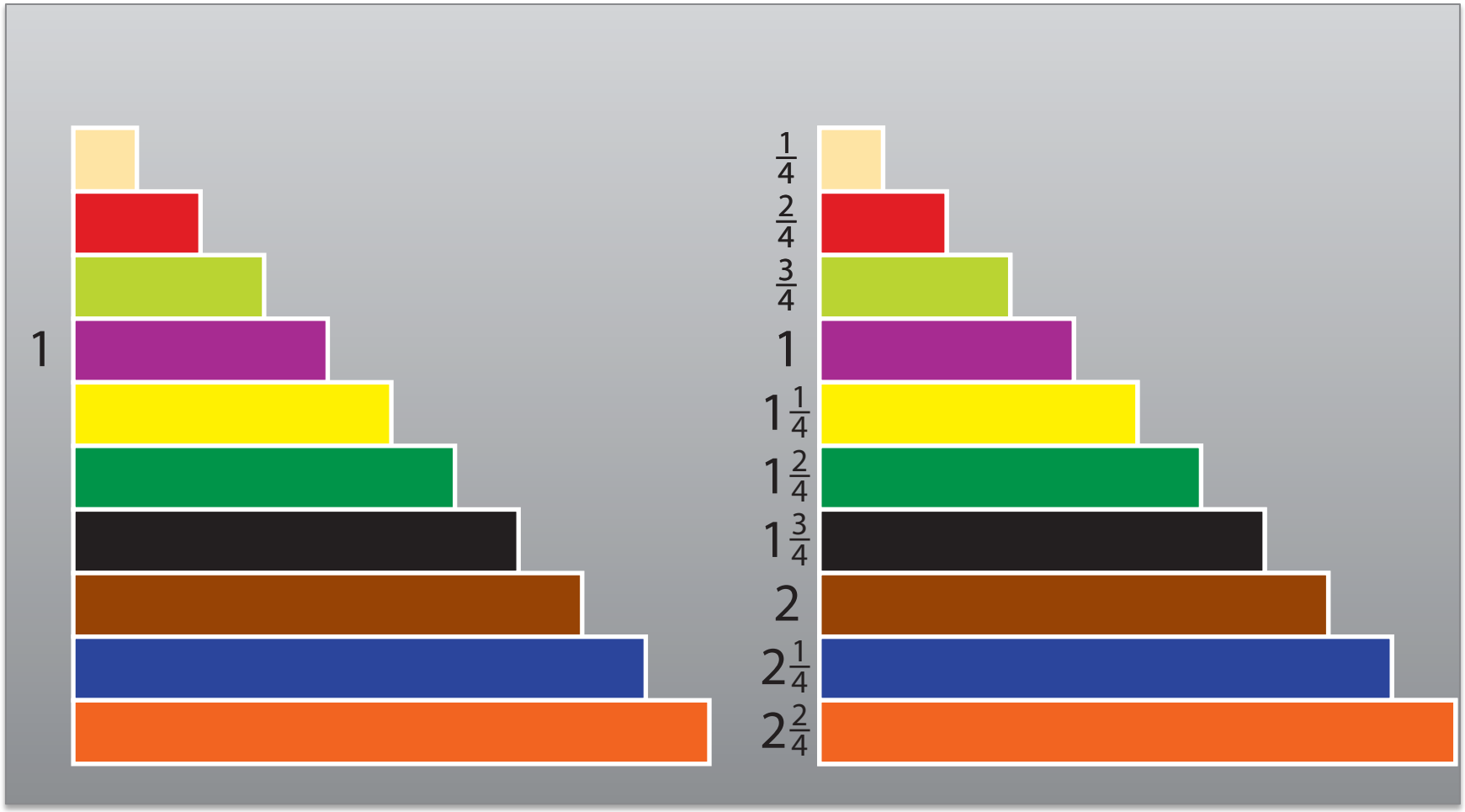

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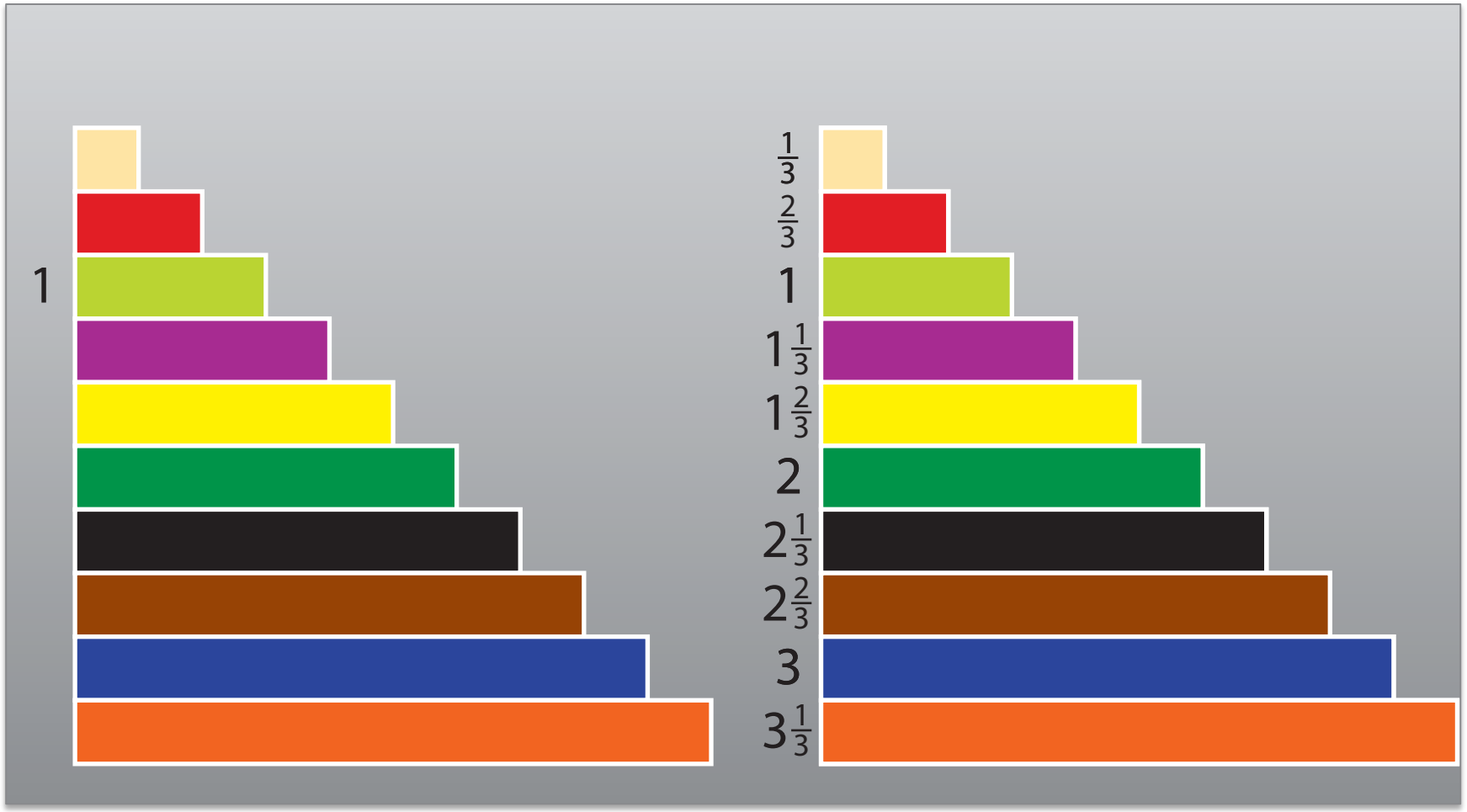

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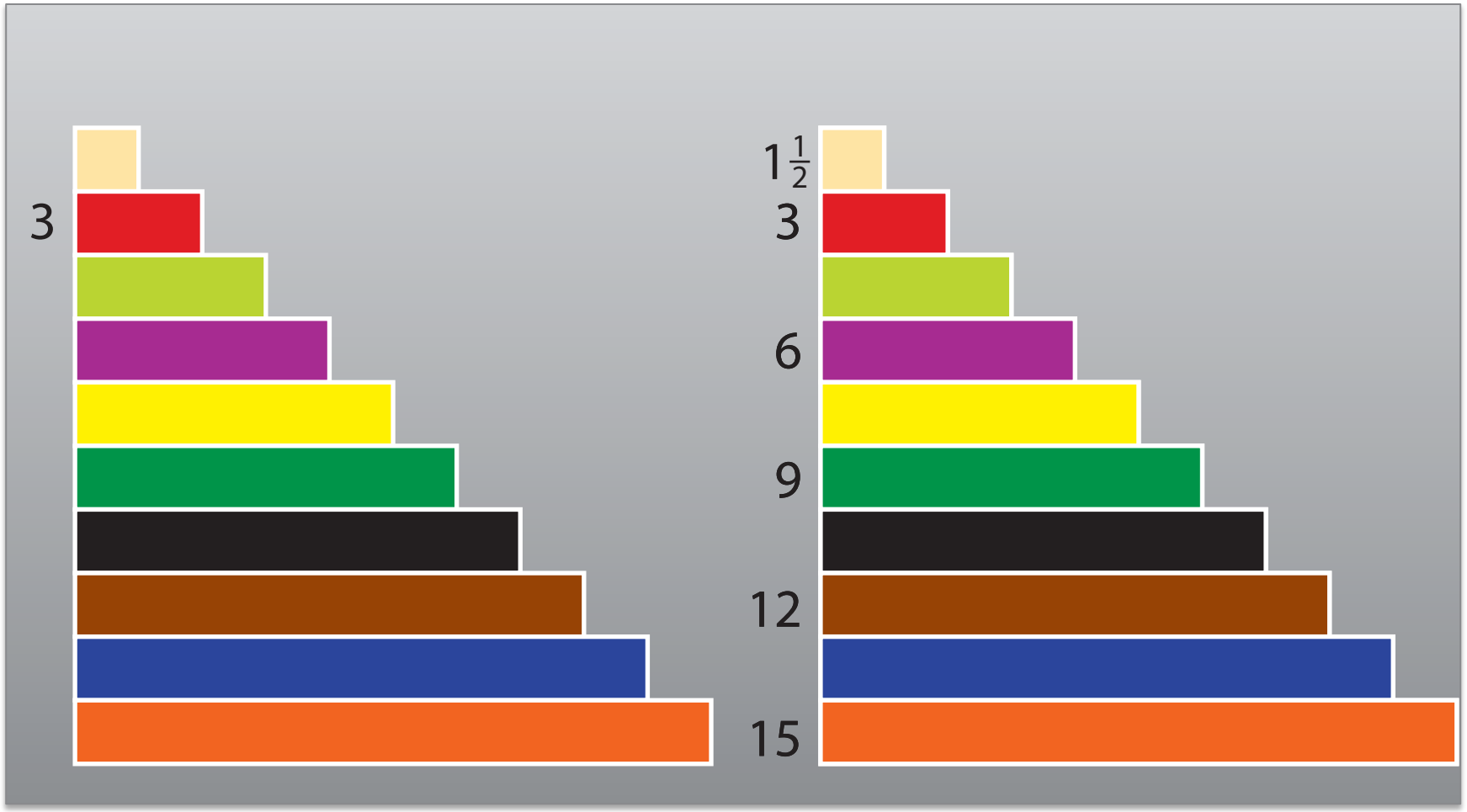
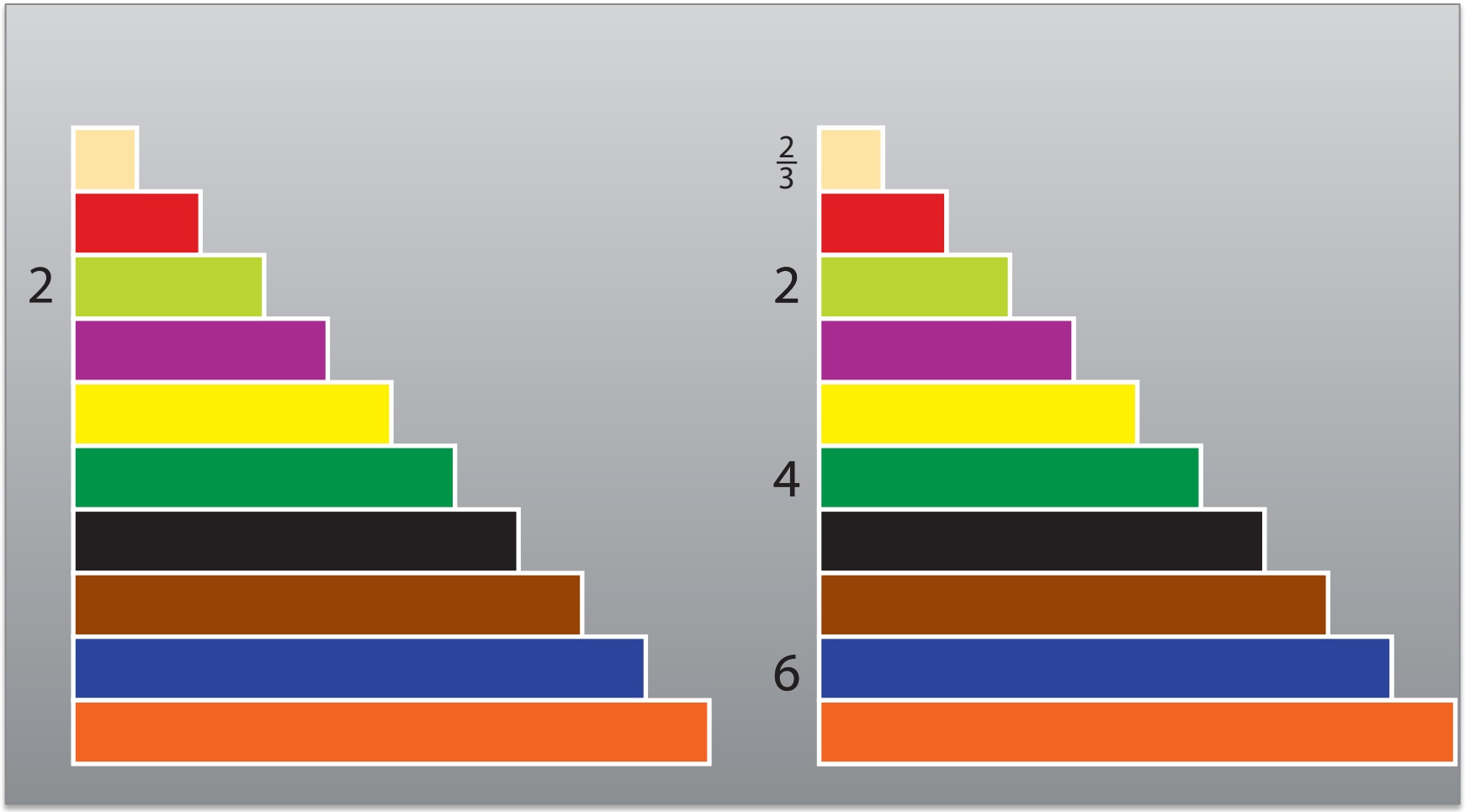
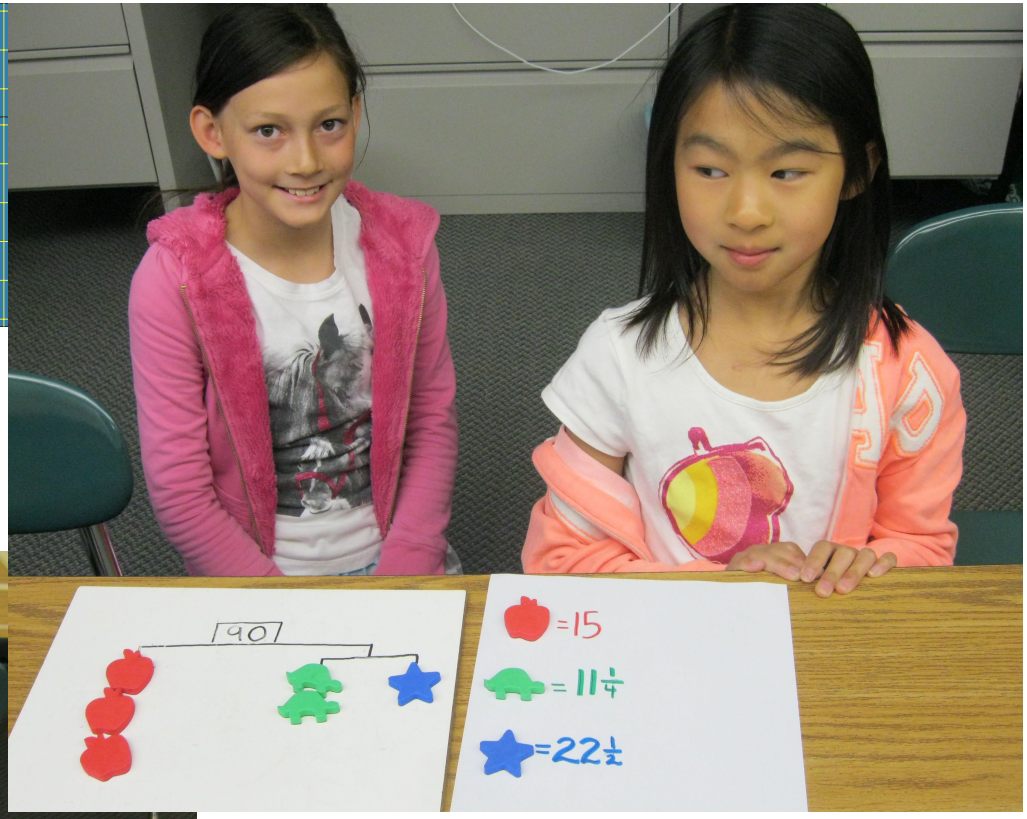


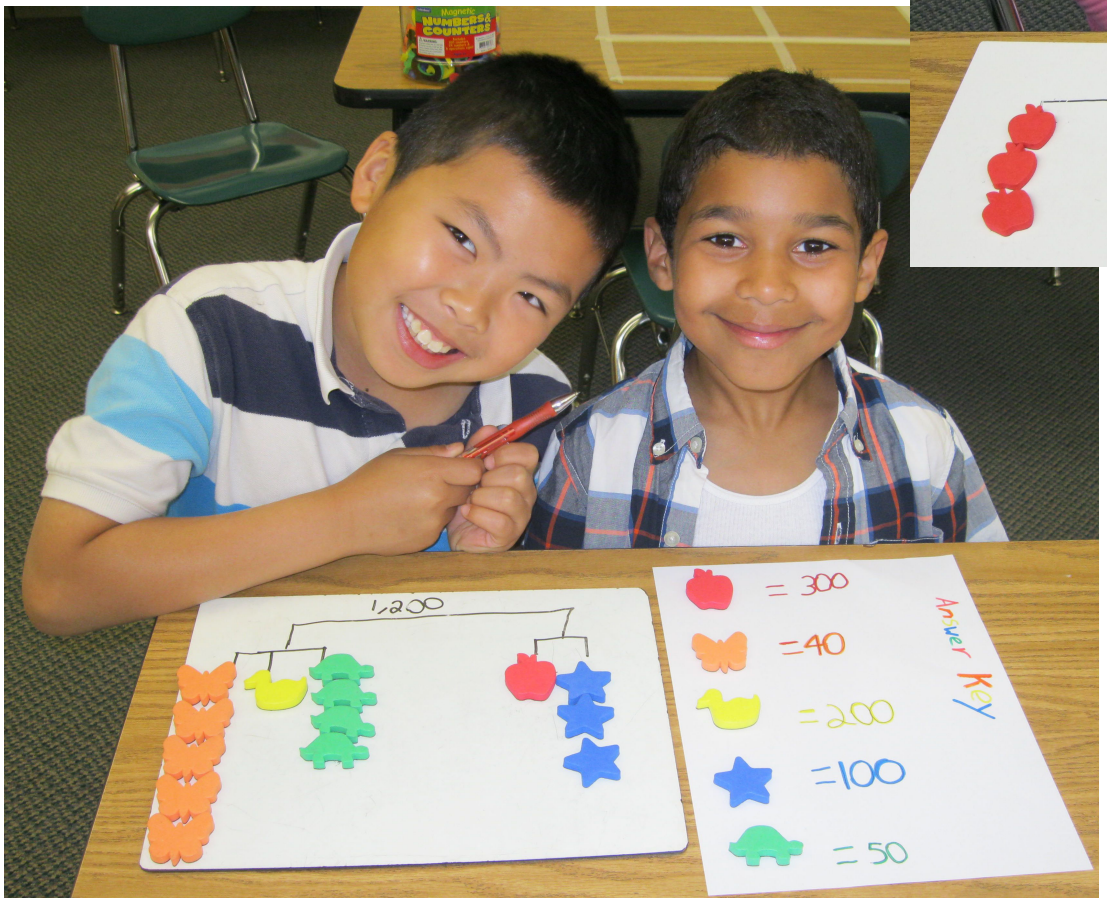
Cuisenaire rod puzzles: multiples & fractions

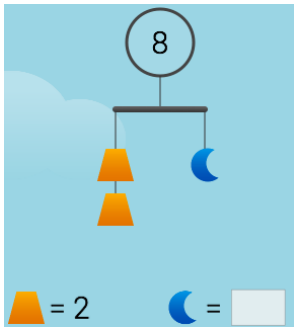


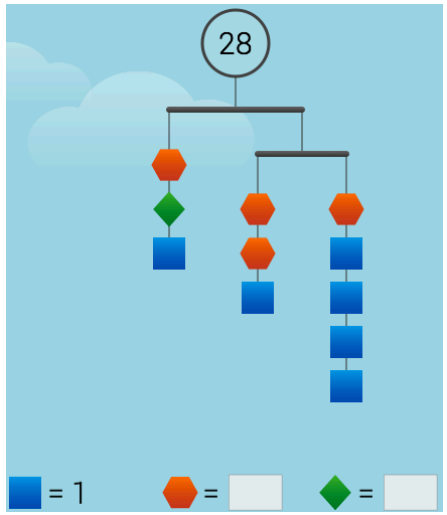
Mobile puzzles: solving equations

- solveme.edc.org





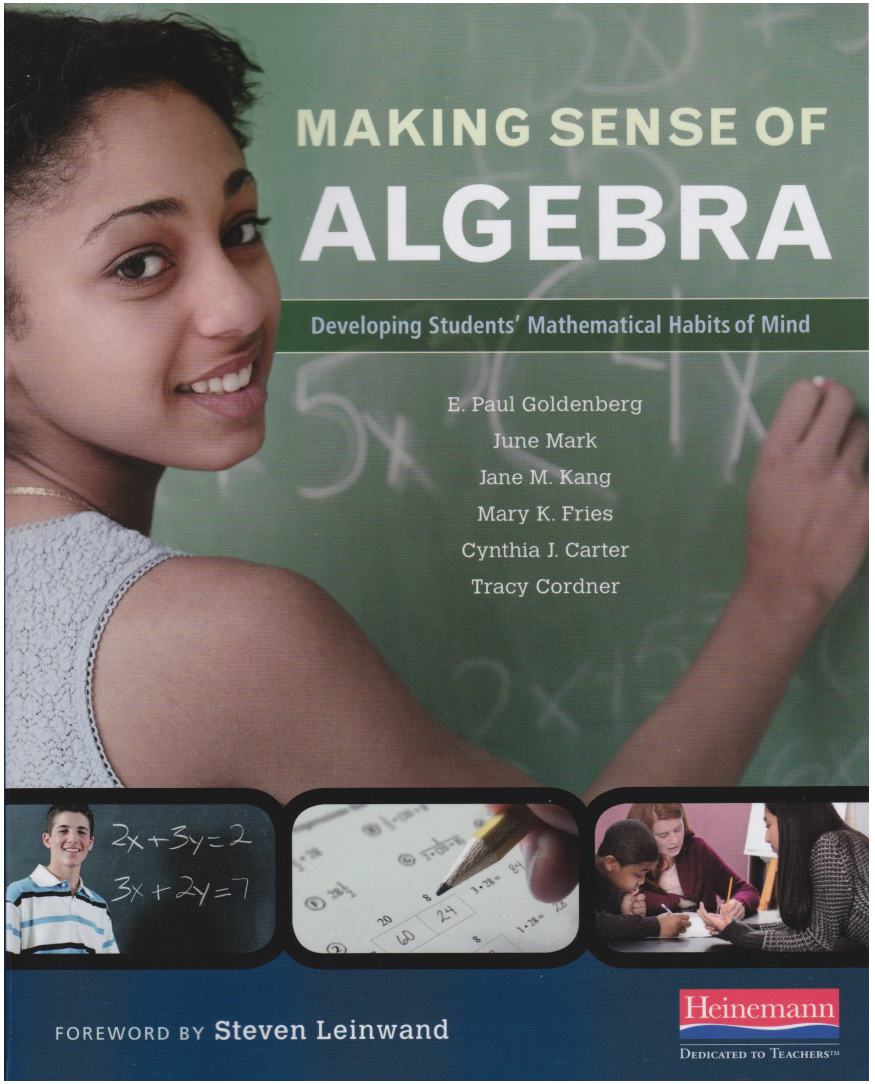




SMP 1, 3, 6, 7

Inventing a method: a dialogue

- Creativity and curiosity
- See dialogues at mathpractices.edc.org
- See *Making Sense of Algebra* → at transitiontoalgebra.com



Latin Square puzzles: logic and arithmetic

- Each element in each row and each column
- Actually quite useful in statistics, but we'll use it for another purpose.

Latin Square a, b, c, d

c	a	d	b
b	d	c	a
a	c	b	d
d	b	a	c

SMP 1, 7

Latin Square puzzles: logic and arithmetic

- **To solve a puzzle, figure out where to *start***

Latin Square x, y, z

	x	
z		

Latin Square **1, 2, 3, 4**

	4		3
		2	
	2		
1			

SMP 1, 7

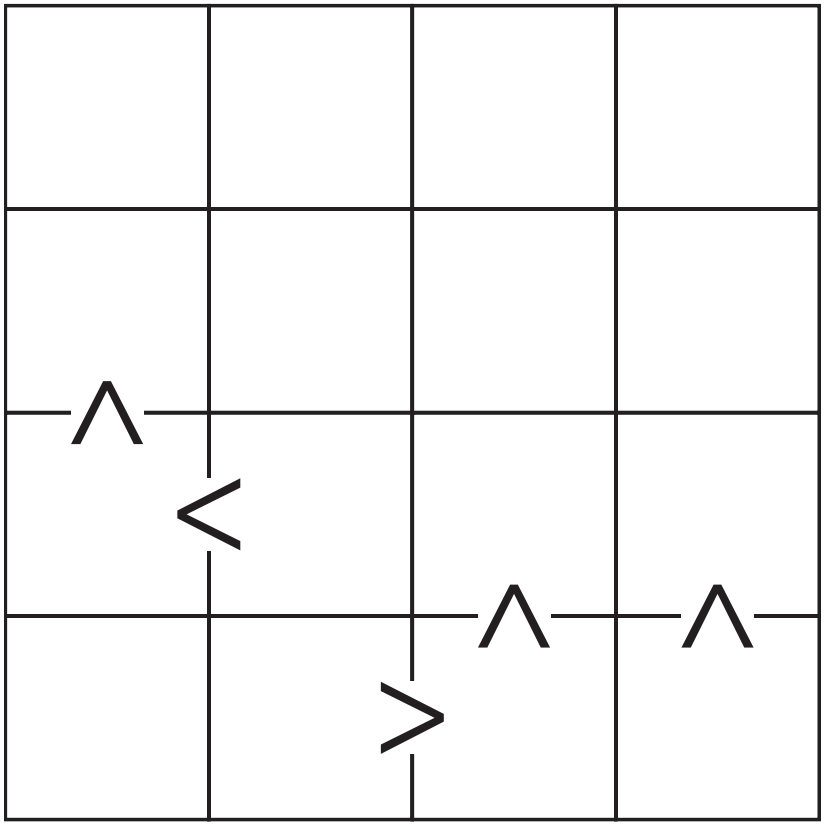
Latin Square puzzles: logic and arithmetic

- Clues show which number is greater.
- Figure out what *can* go in the cells.

  OR

- Figure out what *can't* go in them.

Futoshiki **1, 2, 3, 4**



SMP 1, 7

Latin Square puzzles: logic and arithmetic

- **Clues in each heavy-outlined "cage" show target numbers to be made with given operations.**

MysteryGrid **1, 3, 4, 5**

4, +		4, ÷	1, –
20, x	12, +		
			2, –
	15, x		

SMP 1, 7

Latin Square puzzles: logic and arithmetic

- Futoshiki.org
- KenKenPuzzle.com
- Solveme.edc.org MysteryGrid Puzzles (coming soon!)

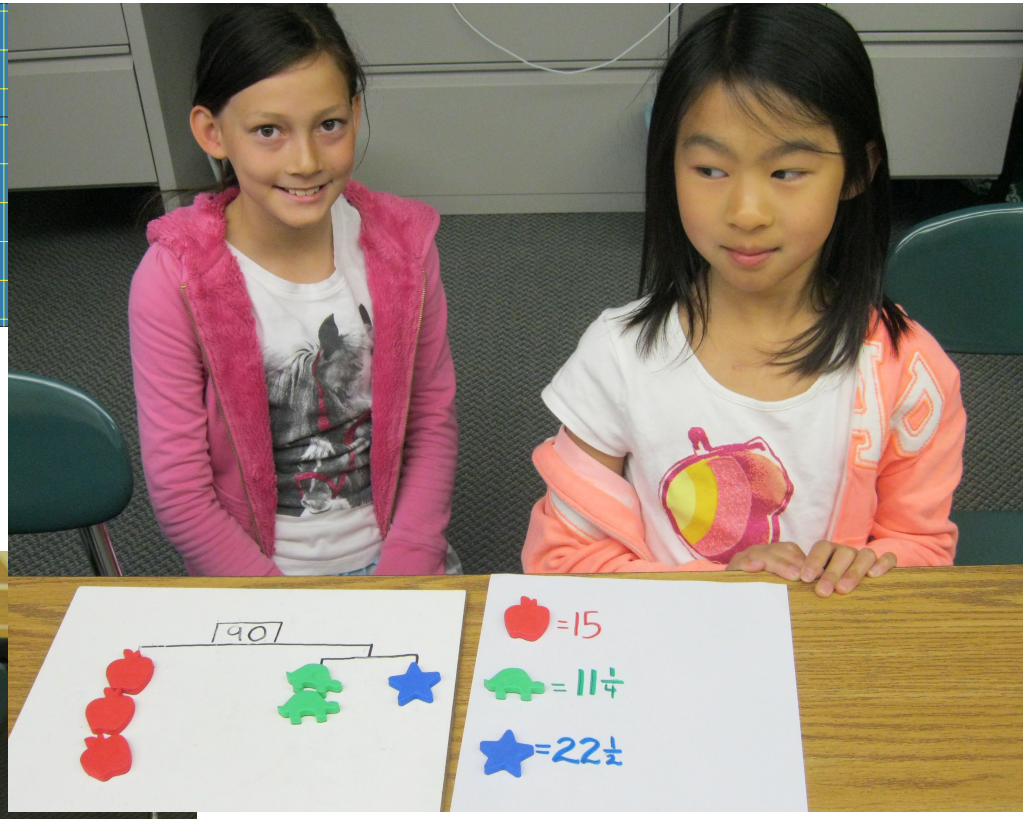
What makes a *good* puzzle

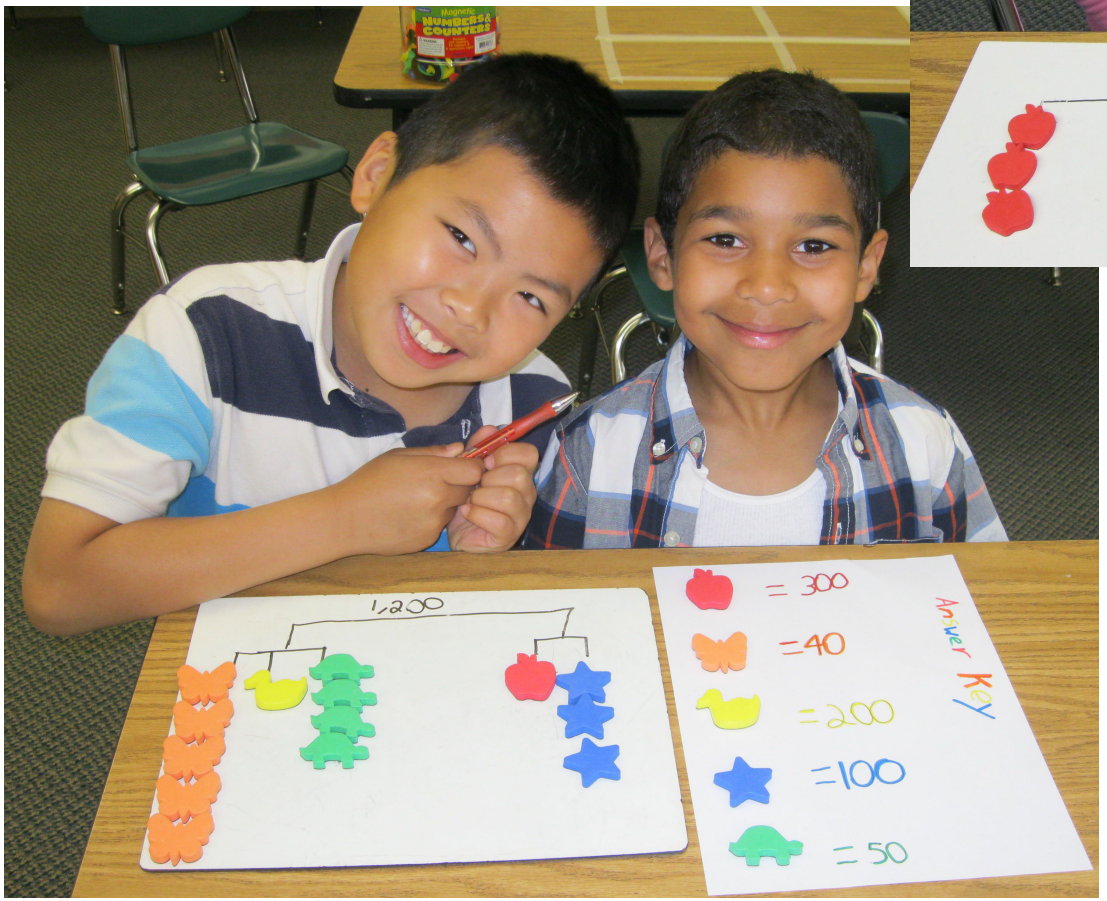
- **Easy enough to do**
- **Hard enough to be fun**
- ***Manageable challenge***

Of course, there *are* other problems worth puzzling through ☺

- **The key is to remember what makes it *worth* puzzling through.**
- **You need**
  - the answer to matter **or**
  - the process to matter **or**
  - some surprise or insight to come.
- **Some *surprise* or *insight* must come**

Thank you!





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