How Engaging Puzzles Build Algebraic Habits of Mind

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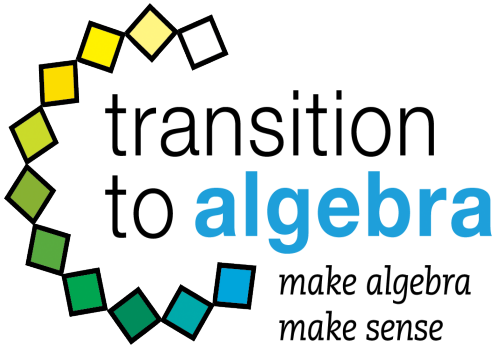
EDC Learning transforms lives.

Transition to Algebra



- A coherent, full-year NSF-funded algebra support curriculum organized around five key ***algebraic habits of mind***

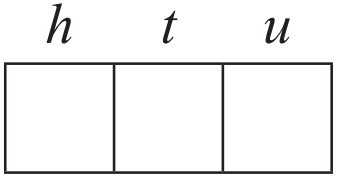
- Quickly giving students the mathematical knowledge, skill, and confidence to succeed in a first-year algebra class

Algebraic Habits of Mind

- Puzzling and Persevering
- Seeking and Using Structure
- Using Tools Strategically
- Describing Repeated Reasoning
- Communicating with Precision

I am a 3-digit number

Who Am I?



- I am even.
- My digits are all different.
- I am greater than 319.
- My hundreds digit is less than 7.
- $u = 1 + h$
- My tens digit is my largest digit.
- My hundreds digit is my only odd digit.
- My units digit is one more than my hundreds digit.
- The sum of all three of my digits is 19.
- My units digit is not 4.

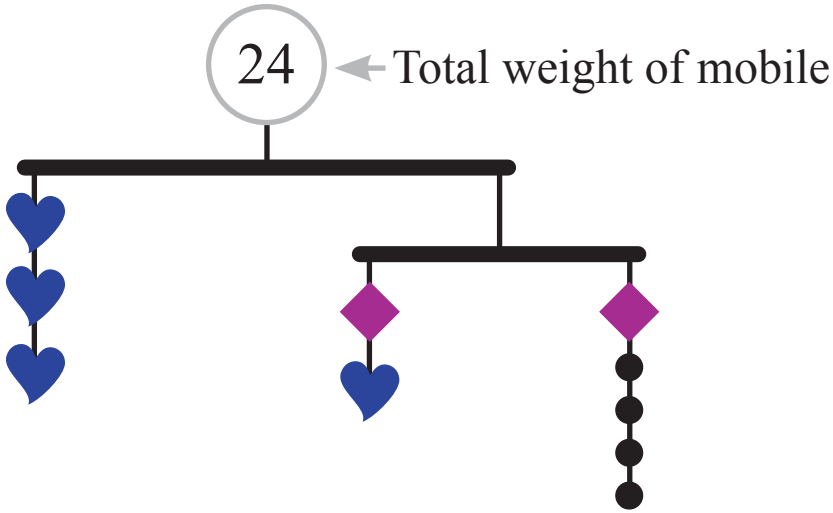
Who Am I? Puzzles

Who Am I?

- I am less than ½. $\frac{\textit{numerator}}{\textit{denominator}} = \frac{\square}{\square}$
- I am not 0.
- My numerator and my denominator both have one digit.
- My denominator is 3 more than my numerator.
- Neither my numerator nor my denominator is a square number.

Find the coefficients a, b, and c in the quadratic $y = ax^2 + bx + c$ so that the roots are $-\frac{2}{3}$ and $-\frac{1}{2}$ and the minimum value y can attain is $8\frac{1}{8}$.

Mobile Puzzles

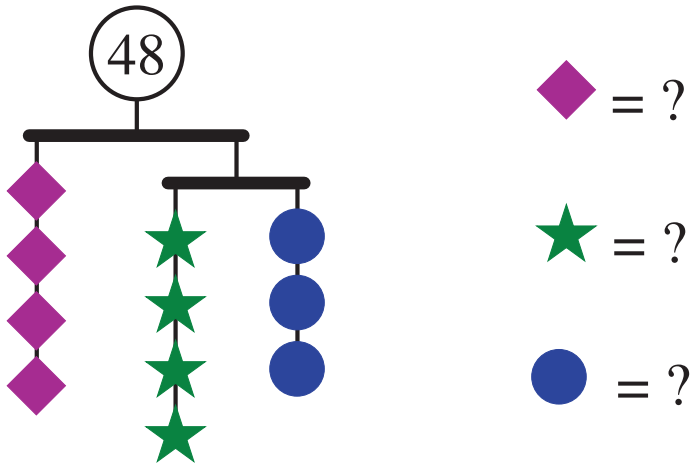


♥ = 4 ◆ = 2 ● = 1

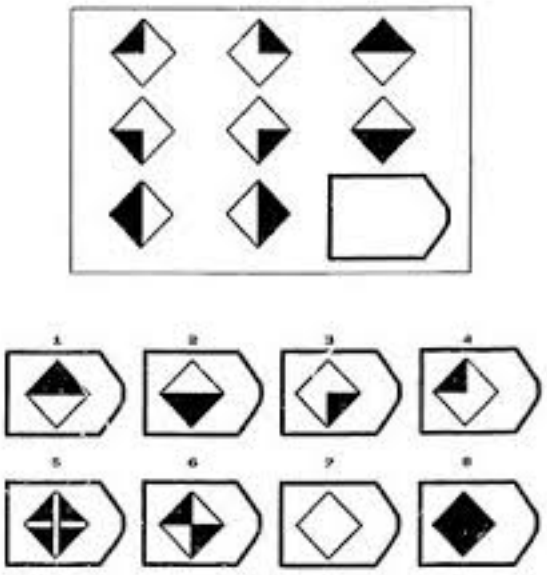
Why Puzzles?

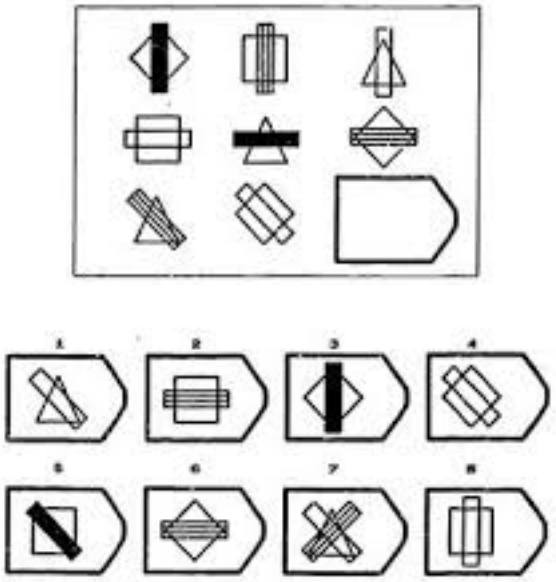
Mathematical Puzzles:

- (are fun and engaging)
- emphasize the logic of algebra
- help students develop strategy in problem solving
- remove the stigma associated with not knowing how to solve a math problem

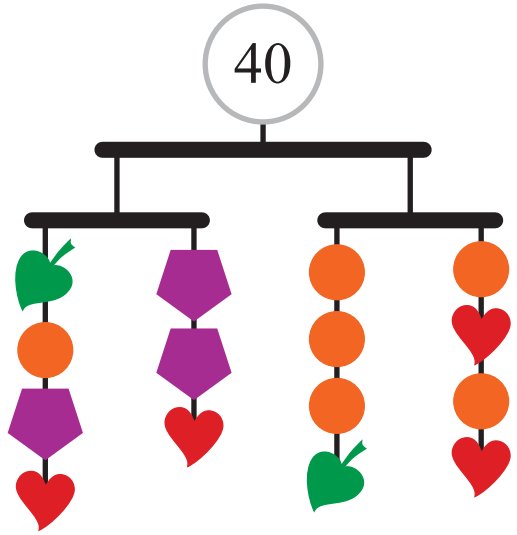


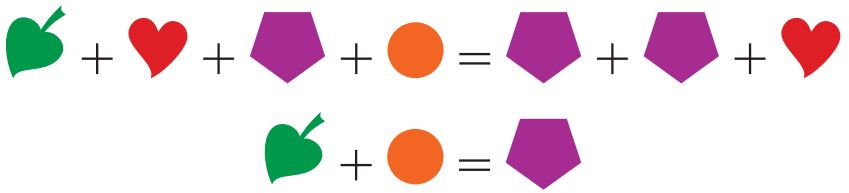
Raven's Progressive Matrices

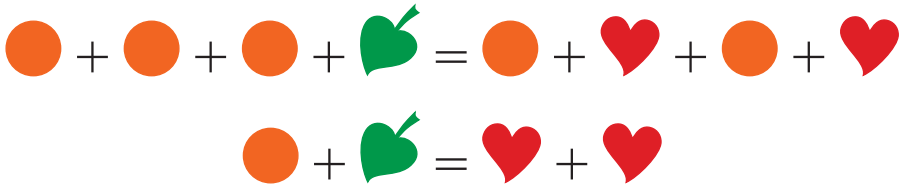


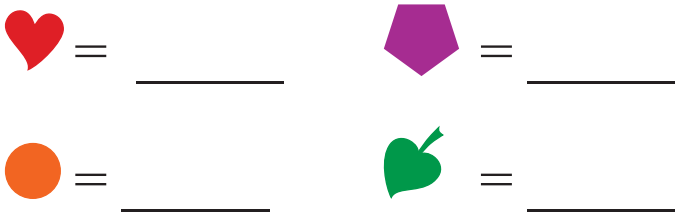


Mobile Puzzles



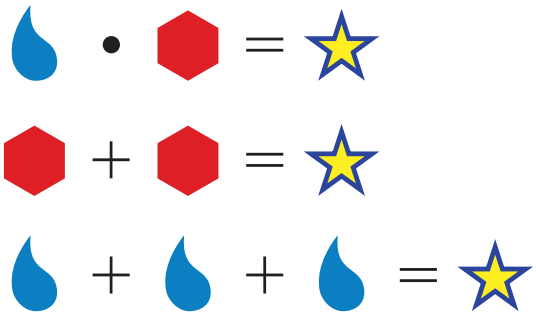






Mystery Number Puzzles

③ What could ☆, 💧, and ⬢ be if all the variables represent different numbers?

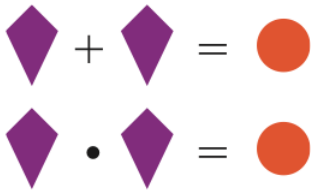


☆ = _____

💧 = _____

⬢ = _____

Mystery Number Puzzles

	Only one solution
	Two solutions
	For some value of ▲, ■ can have any value. For some value of ■, ▲ can have any value.
	Two solutions (assuming different variables can have the same value)

What makes a *good* puzzle?

- Puzzles are the "main course"
  - Mathematical in both ***content*** and ***nature***
- Two dimensions: Cognitive challenge & Required arithmetic/mathematical knowledge
- Good puzzles *feel* do-able and are challenging

Latin Squares Puzzles

- Use the clues to fill in the grid so that every row and every column contains one of each element.

***a*, *b*, *c* Latin Square**

c		a
	c	

MysteryGrid Puzzles

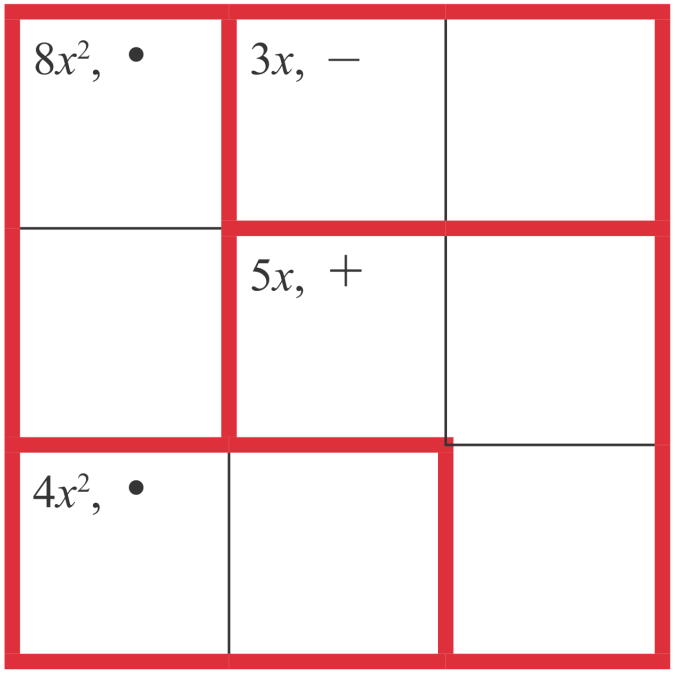
- In MysteryGrid puzzles, the numbers in each "cage" should reach the target number using the given operation.
- For example, a 3-cell, "20, ×" cage means you need to fill that cage with 3 numbers that multiply to 20.

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

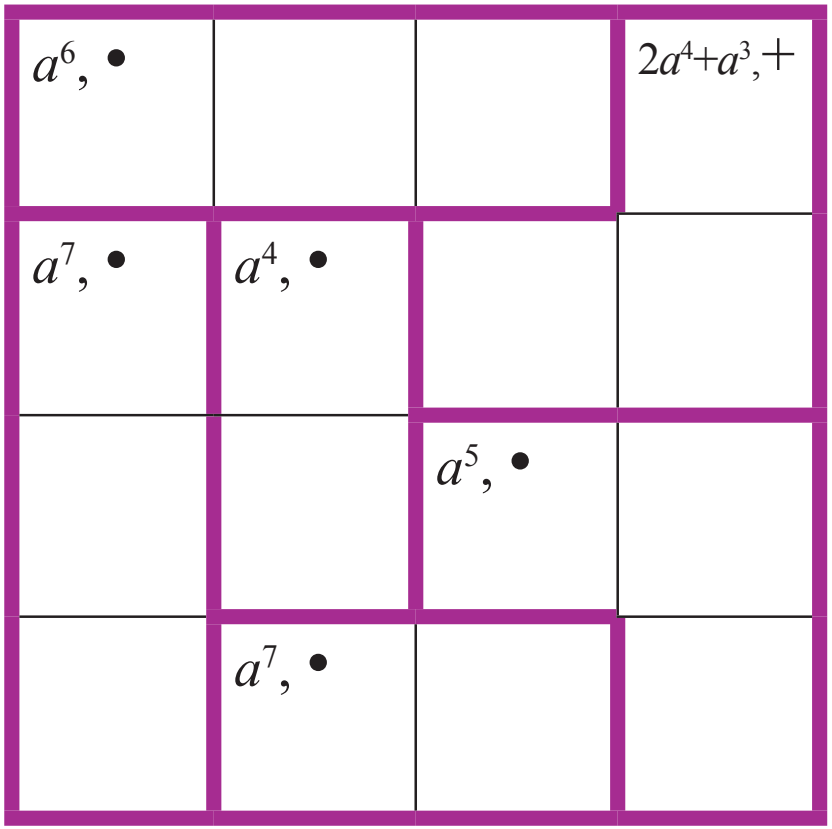
4, +		4, ÷	1, –
20, x	12, +		
			2, –
	15, x		

MysteryGrid Puzzles

MysteryGrid $x, 2x, 4x$



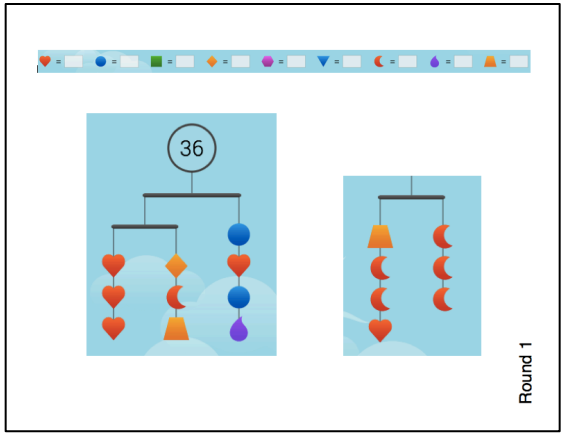
MysteryGrid a, a^2, a^3, a^4

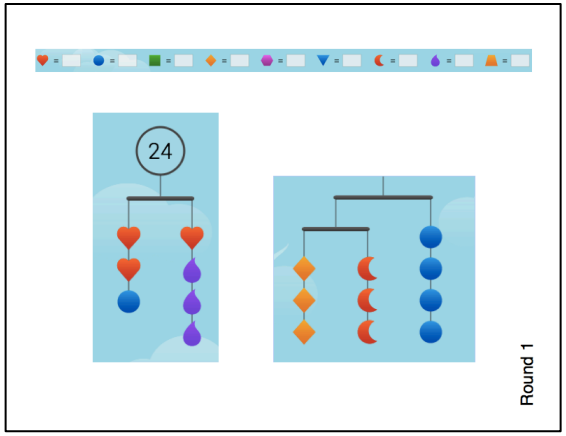


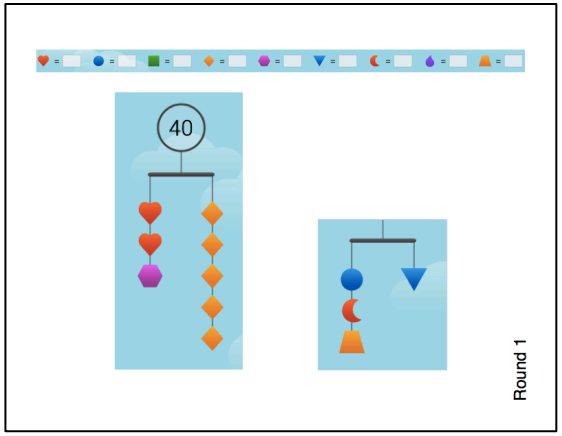
Puzzling and Persevering

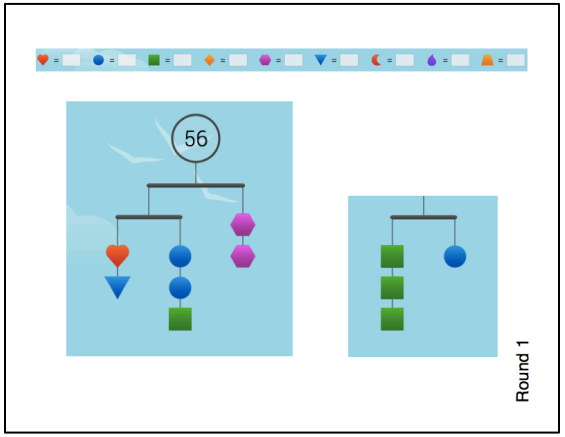
- The I-can-puzzle-it-out disposition
  - Looking for an entry point
  - Building working memory
  - Depending on their own logic
- Puzzle creation: Being *producers*—not just consumers—of mathematics

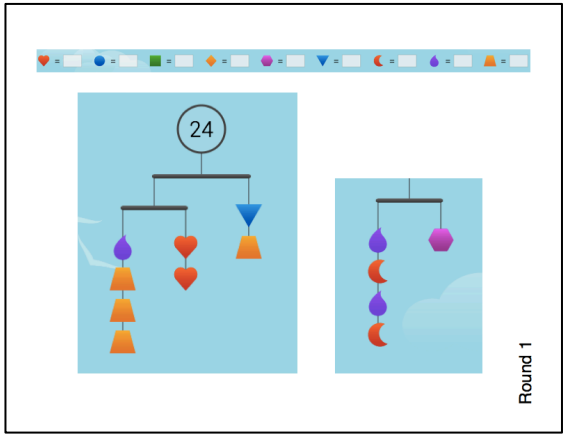
Mobiles: Collaborative Game



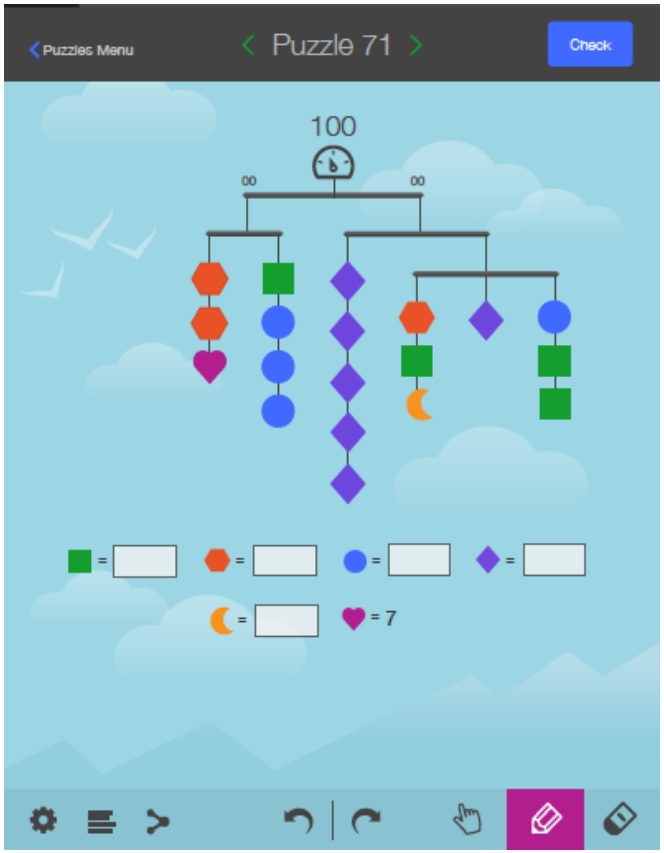








Mobile Puzzle App: SolveMe



Interactive puzzling features:

- Shape equations
- Subtraction, division, factoring
- Substitution
- Annotations
- Sharing
- “Build Your Own” mode

SolveMe.edc.org

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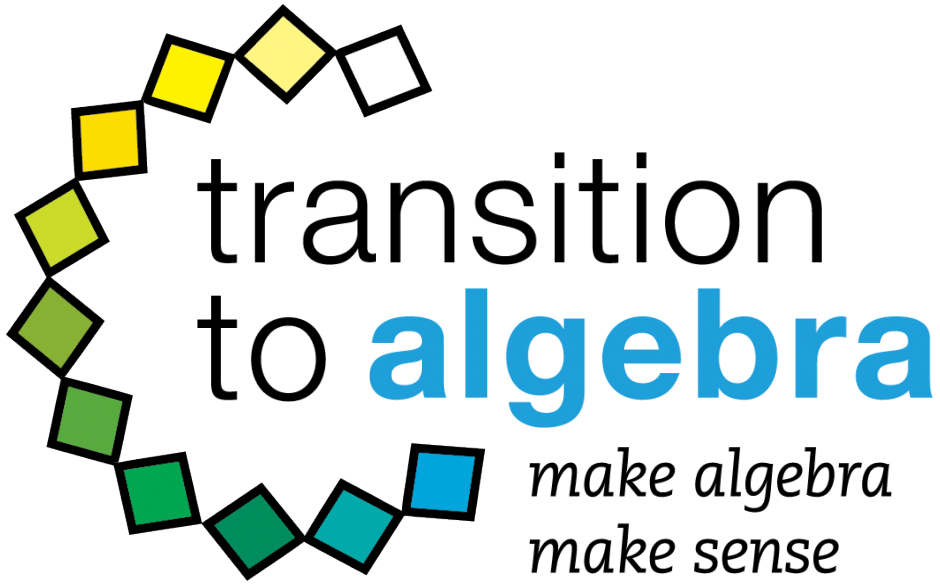

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Full-year algebra-support curriculum with student & teacher materials that supports the Common Core Standards for Mathematical Practice

For for information: transitiontoalgebra.com or jkang@edc.org