

Fumbling Towards Inquiry: Starting Strong in Problem- Based Learning

(So everyone's
happier.)



NCTM Annual Conference 2016

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Geoff Krall

*Fumbling Towards
Inquiry*

Objectives

Experience part of a Problem-Based Learning Lesson

Discuss five design principles and carving a path toward inquiry

Identify first/next steps as a teacher

Student generated
questions

Instruction

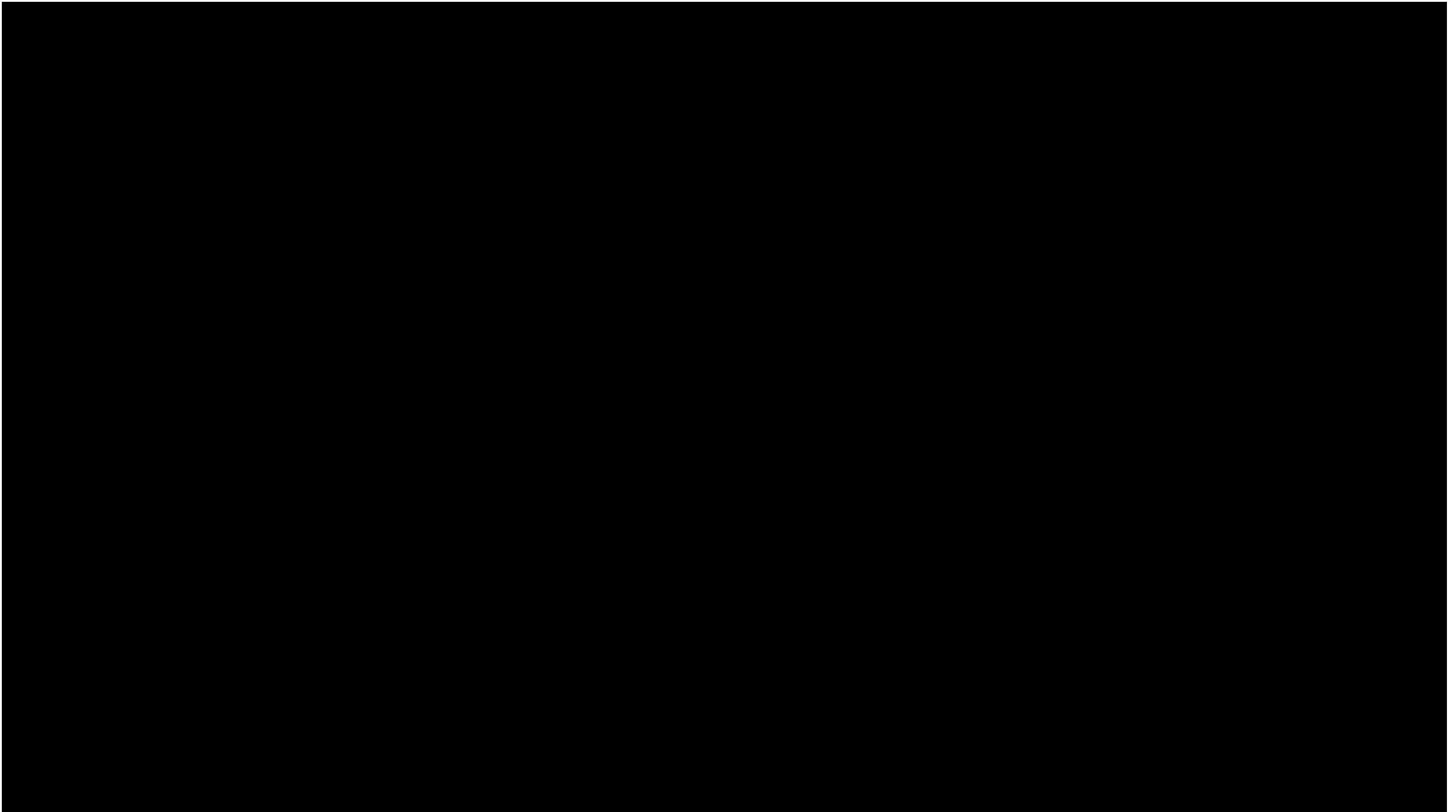
Problem(s)

Content Delivery

Research clearly suggests that problem solving should not be taught as a separate topic in the mathematics curriculum. In fact, research tells us that teaching students to use general problem-solving strategies has little effect on their success as problem solvers. Thus, problem solving must be taught as an integral part of mathematics learning, and it requires a significant commitment in the curriculum at every grade level and in every mathematical topic. - NCTM

Research Brief on Problem Solving

Entry Event: The Race



Problem Solving Framework

Define the Problem

What is the problem about? What is it asking you to do?

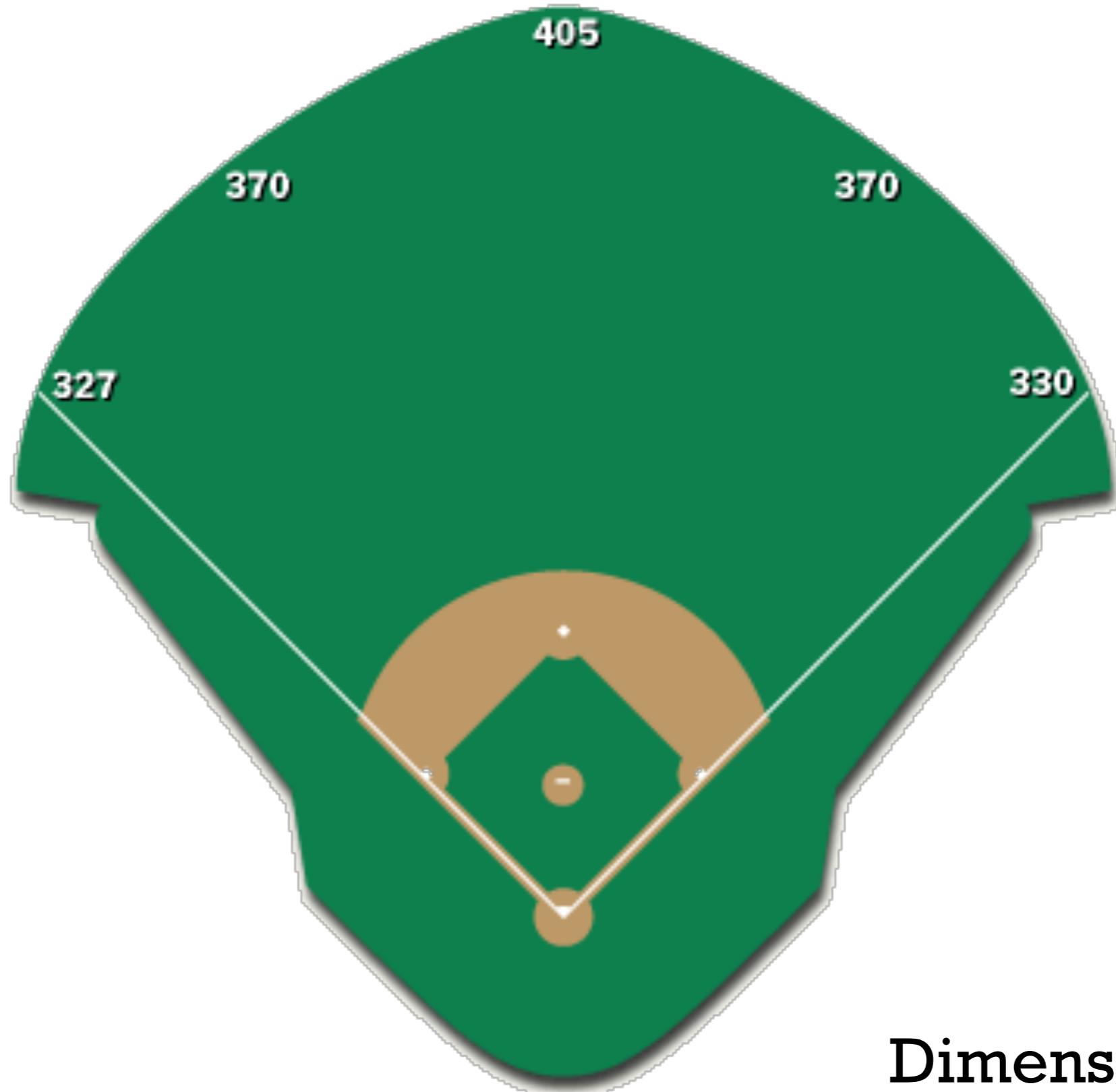
Analyze the Problem

What do you **know/notice** from the problem scenario or previous lessons that can help solve the problem?

What concepts or information do you **need to know** in order to solve the problem?

Brainstorm Strategies for Solving the Problem

What strategies might you use to solve the problem? How will you start the problem?



Dimensions of
Qualcomm Field



comcast
SPORTSNET

00:00:00:00



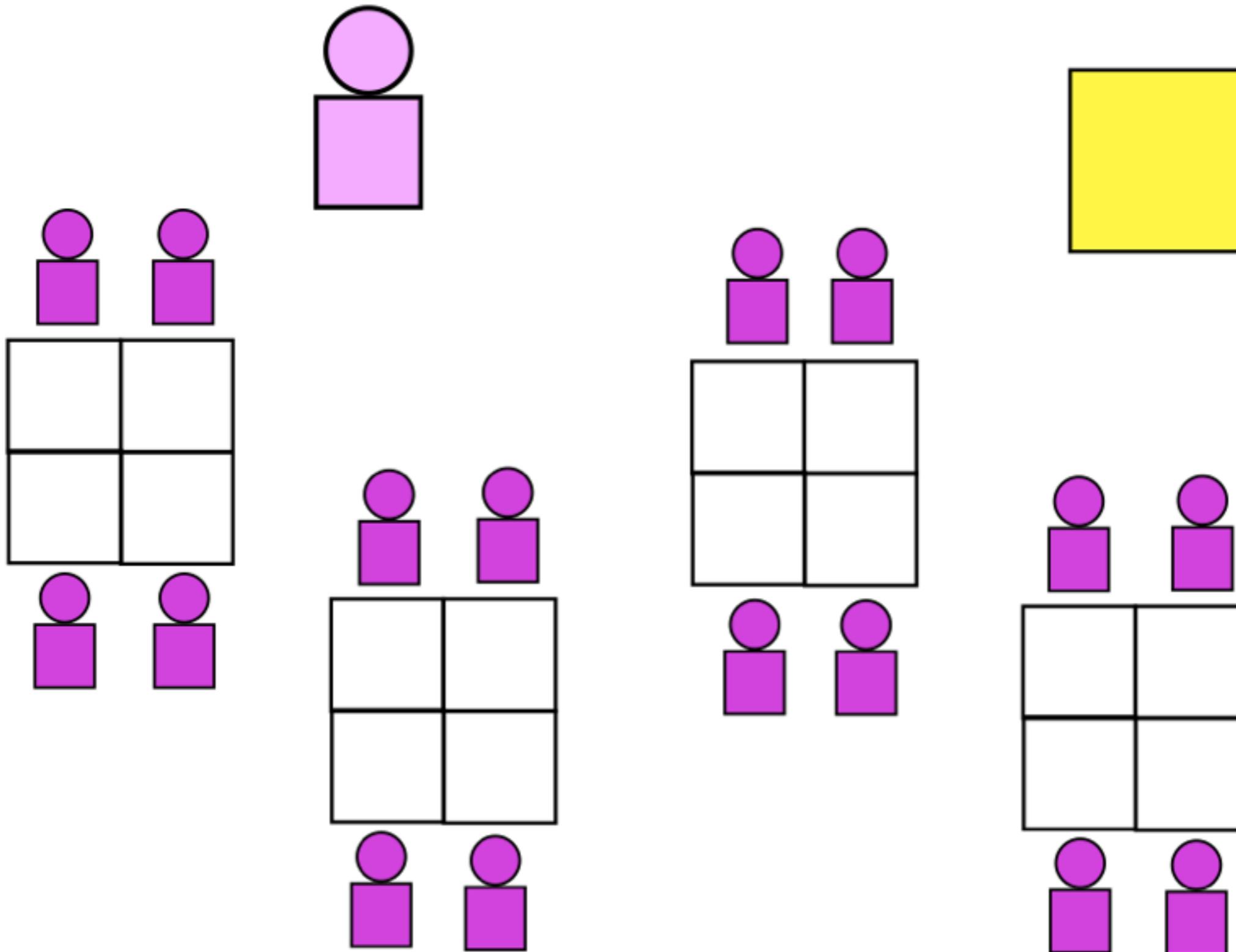
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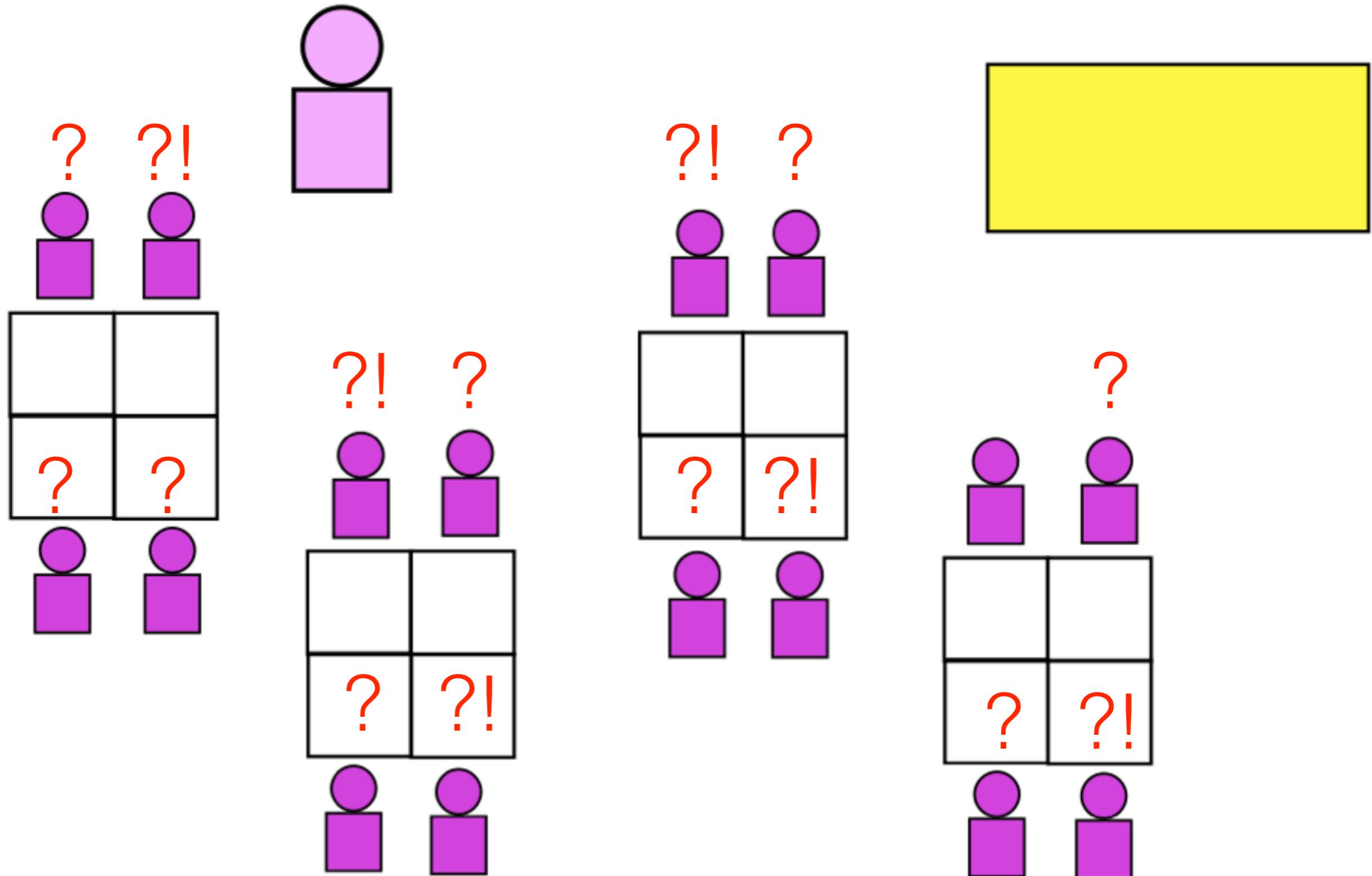
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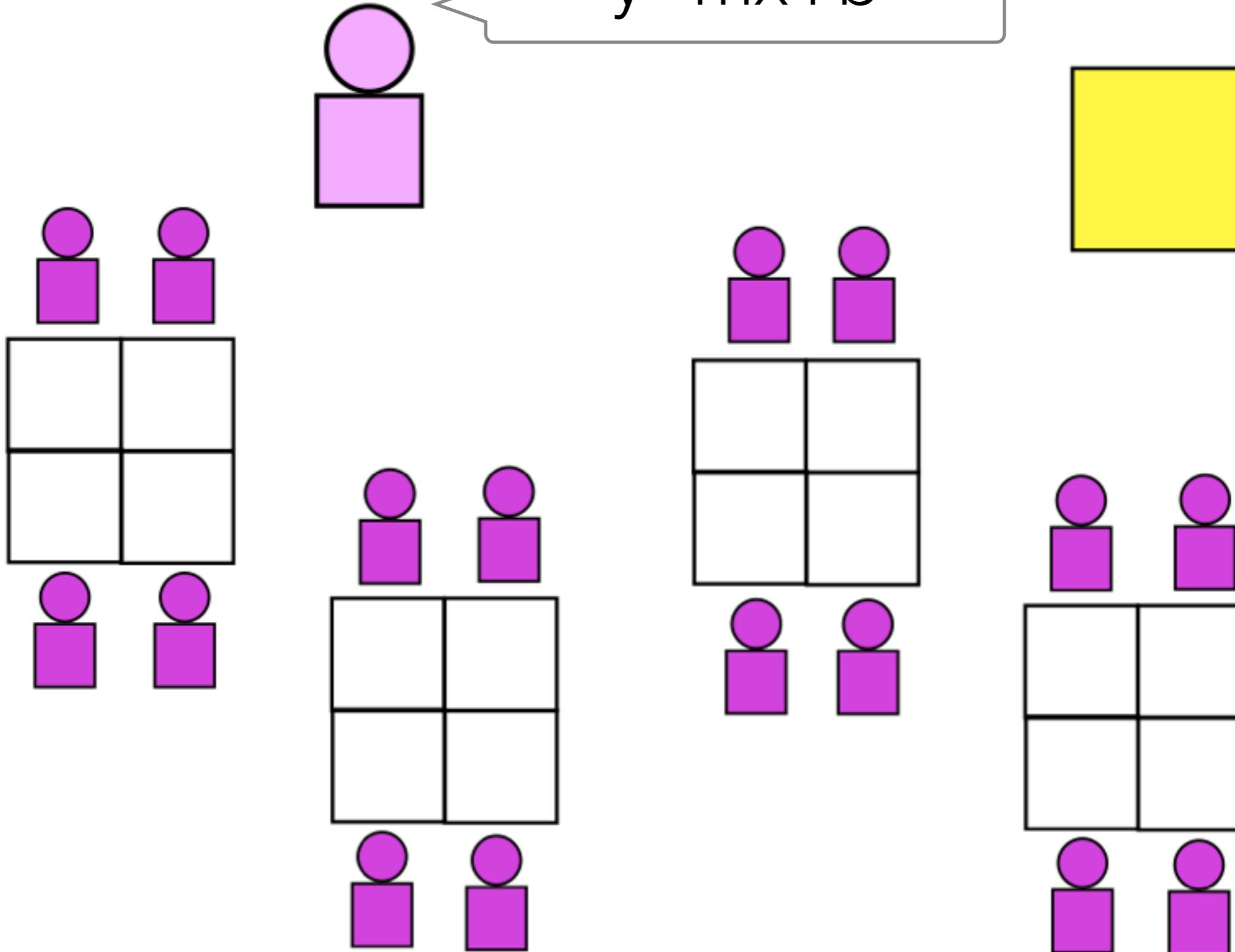
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$$y=mx+b$$



My 2-day Agenda

MONDAY	TUESDAY
<p>Warm Up</p> <p>Show Entry Event (Squirrel Race Guy)</p> <p>Solicit Knows/Need to Knows</p> <p>Reveal crucial info based on NTKs</p> <p>Workshop on Pythagorean Theorem (if necessary)</p> <p>Revisit Knows/Need to Knows</p> <p>Exit Ticket</p>	<p>Warm Up</p> <p>Lesson: Systems of Equations</p> <p>Revisit Need-to-Knows</p> <p>Workshop (if necessary):Writing an equation based on a scenario</p> <p>Student work time:</p> <p>Equation, Graphs, Systems</p> <p>Present solutions in a gallery walk</p> <p>Exit Ticket</p>

[An] important barrier to meaningful problem solving experiences is that **teachers often remove the challenges of a mathematical task by taking over the thinking** and reasoning and telling students how to solve the problem. - NCTM Research Brief on Problem Solving

Five Design Principles to develop a Problem-Based Learning classroom

Design Principle #1: Notch some early wins

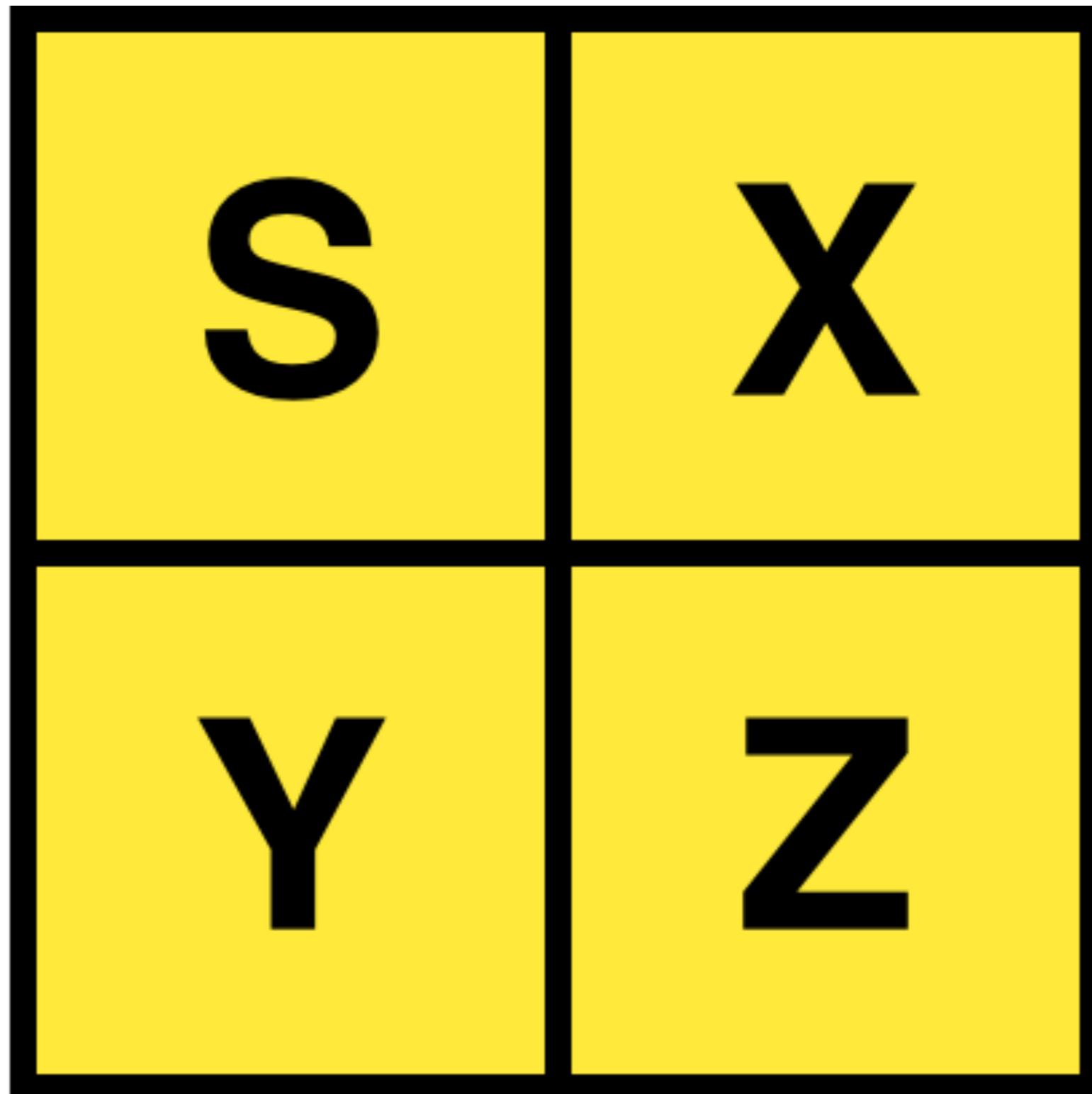
Get kids talking mathematically

Get kids sharing ideas with one another

Start with short 10-20 minute math explorations

Get kids thinking of themselves as mathematicians

Which One Doesn't Belong?

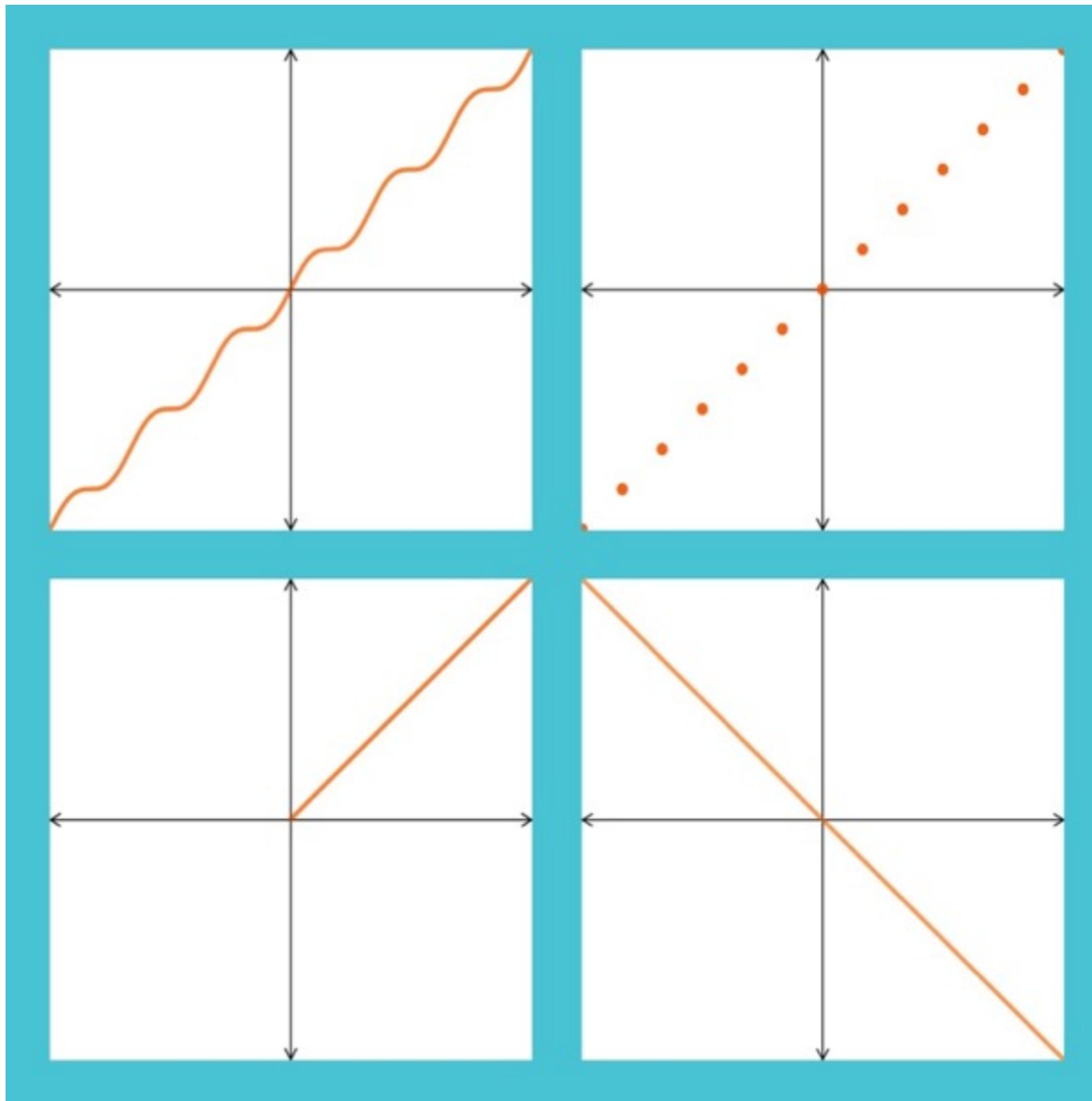


Which One Doesn't Belong?

121	16
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9	73
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Which One Doesn't Belong?



Estimation

How many **cheeseballs** will fit on the *large* plate?



Make an estimate.

* Required

What's too LOW? *

What's too HIGH? *

Your estimate. *

Your reasoning. *

Do better than "I guessed." Try "I noticed"

Your name.

[Home](#)[Kinder](#) ▾[Grade 1](#) ▾[Grade 2](#) ▾[Grade 3](#) ▾[Grade 4](#) ▾[Grade 5](#) ▾[Grade 6](#) ▾[Grade 7](#) ▾

[Home](#) > [Grade 5](#) > Subtracting Mixed Numbers

SUBTRACTING MIXED NUMBERS

Directions: Using the whole numbers from 1 to 9, at most one time each, find three different mixed numbers that will make the equation true. You may reuse the same numbers for each of the three numbers.

$$5 \frac{4}{5} - \underline{\quad} \underline{\quad} \underline{\quad} = 3 \frac{1}{20}$$

Hint

Design Principle #1: Notch some early wins

Design Principle #2: Provide an iterative framework

Get kids talking mathematically

Get kids sharing ideas

Start with short 10-20 minute math explorations

Get kids thinking of themselves as mathematicians

Know / Need-to-Know Process

Problem Solving Framework

Define the Problem

What is the problem about? What is it asking you to do?

Analyze the Problem

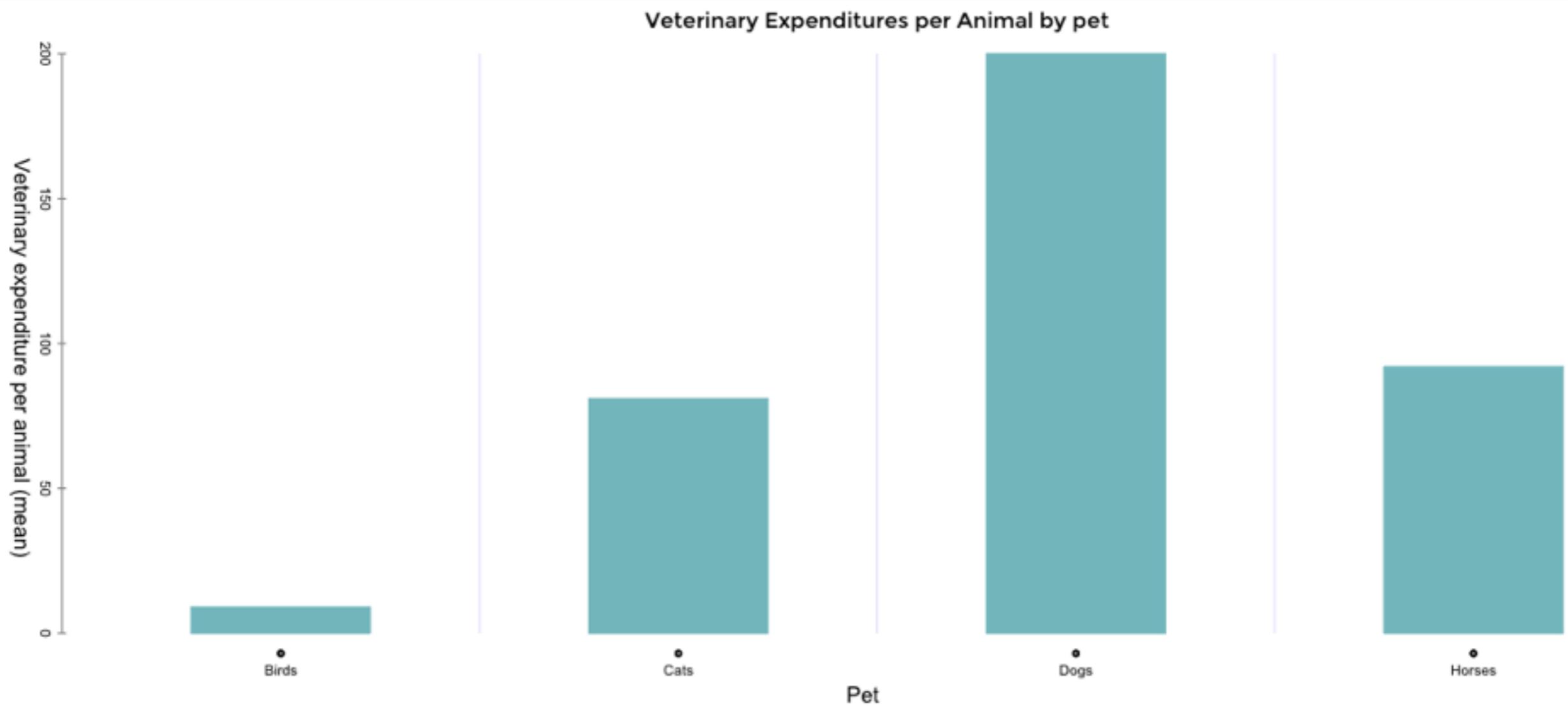
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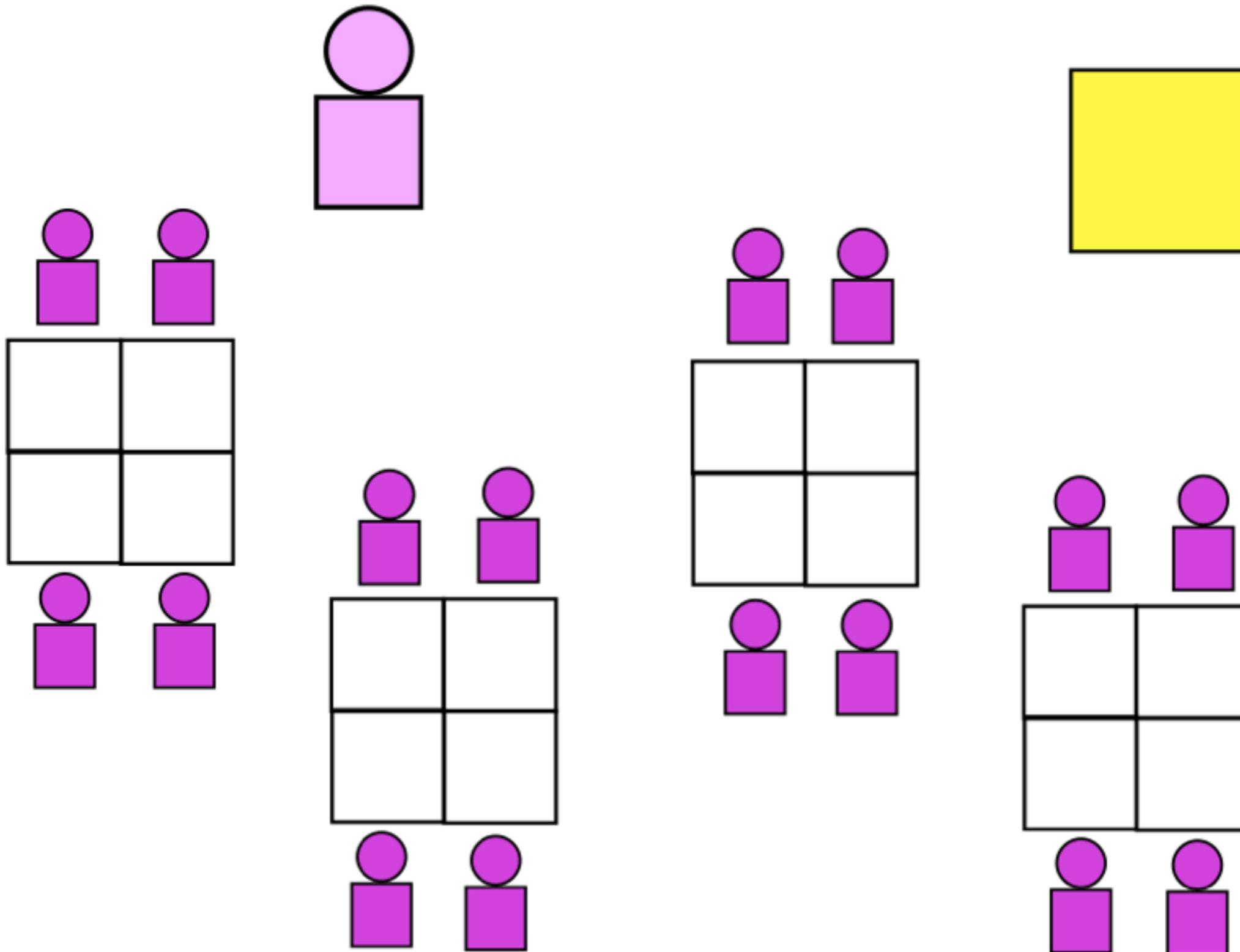
Notice and Wonder

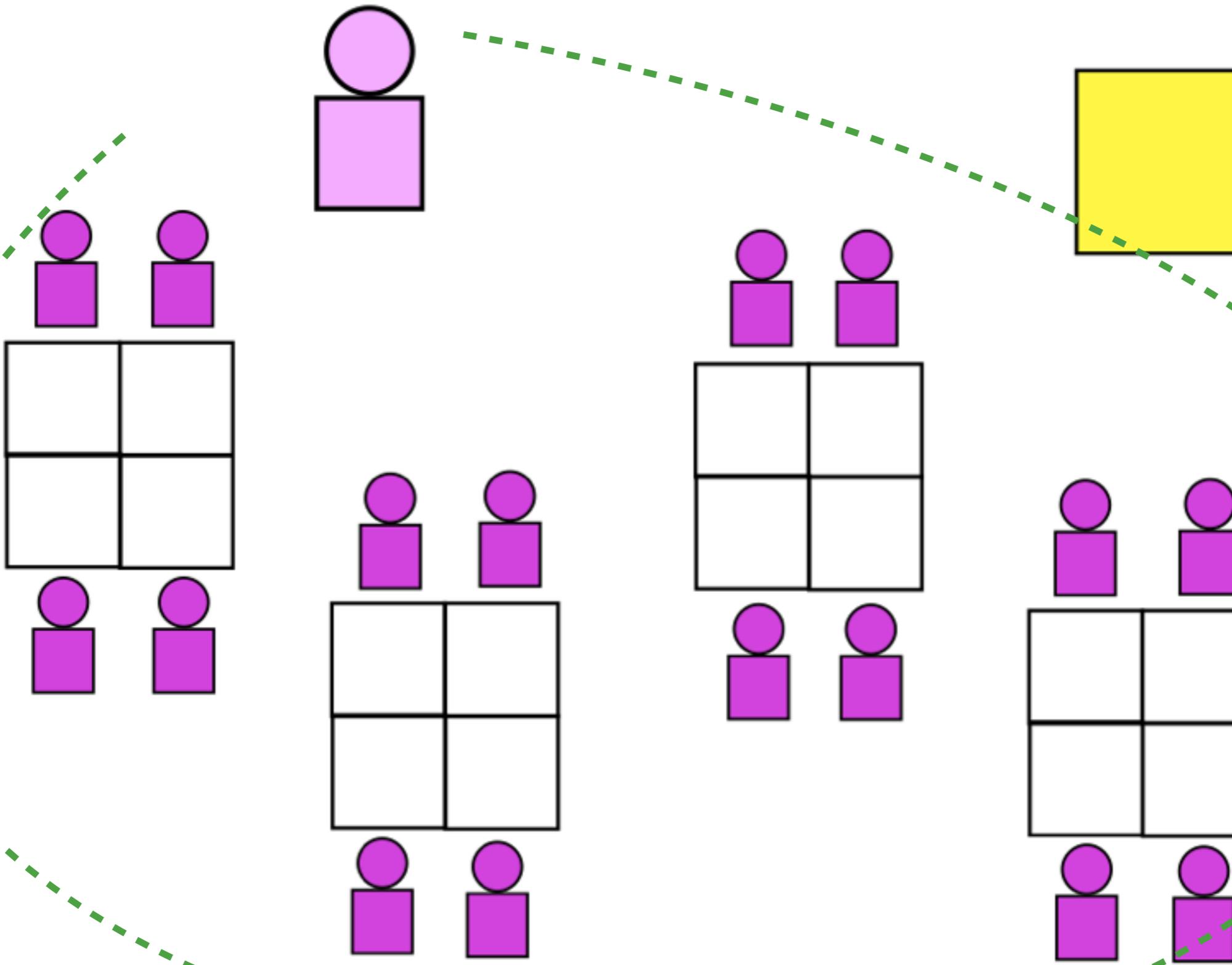


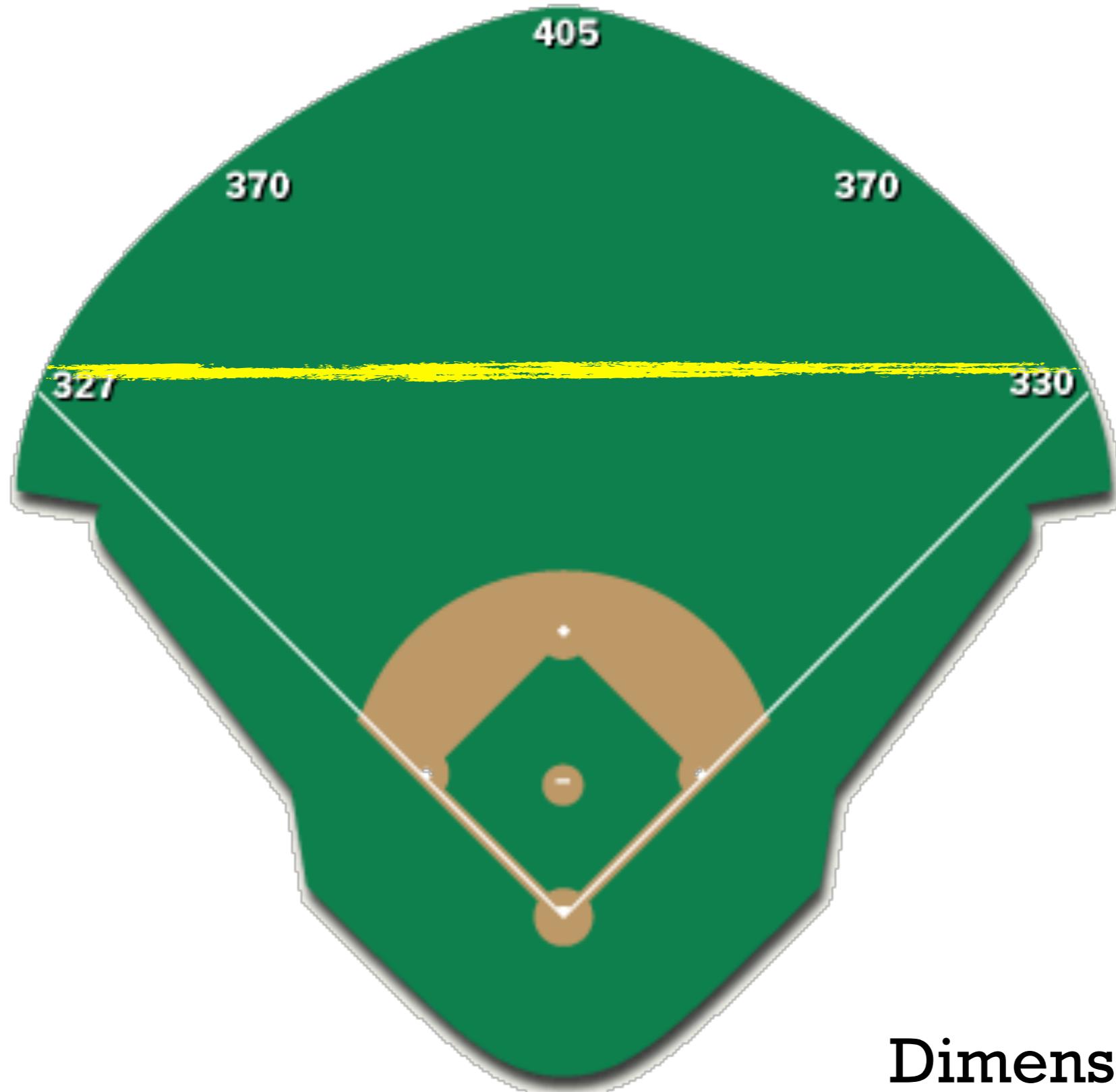
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Design Principle #2: Provide an iterative framework

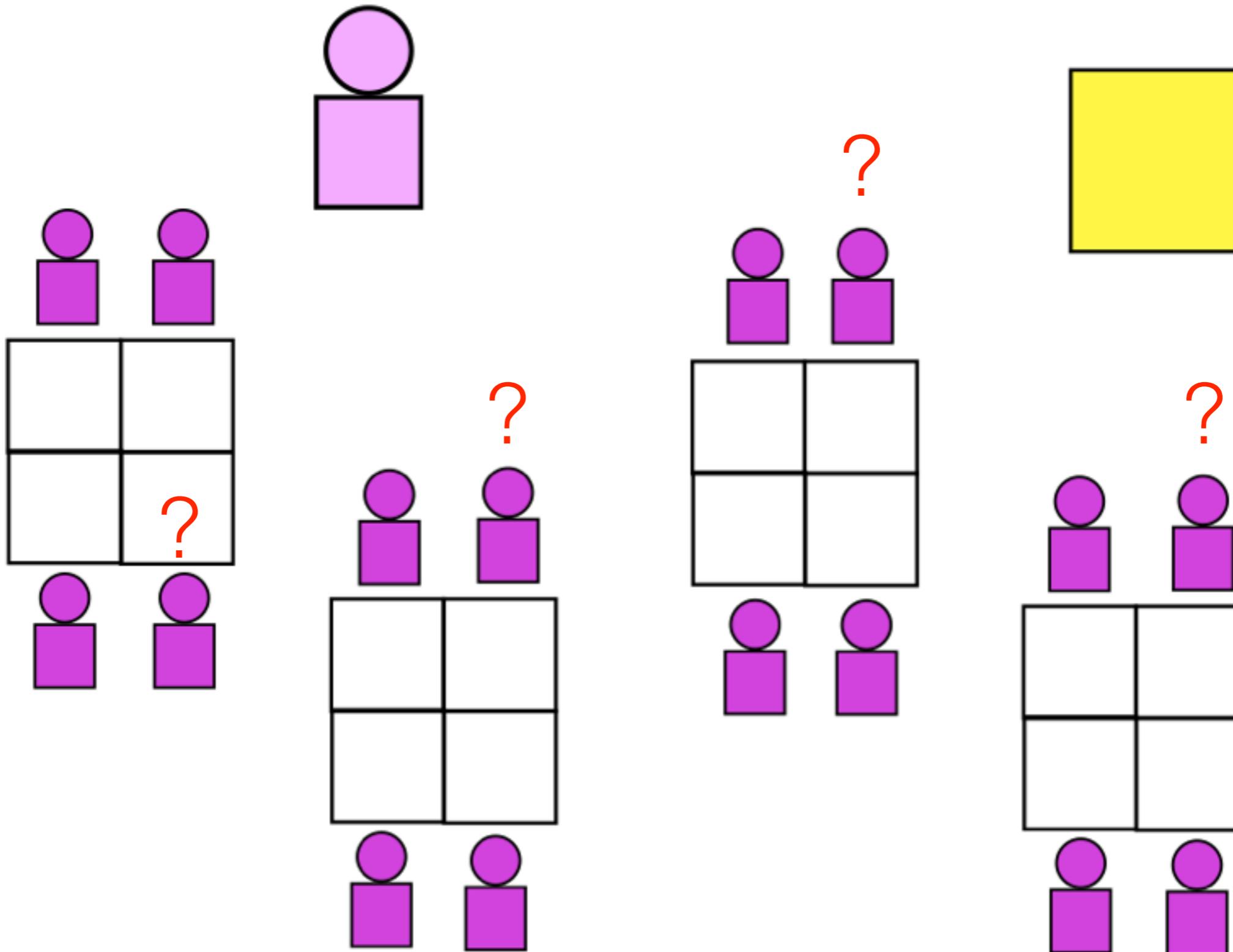
Design Principle #3: Tasks support targeted instruction & group-mate expertise





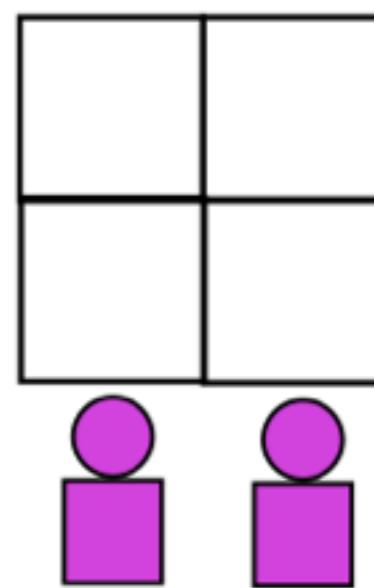
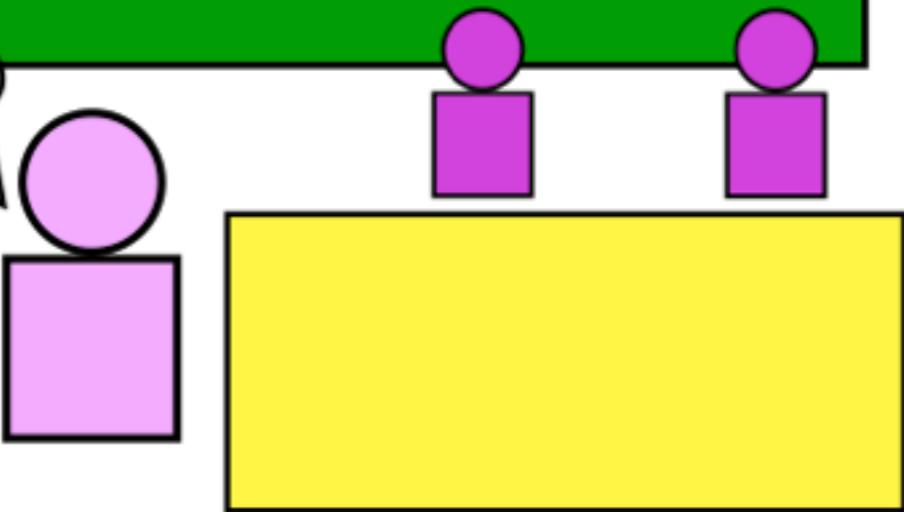
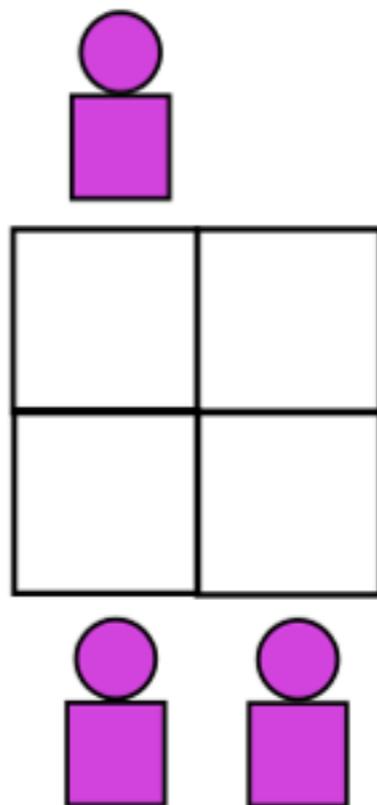
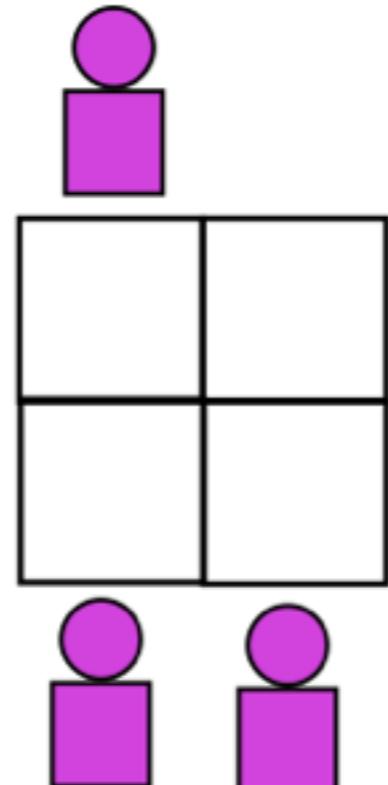
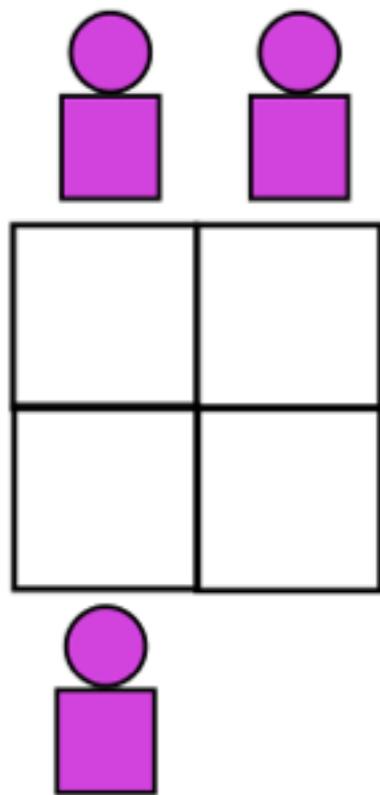


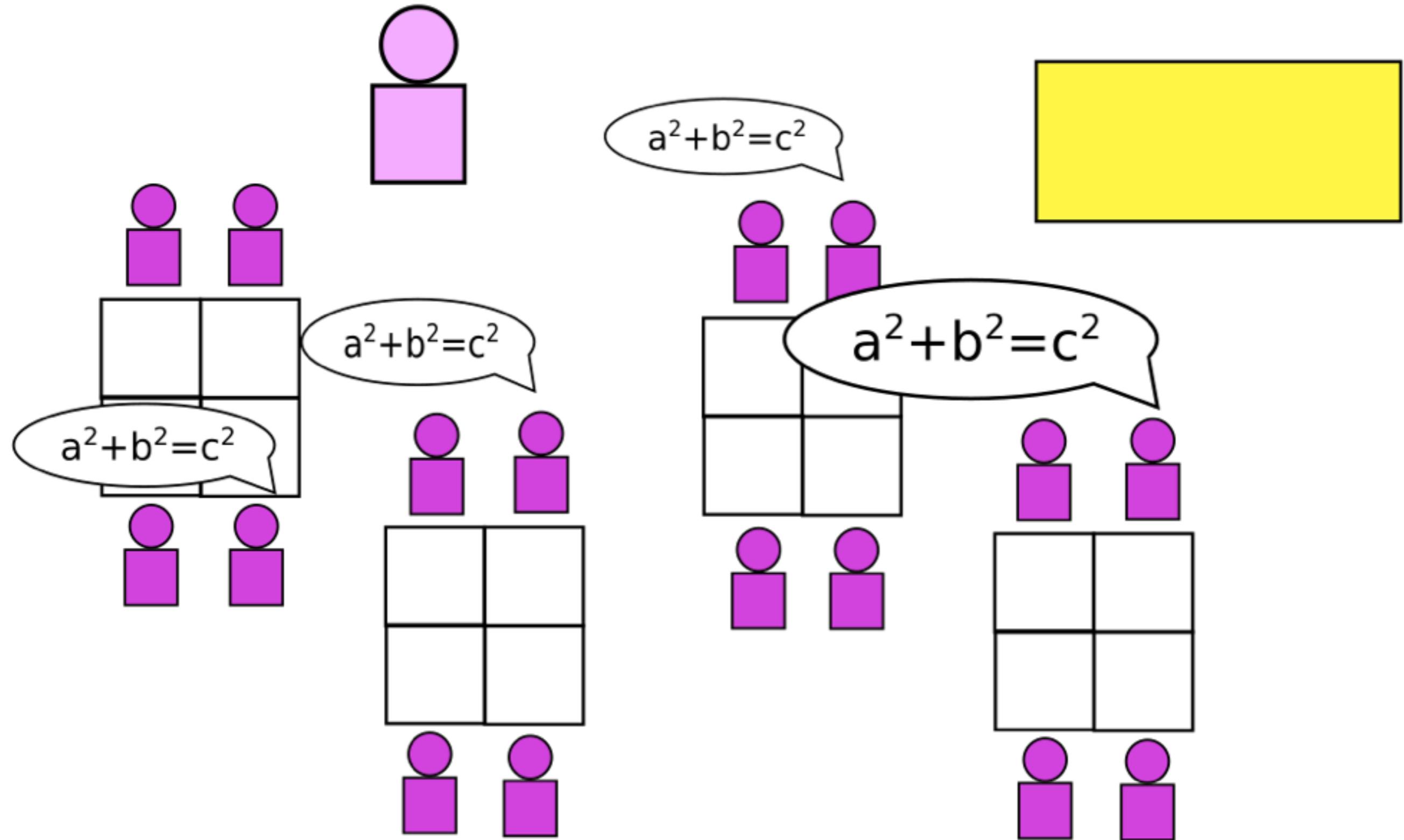
Dimensions of
Qualcomm Field



The diagram illustrates the Pythagorean theorem ($a^2 + b^2 = c^2$) using geometric shapes. A large green horizontal bar at the top contains a white speech bubble containing the equation. Below the bar, a right-angled triangle is shown with its vertical leg divided into two segments by a horizontal line. The segments are labeled 'a' and 'b'. The hypotenuse is labeled 'c'. The area of the triangle is divided into three parts: a pink square on leg 'a', a pink square on leg 'b', and a yellow square on the hypotenuse. The pink squares represent the areas a^2 and b^2 , and the yellow square represents the area c^2 . The total area of the pink squares is equal to the area of the yellow square, visually demonstrating the theorem.

$$a^2 + b^2 = c^2$$





Design Principle #1: Notch some early wins

Design Principle #2: Provide an iterative framework

Design Principle #3: Tasks support targeted instruction & group mate expertise

Design Principle #4: Start slowly and steadily

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY



= Structured teacher-centric environment



= Inquiry

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY



= Structured teacher-centric environment



= Inquiry

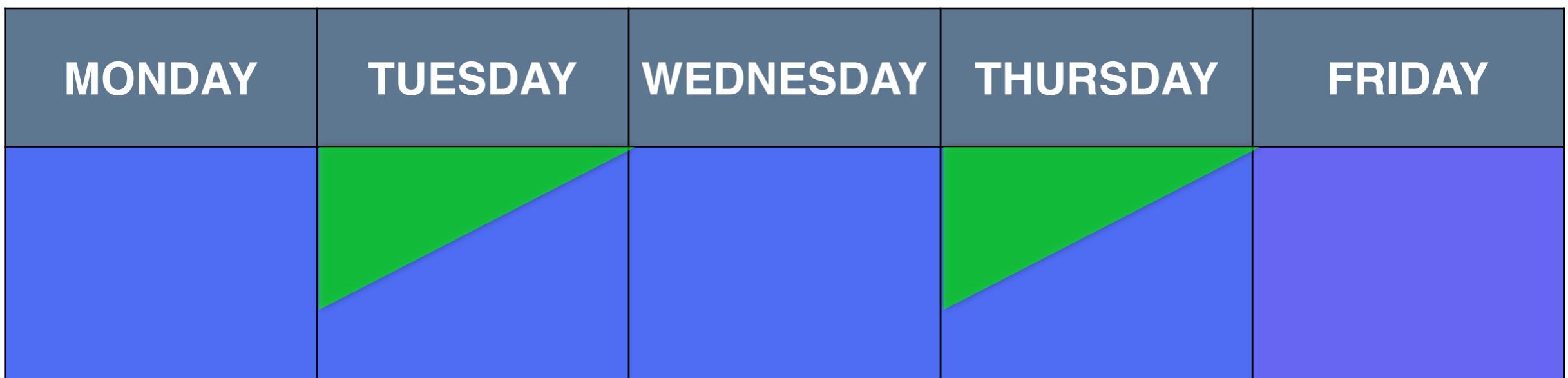
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 = Structured teacher-centric environment

 = Inquiry

WHICH ONE DOESN'T BELONG?

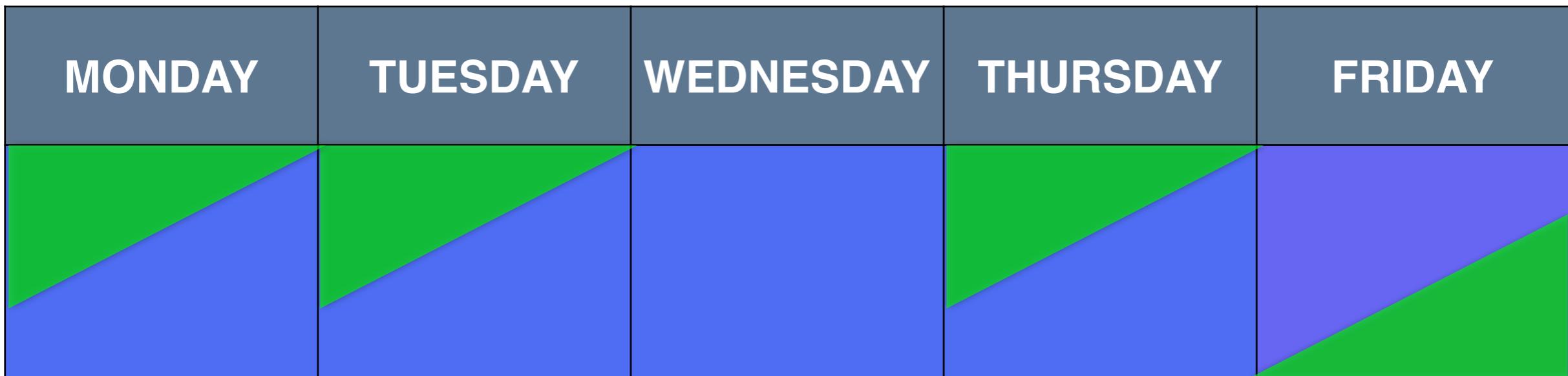
ESTIMATION 180



ESTIMATION180

WHICH ONE DOESN'T BELONG?

ESTIMATION180

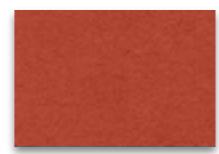
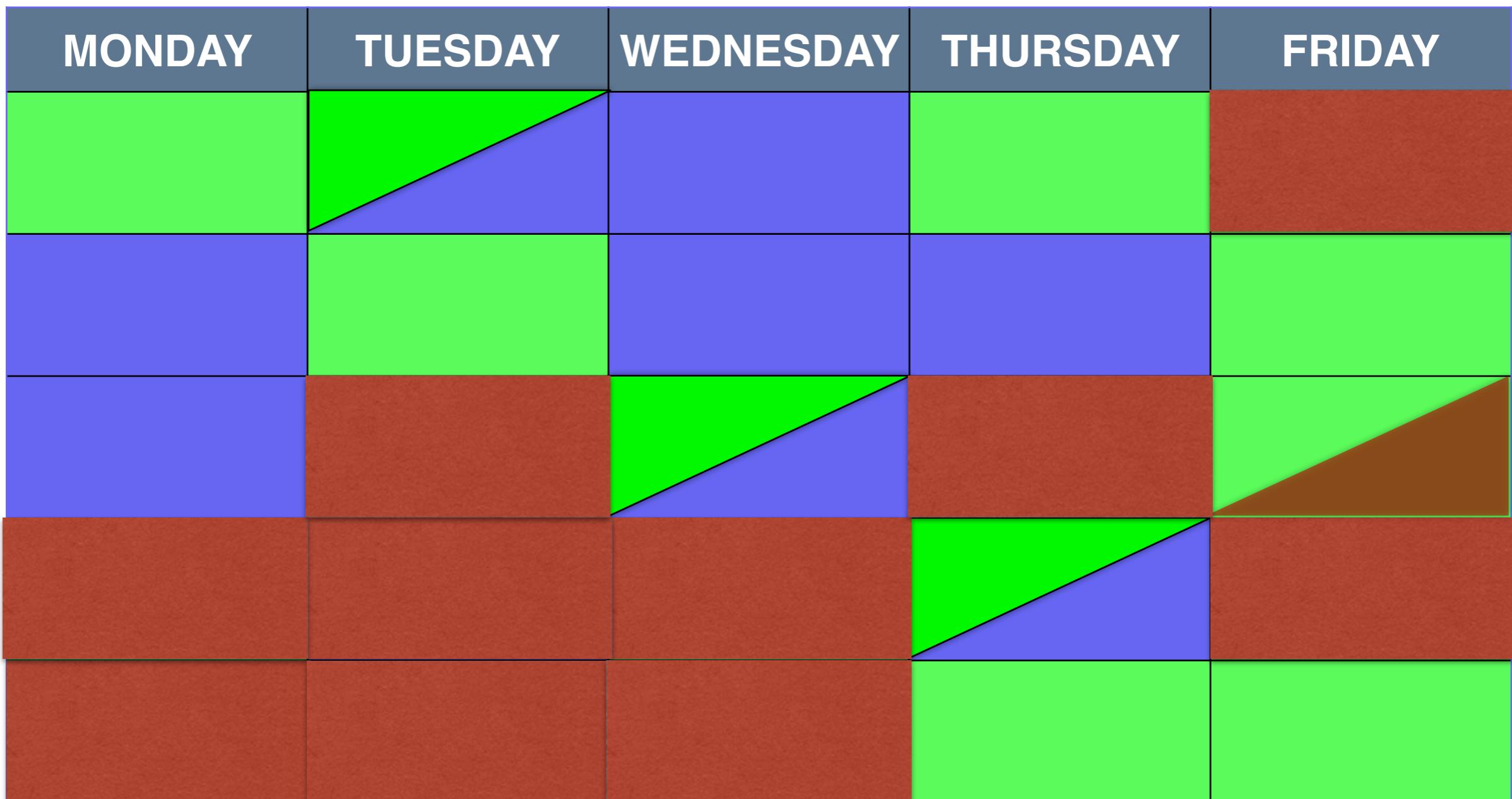


DOK - LEVEL 2/3
OPEN MIDDLE

PROBLEM-BASED LEARNING
TASK & LESSON

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY

3-ACT MATH



= Benchmarking / State testing

To help students become successful problem solvers, teachers must accept that students' problem-solving abilities often develop slowly, thereby requiring long-term, sustained attention to making problem solving an integral part of the mathematics program. - NCTM Research Brief on Problem Solving

Design Principle #1: Notch some early wins

Design Principle #2: Provide an iterative framework

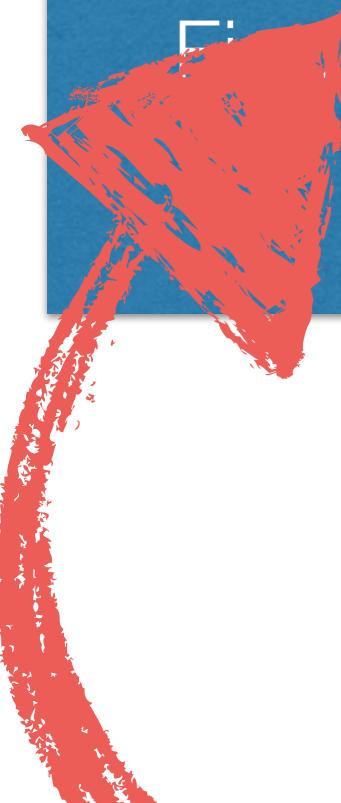
Design Principle #3: Tasks support targeted instruction & group mate expertise

Design Principle #4: Start slowly and steadily

Design Principle #5: Don't go it alone

Partner Up Colleagues Twitter - “The Math Twitter Blogosphere”

Select

 2-3 tasks that will produce rich student-thinking artifacts:
Poster paper
Disciplinary writing

Implement

Sometime within the next couple weeks

Debrief

How did it go?
What kind of work did it produce (LASW protocols)?
What became clear about student understanding of the concept? What remains unclear?

Illustrative Mathematics

Grade 7

Domain: Ratios And Proportional

Cluster: Analyze Proportional Relationships

Standard: Compute Unit Rates Associated

Task: 7.RP Cooking With The Whole Cup

7.RP Cooking with the Whole Cup

Travis was attempting to make muffins to take to a neighbor that had just moved in down the street. The recipe that he was working with required $\frac{5}{8}$ cup of sugar and $\frac{1}{8}$ cup of butter.

a. Travis accidentally put a whole cup of butter in the mix.

i. What is the ratio of sugar to butter in the original recipe? What amount of sugar does Travis need to put into the mix to have the same ratio of sugar to butter that the original recipe calls for?

ii. If Travis wants to keep the ratios the same as they are in the original recipe, how will the amounts of all the other ingredients for this new mixture compare to the amounts for a single batch of muffins?

iii. The original recipe called for $\frac{1}{8}$ cup of blueberries. What is the ratio of blueberries to butter in the recipe? How many cups of blueberries are needed in the new enlarged mixture?

Grade 11: Algebra II

Unit/Problems	Content Standards (CCSS)	Days
Intro Unit (5 days)		
One Cut Problem (Bowman)	MP.1, MP.3, MP.7	1
Too Hot to Handle (NCTM Illuminations)		3
UNIT: Exponential Functions	N-RN.1,2,3, A-SSE.3,4*, F-IF.3,7e,8b, F-BF.2,4a, F-LE.1a,1b,1c,2,3,4,5	25
Wolfram Alpha Real Numbers Investigation (Fred)	N-RN.1,2,3	2
Lost in Recursion (Paul)	F-IF.3	1
National Debt and Wars (NCTM Illuminations)	F-IF.8c	2
Exponential Growth and Credit Cards	F-IF.8c	1

illustrativemathematics.org

emergentmath.com

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