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 Delive

Content Delivery

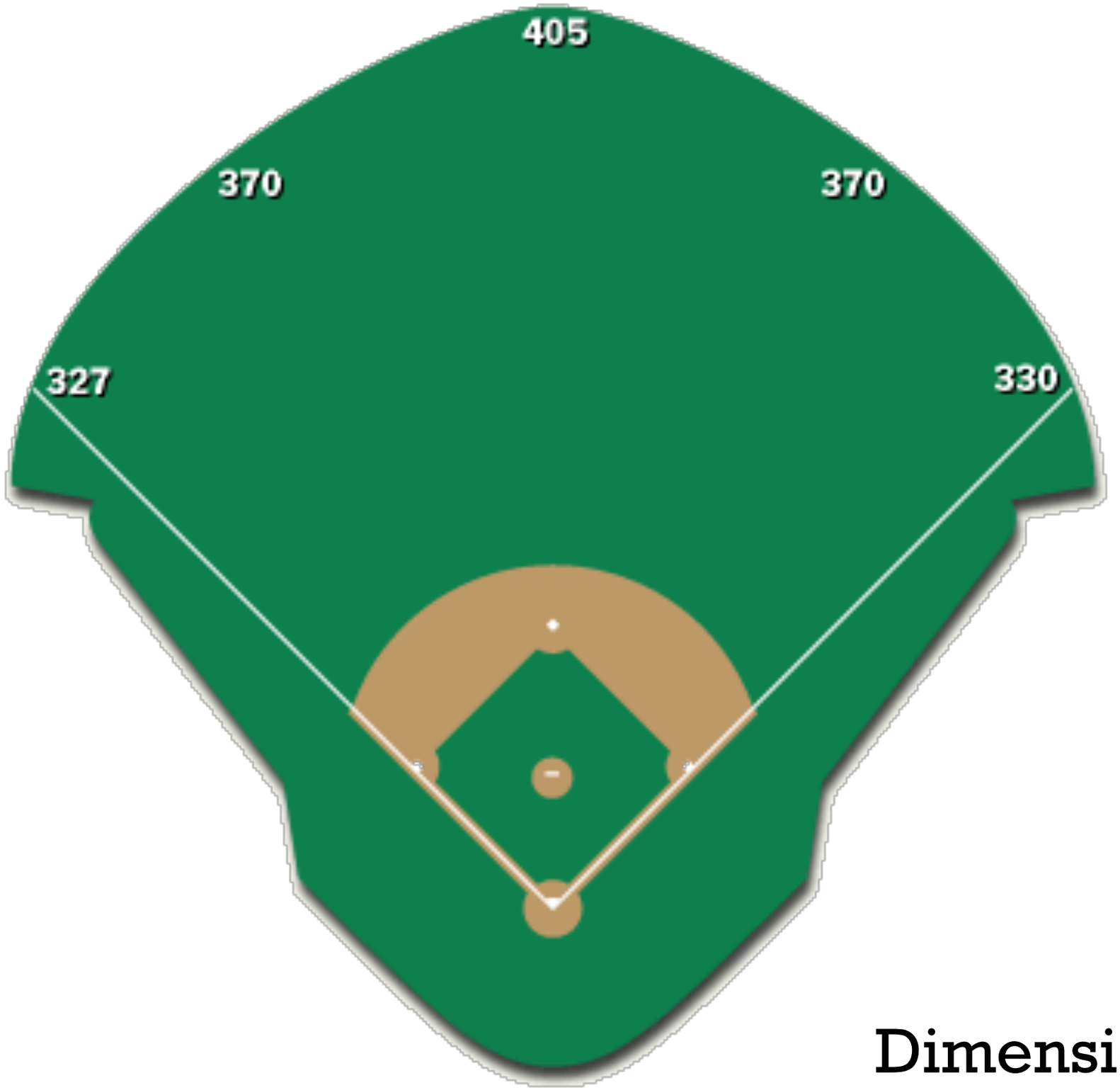
Research clearly suggests that problem solving should not be taught as a separate topic in the mathematics curriculum. In fact, research tells us that teaching students to use general problem-solving strategies has little effect on their success as problem solvers. Thus, problem solving must be taught 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

http://www.nctm.org/uploadedFiles/Research_and_Advocacy/research_brief_and_clips/Research_brief_14_-_Problem_Solving.pdf

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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comcast SPORTSNET
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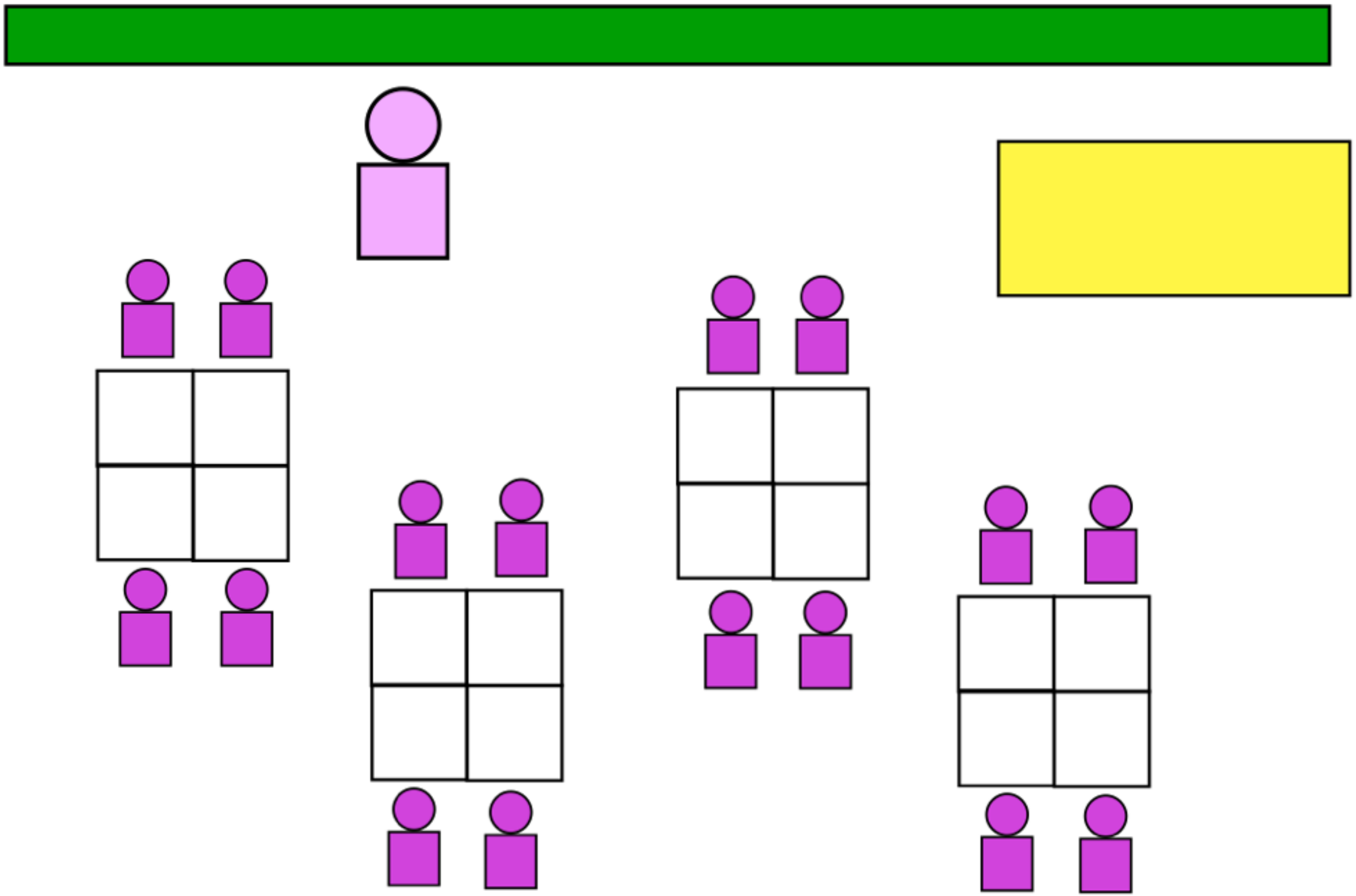

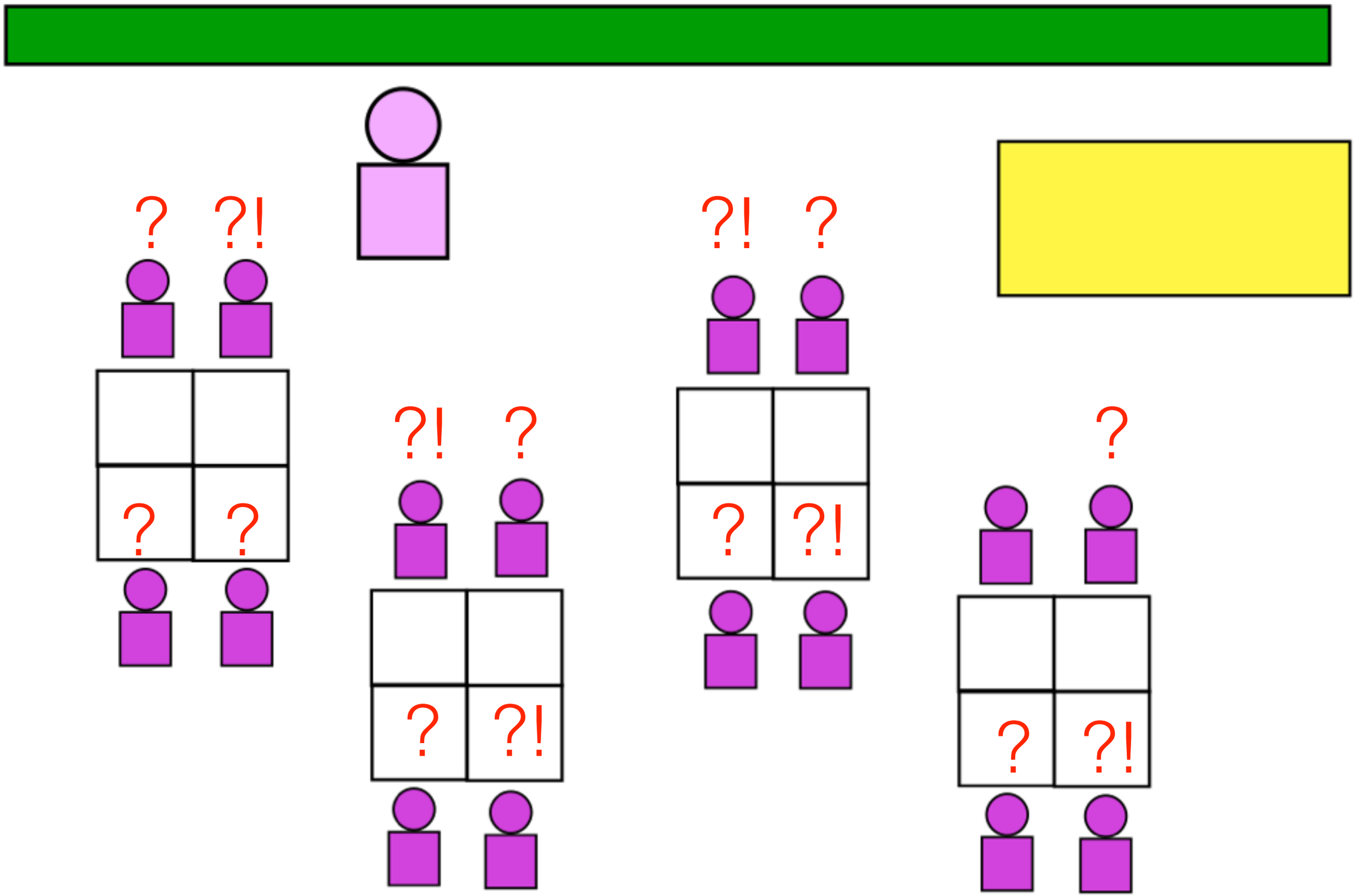

y=mx+b

My 2-day Agenda

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

[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

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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

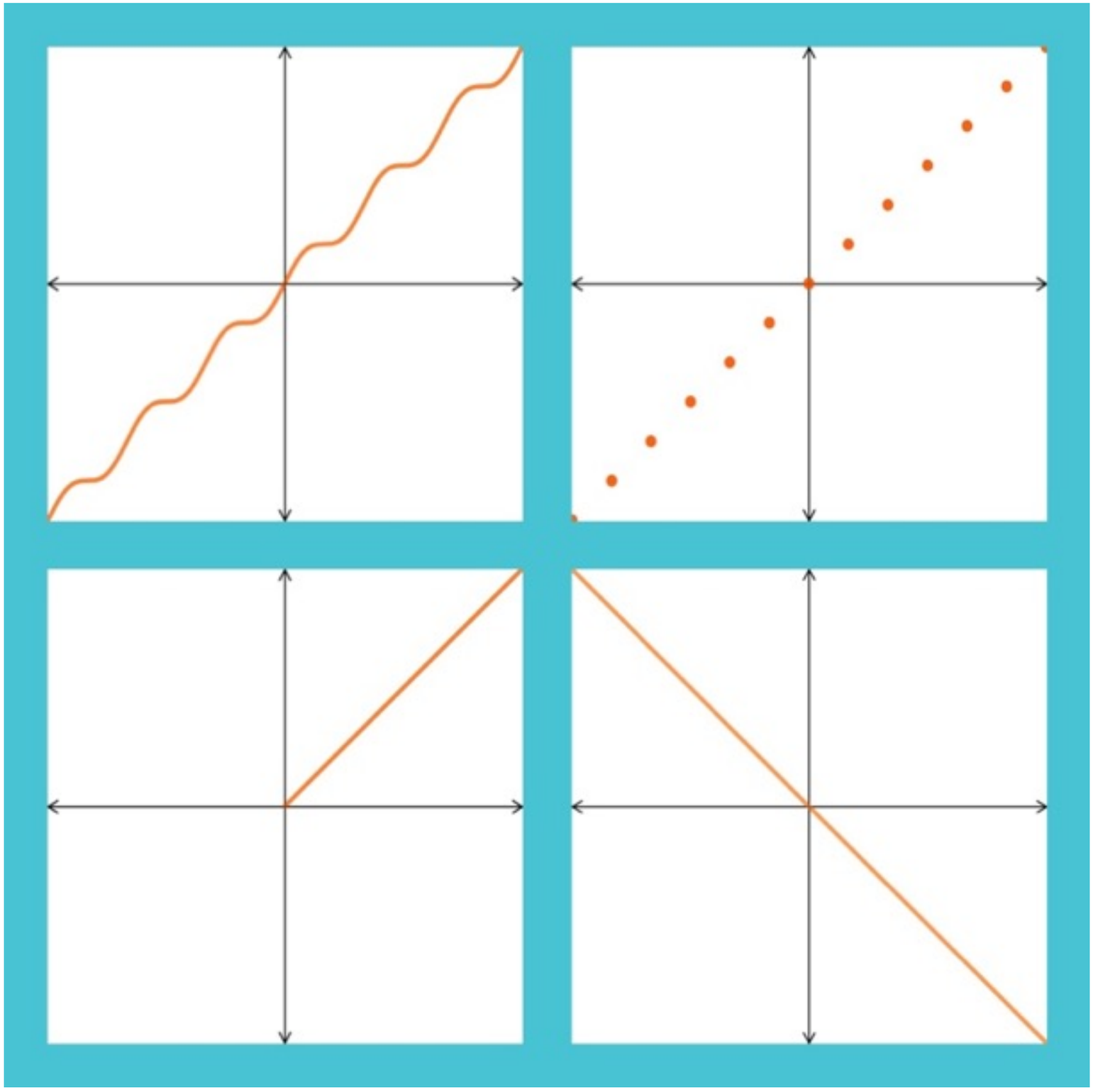
Which One Doesn’t Belong?

Which One Doesn't Belong?

121	16
9	73

wodb.ca

Which One Doesn’t Belong?



wodb.ca

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.

estimation180.com - Andrew Stadel @mr_stadel

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.

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

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

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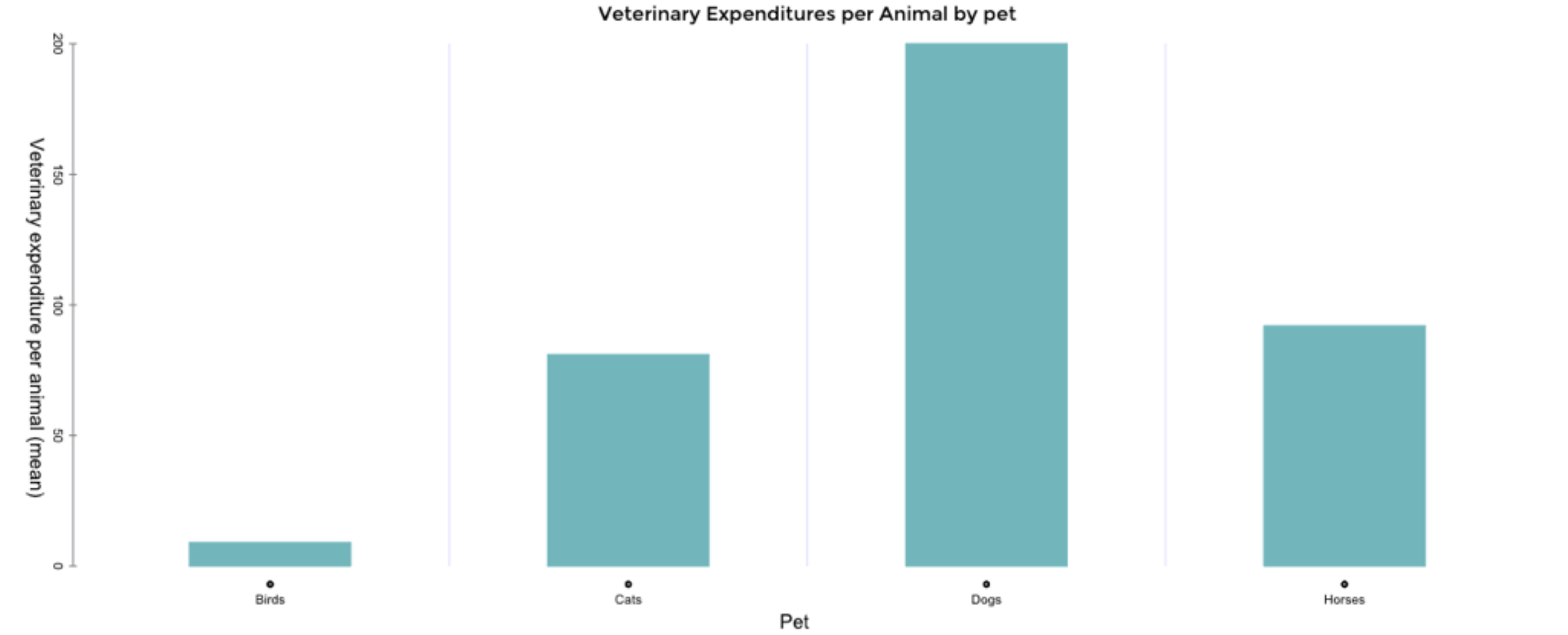
Notice and Wonder

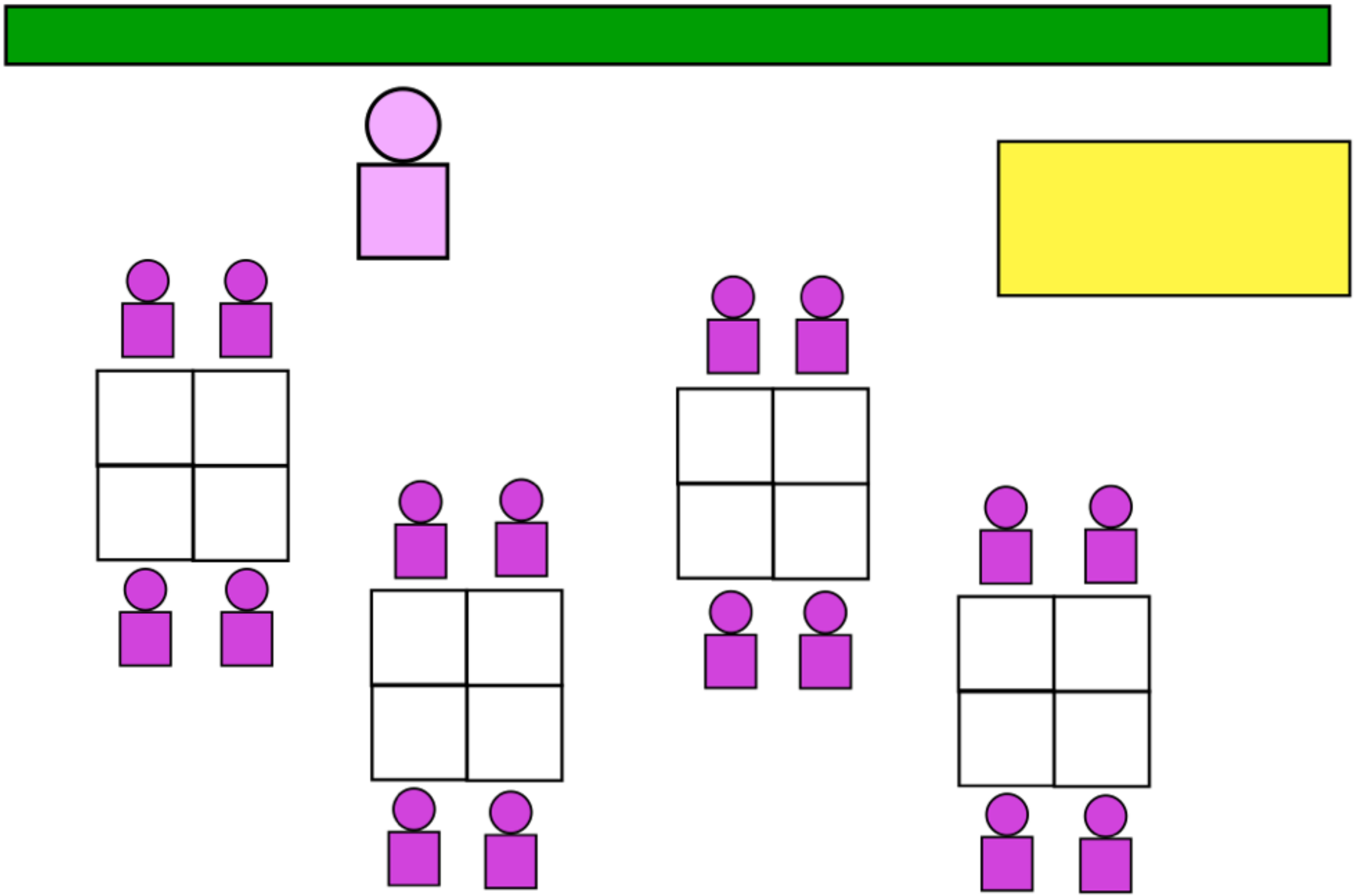


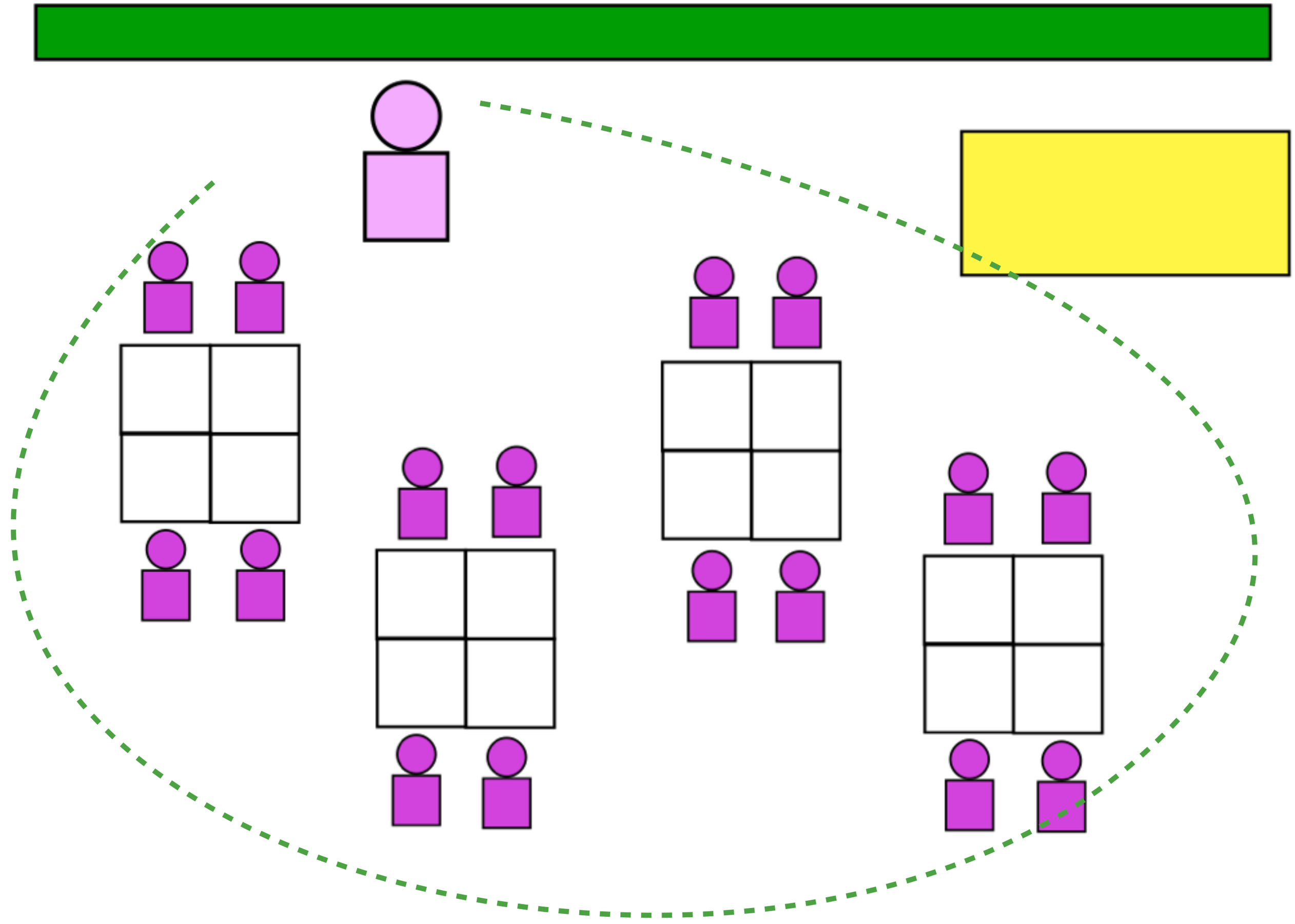
Tuva http://tuva.la/1xRPbUg SOURCE: American Veterinary Medical Association

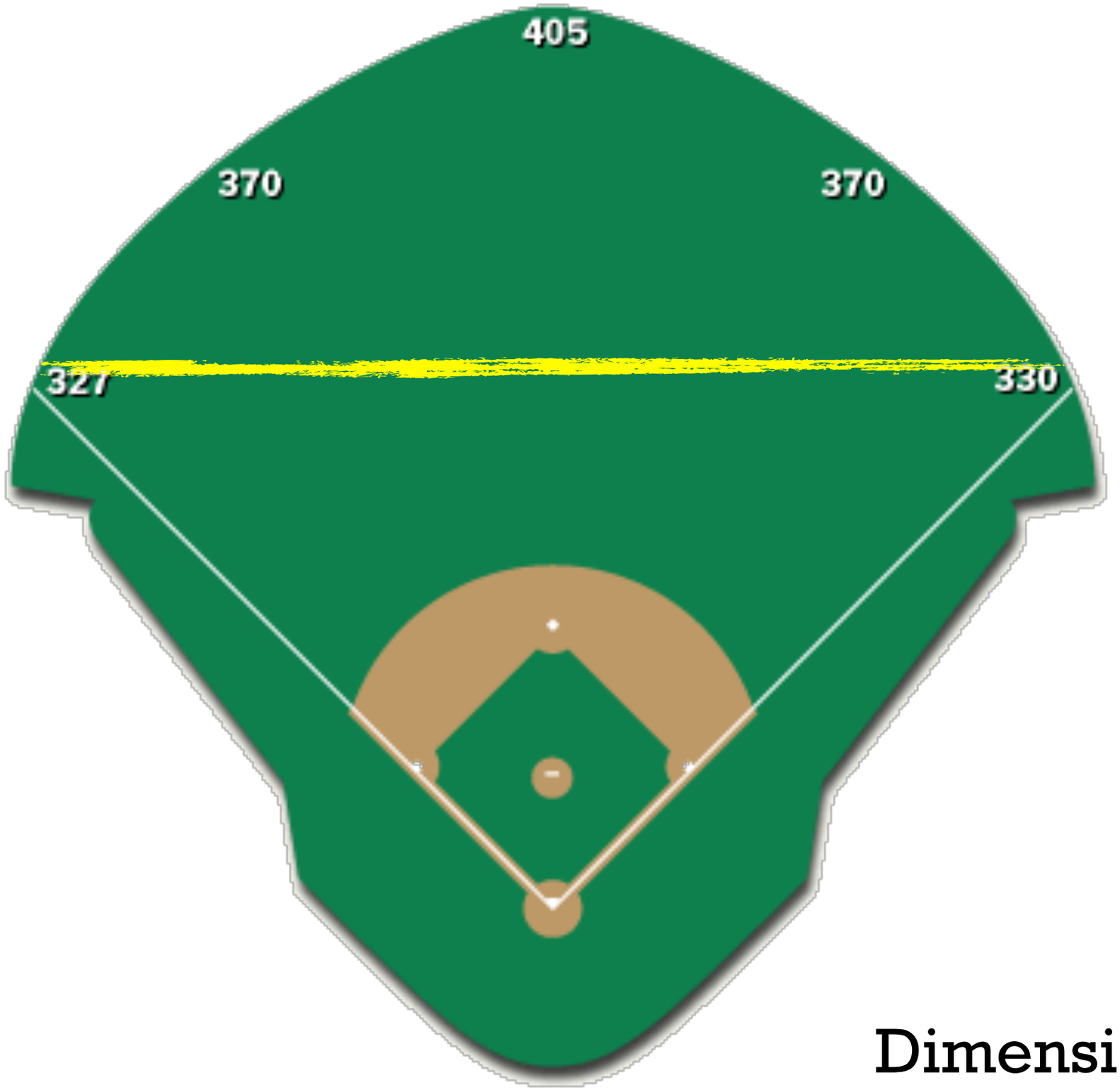
Design Principle #1: Notch some early wins

Design Principle #2: Provide an iterative framework

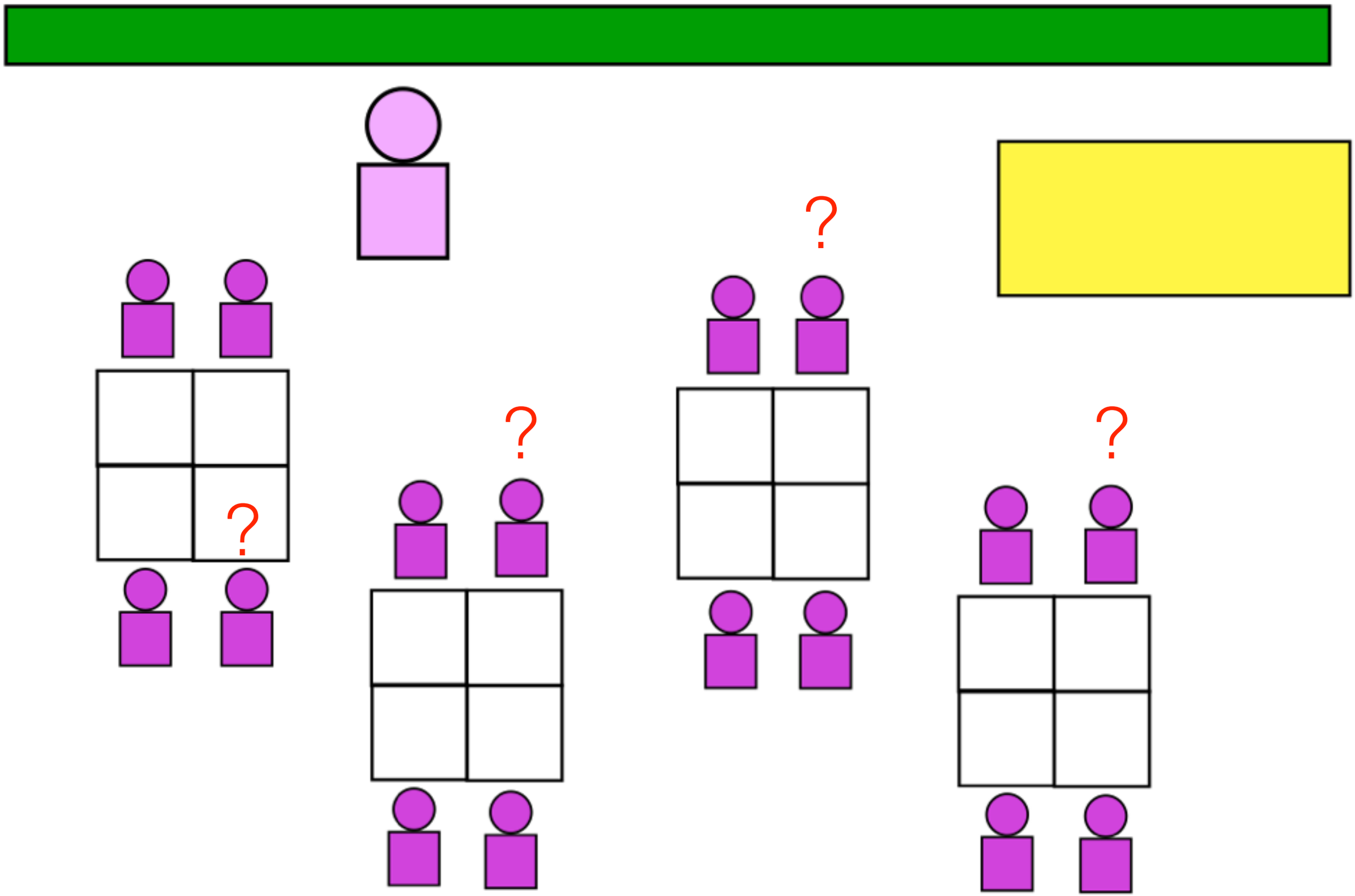
Design Principle #3: Tasks support targeted instruction & group-mate expertise

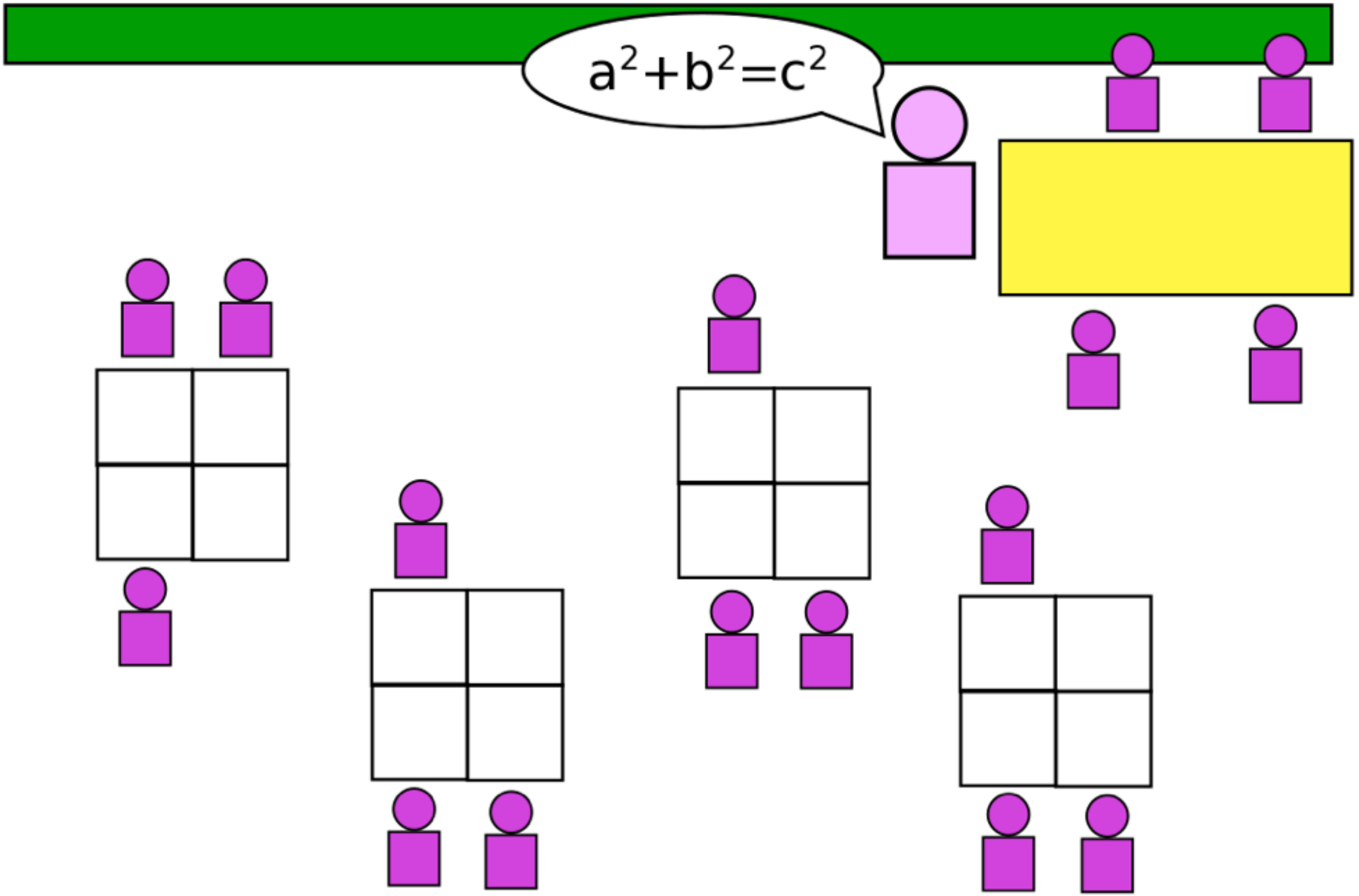






Dimensions of Qualcomm Field




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

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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

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Which One Doesn't Belong?

Estimation180

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Estimation180

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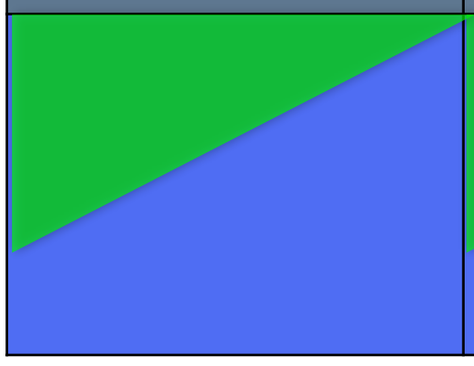
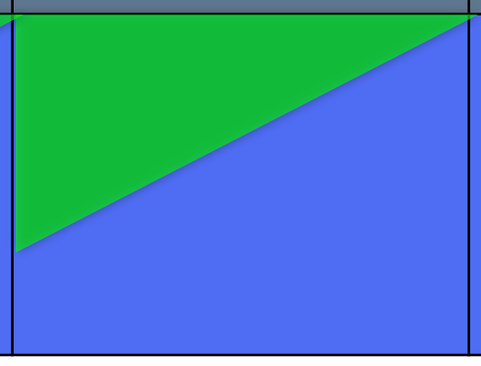
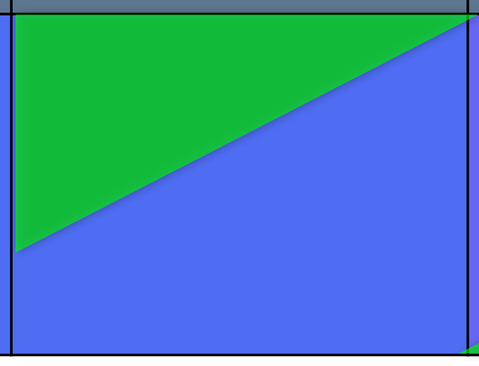
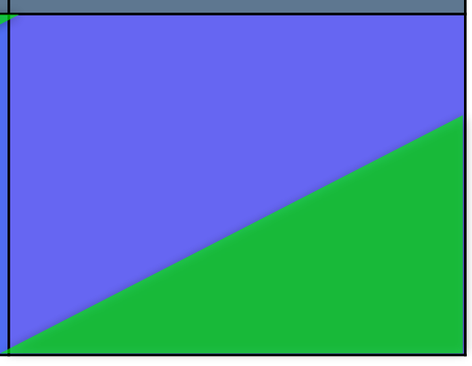
				

Open Middle
DOK - Level 2/3

Problem-Based Learning
Task & Lesson

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY

3-Act Math

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY

= 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

http://www.nctm.org/uploadedFiles/Research_and_Advocacy/research_brief_and_clips/Research_brief_14_-_Problem_Solving.pdf

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

Fi 2-3 tasks that will produce rich student-thinking artifacts:

Poster paper

Disciplinary writing

Implement

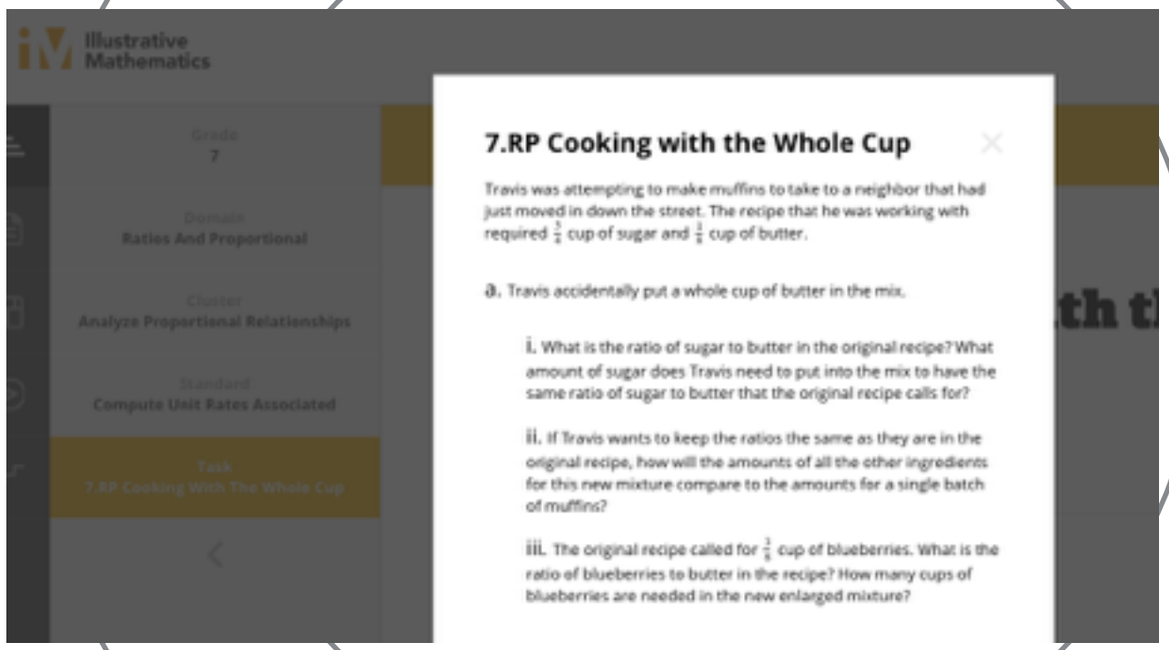
Sometime within the next couple weeks

Debrief

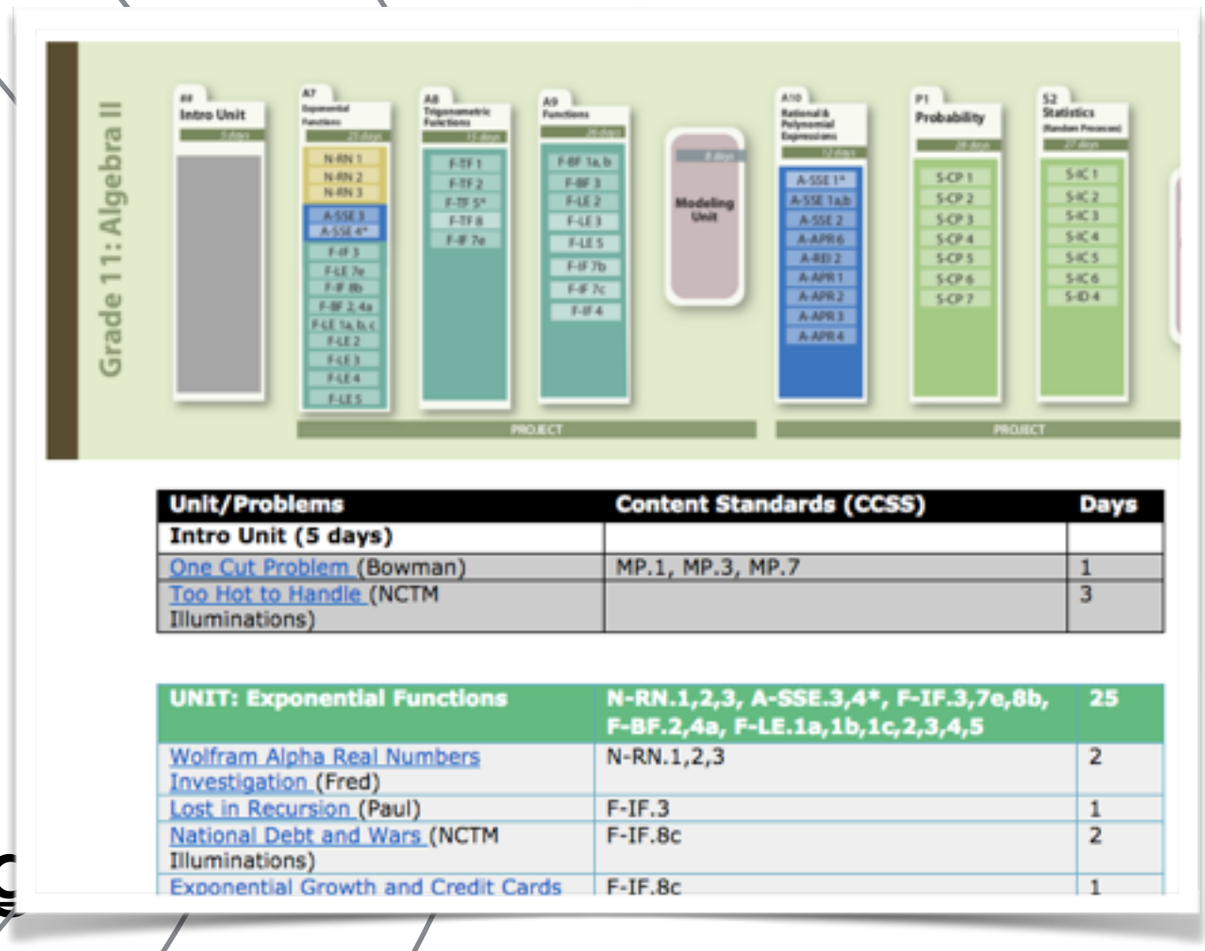
How did it go?

Wh kind of work did it produce (LASW protocols)?

What becam clear about student understanding of the concept? What remains unclear?



illustrativemathematics.org



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

emergentmath.com

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