Fluency
Through Problem-solving

Solve and understand problem-solving tasks that simultaneously build fluency and number sense.

Take away several tasks to use with your students.

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What Is Fluency in Math?

. . . *procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately)* . . .

CCSSM, p. 6

Turn and talk with a partner:

- What does fluency mean to you?
- What are the types of things in math that students should be fluent with?

Routes to Fluency

- Connecting concepts
- Practice
- Problem-solving

What is Problem Solving in Math?

Problem solving involves reasoning and analysis, argument construction, and the development of innovative strategies. These abilities are used not only in advanced mathematics topics—such as algebra, geometry, and calculus—but also throughout the entire mathematics curriculum beginning in kindergarten.

(IES), *Improving Mathematical Problem Solving in Grades 4–8*, 2012

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Three Perspectives on Problem Solving

- **Problem solving as a goal:** Learn about how to problem solve.
- **Problem solving as a process:** Extend and learn math concepts through solving selected problems.
- **Problem solving as a tool for applications and modeling:** Apply math to real-world or word problems, and use mathematics to model the situations in these problems.

Addition Four-Packs with 1 to 9

An Addition Four-Pack is four addition problems that

- Use the same six digits (not including zero)
- No digit is used more than once in each problem
- Each problem in the pack has different addends than the other problems

For example,

$$\begin{array}{r} 21 \\ +\ 53 \\ \hline 74 \end{array} \qquad \begin{array}{r} 23 \\ +\ 51 \\ \hline 74 \end{array} \qquad \begin{array}{r} 15 \\ +\ 32 \\ \hline 47 \end{array} \qquad \begin{array}{r} 12 \\ +\ 35 \\ \hline 47 \end{array}$$

Create Equations with the Digits 1–9

Create as many equations as you can with the following conditions:

- Use the digits 1–9 to create many different equations.
- Use some or all of the digits in each equation.
- Do not use any digit more than once within any single equation.
- Do not use the digit zero.
- You may use any math operation, including exponents.

For example,

- $8 \div 4 = 5 - 3$ → uses the digits 3, 5, 4, and 8
- $5 + 6 \times 4 = 29 \times 1$ → uses the digits 1, 2, 4, 5, 6, and 9

Fill In the Fractions from Least to Greatest with 1 to 9

Fill in the remaining numbers from 1 to 9 in the boxes to create **proper** fractions that make the inequalities true.

- Create only fractions with single digit numerators and denominators.
- No digit may occur more than once within a set of inequalities.

For example, one problem with one possible solution is shown below.

$$\frac{\square}{6} < \frac{\square}{8} < \frac{3}{\square} < \frac{\square}{5} \quad \Rightarrow \quad \frac{\boxed{1}}{6} < \frac{\boxed{2}}{8} < \frac{3}{\boxed{7}} < \frac{\boxed{4}}{5}$$

Order of Operations with 1 to 9

- Create an expression that includes parenthesis using any of the numbers 1 to 9.
  - The numbers cannot be used more than once in the expression.
  - May not include exponents.
  - The parentheses are necessary – the expression would equal a different value if the parenthesis were removed.

- Create a second expression that includes the same numbers in the same order with the same operation symbols, but uses parenthesis differently than in the first expression such that the result is a different overall value for the expression.

For example

$$(1 + 2) \times (4 + 9) = 39 \quad \& \quad (1 + 2) \times 4 + 9 = 21$$

Mystery Math Grids

X	3	5	8
4	12	20	32
2	6	10	16
6	18	15	24

+	3	5	8
4	7	9	12
2	5	7	10
6	9	11	14

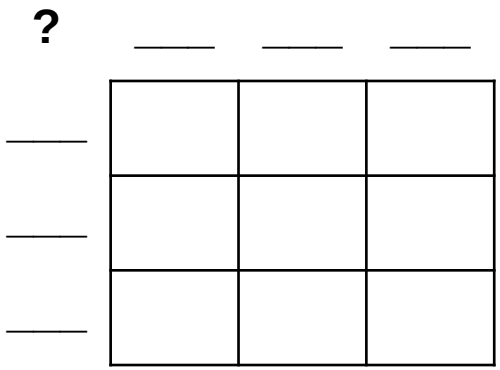
You try it. What are the outside numbers for this Mystery Math Grid?

X			
	6	21	24
	10	35	40
	12	42	48

Create a Mystery Math Grid

- Create a grid and rewrite the final form of the grid (without the outside numbers) on a separate piece of paper or sticky note.

- Exchange and challenge a partner with each other's grids.



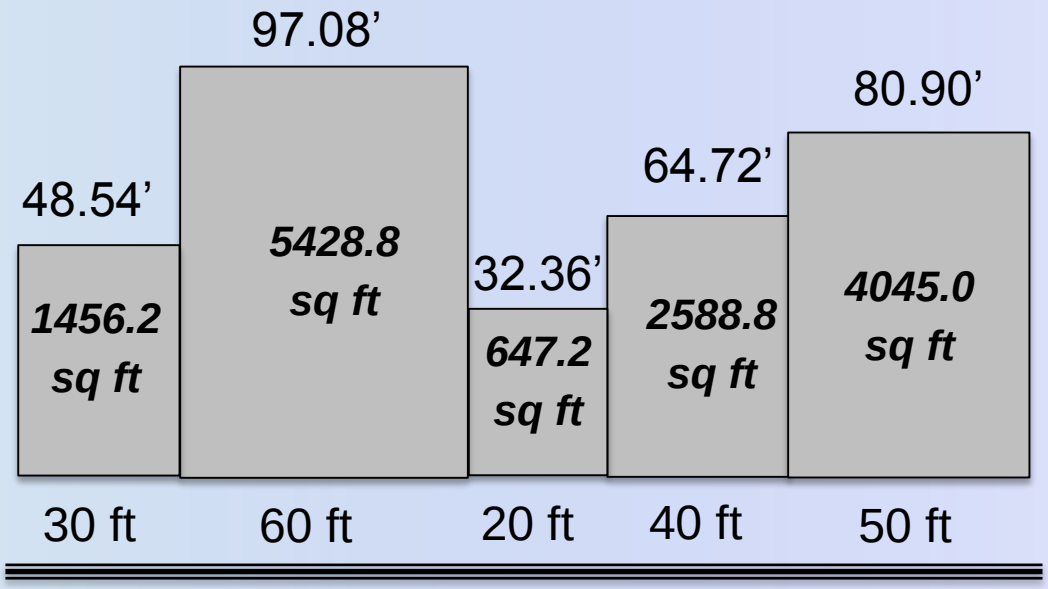
Golden Ratio Design Challenge

Directions

- Design five buildings that fit exactly on a 200-foot city block – choose the dimensions for the rectangular faces of each building such that the ratio of the height to the width is the **Golden Ratio**.
- Include the following:
  - Use five different widths that sum to the block width.
  - The heights should be based on the Golden Ratio.
  - Determine the
    - Area of the face of each building.
    - Total area of all building faces together.
    - Sum of the five building heights.

Golden Ratio Design Challenge

For example



Sum of five heights = 323.60 feet

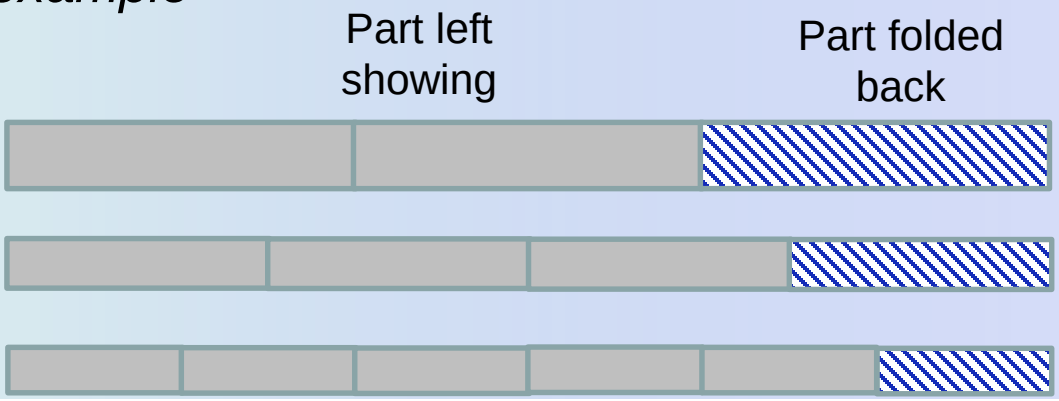
Total area = 14,562.0 sq. ft

Sums of Fraction Strips Less One Unit

Directions for You vs. Partner:

- Randomly pick three strips to put together.
- Fold one unit on each strip underneath (back).
- Determine the sum of the fractions left showing on your strips.
- Who has the greater sum of the fractions showing of their three strips?
- Show visually and numerically.

For example



Consecutive Sums

Find all possible consecutive addition expressions for each sum from 1 to 25 using only positive integers. Three are done for you as examples on the handout.

For example

3 = 1 + 2

9 = 4 + 5 and **9** = 2 + 3 + 4

20 = 2 + 3 + 4 + 5 + 6

Thank you!

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