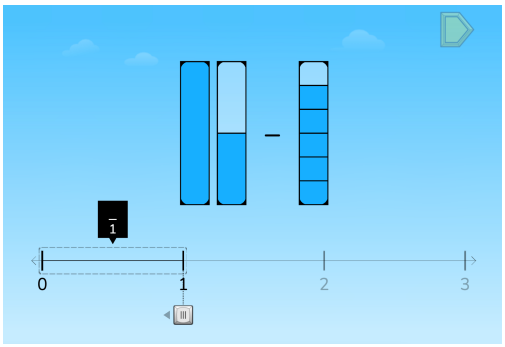
Puzzle Talk Facilitation Guide

This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. ***Pre-work can be given to encourage students to think about the concept prior to the Puzzle Talk.*** *Read the Puzzle Talks Overview to learn more.*

Grade Level: Fifth
Objective: Adding and Subtracting Fractions with Unlike Denominators
Game: Scale Fraction Visual



Teacher Prep

Description

- **Purpose:** Focus on addition and subtraction of fractions using models and plotting the sum or difference on a number line. Use guiding questions for each step in the Problem Solving Process to support student thinking and the development of problem solving skills.
- **Materials Needed:** Provide students with fraction tools (fraction strips, connecting cubes, Cuisenaire rods, etc.), whiteboards, and markers.
- **Puzzle Location:** Grade 5 > Adding and Subtracting Fractions with Unlike Denominators > Scale Fraction Visual > Level 1
- **Duration:** Multiple days
- **Time:** May vary 10 - 20 minutes each session

Look Fors

How does the student:

- use fraction equivalence to help them solve problems?
- break down the mixed numbers to help them add or subtract the numbers?
- model what is happening in the puzzle?
- express their answer? (Do they use a mixed number? fraction?)

Puzzle Progression

Puzzles include a number line that needs to be iterated and fractions and mixed numbers represented with visual models. The fraction models are made up of halves, thirds, fourths, sixths, and eighths. The puzzles progress from two fraction models being added or subtracted to three fraction models being added or subtracted.

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Facilitation Suggestions (This is what a student-led discussion might look like.)

This would occur over multiple days

Notice and Wonder

- Display the first puzzle from Level 1.
- "What do you notice about this puzzle?"
- Allow a few students to share out. Listen for ideas that might include:
  - "There are fraction bars."
  - "The bars are being subtracted."
  - "There is a number line along the bottom of the screen." (Might give the range or how the number line is partitioned.)
- Ask, "What do you wonder about this puzzle?" Allow students to share out. Listen for ideas that might include:
- "What could we click on this puzzle?".

Predict and Justify

- Ask students to think individually about how they could solve the puzzle, then turn and share with a partner before sharing as a class.
- Students should provide mathematical reasoning for the idea they want to try. They can build representations of the puzzle using their fraction tools or sketch on the whiteboard.
- As students share their strategies, list these ideas for the class to consider.

Test and Observe

- Select one of the students' strategies.
- Discuss the size of partitions and denominators as you move the cursor to select how the number line will be partitioned.
- Solve the puzzle and have students describe what happened.

Analyze and Learn

- Pause the animation.
- Ask students how what happened compared to what they thought would happen.
  - If the answer was incorrect, discuss what was learned and what they think is best to try next. Have students share why that is the best way to solve the puzzle.
  - If the answer was correct, how can they take what they learned and apply it to the next puzzle?
- Show the next puzzle and have students discuss their strategies for solving and why with a partner.
- Engage the class in a discussion around why they select a particular denominator to partition the number line. Ask students questions like:

- "What denominator did you use? Why?"
- "Could a different denominator be selected? How could we prove it?"

- Select a student's strategy to try and observe the feedback.
  - You can use the animation controls to pause the puzzle while students check if their answer matches the puzzle on the screen. Discuss how this might provide evidence for why the solution will work - or not work.
- Repeat with additional puzzles in Level 1.

Connect and Extend

Levels 1-2

- Continue with puzzles from Level 1 and have students demonstrate their strategies using whiteboards and fraction tools.
- As you discuss the puzzles ask questions like:
  - "How did you determine how to partition the number line?"
- You can use the animation controls to replay and examine what happens in the puzzle.
  - If the puzzle was correct, discuss why the strategy used was successful.
  - If the puzzle was incorrect, analyze what happened and consider how to adjust the strategy to try again.
    - "What is a number that will be too small? What will happen if we try it?"
    - "What is a number that will be too large? What will happen if we try it?"
- Continue with puzzles from Level 2.
- Have students build a bar model from a puzzle with fraction strips, connecting cubes, blocks, or Cuisenaire rods and use the bar model to represent how they solved the problem.
  - "How did you determine your solution?"
  - "Did you need to convert your fractions to a common denominator?"
  - "How did you find a common denominator?"
  - "Why do fractions need to have a common denominator before we add or subtract them?
- Discuss and record the equations for how students solve the puzzles. (e.g., $1 + 1 + \frac{2}{4} + \frac{1}{4} + \frac{1}{2}$)
- Discuss and record the equations shown in the puzzles.
- Include different ways to write the fractions and mixed numbers.
- Solve the puzzle and have students check their equations and models. Discuss.
- Repeat with additional puzzles from Level 2.

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Additional Ideas for Connecting and Extending this Puzzle

Pose a Problem

- Give students problems that require adding and/or subtracting mixed numbers. Some examples include:
    - Kevin filled 4 glasses with different amounts of water so they would make different sounds when he rubbed his finger along the rim.
        - Glass A held $\frac{5}{8}$ cup of water, glass B held $\frac{3}{4}$ cup of water, glass C held 6 cup of water, glass D held $\frac{2}{6}$ cup of water.
            - How much water did Kevin use?
            - How much water could he put in a fifth glass if he had 3 cups of water?
    - Michael's teacher asked him to solve the problem $\frac{1}{4} + \frac{1}{2}$. Michael added the numerators and added the denominators and got an answer of $\frac{2}{6}$. Is Michael correct? Why or why not?
        - Have students solve the problem and then share their thinking.
        - Discuss why the answer is incorrect. Students might say that $\frac{2}{6}$ is less than $\frac{1}{2}$ so the answer couldn't be correct, etc.
        - Solve the problem together by finding a common denominator.

Model a Puzzle

- Display a puzzle from Level 1 and have students represent the puzzle using a fraction tool, such as fraction strips, Cuisenaire rods or connecting cubes.
- After students have solved the puzzle, ask students to use their bar model from the puzzle to build a number line. Share and compare the number lines students create.
- Discuss the features the number lines have in common.

Students may not understand how to find equivalent fractions.

- Give students whiteboards and dry erase markers. Ask students, "What happens when we multiply a number by 1?" Have students explore a variety of multiplication problems with a factor of 1. Share students' work to prove the Identity Property of Multiplication. Then ask students to draw a picture to represent the following fractions: $\frac{2}{2}$, $\frac{4}{4}$, $\frac{8}{8}$. Ask students, "What do you know about a fraction with the same number for its numerator and denominator?" Share students' work to prove that fraction is equal to 1. Then show students the problem $\frac{2}{3} \times \frac{2}{2}$ and say, "In this problem, we are multiplying $\frac{2}{3}$ by $\frac{2}{2}$. We just

proved that a fraction like 2/2 is equal to 1, so we are multiplying 2/3 by 1. Does multiplying a number by 1 change its value? Why or why not?" Have students solve the problem. Explain to students that $\frac{2}{3}$ and $\frac{4}{6}$ are equivalent fractions. Multiplying $\frac{2}{3}$ by a form of 1 ($\frac{2}{2}$) changes the size and number of equal pieces, but does not change the value of the fraction. Say to students, "Multiplying any fraction by a form of 1 will help you find an equivalent fraction." Have students practice finding equivalent fractions.

Support students who may not understand how to express a mixed number as a fraction.

- Display a puzzle in Level 2. Ask students, "Look at the fractions you see in this puzzle. How many one thirds/fourths/sixths would it take to have 1 whole? How do you know?" Solve the puzzle and look at the fraction together. Say to students, "If it takes __ thirds/fourths/sixths to make 1 whole, how many 1 wholes can we make out of the fraction pieces we have?" Work together to represent this with a whole number. Then ask students, "How many thirds/fourths/sixths are left over?" Write this as a fraction. Put the two numbers together to make a mixed number. Solve other puzzles in Level 2 and repeat.

Puzzle Talk Pre-Work

ST Math
Created by MIND Research Institute

Adding and Subtracting Fractions with Unlike Denominators: Scale Fraction Visual

Name: _____ Date: _____

A fraction with a numerator greater than its denominator (e.g., $\frac{12}{4}$ or $\frac{3}{2}$) is sometimes called an "improper fraction". The word improper means "incorrect". Is it incorrect to write a fraction this way? Why or why not?

What are examples of real life situations where fractions might be expressed as mixed numbers?

Mike was cleaning up after a big birthday party. As he cleaned up the lemonade pitchers, he saw $2\frac{3}{8}$ cups were left in one pitcher, $1\frac{1}{4}$ cups in another, 2 cups in another, and $\frac{2}{8}$ cup in the last pitcher. How many total cups of leftover lemonade does Mike have?