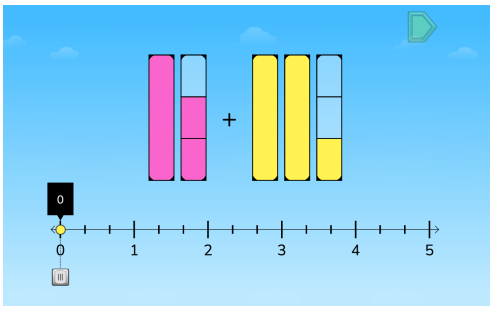
Puzzle Talk Facilitation Process

ST Math
Created by MIND Research Institute

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: Fourth
Objective: Addition and Subtraction with Fractions
Game: Scale Fraction Addition and Subtraction



Teacher Prep

Description

- **Purpose:** Focus on adding and subtracting fractions using models and plotting their 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 (Cuisenaire rods, strips of paper for folding, fraction strips, number line, etc.), whiteboards, and markers.
- **Puzzle Location:** Grade 4 > Addition and Subtraction with Fractions > Scale Fraction Addition and Subtraction > Level 1
- **Duration:** Multiple days
- **Time:** May vary 10 - 20 minutes each session

Look Fors

How does the student:

- explain the fractions they see in the visual model? (Can they see the wholes and parts in the model? On the number line?)
- understand the relationship between the mixed numbers and fractions greater than 1? (Do they understand that 1 ¼ would be ¼ + ¼ + ¼ + ¼ + ¼?)
- represent addition and subtraction on the number line?
- explain the relationship between the visual model representation and the number line representation?

Puzzle Progression

Puzzles include a fraction model and a number line with tick marks. Fractions are made up of mixed numbers with denominators of 2, 3, 4, 5, and 6. Puzzles start with addition and progress to subtraction. The highest levels have a mix of addition and subtraction.

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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.
- Ask, "What do you notice about this puzzle?"
- Allow a few students to share out. Listen for ideas that might include:
  - "There are two sets of bars."
  - "There is an addition symbol between the sets of fraction bars."
  - "There is a number line." (Might also give the range of the number line.)
  - "There is a slider bar at the bottom of the screen."
- 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 use their fraction tools and whiteboard to represent the puzzle.
- List these ideas for the class to consider.

Test and Observe

- Select one of the student's strategies.
- Solve the puzzle and have students describe what happened.

Analyze and Learn

- 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 it and why.
- Select a student's strategy to try and observe the feedback.
- Replay the puzzle, pause the puzzle before JiJi crosses the screen, and ask questions like:
  - "How does the model (bars) relate to the number line?"

- "How could we line up the fraction bars on a number line?"
- "What equation can you write to represent this puzzle?"
- "How can we combine the mixed numbers to find the sum?"

- Repeat with additional puzzles in Level 1.

Connect and Extend

Levels 2-3

- Display the first puzzle in Level 2.
- Have students discuss how to solve it. Select a student's strategy and try it.
- You can use the puzzle 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 big? What will happen if we try it?"
- Continue with additional puzzles from Level 2.
- Display the first puzzle in Level 3.
- Have students discuss how to solve these puzzles.
- Encourage students to write equations to represent the puzzles.
  - "What are some things you need to understand about unit fractions to be able to solve this puzzle?"
  - "Where do you see halves in this problem?"
  - "How did you know where to place the dot on the number line?"
  - Try their strategies and discuss what was observed.
- Display the first puzzle in Level 5 but don't show it to students right away. Instead, read the puzzle to the students and ask them to draw the model that represents the equation (e.g., 2 1/3 – 1 1/3).
- Have students compare their model to their neighbors. Then show the puzzle and have students see if their model matches. Solve the puzzle together. Repeat with other puzzles in Level 5.

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Additional Ideas for Connecting and Extending this Puzzle

Model a Problem

- Give students an Open Number Line Math Mat and give them an addition or subtraction problem with mixed numbers.
- Have students determine how to model the problem on the number line.
- They will have to determine how to iterate the line to model the problem.
- Share student strategies in the whole group.

Pose a Problem

- Pose story problems for students that involve addition or subtraction with mixed numbers. For example:
    - Mary found a recipe for fruit punch. If she mixes 8 1/4 cups of lemon lime soda, 3 2/4 cups pineapple juice and 2 3/4 cups mango juice, how many cups of fruit punch will Mary make? Explain.
- Share student strategies in the whole group.

Support students who may not understand why the denominator stays the same when you add fractions.

- Give students four paper strips and have students leave one strip as the whole, and fold and cut the others into halves, fourths and eighths. Give students an addition problem with the same denominator, such as 2/8 + 3/8. Work together to use the fraction strips to model the problem. Ask students to explain why the answer is 5/8. Discuss what the numerator and denominator represent. Help students to see that the numerator is the counting number and we counted 5 of the 1/8 pieces. The denominator is the cutting number and we cut that strip into 8 pieces, which means each piece is one eighth. The denominator doesn't change because the size of the pieces doesn't change. Repeat with other problems involving addition of fractions with the same denominator. Multiple sets of fraction strips could also be used to show the addition of mixed numbers.

Support students who may not understand how to represent a mixed number as an equivalent fraction.

- Give students whiteboards and dry erase markers. Give students 4 paper strips and have students leave one strip as the whole, and fold and cut the others into halves, fourths and eighths. Ask students, "How many one fourths does it take to equal the whole?" Have students use the fraction strips to prove that 4 one fourths equals 1 whole. Ask students to write down "1 = ¼ + ¼ + ¼ + ¼ ". Do the same with halves and eighths. Ask students,

"How many one fourths does it take to equal 1 2/4?" Model for students that we know 1 is equal to four fourths so 1 2/4 would be

Puzzle Talk Pre-Work

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Addition and Subtraction with Fractions:
Scale Fractions Addition and Subtraction

Name: _____ Date: _____

Owen and Lucas each packed ½ of a candy bar for lunch. Owen's ½ of a candy bar is bigger than Lucas' ½ of a candy bar. How is this possible? Explain.

Name two fractions equivalent to 1/3. How can you prove they are equivalent?

Phoebe invited 2 friends over for dinner. She cut the lasagna she made into 3 equal pieces. When her friends arrived, Phoebe saw that they had brought 3 more friends with them. How could Phoebe cut the lasagna so that all 6 people get an equal amount of lasagna? Explain.