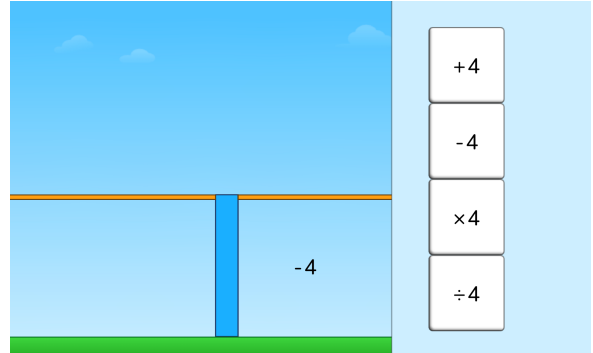


This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. **Pre-work can be given to encourage students to think about the concept prior to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

Grade Level: Eighth

Objective: Solving Two-Step Equations

Game: Inverse Game



Teacher Prep

Description

- **Purpose:** Focus on how to select the inverse operation (or reciprocal) of whole numbers and fractional numbers to bring the visual equation back into balance. 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 whiteboards and markers.
- **Puzzle Location:** Grade 8 > Solving Two-Step Equations > Inverse Game
- **Game in a Minute:** [View video.](#)
- **Duration:** Multiple days
- **Time:** May vary 10 - 20 minutes each session

Look Fors

How does the student:

- select the inverse operation?
- describe their reasoning behind selecting the inverse operation or reciprocal?

Puzzle

Progression

Students will encounter puzzles that include a blue stack with an operation and number next to it and a column of operations and numbers next to it in white boxes. Students must select the inverse operation to balance the equation and allow Jiji to cross. As puzzles progress, students will solve puzzles that involve fractions and their reciprocals.



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 students: "What do you notice?"
- Allow a few students to share out. Listen for ideas that might include the following:
 - "I notice a blue stack with a +2 next to it..."
 - "There are four white boxes with operations and numbers."
- Ask: "What do you wonder about this puzzle?" Allow students to share out. Listen for ideas that might include the following:
 - "What could we click on this puzzle?"
 - "How do we get Jiji across the screen?"

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 whiteboard to represent the puzzle.
- List these ideas for the class to consider.

Test and Observe

- Choose one of the ideas from the class to try. Typically, a teacher might choose an incorrect answer the first time in order to allow for enhanced discussion and exploration of why Jiji was unable to cross the screen.
- Play the puzzle and ask students to observe what happens in the puzzle. *Remember to use the animation control features to replay or stop during points in the feedback to highlight important ideas.*
- Based on what they have learned from the feedback, ask students to choose another idea to try.
- Play the puzzle and ask students to observe what happens in the puzzle, using the animation control features and stopping when appropriate.
- Consider:
 - "What operation do we use to make the stacks equivalent?"
 - For example, students might notice that subtraction is chosen to "undo" addition because they are inverse operations.
 - "What number do you think we should try? Why?"
 - For example, students might notice that when selecting addition or subtraction as the inverse operation, the whole number remains the



same.

- “What will happen if we select one of the other choices? Can you predict what the feedback will show us?”
- 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 will not work.

Analyze and Learn

- Continue with puzzles from Levels 1 and 2.
- Discuss ways to get Jiji across the screen.
 - “Does the operation we choose impact the number that we need to use?”
 - For example, students might notice that when choosing addition or subtraction as the inverse operation, the number remains the same. When choosing multiplication or division as the inverse operation, the reciprocal of the number is used.
 - “How is this puzzle like the puzzle we solved earlier? How is it different?”
- 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.

Connect and Extend

- Continue with puzzles from Levels 2 and 3.
- As you discuss the puzzles, ask questions such as these:
 - “What operations are used in this equation?”
 - “What do you know about these operations?”
 - “What steps could you use to undo the operations used in this puzzle?”
- Ask students to design an *Inverse Game* puzzle and find a partner to solve their puzzle.
- Using calculators, explore equations that involve multiple operations. For example, give a beginning number such as 10. Choose 2 different operations to change 10, such as $10 \times 3 + 2$. Use the calculator to see that the operations have changed the 10 to 32. Explore how to undo the operations used to make the number 10 again. Does the order in which you perform the operations matter?