

Puzzle Talk Facilitation Guide

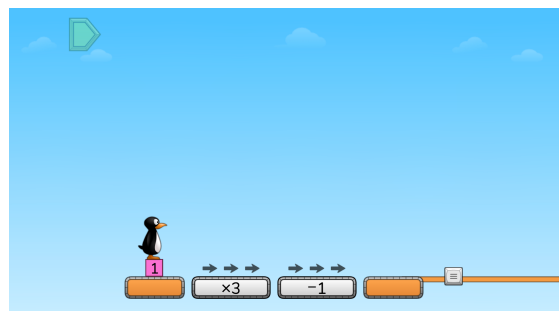


This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. **Pre-work can be given to encourage students to think about the concept prior to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

Grade Level: Eighth

Objective: Function Concepts

Game: Linear Transform



Teacher Prep

Description

- **Purpose:** Identify inputs, outputs, multiplier, and offset for a linear relationship. 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 > Function Concepts > Linear Transform > Level 3
- **Game in a Minute:** [View video](#)
- **Duration:** Multiple days
- **Time:** May vary 10–20 minutes each session

Look Fors

How does the student:

- recognize the multiplier? (*Students might connect multiplier to slope.*)
- recognize the offset? (*Students might connect offset to y-intercept.*)
- identify patterns in tables to determine the multiplier and offset?
- use a variety of representations (such as equations, tables, and graphs) to represent a linear relationship?

Puzzle Progression

Students encounter puzzles where they are given an input and use the functions or rules to determine the output. As students progress through the puzzles, they are given the input and output and need to determine the function. In later levels, an input/output table is presented and students use the functions (multiplier and offset) to determine the output. Finally, students determine the multiplier as well as the offset based on the values given in a table.



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 3. Ask: "What do you notice about this puzzle?"
- Allow a few students to share out. Listen for ideas that might include something like:
 - "Jiji is standing on a block labeled with the number 6."
 - "There are conveyor belts labeled with an operation and a number."
 - "The right side of the screen shows a height of 13."
- 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 could we change from 6 to 13 using the available operations and numbers?"

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 and demonstrate how the operations would affect the beginning number.
- 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 points.*
- 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 happened when we chose the multiplication operation rather than the division operation?"
 - For example, multiplication by a whole number will increase the height of



the block, while division by a whole number will decrease the height of the block.

- “What happened when we chose the addition operation rather than the subtraction operation?”
 - For example, addition of a positive integer will increase the height of the block, while subtraction of a positive integer will decrease the height of the block.
- “Does the order of the operations matter?”
 - For example, does multiplication or division always occur on the first conveyor belt? Why or why not?
- 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.

Analyze and Learn

- Continue with puzzles from Levels 3 and 4. The puzzles in Level 4 use a table.
- Discuss the difference between an input, an output, multiplier, and the offset.
 - “What is happening in this puzzle? How does the multiplier change the block in comparison to how the offset changes the block?”
 - For example, students can examine how the block changes when it is multiplied. Consider the differences in how the block changes when multiplied compared to how the block changes when a constant value is added.
 - “Could we represent this information on a coordinate plane?”
 - For example, once students notice the table used in Level 4, they could graph the input and output to explore the relationship between the values. By connecting the points, students can notice the linear relationship.
- 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

- Continue with puzzles from Level 5. These puzzles require students to determine the multiplier as well as the offset based on the values given in a table.



Extend

- As you discuss the puzzles, ask questions such as these:
 - “How are these puzzles different from the puzzles we’ve solved before?”
 - “How can we use what we have done before to solve this puzzle?”
 - “The equation $y = mx + b$ is often used to describe this relationship. Using this puzzle, what is represented by m ? What is represented by b ?”
- Challenge students to design their own *Linear Transform* puzzle.
- Give students a table, graph, or equation, such as $y = 3x - 5$. Ask them to draw the *Linear Transform* puzzle that would represent the given information.
- Pair students and display a puzzle. One partner writes an equation to represent the given puzzle while the other partner draws a graph. The pair can discuss how both of their representations match the puzzle.