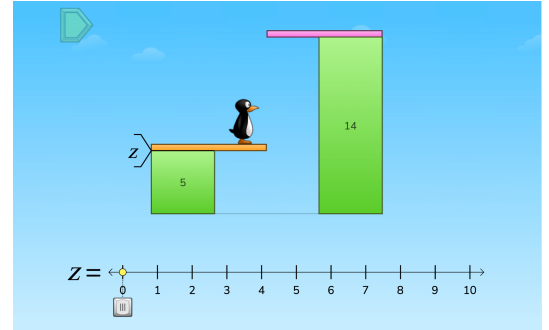


This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. **Pre-work can be given to encourage students to think about the concept prior to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

Grade Level: Sixth

Objective: Solving One-Step Equations (G6)

Game: Variable Stacks



Teacher Prep

Description

- **Purpose:** Focus on the equivalence between two expressions by solving for the missing value. 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 6 > Solving One-Step Equations (G6) > Variable Stacks > Level 1
- **Duration:** Multiple days
- **Time:** May vary 10 - 20 minutes each session

Look Fors

How does the student:

- represent the puzzle with an equation?
- record the steps needed to isolate the variable and solve the equation?
- identify the operations and use their inverse relationship to solve the equation?

Puzzle

Progression

There are five levels in this game. Puzzles include a number line 0 to 10 and two visual models that represent variable stacks. Puzzles begin with adding an unknown and progress to multiplying an unknown and continue to progress to include models representing two-step equations. The two steps include adding and multiplying by $2x$. The highest level uses number cards instead of a number line to select the solution.



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 their thinking with the whole class. Listen for ideas that might include:
 - "Jiji is standing on a stack that says 11."
 - "There is a stack across from Jiji that says 8."
 - "There is a number line at the bottom of the screen." (Might also give the range or describe 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?"
 - "How could we make the stacks the same height?"

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

- Select one of the students' 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.
- Ask students questions like:
 - "In this puzzle, what does the variable represent?"



- “What operation do we use to make the stacks equivalent?”
- Select a student's strategy to try and observe the feedback.
 - You can use the puzzle 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.

Levels 2-3

- Display the first puzzle in Level 2.
- Continue with puzzles from Level 1.
- Discuss different ways to represent and solve the puzzle.
 - “What is an equation that could be used to represent this puzzle?”
 - For example, $11 = 8 + y$.
 - “What operation is used in this equation?”
 - “How can we isolate the variable?”
 - For example, with $11 = 8 + y$, the student might subtract 8 from each side of the equation. Within the puzzle, this could be modeled by thinking about how to remove the same amount from each stack so the stacks are equivalent.
- 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 puzzles from Levels 2 and 3. Level 2 puzzles involve one-step equations with multiplication. Level 3 puzzles introduce 2-step equations involving addition and multiplication.
 - “How are these puzzles different from the puzzles we’ve solved before?”
 - “What mathematics do you see in this puzzle?”
 - “What equation could you write to represent this puzzle?”
 - “How could we isolate the variable?”
 - “What steps could you use to undo the operations used in this puzzle?”

Connect and Extend