

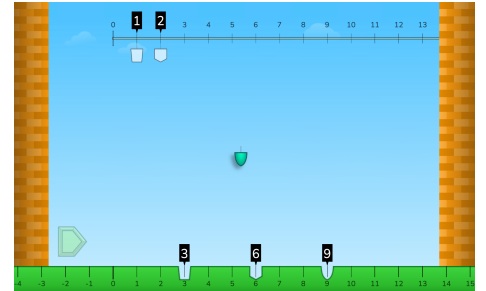


This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. **Pre-work can be given to encourage students to think about the concept prior to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

Grade Level: Seventh

Objective: Proportional Relationships

Game: Ornaments Proportions



Teacher Prep

Description

- **Purpose:** Focus on the connection between unit rates or the constant of proportionality to find equivalent ratios. 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 7 > Proportional Relationships > Ornaments Proportions > Level 2
- **Duration:** Multiple days
- **Time:** May vary 10 - 20 minutes each session

Look Fors

How does the student:

- determine where to place the ornament?
- predict whether the number line will shrink or stretch?
- write rates and identify the constant of proportionality?
- find the equivalent ratio?

Puzzle Progression

Puzzles include six levels. In these puzzles, students must use proportionality to determine equivalent ratios. Level 1 requires students to do this visually. Level 2 introduces numbers. Level 3 adds complexity with only 2 ornaments. At level 3, students may begin to see the ratios. Levels 4-6 increase in difficulty as students are given less information as they begin each puzzle.



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 2.
- Ask students, "What do you notice?"
- Allow a few students to share their thinking with the whole class. Listen for ideas that might include:
 - "There is a number line on the ground and a number line in the sky." (Might also give the ranges of the number lines or how the number lines are partitioned.)
 - "There are highlighted numbers marked on the number line."
 - "For each shape in the ground, there is a matching shape in the sky."
- 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?"
 - "Is there a way we can match the shapes?"

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, such as sketching a number line or writing ratios.
- 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.
- Replay the puzzle and pause the animation. Engage students in a discussion by asking questions like:
 - "How can we match up the shapes with one another?"
 - For example, students might notice that the top number line needs to stretch or shrink in order to line up the ornaments.
 - "Is this the only placement for the ornament?"
- 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.

- Continue with puzzles from Levels 2 and 3.
- Discuss different ways to represent and solve the puzzle.
 - “In this puzzle, can we find a unit rate (which is also known as the constant of proportionality or unit ratio)?”
 - For example, students should check to see if 1 is one of the numbers included in the set. If not, can they find a multiplicative relationship between the numbers to determine the constant of proportionality?
 - “Do the number lines begin as identical to one another? How does the relationship between the number lines change when we shrink or stretch the top number line?”
 - “What rates can you write to represent this puzzle?”
 - For example, do students label the rates with words, such as “top” and “bottom” to indicate the relationship between the number lines? Can students generate a new ornament and determine its placement on 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.

Levels 4-5

- Display a puzzle from Level 4.
- Ask students how this puzzle compares to the ones that you solved in earlier levels. Level 4 puzzles use three ornaments.
- Have students discuss strategies they would use to solve this puzzle and why.
- Select a student's strategy to try. Before trying the strategy, have students describe what they think will happen in the animation and why.
- Play the puzzle and ask students to compare what they thought would happen to what actually happened. Ask, “What did you learn?”
- 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 4 and 5. Level 5 puzzles require students to determine the placement of the ornament on both number lines - leading to an opportunity for a variety of possible answers.
 - “How are these puzzles different from the puzzles we’ve solved before?”
 - “Does this puzzle represent a proportional relationship? How could you prove your thinking?”
 - “How could we determine the constant of proportionality?”
 - For example, using the placement of the same ornament on the two number lines to find the relationship between the numbers and determine the unit rate.