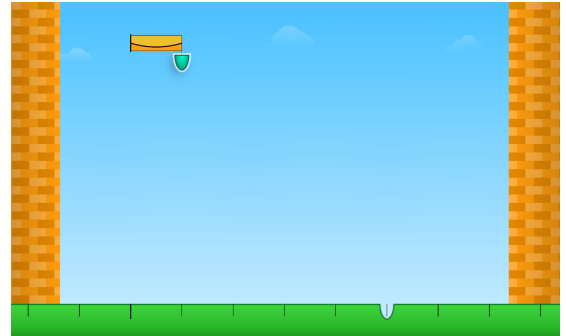


This is a guide to provide support for facilitating student thinking as teachers engage students in academic discourse around math concepts and strategies using ST Math puzzles. This talk can be done over multiple days. **Pre-work can be given to encourage students to think about the concept prior to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

Grade Level: Sixth
Objective: Proportional Reasoning
Game: Kaboomerang!!



Teacher Prep

Description

- **Purpose:** Focus on solving problems involving ratios of quantities and scaling. 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 > Proportional Reasoning > Kaboomerang!! > 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?
- use the number line to help them determine how much to scale the ornaments?
- predict whether the configuration should shrink or stretch?
- find the equivalent scale?
- identify the ratio?

Puzzle Progression

In these puzzles, students must use ratios of quantities and scaling to choose the configuration that matches the one on the ground. Level 1 requires students to do this visually with one set of ornaments. Level 2-3 introduces a second set of ornaments where students have to choose the set that can be scaled correctly. At times, a constant is introduced in the puzzles. Levels 5-6 increase in difficulty as students are given 3 sets of ornaments with and without constants.



Facilitation Suggestions (This is what a student-led discussion might look like.)

This would occur over multiple days

Notice and Wonder

- Display a puzzle from Level 2 that has 2 sets of ornaments.
- 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 are tick marks in the ground, some missing shapes, and 2 sets of ornaments in the sky on a rectangle."
 - "There are two different shapes in the sky and in the ground."
 - "Jiji is holding a boomerang."
- 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?"
 - "What have we seen in other puzzles that we can use here?"
 - "I wonder why Jiji has a boomerang?"

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.
- List these ideas for the class to consider.

Test and Observe

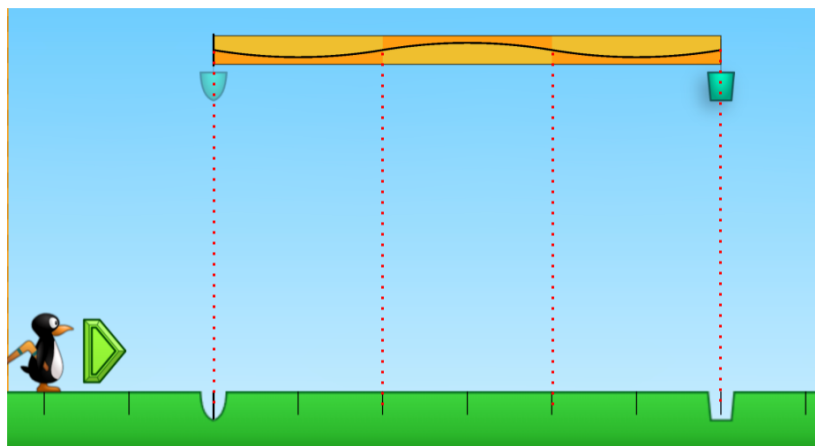
- Select one of the students' strategies.
- Solve the puzzle and have students describe what happened.

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 fill the hole in the ground?"
 - For example, students might notice that the top number line needs to stretch or shrink in order to line up the ornaments and that only one ornament set is used.



- For example, students might notice there is a bolder tick mark that is the starting point.
- 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.
- Ask students - "In this puzzle, can we find a relationship between the length of the orange-yellow bar chosen and the tick marks between the potholes in the number line on the ground?"
 - For example, students should begin to notice that they can use numbers to represent the spacing which can help them write equivalent proportions between the ornament bar sections at the top and the number line tick marks between the potholes.



- Continue with puzzles from Levels 2 and 3.
- Discuss different ways to represent and solve the puzzle.
 - "What do you notice about the spacing of the ornaments? What happens to the spacing when we stretch or shrink the orange-yellow bar?"
 - For example, students should notice that the spacing remains constant as the bar stretches or shrinks.
 - "What do you notice about the orange-yellow bars in relation to the ornaments? Why might this be important?"
 - For example, students should notice the distance in terms of orange-yellow partitions from the start point (bold line) to the first ornament and from the first ornament to the second ornament.
 - For example, students might also notice the order of the ornaments on the bar and the potholes in the ground must match.
 - "In this puzzle, can we find a relationship between the length of the orange-yellow bar chosen and the tick marks between the potholes in the



number line on the ground?”

- For example, students should begin to notice that they can use numbers to represent the spacing which can help them write equivalent proportions between the ornament bar sections at the top and the number line tick marks between the potholes.
- “Do the ornament bars always begin as identical to one another? How does the relationship between the ornament bars and the number line change when we shrink or stretch the ornament bar?”
 - For example, students might see that the bars are the same or not the same but either way, the spacing of the orange-yellow bars is always consistent.
- “How can we express the ornament bars as ratios? How can you represent the relationship between the ornament bars and the number line as a proportion?”
 - For example, do students see the relationship between the sections on the ornament bar and the sections on the number line. 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.

Connect and Extend

Levels 4-6

- 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 3 ornaments, some with fixed 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?”
- 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.
- Continue with puzzles from Levels 4 and 5. These puzzles require students to choose between 3 ornament bars. You may want to call attention to the switch



from using the orange/yellow bars to the line with only tick marks. Students should notice that the bold start line remains aligned to the ground for all options no matter how much the distance among tick marks is stretched. Call out what happens when an ornament moves across the reference point (the order reverses).

- “How are these puzzles different from the puzzles we’ve solved before?”
- “How have the ornament bars changed?”
- “What do you notice about the order of the ornaments as they are flipped over the bold start line?”
- “Does this puzzle represent a proportional relationship? How could you prove your thinking?”
- “How could we determine the unit rate or the ratio?”
 - 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.
- Try puzzles from level 6.
 - Level 6 has instant elimination mode which does not allow students to preview their solution. It does not have a go button. However, If students can consistently solve level 5 puzzles, they’ll be able to do level 6. If students are struggling, they may need to return to level 5.