Notes for the Teacher

Students develop early algebraic reasoning skills by writing and analyzing inequality statements. Students use a scale to compare shapes with unknown values from 1 to 5. Through observing which way the scale tilts when various shapes are placed onto it, students write corresponding statements with "greater than" and "less than" symbols to represent the relationships between the shapes. By using logic to analyze these algebraic statements, students determine the value of each shape.

Objectives:

- Students will use a scale to develop their understanding of inequalities.

- Students will use the greater than and less than symbols to represent comparisons made on a scale.

- Students will write inequalities that use shapes in place of numerical values.

- Students will use logical reasoning to find the unknown values of shapes.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

Common Core State Standards: 6.EE2, 7.EE4

Grade Range: Grades 4–7

Introduce:

Open **Balance**--**Reasoning with Inequalities.gsp** and distribute the worksheet. Use a projector to show sketch page "Puzzle A." Explain to students that each of the five shapes shown has been assigned a secret value of 1, 2, 3, 4, or 5, and that no two shapes have the same value. The value of each shape corresponds to its weight. A shape with value of 3 is heavier than a shape with a value of 1.

Ask, "How can we find the value of each shape?" Give students time to think and then ask volunteers to share their strategies. Students will likely suggest placing shapes on the balance to compare their values.

Suppose that students propose comparing the values of a star and a heart. Ask a volunteer to drag the two shapes onto separate sides of the scale using the **Arrow** tool. Ask, "What information have we learned?" (The heart has a greater value than the star.)

"How do you know that?" (The side of the scale containing the heart tips down. That mean the heart has a greater value.) Draw the following on the board:
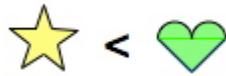
Read the inequality statement to students: "The value of the star *is less than* the value of the heart." Point to the less than symbol and explain or review what it means. Use whatever method your curriculum suggests to help students remember the meaning of the less than symbol.

Press the *Reset* button with the **Arrow** tool. The shapes return to their original positions, leaving the balance empty.

Ask students what to do next. They will likely suggest performing another comparison, such as the circle and the triangle. Have a volunteer drag the shapes to opposite sides of the scale. Ask, "Which shape has a greater value, the circle or the triangle?" (the circle) Draw the following on the board:

Review the meaning of the greater than symbol and how it is read: "The value of the circle *is greater than* the value of the triangle."

Have volunteers come to the computer and test different pairs of shapes. For each comparison, students should write a statement on the board using the greater than and less than symbols to represent the relationship between the shapes. Have students point to each corresponding part of the statement as they read their comparison statement aloud.

Help students apply their logical reasoning skills to figure out the numerical values of the shapes. Encourage students to use shapes and symbols to record the outcomes of the comparisons. For example, students may determine that the following is true:

 and
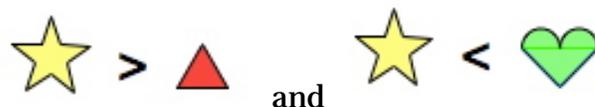
Combining both statements allows student to put the star, triangle, and heart in order. Students might draw the shapes in a column with the shape with the least value on top:

By making other comparisons with the scale, students should be able to place the circle and the square in their proper places relative to the triangle, star, and heart.

Ask students to explain their reasoning as they select shapes to compare and determine the relationships between them. Some sample student steps and remarks for Puzzle A include:

> *If the value of the triangle is less than the value of the star, and the value of the star is less than the value of the heart, then the value of the triangle must be less than the value of the heart.*

> *If we compare the star and the square next, then we can determine whether the value of the square is greater or less than the value of the star.*

> *The value of the square is less than the value of the star. Now we need to find out how the value of the square compares to the value of the triangle.*

> *The value of the square is less than the value of the triangle. That means I can put four of the shapes in order from least to greatest value:*

> *Now we need to compare the circle with another shape. Let's try the triangle.*

> *The value of the circle is greater than the value of the triangle, but we don't know how it compares to the value of the star or the value of the heart. Let's compare the circle and the star.*

> *The value of the star is greater than the value of the circle. So we know the circle goes between the star and the triangle. Our final order of shapes is shown*

below. Since their values are from 1 to 5, this order includes their numerical values:

⬜ = 1

🔺 = 2

🟠 = 3

⭐ = 4

💚 = 5
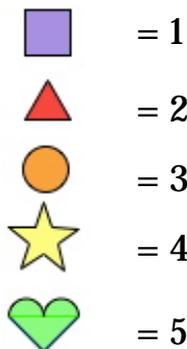
After the solution has been found, tell students that they will work in pairs to solve similar puzzles.

Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Balance--Reasoning with Inequalities.gsp** and go to page "Puzzle B." Be sure students understand how to record their inequality statements and the value of each shape.

Tell students that once they complete Puzzle B, they should move on to pages "Puzzle C" and "Puzzle D." As you circulate, observe students as they work and note the strategies that they use to order the shapes and determine their values. If students seem to be randomly comparing shapes, suggest that they develop a more efficient strategy.

If there is time remaining, have students make up problems for each other to solve on page "Make Your Own." While one student looks away, her partner should assign values from 1 to 5 to each shape, using each value just once. The student should then press *Hide Values*. The puzzle is now ready to be solved. Partners should take turns creating and solving problems for each other.

Discuss:

Call students together to discuss and summarize what they have learned. Open **Balance--Reasoning with Inequalities.gsp** and go to page "Puzzle B." Review the answers for Puzzles B through D.

Answers:

Puzzle B

⭐ = 3   🟪 = 1   🟠 = 5   🔺 = 2   💚 = 4

Puzzle C

⭐ = 1   🟪 = 5   🟠 = 4   🔺 = 3   💚 = 2

Puzzle D

⭐ = 2   🟪 = 3   🟠 = 1   🔺 = 5   💚 = 4

You may wish to have volunteers come up to the computer and share their solutions and their strategies for solving each puzzle. After reviewing the answers, ask students to compare their different strategies for finding the hidden values. Here are some sample strategies:

- *We picked one shape and compared it to each remaining shape. Then we picked another shape and compared it to each remaining shape. We knew we didn't have to compare it to the first shape since we had already compared those two shapes. We continued like this until we had compared all shapes.*

- *We put the shapes into the right sequence one shape at a time. First, we compared two shapes and figured out which was lighter. Then, we tested a third shape to figure out where it belonged in relationship to the first two shapes. We continued this way with the fourth and fifth shapes.*

- *After we ordered the first three shapes, we compared the fourth shape to the lightest of those three shapes. If the fourth shape was lighter, we were really lucky—We knew without making any more comparisons that it was the lightest shape of all!*

- *We used more than one shape on a side of the scale to find relationships. For example, in Puzzle C, we knew that the star was less than the heart, so we*

compared 2 stars to 1 heart. The scale balanced, so we knew that either the star = 1 and the heart = 2, or the star = 2 and the heart = 4. Then we compared 1 star and 1 heart to 1 triangle. Again the scale balanced! So, we knew the star = 1, the heart = 2, and the triangle = 3. Then we used 1 star and 1 triangle to find which shape had a value of 4. It was the circle. That left the square with a value of 5.

Related Activities:

- *Balance—Introducing Symbols and Equality*

- *Balance—Balancing with Powers of Two*

License (CC-BY-NC-SA 3.0)