Notes for the Teacher

Students use a scale to develop early algebraic concepts. They must determine different ways to place shapes with assigned numerical values on one side of a scale to balance with given shapes on the other side. Students develop the understanding that a symbol, such as one of these shapes, has the same value each time it appears, and that an equal sign means "the same as."

Objectives:

- Students will use a balance to develop early algebraic concepts.
- Students will understand that a symbol can represent a number, and if the same symbol is used more than once, it still represents the same number.
- Students will understand that an equal sign means "the same as."
- Students will develop strategies for finding different combinations of shapes to balance a scale.

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, 6

Grade Range: Grades 4–7

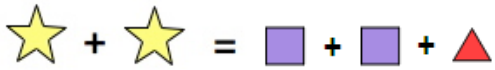
Introduce:

Open **Balance--Introducing Symbols and Equality.gsp** and distribute the worksheet. Use a projector to show sketch page "Balance." Point to the balance on the sketch page. Explain that this balance is used to compare objects. Check for understanding of how a balance works in the real world. Use the **Arrow** tool to drag two stars onto one side of the balance. Ask, "Is the same amount on both sides of the balance?" (No, there is more on the side with the two stars, so it tips lower.) "How do we know when the amount on both sides of the balance is the same?" (The balance is even and doesn't tip to either side.)

Ask, "What shapes can we drag onto the other side to balance the two stars?" There are many possible combinations of shapes students might suggest. As an example, suppose students propose two squares and a triangle. Drag the shapes onto the other side of the

balance and observe that the balance returns to a level position, which proves they are correct.

Say, “We can represent what we see by writing an equation. An equation uses an equal sign to show that the quantities on either side of it have the same value.” Draw the following on the board:



Say, “One star plus one star is the same as, or equal to, two squares plus one triangle.” On the sketch page, identify the value for each shape. Ask, “What is the value of each star? (5) So what does a star plus a star equal?” (10) What is the value of each square? (4) And what is the value of a triangle? (2) So what do two squares plus a triangle equal?” (10)

Write the following on the board beneath the equation:

$$5 + 5 = 4 + 4 + 2$$

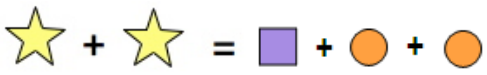
$$10 = 10$$

Now use the **Arrow** tool to drag the two squares and the triangle back to the left side of the divider. Ask, “What other combinations of shapes will make the scales balance with the two stars on one side?” Have volunteers come to the computer and try out different combinations of shapes. When the balance is level again, have students represent their model in two ways:

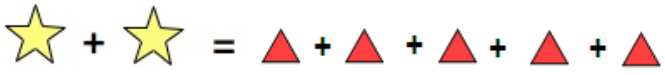
1) By writing an equation using the shapes, and

2) By writing a matching equation using the numerical values for the shapes.

Have students read their equations using the words “is equal to” or “the same as” for the equal sign. Here are some possible solutions:

- 

  5 + 5 = 4 + 3 + 3

- 

  5 + 5 = 2 + 2 + 2 + 2 + 2

- 

  5 + 5 = 5 + 3 + 2

- 

  5 + 5 = 5 + 4 + 1

Show students that they can press the *Reset* button with the **Arrow** tool to clear the balance. After several solutions have been found, stop and tell students that today they will work in pairs to make the scales balance with other given sets of shapes on one side.

Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Balance--Introducing Symbols and Equality.gsp** and go to page "Balance." Be sure students understand how to record their solutions by writing equations using just shapes as well as just the numerical values of the shapes.

As you circulate, observe students as they work. Do students understand that each shape represents a specific value? Do students see that each shape represents that same value every time it appears? When writing equations, do students understand that the equal sign means "the same as"? What strategies are students using to find shapes that balance?

Discuss:

Call students together to discuss and summarize what they have learned. Open **Balance--Introducing Symbols and Equality.gsp** and go to page "Balance." Have volunteers come to the computer and share the different solutions they found. Ask students to discuss the different strategies they used to balance the scale. Here are some sample responses:

- *To balance three triangles, we put three triangles on the other side of the balance. It seemed like cheating, but it worked!*
- *Since each heart is equal to 1, we knew we could find one solution by adding hearts until the scale balanced. But for many of the problems, there weren't enough hearts to use.*
- *We started with the shape with the greatest value (the star) and then added shapes with smaller values until the scale balanced.*
- *We found the total value of the given shapes, and then placed shapes on the other side to match that value. For example, if the given shapes had a total value of 6, we thought of different combinations of shapes that had a total value of 6.*
- *To find a different combination of shapes with the same value, we just replaced one shape with two shapes that had the same total value as that one shape. For*

example, to find combinations of shapes equal to the star plus the square, we replaced the star with a circle and a triangle. So we found that the star plus the square is equal to a circle plus a triangle plus a square.

- *If the sum of the shapes was even, we used triangles to balance them.*

Explore More:

There are several engaging ways to extend this activity:

- Have students create problems similar to those on the worksheet and then share them with their partners to solve. For example, how many ways can students find to balance a scale if a star, a square, a circle, a triangle, and a heart all sit on one side?

- Have students change the numerical values of one or more shapes and then create problems similar to those on the worksheet for their partners to solve. For example, a student might change the values so that star = 20, square = 10, circle = 5, square = 4, and heart = 1 and ask a partner to find as many ways as possible to balance one star.

- Change the numerical values of all the shapes so that star = 6, square = 9, circle = 12, triangle = 18, and heart = 36. Ask students to find as many ways as they can to balance a scale with one heart on one side.

Related Activities:

- *Balance—Balancing with Powers of Two*

- *Balance—Reasoning with Inequalities*

License (CC-BY-NC-SA 3.0)

Portions of this material are based upon work supported by the National Science Foundation under award number DRL-0918733. Any opinions, findings, and conclusions or recommendations expressed in this work are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.