Notes for the Teacher

This activity is the culmination of three balance activities in which students develop intuitive strategies for solving algebraic equations. In the first activity, students solved algebraic equations in which the unknown sat by itself on one side of the equation. In the second activity, students wrote and solved algebraic equations in which they needed to isolate the unknown numerical value. In this final activity, students add one more technique to their algebraic tool kit: simplifying algebraic equations by removing identical shapes from both sides of a scale.

Objectives:

- Students will use a scale to represent algebraic equations.
- Students will develop and use intuitive strategies to write and solve algebraic equations in which there is one unknown value.
- Students will simplify and solve algebraic equations by removing identical shapes from both sides of 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.

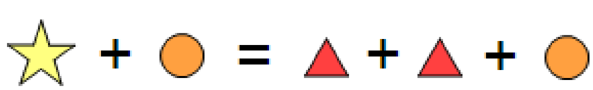
Common Core State Standards: 6.EE2, 4, 5, 6, 7; 7.EE4

Grade Range: Grades 5–7

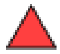
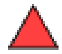
Introduce:

Open **Balance--Solving for Unknowns Part Three.gsp** and distribute the worksheet. Use a projector to show sketch page “Puzzle A.” Point out the numerical values of the star and the circle. Ask, “How can we find the value of the triangle?” If students have worked on the previous Solving for Unknowns activities, they may suggest writing an equation to represent the shapes on the scale and then substituting the known values of the star and the circle. Work through this solution with the class.

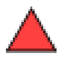
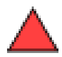
Ask, “What equation can we write to represent the balance scale?” Write the equation on the board as students describe it:

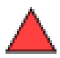
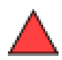


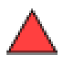
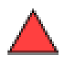
Ask, “What values do we know?” (star = 10, circle = 15) “What does the equation look like if we substitute the known values for these shapes?”

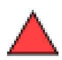
10 + 15 =  +  + 15

“How can we find the value of the triangle?” Work through the solution with the class. Have students explain how they determined the value of the triangle. One solution method is shown below:

10 + 15 =  +  + 15

25 =  +  + 15

10 =  + 

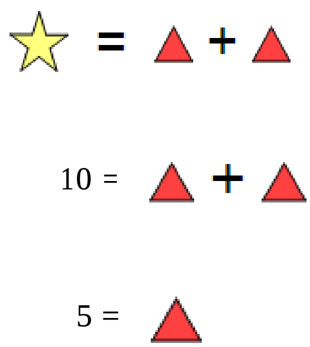
5 = 

Other student solutions may include the following:

- *I found the total value on the left, 25. Then I added on from the known value on the right, 15, to reach 25. I found 15 + 10 = 25. Since I knew the amount I added on, 10, was the value of 2 triangles, I divided 10 by 2 to get 5 for the value of each triangle.*
- *I subtracted the total known value of the shapes on the right, 15, from the total value on the left, 25, to get 10. Then, since there were 2 triangles on the right, I divided 10 by 2 to get 5. That gave me the value of 1 triangle.*

Press the *Show Triangle* button with the **Arrow** tool to check the value of the triangle. (triangle = 5)

Now work through a different solution method with the class. Say, “Notice there is one circle on each side of the balance scale. What do you predict will happen if I remove a circle from the left side of the scale?” (The scale will tilt to the right.) Drag a circle from the left side of the scale with the **Arrow** tool, placing it to the left of the vertical divider. Ask, “How can I make the scale balance again?” (Remove a circle from the right side of the scale.) Drag a circle from the right side of the scale and place it to the left of the vertical divider. Ask, “Why is the scale balanced again?” (We removed the same amount from both sides.) “What equation can we write for the scale now?”



Ask, “Which method made it easier to solve for the value of the triangle?” Students will likely say that the second method was easier because the calculations were simpler.

Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Balance--Solving for Unknowns Part Three.gsp** and go to page “Puzzle B.” Be sure students understand how to write an equation using the shapes (in worksheet language, a “shape equation”) and then substituting the known values to solve for the unknown value (a “value equation”).

Tell students they should solve Puzzles B–F. As you circulate, observe students as they work. If you see students writing and solving equations that represent the scale as it is initially shown, ask students if there is an easier method. Ask, “Are any shapes common to both sides of the scale? What can you do with these shapes and still have the scale stay level?” Help students understand that if they take the same number of the same shape off of both sides of the scale, and the scale will balance. By eliminating shapes in this way, the equations students write will be easier to solve.

If there is time, have students go to page “Make Your Own” and make their own puzzle for their partners to solve. Review the steps on the worksheet to be sure students understand how to create a puzzle.

Discuss:

Call students together to discuss and summarize what they have learned. Open **Balance--Solving for Unknowns Part Three.gsp** and go to page “Puzzle B.” Have volunteers come to the computer and share their solution methods. Continue through Puzzles C–F. Ask students to discuss the different strategies they developed to find the unknown values. Some student strategies may include the following:

- *For Puzzle B, we took a square and a star off both sides of the balance. The heart remained on the left and the circle remained on the right, so our equation was heart = circle, or 22 = circle. It was easy to find the value of the circle.*

- *For Puzzle C, we took 2 hearts off each side of the balance. We were left with 1 heart on the left and 3 stars on the right. The value of each star was 10. So, our equation was 1 heart = 3 × 10, or 1 heart = 30.*

- *For Puzzle D, we were able to take 1 triangle, 1 circle, 1 square, and 1 heart from each side of the balance. That left us with 4 triangles = 2 stars. We thought that was the same as 2 triangles = 1 star. Since the star = 6, one triangle = 3 because 3 + 3 = 6.*

- *For Puzzle E, we took 1 circle and 1 star from each side of the balance. That left us with 4 stars = 4 circles. The value of the star was 152! We realized that a circle must be the same value as a star since there are 4 of each. So, 1 circle = 152.*

- *For Puzzle F, we were only able to take 1 square from each side of the balance. That left 2 squares + 1 star = 1 heart. When we substituted the known values, we got 2 squares + 24 = 42. We subtracted 24 from both sides and got 2 squares = 18. Then we divided both sides by 2 to get 1 square = 9. It was a lot of steps to find the value of one square, but there would've been more if we hadn't taken the squares off first.*

If there is time, have students share the puzzles they created on the "Make Your Own" page and have volunteers solve them at the computer.

Related Activities:

- *Balance—Solving for Unknowns, Part One*
- *Balance—Solving for Unknowns, Part Two*
- *Sneaky Sums—Unknowns in a Grid*
- *Mystery Sums, Part One—Deduce the Unknown Addends*
- *Mystery Sums, Part Two—Deduce the Unknown Addends*
- *Mystery Sums, Part Three—Dancing Addends*

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