Math Objectives

- Students will describe what it means to solve a **linear equation**.
- Students will recognize how to maintain the equality between two expressions when adding or taking away tiles

Vocabulary

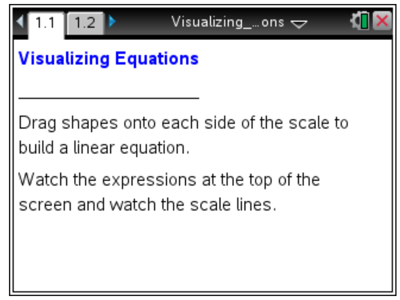
- Linear Equations

About the Lesson

- This lesson is intended to develop and deepen student understanding of solving linear equations by maintaining the balance of the relationship—what you do to one side, you do to the other.
- This lesson involves using tiles to represent expressions and equations that involve one variable. Students will move tiles representing x and $-x$ and 1 and –1 to form equations.
- As a result, students will...
  - see how the expressions in the equation are changed and how the balance between the expressions is affected as tiles are added or removed.

TI-Nspire™ Navigator™ System

- Send the .tns file to students.
- Use the Teacher Edition Software or Live Presenter to show students how to move the rectangles from the bottom of the screen to the left or right sides.
- Use Quick Poll questions to adjust the pace of the lesson according to student understanding.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag an object

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.

Lesson Materials:

Student Activity

- Visualizing_Equations_Student.pdf
- Visualizing_Equations_Student.doc

TI-Nspire document

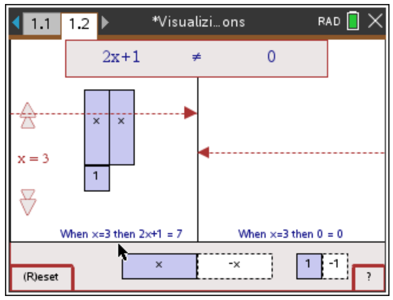
- Visualizing_Equations_.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

> **Tech Tip:** If students experience difficulty dragging a tile, check to make sure that they have moved the cursor (arrow) to the middle of the tile. The cursor should become a hand ( ) getting ready to grab the tile. Press to grab the tile and the hand will close ( ). Drag the tile. After the tile has been moved, press again to release the tile.
>
> **Tech Tip:** The student should click on the question mark on the bottom right of the screen to see directions again:

Move to page 1.2.



1. a. Drag two x tiles and one 1 tile to the left side, and describe the changes that occur on the screen.

   <u>Answer:</u> (The balance line rises on the left side. The expression on the left side changes from 0 to x to $2x$ to $2x + 1$. This could be built in a different order depending on the order in which the tiles were moved onto the scale. The line at the top says "$2x + 1 \neq 0$."

   b. What expression is represented on the left side?

   <u>Answer:</u> $2x + 1$

   > **Teacher Tip:** Teachers might ask students whether the order in which the tiles are dragged would affect the resulting expression.

   c. Place tiles on the right side to make it match the left side. How can you tell that the scale is balanced?

   <u>Answer:</u> The balance lines are the same height on both sides, and the line at the top displays $2x + 1 = 2x + 1$.

TI-Nspire Navigator Opportunities
Use a True/False Quick Poll to gather students predictions about what will happen to the scale when two 1s are added to each side of the scale. For example: When two 1s are added to both sides, the scale will be balanced.

A. True B. False

Repeat for other questions such as Question 3 and Question 4 part b.

2. a. Describe what happens when you add two $\boxed{1}$ tiles to the left side and add two $\boxed{1}$ tiles to the right side.

Answer: There is a new expression on each side, and the scales are still balanced.

b. What is the new expression on the left side?

Answer: Left side: $2x + 3$

c. What is the new expression on the right side?

Answer: Right side: $2x + 3$

3. Describe what happens when you remove one $\boxed{1}$ from either side of the equation.

Answer: The scale is not balanced, and the expressions on the two sides are different.

> **Teacher Tip:** Monitor students' answers to be sure that they understand the balance scale and the effect of adding the same value to each side of the scale before they continue with the activity.

> **Teacher Tip:** As a result of Questions 1 – 3, students should know how to move positive tiles to get the desired results and recognize that the expression and scale lines are changing. In addition, students should note that the expressions change to represent the number of tiles on each side and that the scale is not balanced unless exactly the same set of x or $-x$ tiles and 1 or –1 tiles are on both sides.

4. Press $\boxed{\text{R}}$ or click **(R)eset** in the lower left corner of the screen to reset the page.

a. Place one $\boxed{x}$ tile on the left side. What is the expression on the left side?

Answer: x

b. Drag one $\boxed{-x}$ tile to the left side. What happens as a result?

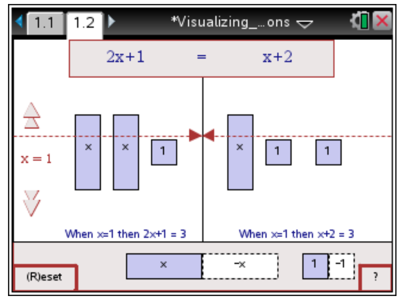
Answer: This balances the scale, and the expression becomes 0.

c. Why does this happen?

Answer: The sum of the two tiles is 0; they are additive inverses of each other.

> **Teacher Tip:** Teachers might want to remind students of the Additive Inverse Property—the sum of a number and its opposite is 0.

5. Press the Reset box. Drag two $\boxed{x}$ tiles and one $\boxed{1}$ tile to the left side and one $\boxed{x}$ tile and two $\boxed{1}$ tiles to the right side. The tiles should represent 2*x* + 1 on the left side and *x* + 2 on the right side.



a. Press the up and down arrows on the left side and describe what happens.

Answer: The heights of the dotted line segments of the balance change.

b. Press the up and down arrows until the two sides are balanced.

Then, add or remove tiles to get one $\boxed{x}$ alone on the left side. Be sure to keep the scale balanced. Describe the approach you used, and explain why you used those moves.

Sample Answer: I removed an *x* tile from both sides so that the scale would remain balanced; then I removed a 1 tile from both sides so that the scale would remain balanced.

> **Tech Tip:** In 5b, clicking the arrows changes the value of *x* on a horizontal number line where the scale is balanced for the given equation. Clicking the outer part of the change the value of *x* by 1, while the inside part changes the value of *x* by 0.1.

TI-Nspire Navigator Opportunities

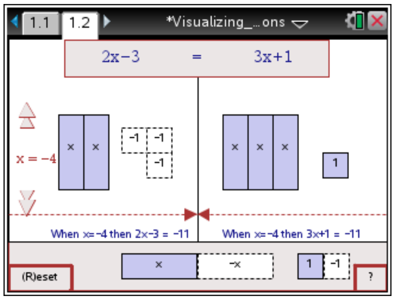
Choose one student to be the Live Presenter. Have them show how they can balance the scale. Discuss with students if there are other possible values for *x* to balance the scale when clicking the arrows. (No)

c. What is the final answer? *x* =

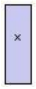
Answer: *x* = 1

6. Renee and Tameka are using tiles to solve the balanced equation 2*x* – 3 = 7. Renee plans to add 3 to the left side as her first step. Tameka plans to add 3 to both sides for her first step.
Who is correct? Explain your reasoning.

Answer: Tameka is correct. In order to keep the equation balanced you must add the same number to both sides of the equation.

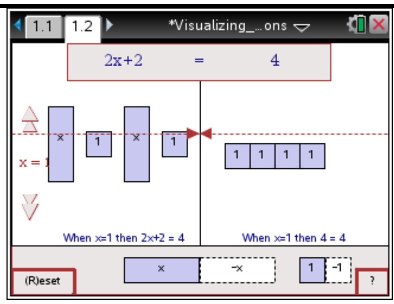


7. Click the Reset box. Then place tiles on the screen to represent $2x - 3$ and $3x + 1$. Press the arrows until the two sides are balanced.

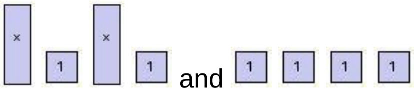
   Add or remove tiles to get one  alone on one side and keep the scale balanced. What did you move, and what is the final answer?

   Possible answer: I removed 2-x tiles from both sides; I then added a negative 1 tile and a positive 1 tile to the left side; I then removed a positive 1 tile from both sides. One x tile is balanced by four negative 1 tiles.
   $x = -4$

TI-Nspire Navigator Opportunities
After students have solved the equation for the value of x, use Screen Capture or Quick Poll to see what value each student got. Discuss any discrepancies.

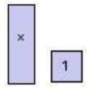
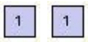


8. Click the Reset box on the bottom left corner of the screen. On one side of the scale, Tameka had two sets of $x + 1$ and on the other side four ones. Move tiles so that your screen is set up the same way.

   a. Write the equation she was solving in two different ways. Use the tiles and the scale to explain how you know you have a correct representation.

      Answer: $2x + 2 = 4$; $2(x+1) = 4$; $x + 1 + x + 1 = 1 + 1 + 1 + 1$ or another equivalent form. These are correct because two xs and two ones are the same as 2 sets of $x + 1$. The other forms just express the xs and the 1s in different arrangements.

   b. Her first step was to divide each side into two equal groups. Next, she decided to remove one group from each side. She removed  from one side and  from the other. What do you think about her strategy?

      Answer: She would have a correct strategy because she really divided both sides of the equation by two. One form of the equation is $2(x + 1) = 2(2)$. Dividing each side of the equation by two keeps the equation balanced.

Teacher Tip: Be careful that students don't become confused by apparently removing $x + 1$ from the left side and 2 from the right side. As they should observe from looking at the tiles and one of the representations ($x + 1 + x + 1 = 1 + 1 + 1 + 1$), the value of x must be equal to 1.

Wrap Up

Upon completion of this activity, the teacher should insure that students are able to:

- Solve simple linear equations.
- Regroup expressions in different ways corresponding to different algebraic representations.
- Recognize that when solving linear equations, whatever is done to one side must be done to the other.