Math Objectives

- Students will identify expressions that balance an equation.
- Students will find values that satisfy integer equalities.
- Students will recognize and use the additive inverse property.
- Students will use appropriate tools strategically (CCSS Mathematical Practice).

Vocabulary

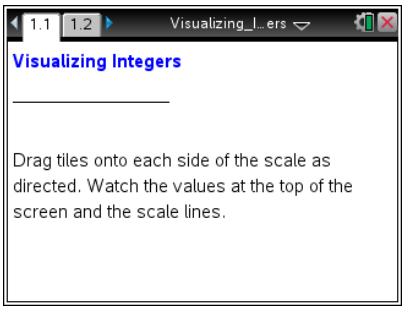
- equation
- additive inverse property

About the Lesson

- This activity is intended to develop student understanding of the additive inverse property through simple integer equalities.
- As a result, students will:
  - Move integer algebra tiles on a balance-scale and observe the changes in the balance-scale.
  - Observe changes in the total numerical value of each side of the equation and how those changes affect the balance.

TI-Nspire™ Navigator™ System

- Use Quick Poll to check student understanding.
- Use Screen Capture to examine patterns that emerge.
- Use Live Presenter to engage and focus students.



TI-Nspire™ Technology Skills:

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

Tech Tips:

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

Lesson Materials:

Student Activity

Visualizing_Integers_Student.pdf

Visualizing_Integers_Student.doc

TI-Nspire document

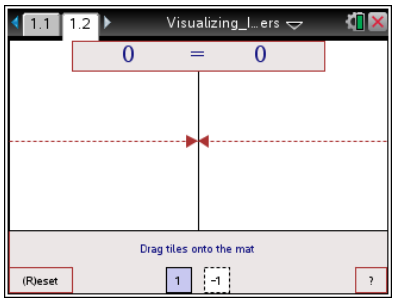
Visualizing_Integers.tns

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 close to the point on the upper left corner of the tile. The arrow should become a hand (☜) getting ready to grab the point. Also, have them make sure the word point appears. They are then to press ctrl ☜ to grab the point. Tell them the hand will close. After the tile has been moved, they press ☜ to release the tile.

Move to page 1.2.



1. Move two [1] tiles to the left side of the platform on the balance-scale. Describe the changes that you observe.

   Answer: As each [1] tile is placed on the left platform, the number at the top left of the screen increases by 1, and the horizontal line on the left rises. The balance-scale is no longer level. The top line displays $2 \neq 0$.

2. Move one [-1] tile to the right side. Describe the changes that you observe.

   Answer: As [-1] is placed on the right platform, the number at the top right of the screen decreases by 1, and the horizontal line on the right becomes lower. The difference between the left side and the right side increases. The top line displays $2 \neq -1$.

3. How do you know from the balance-scale that the values are unequal?

   Answer: The values are unequal because the balance-scale is not level. The horizontal line on the left is higher than the horizontal line on the right. The top line displays $2 \neq -1$.

4. What tiles can you add to balance the scale? Illustrate or describe your strategies to support your answer.

   Answer: Answers will vary. Possible responses are: Add three [1] tiles to the right,; add three [-1] tiles to the left,; add two [-1] tiles to the left and one [1] tile to the right,; add one [-1] tile to the left and two [1] tiles to the right.

TI-Nspire Navigator Opportunities

Take a screen capture and show students all the different possible answers to question 4. You may also elect to have one student to be the Live Presenter and show how he/she accomplishes this.

Click on the Reset box at the bottom left of page 1.2 to reset all tiles to a position below the platform.

Teacher Tip: The slider at the bottom of page 1.2 has been provided to set all tiles back to their start position. Students need only click on the slider to activate it.

5. What value makes the statement –1 + _?_ = 1 true? Move tiles to represent this number sentence. Then explain how the balance-scale confirms that it is true.

   Answer: The number 2 makes the statement true. When one -1 tile and two 1 tiles are moved to the left platform and one 1 tile is moved to the right platform, the balance-scale is level and the top line displays 1 = 1.

   Teacher Tip: You might want to introduce students to the word *satisfy* in its mathematical sense by stating that "2 satisfies the equation because it makes the sentence true."

6. What value makes the statement –1 + _?_ = –3 true? Move tiles to represent this number sentence. Then explain how the balance-scale confirms that it is true.

   Answer: The number –2 will make the statement true. When one -1 tile and two -1 tiles are moved to the left platform and three -1 tiles are added the right platform, the balance-scale is level.

   Teacher Tip: You might note that the expressions –1 + –2 and –1 – 2 have the same numerical value. You might want to introduce a definition of *subtraction* as "adding the opposite."

Click on the reset box at the bottom left of page 1.2 to reset all tiles to a position below the platform.

7. In how many ways can you use four tiles to make a true statement? Write each of the possible number sentences represented by your tiles.

Answer: Six true statements can be made. Each can also be reversed.

1 + 1 = 1 + 1
–1 + –1 = –1 + –1
–1 + 1 = –1 + 1
–1 + –1 + 1 = –1
1 + 1 + –1 = 1
1 + 1 + –1 + –1 = 0

Teacher Tip: Have students see whether –1 + 1 = 0 is equivalent to 0 = –1 + 1. Remind them of the Symmetry Property of Equality. Do the same with 1 + –1 = 0 and –1 + 1 = 0 using the Commutative Property. Use these equivalent relations to dispel the myth that the variable to be solved is always on the left.

TI-Nspire Navigator Opportunities

Take a screen capture and show students all the different possible answers to question 7.

8. Using what you learned in questions 1 through 7, fill in the blank with the value that makes each of the following true.

Answer:

a. –2 + **2** = 0 b. 3 + **–3** = 0 c. 38 + –20 + **–18** = 0

Teacher Tip: You might want to define the Additive Inverse Property and discuss these statements using the word *opposites.* If you want to use terminology specific to algebra tiles, you can introduce the term “zero-pair.”

9. Use six tiles on one side of the scale to make a true statement. Describe your reasoning. Then draw a sketch of the model that you created.

   Answer: The only possible response is –3 + 3 = 0, though this equation may be rewritten using the Symmetry Property of Equality or the Commutative Property. Since all six tiles must be on one side of the equation, half must be positive and half must be negative. This is the only way a sum of zero can be achieved.

10. Is it possible to balance the scale using five tiles? Justify your answer.

    Answer: It is not possible to balance the scale using five tiles because one tile will always be "left over." Specifically, two additive inverses can be created on either side of the equation, but one 1 tile or one -1 tile will always remain. As a result of the additive inverse, it is always possible to make a balanced scale using an even number of tiles. By the same logic, it is never possible to make a balanced scale using an odd number of tiles.

TI-Nspire Navigator Opportunities

Use the Yes/No option of Quick Poll to collect the answers to question 10. Then ask a student to explain his or her answer.

Wrap Up:

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

- Understand what operations maintain the balance in an equation.
- Describe what it means for a value to satisfy an equation.
- Find values that satisfy integer equalities.
- Use the Additive Inverse Property and/or the concept of "opposites" in combining integers.