Lesson 1: Positive and Negative Numbers on the Number Line—Opposite Direction and Value

Student Outcomes

- Students extend their understanding of the number line, which includes zero and numbers to the right, that are above zero, and numbers to the left, that are below zero.
- Students use positive integers to locate negative integers, moving in the opposite direction from zero.
- Students understand that the set of integers includes the set of positive whole numbers and their opposites, as well as zero. They also understand that zero is its own opposite.

Classwork

Opening Exercise (3 minutes): Number Line Review

Display two number lines (horizontal and vertical), each numbered 0–10. Allow students to discuss the following questions in cooperative learning groups of 3 or 4 students each.

Students should remain in the groups for the entire lesson.

Questions to Discuss:

- What is the starting position on both number lines?
  - 0 *(zero)*
- What is the last whole number depicted on both number lines?
  - 10 *(ten)*
- On a horizontal number line, do the numbers increase or decrease as you move further to the right of zero?
  - *Increase.*
- On a vertical number line, do the numbers increase or decrease as you move further above zero?
  - *Increase.*

Scaffolding:

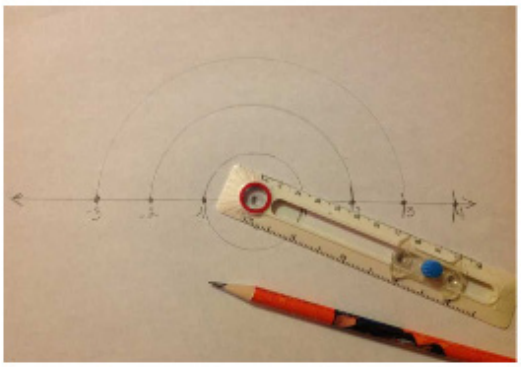
- Create two floor models for vertical and horizontal number lines using painter's tape for visual learners.
- Have a student model movement along each number line for kinesthetic learners.
- Use polling software for questions to gain immediate feedback while accessing prior knowledge.

Exploratory Challenge (10 minutes): Constructing the Number Line

The purpose of this activity is to let students construct the number line (positive and negative numbers and zero) using a compass.

- Have students draw a line, place a point on the line, and label it 0.
- Have students use the compass to locate and label the next point 1 thus creating the scale. Students will continue to locate other whole numbers to the right of zero using the same unit measure.
- Using the same process, have students locate the opposites of the whole numbers. Have students label the first point to the left of zero, -1.

- Introduce to the class the definition of the *opposite* of a number.
  - *Sample Student Work*



Given a nonzero number, a, on a number line, the opposite of a, labeled $-a$, is the number such that:

- 0 is between a and $-a$.
- The distance between 0 and a is equal to the distance between 0 and $-a$.

The opposite of 0 is 0.

- The set of whole numbers and their opposites, including zero, are called *integers.* Zero is its own opposite. The number line diagram shows integers listed in order from least to greatest using equal spaces.

MP.6 Monitor student constructions, making sure students are paying close attention to the direction and sign of a number.

Example 1 (5 minutes): Negative Numbers on the Number Line

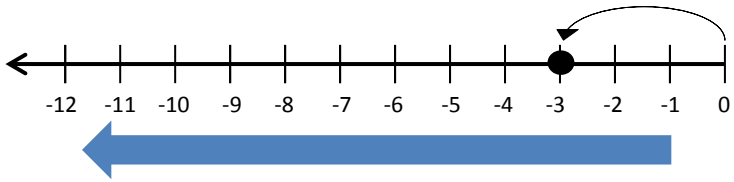
Students will use their constructions to model the location of a number relative to zero by using a curved arrow starting at zero and pointing away from zero towards the number. Pose questions to the students as a whole group, one question at a time.

Starting at 0, as I move to the right on a horizontal number line, the values get larger. These numbers are called positive numbers because they are greater than zero. Notice the arrow is pointing to the right to show a positive direction.

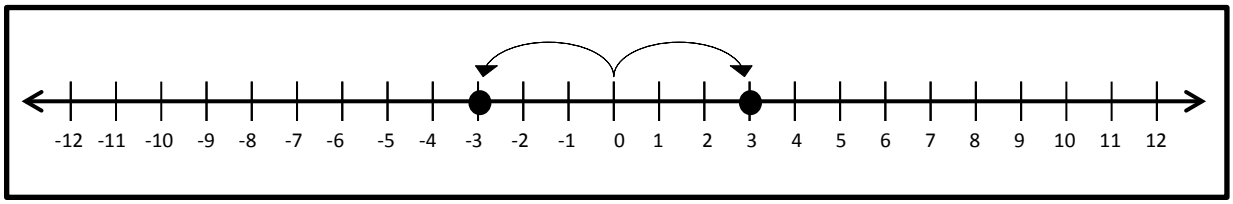
- How far is the number from zero on the number line?
  - 3 *units*
- If 0 was a mirror facing towards the arrow, what would be the direction of the arrow in the mirror?
  - *To the left.*

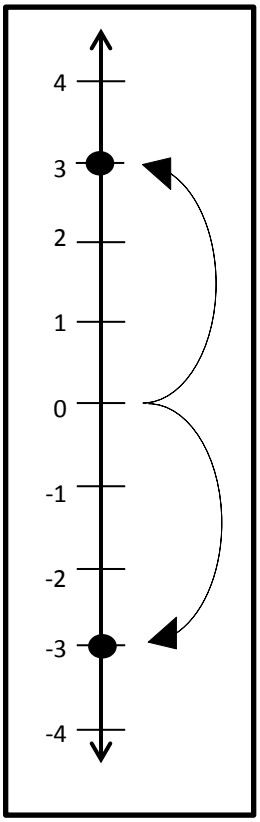
- Would the numbers get larger or smaller as we move to the left of zero?
  - *Smaller.*

Starting at 0, as I move further to the left of zero on a horizontal number line, the values get smaller. These numbers are called negative numbers because they are less than zero. Notice the curved arrow is pointing to the left to show a negative direction. The position of the point is now, negative 3, written as -3.



- Negative numbers are less than zero. As you look to the left, the values of the numbers decrease.





- What is the relationship between 3 and -3 on the number line?
  - *3 and -3 are located on opposite sides of zero. They are both the same distance from zero. 3 and -3 are called opposites.*
- As we look further right on the number line, the values of the numbers increase. For example, $-1 < 0 < 1 < 2 < 3$.
- This is also true for a vertical number line. On a vertical number line, positive numbers are located above zero. As we look upward on a vertical number line, the values of the numbers increase. On a vertical number line, negative numbers are located below zero. As we look further down on a vertical number line, the values of the numbers decrease.
- The set of whole numbers and their opposites, including zero, are called integers. Zero is its own opposite. A number line diagram shows integers listed in increasing order from left to right using equal spaces. For example: $-4, -3, -2, -1, 0, 1, 2, 3, 4$.
- Allow students to discuss the example in their groups to solidify their understanding of positive and negative numbers.

Possible discussion questions:

- Where are negative numbers located on a horizontal number line?
- Where are negative numbers located on a vertical number line?
- What is the opposite of 2?
- What is the opposite of 0?
- Describe the relationship between 10 and -10.

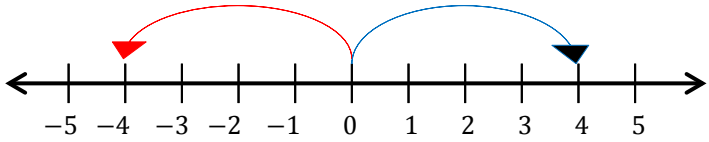
Example 2 (5 minutes): Using Positive Integers to Locate Negative Integers on the Number Line

Have students establish elbow partners and tell them to move their finger along their number lines to answer the following set of questions. Students can discuss answers with their elbow partners. The teacher circulates around the room and listens to the student-partner discussions.

- Describe to your elbow partner how to find 4 on a number line. Describe how to find -4.
  - *To find 4, start at zero and move right to 4. To find -4, start at zero and move left to -4.*

Model how the location of a positive integer can be used to locate a negative integer by moving in the opposite direction.

- Explain and show how to find 4 and the opposite of 4 on a number line.
  - *Start at zero and move 4 units to the right to locate 4 on the number line. To locate -4, start at zero and move 4 units to the left on the number line.*
- Where do you start when locating an integer on the number line?



  - *Always start at zero.*
- What do you notice about the curved arrows that represent the location of 4 and -4?
  - *They are pointing in opposite directions.*

Scaffolding:

- As an extension activity, have students identify the *unit* differently on different number lines, and ask students to locate two whole numbers other than 1 and their opposites.

Exercises 1–6 (13 minutes)

The teacher will create and display one large horizontal and vertical number line on the board, numbered -12 to 12, for the class. Distribute an index card with an integer on it to each group.[1] Students will work in groups first, completing the exercises in their student materials. Conclude the exercise by having students locate and label their integers on the displayed teacher's number lines.

Exercises 1–6

1. Complete the diagrams. Count by 1'*s* to label the number lines.

2. Plot your point on both number lines.

(Answers may vary.) -4

[1] Depending on the class size, label enough index cards for ten groups (one card per group). Vary the numbers using positives and negatives, such as -5 through 5, including zero. If each group finds and locates the integer correctly, each group will have a card that is the opposite of another group's card.

3. **Show and explain how to find the opposite of your number on both number lines.**

   I found my point by starting at zero and counting four units to the right to end on 4. Then I started on 0 and moved to the left four units to end on −4.

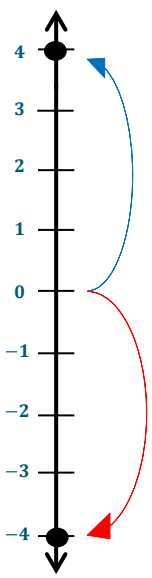
4. **Mark the opposite on both number lines.**

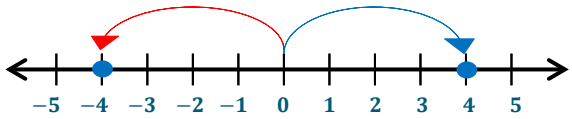
   (Answers may vary.) −4

5. **Choose a group representative to place the opposite number on the class number lines.**

6. **Which group had the opposite of the number on your index card?**

   (Answers may vary.) Jackie's group. They had −4.





Closing (2 minutes)

Give an example of two opposite numbers and describe their locations on a horizontal and vertical number line.

- 6 and −6 are the same distance from zero but on opposite sides. Positive 6 is located 6 units to the right of zero on a horizontal number line and 6 units above zero on a vertical number line. Negative 6 is located 6 units to the left of zero on a horizontal number line and 6 units below zero on a vertical number line.

Exit Ticket (7 minutes)

Name _____ Date_____

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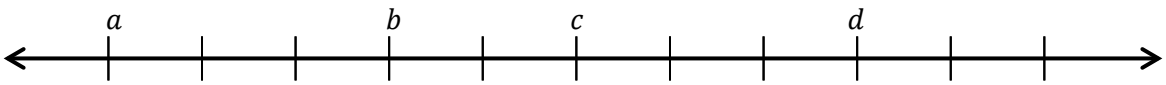
Exit Ticket

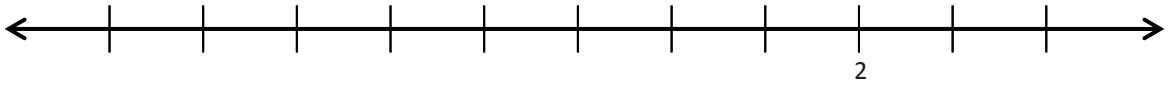
1. If zero lies between a and d, give one set of possible values for a, b, c, and d.



2. Below is a list of numbers in order from least to greatest. Use what you know about the number line to complete the list of numbers by filling in the blanks with the missing numbers.

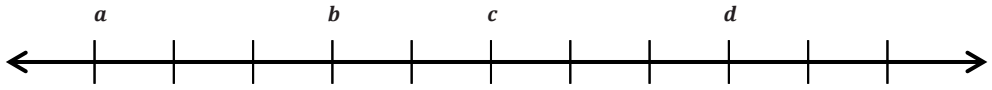
$$-6, -5, \_\_\_\_\_, -3, -2, -1, \_\_\_\_\_, 1, 2, \_\_\_\_\_, 4, \_\_\_\_\_, 6$$

3. Complete the number line scale. Explain and show how to find 2 and the opposite of 2 on a number line.



Exit Ticket Sample Solutions

1. If zero lies between a and d, give one set of possible values for a, b, c, and d.



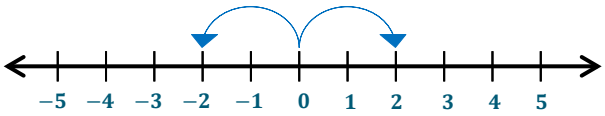
$a: -4;\ b: -1;\ c: 1;\ d: 4$

2. Below is a list of numbers in order from least to greatest. Use what you know about the number line to complete the list of numbers by filling in the blanks with the missing numbers.

$-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6$

3. Complete the number line scale. Explain and show how to find 2 and the opposite of 2 on a number line.

I would start at zero and move 2 units to the left to locate the number -2 on the number line. So to locate 2, I would start at zero and move 2 units to the right (the opposite direction).



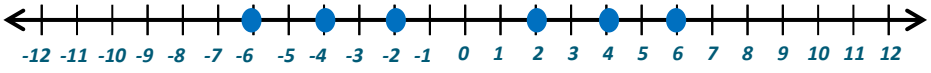
Problem Set Sample Solutions

1. Create a scale for the number line in order to plot the points $-2, 4$, and 6.

   a. Graph each point and its opposite on the number line.

   b. Explain how you found the opposite of each point.

   To graph each point, I started at zero and moved right or left based on the sign and number (to the right for a positive number and to the left for a negative number). To graph the opposites, I started at zero, but this time I moved in the opposite direction the same number of times.

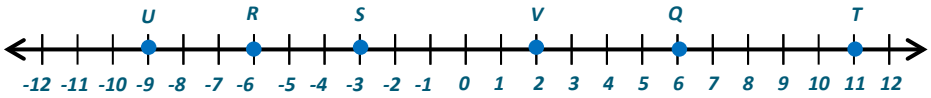


2. Carlos uses a vertical number line to graph the points $-4, -2, 3$, and 4. He notices that -4 is closer to zero than -2. He is not sure about his diagram. Use what you know about a vertical number line to determine if Carlos made a mistake or not. Support your explanation with a number line diagram.

   Carlos made a mistake because -4 is less than -2, so it should be further down the number line. Starting at zero, negative numbers decrease as we look further to the left of zero. So, -2 lies before -4 on a number line since -2 is 2 units below zero and -4 is 4 units below zero.

3. Create a scale in order to graph the numbers -12 through 12 on a number line. What does each tick mark represent?

Each tick mark represents 1 unit.



4. Choose an integer between -5 and -10. Label it R on the number line above and complete the following tasks.

(Answers may vary. Refer to the number line above for sample student work.) $-6, -7, -8,$ *or* -9

a. What is the opposite of R? Label it Q.

6

b. State a positive integer greater than Q. Label it T.

11

c. State a negative integer greater than R. Label it S.

-3

d. State a negative integer less than R. Label it U.

-9

e. State an integer between R and Q. Label it V.

2

5. Will the opposite of a positive number *always, sometimes, or never* be a positive number? Explain your reasoning.

The opposite of a positive number will never be a positive number. For two nonzero numbers to be opposites, 0 has to be in between both numbers, and the distance from 0 to one number has to equal the distance between 0 and the other number.

6. Will the opposite of zero *always, sometimes, or never* be zero? Explain your reasoning.

The opposite of zero will always be zero because zero is its own opposite.

7. Will the opposite of a number *always, sometimes, or never* be greater than the number itself? Explain. Provide an example to support your reasoning.

The opposite of a number will sometimes be greater than the number itself because it depends on the given number. For example, if the number given is -6, then the opposite is 6, which is greater than -6. If the number is 5, then the opposite is -5, which is not greater than 5. If the number is 0, then the opposite is 0, which is never greater than itself.