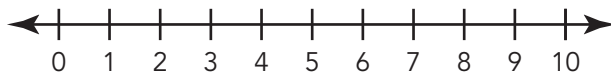# Human Number Line

Introduction to Negative Numbers

WARM UP

Plot each number on a number line. Then, insert a $>$ or $<$ symbol to make each inequality statement true.


```
   0  1  2  3  4  5  6  7  8  9  10
```

1. $\frac{3}{4}$ _____ $1\frac{1}{2}$

2. 5.6 _____ 5.06

3. 7.65 _____ 6.75

LEARNING GOALS

- Use positive and negative numbers to describe quantities having opposite directions.
- Explain the meaning of 0 in contexts represented by positive and negative numbers.
- Identify and represent a number and its opposite on a number line.
- Represent, interpret, and order positive and negative integers and other rational numbers using number lines and inequality statements.

KEY TERMS

- negative numbers
- infinity

You have used numbers equal to or greater than 0 to represent real-world situations. But how can you use numbers less than 0 to describe real-world situations?

Number Line Geography

1. What do you know about a number line?

2. Label the number line and be sure to include 0. Then plot and label a single point of your choice on the number line.

   a. Draw a ray, or an arrow, beginning at your point to represent the numbers larger than the value at your point.

   b. Draw a ray, or an arrow, beginning at your point to represent the numbers smaller than the value at your point.

   c. At the ends of a number line, there are arrows going in both directions. What do these arrows indicate?

   d. What do you think is on the number line to the left of 0?

Investigating Time on a Number Line

Let's use a number line to represent time.

Your teacher will assign students to participate in the activity. Be sure to record what happens on the number line.

1. For each student, plot and label the point where the student stands on the number line. Also identify what time is represented by the point.
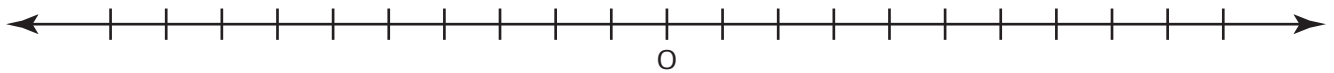
Student A: Stand at 0 to represent the time right now.
Student B: Stand at the point that represents 3 hours from now.
Student C: Stand at the point that represents 3 hours ago.
Student D: Stand at the point that represents 5 hours from now.
**Student E: Stand at the point that represents 2 hours ago.**
Student F: Stand at the point that represents 7 hours ago.

A number line can be created by reflecting the positive numbers across zero. The values to the left of zero on the number line are called **negative numbers** and are labeled with a negative sign. The positive values extend to positive infinity, and the negative numbers extend to negative infinity. **Infinity**, represented by the symbol ∞, means a quantity with no end or bound. The number line goes on forever in both directions!

A negative number is written with a negative sign. You can write a positive number with a positive sign or without any sign. For example, positive 5 can be written as +5 or 5.

Negative infinity   Positive infinity
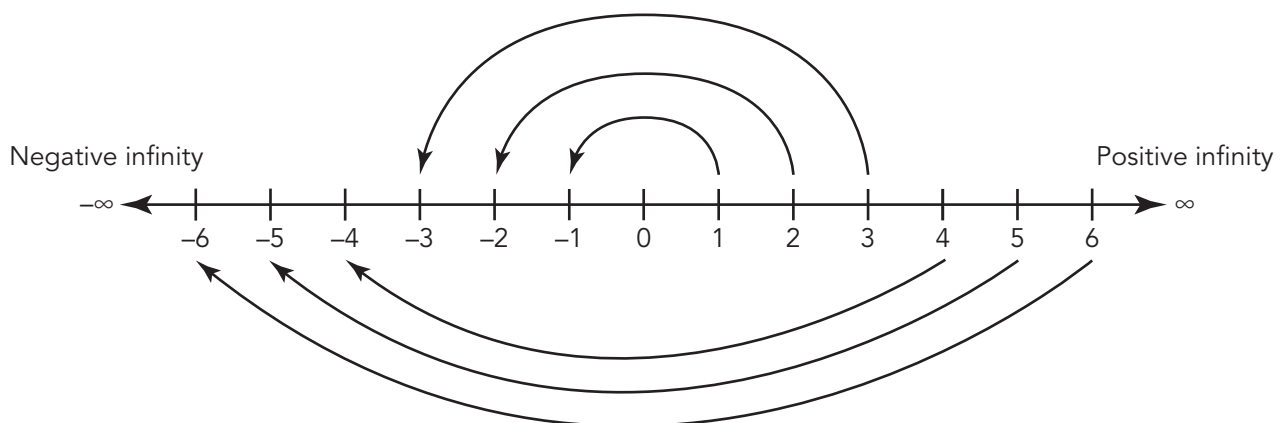
2. Describe the change in the values of the numbers as you move to the right on the number line.

3. Describe the change in the values of the numbers as you move to the left on the number line.

Consider your class time number line.

4. Describe the locations of the points that represent time in the future.

5. Describe the locations of the points that represent time in the past.

6. How would your number line be labeled differently from one created by a class that starts at a different time?

7. What observations can you make about where a given number of hours before or after time 0 is plotted? What do you notice about its distance from 0? For example, what do you notice about 3 hours before and 3 hours after now? Or 6 hours before and 6 hours after now?

Representing Opposites on a Number Line

Let's think more about both sides of 0 on a number line.

Your teacher will model a number line.

1. Create and label a number line according to the model.

2. Plot and label the location where each student stands on the number line. In the table, identify the value represented by the location where the student is standing.

Student A: Stand at 0.
Student B: Stand at 4.5.
Student C: Stand at the opposite of 4.5.
Student D: Stand at −6.
Student E: Stand at the opposite of −6.
Student F: Stand at a location between 2 and 3.
Student G: Stand at the location that is the opposite of Student F.

Student	Value
A	
B	
C	
D	
E	
F	
G	

3. Describe the number line relationship of the students who were opposites of each other.

> *There is only one number that is its own opposite.*

Opposite numbers are reflections of each other across 0 on the number line.

- The opposite of a positive number is a corresponding negative number.

- The opposite of a negative number is a corresponding positive number.

Attaching a negative sign to a number means reflecting that number across 0 on the number line.

4. Use symbols to represent the opposite of 4.5 and the value it represents.

$-(4.5) =$ _____

5. Use symbols to represent the opposite of −6 and the value it represents.

$-(-6) =$ _____

6. What do you notice about the distance from 0 of corresponding opposite numbers?

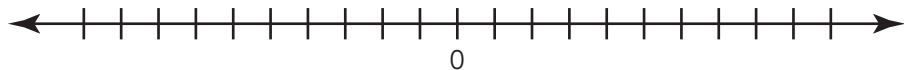> *Don't forget to label the number line!*

7. What is the opposite of 0?

8. Name the opposite of each number. Then, plot each number and its opposite on the number line.

a. $1\frac{1}{2}$ b. −5   c. −9.9

Representing Money on a Number Line

Alyson and her friends are trying to decide if they can go to the movies. Each ticket costs $9.00. After checking their wallets, each friend comments on how much money they have.

- Alyson: I have $2.50 more than the movie costs.

- Sharon: Oh, I don't have enough money. I'm $4.00 short.

- Brian: Not only can I buy a ticket, but I have just enough money to buy the $8.00 snack combo!

- Eileen: If I can find one more quarter, I can go.

Myron and Paulie created different number lines to represent the scenario.
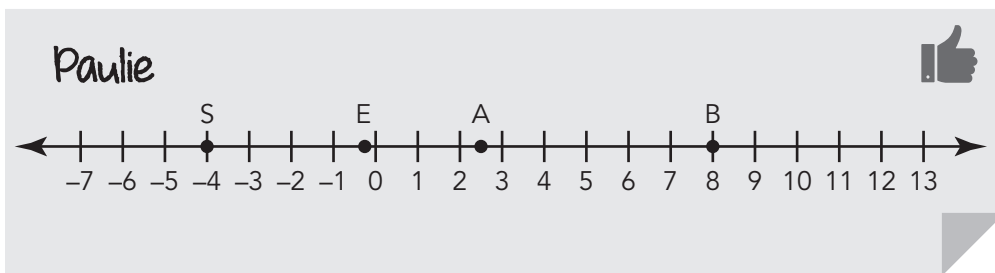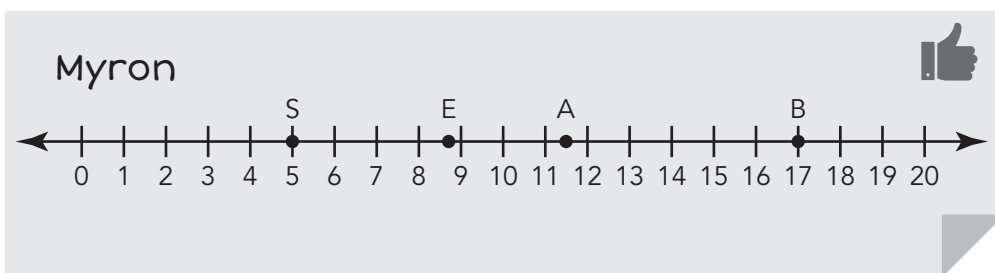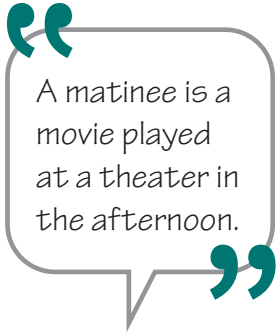
Myron

Paulie

Analyze each representation of the scenario.

1. What does each point represent on Myron's number line?

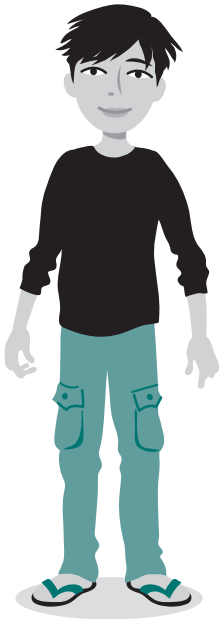**2. What does each point represent on Paulie's number line?**

3. Myron and Paulie are thinking about 0 differently. Explain what 0 represents on each number line.

4. Suppose the four friends decide to go to a matinee instead, where the ticket price is $7.50.

a. How would Myron's number line change?

b. How would Paulie's number line change?

Temperature Connection

Number lines can also be vertical, like a thermometer or a measure of elevation.

1. **Discuss and write a sentence to describe the meaning of each statement.**

   a. **The weather forecaster predicts the temperature will be below zero.**

   b. **A submarine travels at 3000 feet below sea level.**

   c. **Badwater Basin in Death Valley, California, is 86 meters below sea level.**

2. **Mark each temperature on the thermometer shown.**

   a. **The highest temperature on record in the United States is 134°F. It occurred in 1913 in Death Valley, California.**

   b. **The lowest temperature on record is −80°F. It occurred at Prospect Creek Camp, Alaska.**

   c. **The lowest temperature recorded in the contiguous 48 states is −70°F. It occurred in Montana.**

   d. **The highest winter average temperature in the United States is 78°F, which occurs in Honolulu, Hawaii.**

140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80

°F
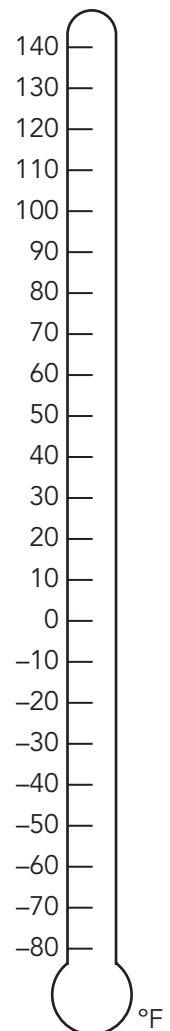
3. Which is colder, the lowest temperature recorded in Alaska or the lowest temperature recorded in Montana? How do you know?

4. Yadi and Eric were comparing 25 degrees to −27 degrees.

   • Yadi wrote 25 < −27 and justified her comparison by stating that the further a number is from zero, the greater the number.

   • Eric wrote 25 > −27 and justified his comparison by stating that the greater temperature will be above the second temperature on a thermometer.

   Who is correct? Explain your choice.
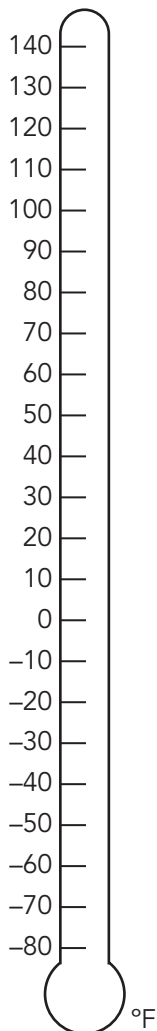
5. Plot each set of temperatures on the thermometer. Then insert a > or < symbol to make each number sentence true.

   a. −26°F _____ −31°F

   b. −6°F _____ −17°F

   c. −9°F _____ 8°F

6. Order the temperatures from least to greatest.

   25°F   −33°F   0°F   105°F   −40°F   −5°F   67°F

Comparing and Ordering Rational Numbers

Helen and Grace started a company called Top Notch. They check the company's bank balance at the end of each week. The table shown represents the first 10 weeks of operation. Overdrafts, or weeks when they owe the bank money, are represented by amounts within parentheses. For example, ($25) denotes an overdraft of $25; they owe the bank $25. Amounts that are not in parentheses are when they made money.

Week	1	2	3	4	5	6	7	8	9	10
Balance	$159	($201)	$231	($456)	($156)	($12)	$281	$175	$192	$213
+/− Number										

```
   ◄──┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────►
    −450 −400 −350 −300 −250 −200 −150 −100  −50   0   50  100  150  200  250
```
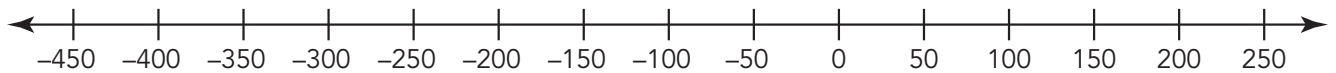
1. **Use the table and number line to answer each question.**

   a. **Write each as a positive or negative number and then plot the number on the number line.**

   b. **What does 0 represent in this situation?**

   c. **In which week did they have the highest bank balance?**

   d. **In which week did they show greatest overdraft?**

2. **For each pair of weeks, write an inequality statement to compare the positive and negative numbers. Interpret the statement in context.**
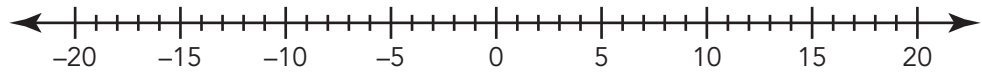
   a. **Week 1 and Week 5**   b. **Week 4 and Week 6**

You can compare different types of numbers by plotting the numbers on a number line.

3. **Use the number line to answer each question.**

   a. **Plot each value on the number line.**

   $$-6\frac{2}{3} \quad -20 \quad 0 \quad 10.5 \quad -17\frac{1}{2} \quad -7.98 \quad 12 \quad -3 \quad -13$$

   ```
   ←——|——|——|——|——|——|——|——|——→
     -20  -15  -10  -5   0   5   10   15   20
   ```

   b. **Which of the numbers has the least value? How do you know?**

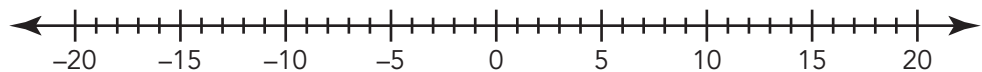   c. **Which of the numbers has the greatest value? How do you know?**

   d. **Order the numbers from least to greatest.**

> *How do you know which rational number is greater by looking at the number line?*

4. **Plot each rational number on the number line. Then, insert a >, <, or = symbol to make each number sentence true.**

   a. -10.25 _____ $-15\frac{2}{3}$

   ```
   ←——|——|——|——|——|——|——|——|——→
     -20  -15  -10  -5   0   5   10   15   20
   ```

   b. -17 _____ -17

   ```
   ←——|——|——|——|——|——|——|——|——→
     -20  -15  -10  -5   0   5   10   15   20
   ```

   c. $5\frac{2}{3}$ _____ -8.28

   ```
   ←——|——|——|——|——|——|——|——|——→
     -20  -15  -10  -5   0   5   10   15   20
   ```
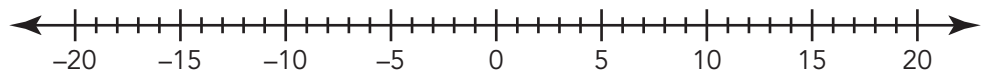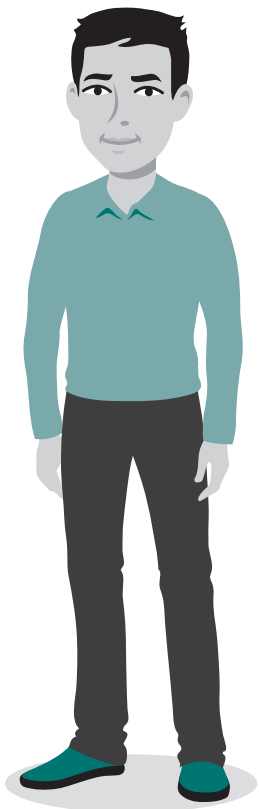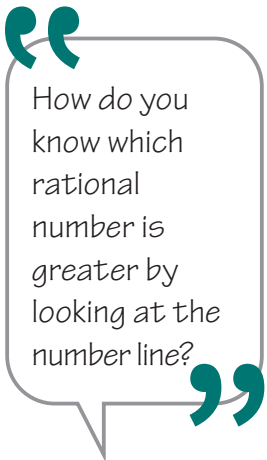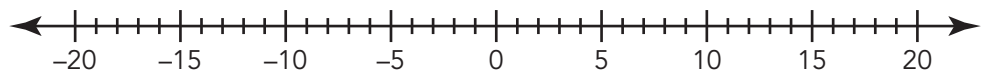
TALK the TALK 💬

Putting It All Together

1. What does 0 mean on a number line?

2. What does *opposite* mean in terms of a number line?

3. Compare the types of numbers. Use what you know about number lines to explain your reasoning.

   a. Which is greater—a negative or a positive rational number?

   b. Which is greater—zero or any positive rational number?

   c. Which is greater—zero or any negative rational number?

   d. How do you decide which of two numbers is greater if both numbers are positive?

   e. How do you decide which of two numbers is greater if both numbers are negative?

4. Your sixth grade cousin goes to school in a different state. His math class has not yet started comparing integers. Write him an email explaining how to compare any two numbers. Be sure to include 1 or 2 examples and enough details that he will be able to explain it to his class.

_____

_____

_____

_____

_____

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_____

Assignment

Write

Write a sentence to explain the relationship between *opposites* and *negative numbers.*

Remember

The rational number line is used to represent positive numbers, negative numbers, and zero. The values to the left of zero on the number line are reflections of the values on the right across 0.

Practice

1. Plot each number and its opposite on the number line.
   a. -1
   b. 0.1
   c. $1\frac{3}{4}$
   d. -1.9
   e. 0.009

2. Order the numbers from least to greatest.

   $0.125 \quad 1\frac{1}{5} \quad -\frac{4}{9} \quad \frac{4}{11} \quad -\frac{3}{2} \quad -2.75$

3. The Ravine Flyer II is a steel and wood roller coaster that takes advantage of the terrain in Erie, PA, to make the ride more exciting. Although the coaster is only 80 feet high, it follows the line of a cliff in order to drop to -35 feet (0 represents the height of the cliff).
   a. Plot the highest and lowest points of the roller coaster on a vertical number line.
   b. Explain why a vertical number line better represents the problem context than a horizontal number line.
   c. How many total feet does the roller coaster drop?

4. The Monster is a roller coaster that uses a design similar to the Ravine Flyer II. The Monster reaches a height of 120 feet, but then drops to -25 feet. Order the highest and lowest points of the two roller coasters from least to greatest.

5. An amusement park wants to design a coaster that rises 60 feet above ground and then drops the same distance below ground through a tunnel. Represent the underground depth with a number, and explain its relationship with the above ground height.

Stretch

Create a new situation, similar to Activity 1.3 *Representing Money on a Number Line*, in which zero can have two different meanings.

Review

Name the two quantities that are changing in each and determine which quantity is the dependent quantity and which is the independent quantity.

1. Terrence types 80 words per minute.
2. To determine the total weekly wages of his employees, Mr. Jackson multiplies the total number of hours his employees work by $12.
3. A mountain climber is ascending a mountain at a rate of 5 feet per minute. Define variables and write an equation that represents the situation. Graph the equation on a coordinate plane.

Perform the indicated operation.

4. $11\frac{4}{5} + 5\frac{2}{3}$
5. $\frac{27}{4} \div \frac{3}{2}$