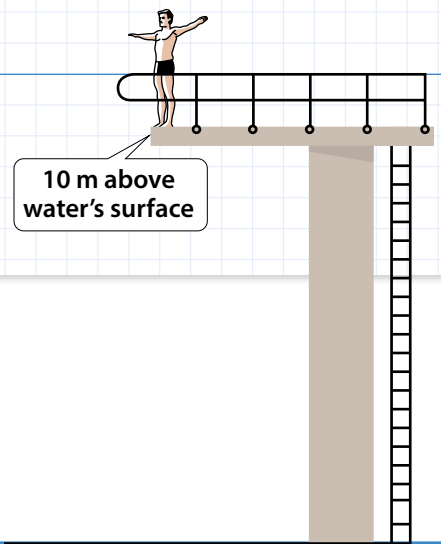


# Explore Adding and Subtracting with Integers



Previously, you learned how to add positive and negative numbers. In this lesson, you will learn about subtracting positive and negative fractions and decimals.

► Use what you know to try to solve the problem below.

A pool's diving platform is 10 m above the water's surface. The bottom of the pool is at  $-5$  m, relative to the surface of the water. What is the distance between the diving platform and the bottom of the pool?

**TRY IT**



**Math Toolkit** grid paper, integer chips, number lines

**DISCUSS IT**

**Ask:** How does your work represent the surface of the water?

**Share:** In my work ... represents ...



**Learning Targets** SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6

- Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.
- Apply properties of operations as strategies to add and subtract rational numbers.

## CONNECT IT

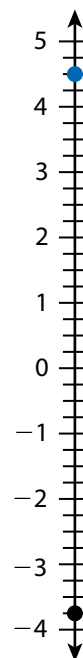
1 **Look Back** What is the distance between the diving platform and the bottom of the pool? How do you know?

2 **Look Ahead** In the **Try It**, you found the distance between two elevations represented by integers. You can also find the distance between non-integers.

a. Explain how you can use the number line to find the distance between 4.5 and  $-3.75$ .

b. You can use both the expression  $|4.5 - (-3.75)|$  and the expression  $|-3.75 - 4.5|$  to find the distance between 4.5 and  $-3.75$ . Why?

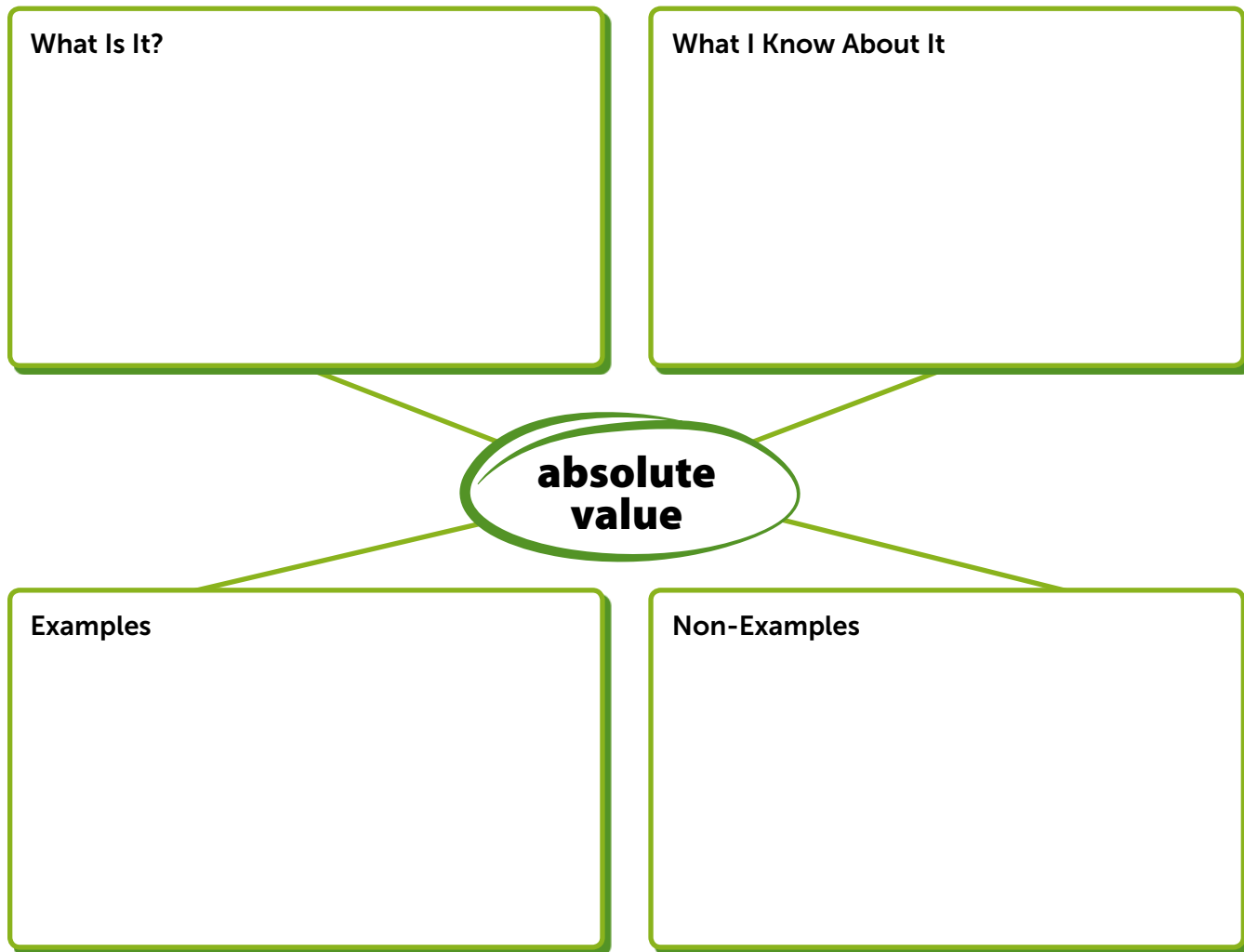
c. You can subtract to find the difference between 4.5 and  $-3.75$ . Explain why  $-3.75 - 4.5$  is the opposite of  $4.5 - (-3.75)$ .



3 **Reflect** How is finding the distance between two numbers on the number line like finding the difference between two numbers? How is it different?

## Prepare for Subtracting Positive and Negative Numbers

- 1 Think about what you know about numbers and absolute value. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.



- 2 Is  $-4$  the absolute value of  $3 - 7$ ? Explain.

- 3 The top of a molehill is 4 in. above ground level.  
The bottom of a mole's burrow is at  $-9$  in. relative to ground level.
- a. What is the distance between the top of the molehill and the burrow? Show your work.

**SOLUTION** \_\_\_\_\_

\_\_\_\_\_

- b. Check your answer to problem 3a. Show your work.



## Develop Subtracting Positive and Negative Fractions and Decimals

► Read and try to solve the problem below.

During December, the average daily temperature in a town is  $-1.7^{\circ}\text{C}$ . The average daily temperature in the same town is  $3.2^{\circ}\text{C}$  lower in January. What is the average daily temperature in January?

TRY  
IT



**Math Toolkit** grid paper, number lines, place-value charts

DISCUSS IT

**Ask:** What did you do first to find the temperature in January?

**Share:** I started by ...

► Explore different ways to understand adding or subtracting negative decimals.

During December, the average daily temperature in a town is  $-1.7^{\circ}\text{C}$ . The average daily temperature in the same town is  $3.2^{\circ}\text{C}$  lower in January. What is the average daily temperature in January?

### Model It

You can write an expression to represent the situation.

You can write a **subtraction** expression:

$$-1.7 - 3.2$$

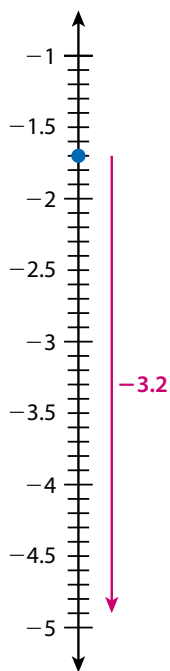
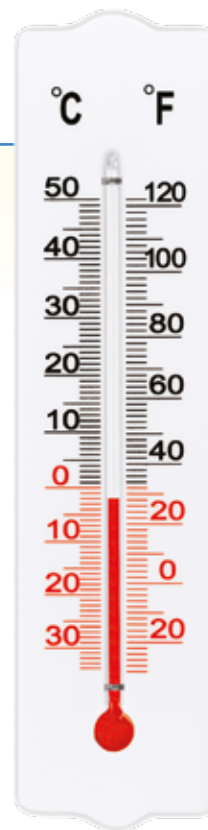
You can also write an **addition** expression:

$$-1.7 + (-3.2)$$

### Model It

You can use a number line to add or subtract negative decimals.

The average temperature in January was  $3.2^{\circ}\text{C}$  lower than in December.



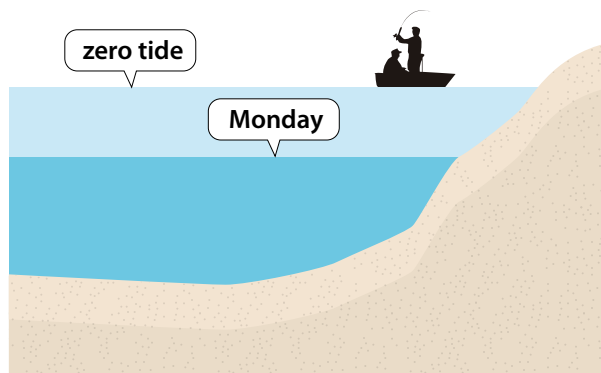
## CONNECT IT

- Use the problem from the previous page to help you understand how to subtract with negative decimals and fractions.
- 1 Look at the first **Model It**. Why can you write both an addition expression and a subtraction expression for the situation?
  - 2 Look at the second **Model It**. How does the number line represent both the addition expression and the subtraction expression?
  - 3 What is the average temperature in January?
  - 4 How is adding two negative decimals like adding two positive decimals? How is it different?
  - 5 How is subtracting a negative decimal like subtracting a negative integer?
  - 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to subtract negative decimals.

## Apply It

► Use what you learned to solve these problems.

- 7 On Monday, the low tide at Cook Inlet, Alaska, is  $-1\frac{1}{2}$  ft. On Tuesday, the low tide is  $-1\frac{1}{3}$  ft. How does the low tide on Tuesday compare to the low tide on Monday? Show your work.



**SOLUTION** \_\_\_\_\_

- 8 Find  $3\frac{1}{4} - 4\frac{1}{2}$ . Show your work.

**SOLUTION** \_\_\_\_\_

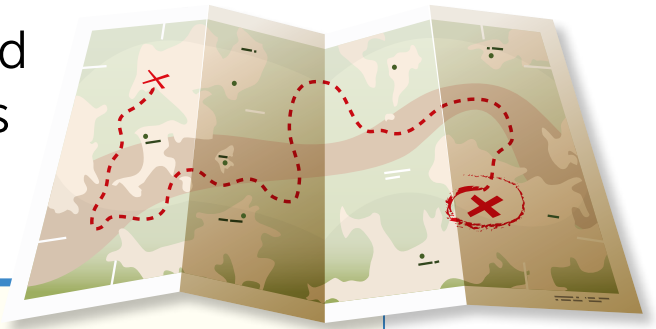
- 9 Find  $5.4 - 7.1$ . Show your work.

**SOLUTION** \_\_\_\_\_



## Practice Subtracting Positive and Negative Fractions and Decimals

- Study the Example showing how to subtract negative fractions. Then solve problems 1–5.



### Example

A path from a dry lake bed starts at an elevation of  $-12\frac{1}{2}$  ft relative to sea level. The path ends at an elevation of  $60\frac{1}{3}$  ft above sea level. What number represents the change in elevation from the start to the end of the path?

You can subtract to find the change in elevation.

$$\begin{aligned} 60\frac{1}{3} - \left(-12\frac{1}{2}\right) &= 60\frac{1}{3} + 12\frac{1}{2} \\ &= 60\frac{2}{6} + 12\frac{3}{6} \\ &= 72\frac{5}{6} \end{aligned}$$

The number that represents the change in elevation is  $72\frac{5}{6}$ .

- 1 You can also find  $12\frac{1}{2} - 60\frac{1}{3} = -72\frac{5}{6}$ . What information does that give you about the path in the Example?
- 2 The lowest point of the dry lake bed in the Example has an elevation of  $-18\frac{3}{4}$  ft. What number represents the change in elevation from the start of the path to the lowest point in the dry lake bed? Show your work.

### SOLUTION

- 3 What is  $2.6 - 7.3$ ? Show your work.

**SOLUTION** \_\_\_\_\_

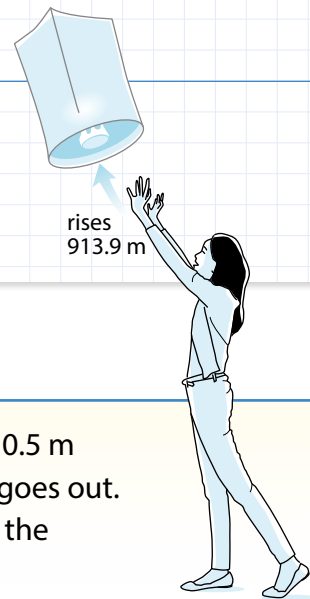
- 4 When Daria gets to school, the temperature is  $5.7^{\circ}\text{F}$ . The temperature changes by  $-9.5^{\circ}\text{F}$  by the time she goes to bed. What is the temperature when Daria goes to bed? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 An otter is swimming at  $-4.2$  yd relative to the surface of the water. It dives 8.6 yd deeper. After the dive, what is the otter's elevation relative to the surface of the water?

- A  $-12.8$  yd
- B  $-4.4$  yd
- C  $4.4$  yd
- D  $12.8$  yd

## Develop Adding and Subtracting Positive and Negative Fractions and Decimals



► Read and try to solve the problem below.

Mei releases a lantern for the Lantern Festival. She stands in a field that is 0.5 m below sea level. The lantern rises 913.9 m. Then the candle in the lantern goes out. The lantern comes down 925.2 m to land on the surface of a lake. What is the elevation of the lake relative to sea level?

**TRY  
IT**



**Math Toolkit** grid paper, number lines, place-value charts

**DISCUSS IT**

**Ask:** What did you do first to find the elevation of the lake?

**Share:** The first thing I did to find the elevation was . . .

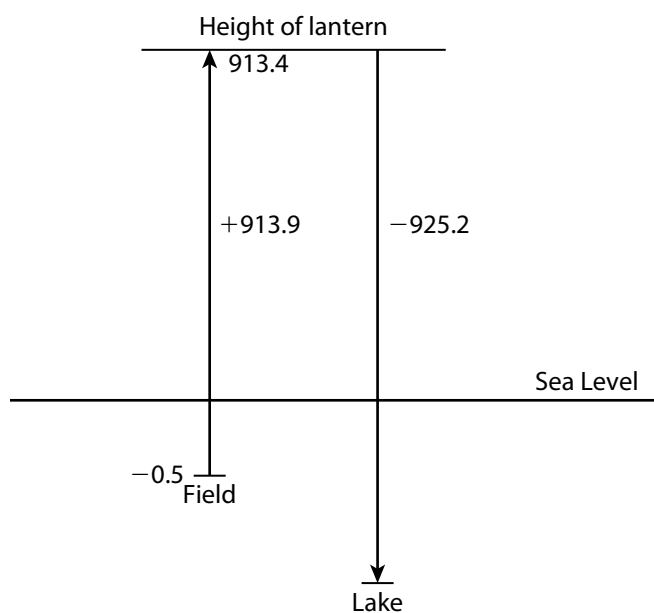
➤ Explore different ways to understand adding and subtracting positive and negative numbers.

Mei releases a lantern for the Lantern Festival. She stands in a field that is 0.5 m below sea level. The lantern rises 913.9 m. Then the candle in the lantern goes out. The lantern comes down 925.2 m to land on the surface of a lake. What is the elevation of the lake relative to sea level?



### Picture It

You can draw a diagram to model the lantern's movement.



### Model It

You can add and subtract from left to right to simplify.

$$\begin{aligned} -0.5 + 913.9 - 925.2 &= -0.5 + 913.9 - 925.2 \\ &= 913.4 - 925.2 \end{aligned}$$

### Model It

You can reorder the terms before simplifying.

$$\begin{aligned} -0.5 + 913.9 - 925.2 &= -0.5 + 913.9 + (-925.2) \\ &= -0.5 + (-925.2) + 913.9 \\ &= -925.7 + 913.9 \end{aligned}$$

## CONNECT IT

► Use the problem from the previous page to help you understand how to add and subtract positive and negative numbers.

- 1 Look at **Picture It**. Does the lantern end up lower or higher than its starting point? How do the arrows show the lantern's movement?
- 2 Look at the first **Model It**. What is the value of the expression  $-0.5 + 913.9 - 925.2$ ? How does the expression show the movement of the lantern?
- 3 Look at the second **Model It**. Why can you change the order of the terms?
- 4 How does changing the order of the terms change the way you find the sum?
- 5 Consider the expression  $1\frac{5}{6} - 2\frac{1}{3} - 1\frac{1}{6}$ . To find the value, which two terms might you combine first? Why?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.



## Practice Adding and Subtracting Positive and Negative Fractions and Decimals

- Study the Example showing adding and subtracting positive and negative fractions. Then solve problems 1–4.

### Example

Hummingbirds sip  $2\frac{1}{2}$  fl oz of the liquid in a feeder.

Then  $1\frac{1}{2}$  fl oz of food is added to the feeder. Last, hummingbirds sip another  $3\frac{1}{4}$  fl oz of food. What is the overall change in the amount of food in the feeder?

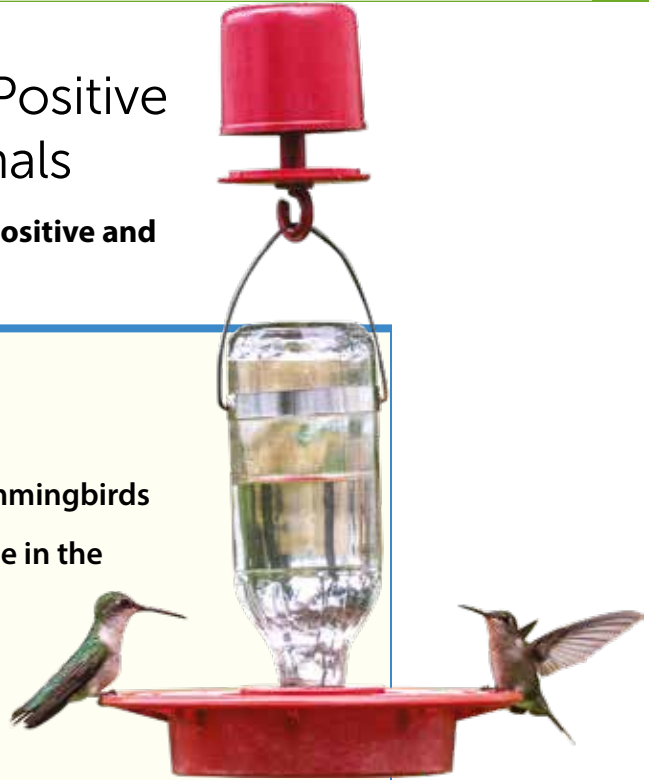
You can write an expression to represent the situation.

$$-2\frac{1}{2} + 1\frac{1}{2} - 3\frac{1}{4}$$

You can begin simplifying the expression by reordering the terms.

$$\begin{aligned} -2\frac{1}{2} + 1\frac{1}{2} - 3\frac{1}{4} &= -2\frac{1}{2} - 3\frac{1}{4} + 1\frac{1}{2} \\ &= -5\frac{3}{4} + 1\frac{1}{2} \\ &= -4\frac{1}{4} \end{aligned}$$

The overall change in the amount of food in the feeder is  $-4\frac{1}{4}$  fl oz.



- 1 The feeder in the Example had 16 fl oz of food in it to start. How much food does it have now? Show your work.

### SOLUTION

- 2 Is each expression equivalent to  $-2.7 + (-3.1)$ ?

	Yes	No
a. $-2.7 - 3.1$	<input type="radio"/>	<input type="radio"/>
b. $-2.7 + (-3) + (-0.1)$	<input type="radio"/>	<input type="radio"/>
c. $-2 + (-0.7) + (-3) + (-0.1)$	<input type="radio"/>	<input type="radio"/>
d. $-2 + 0.7 + (-3.1)$	<input type="radio"/>	<input type="radio"/>

- 3 Reth is playing a game. First, he loses 4.8 points. Then he gains 2.5 points. Finally, he loses another 7.8 points. What is the overall change in Reth's score? Show your work.

**SOLUTION** \_\_\_\_\_

- 4 An autonomous underwater vehicle (AUV) is at an elevation of  $-8.25$  ft. It dives down  $6\frac{2}{3}$  ft to collect a specimen. Then the AUV dives another  $15\frac{3}{4}$  ft. What is the final elevation of the AUV? Show your work.



AUV: autonomous underwater vehicle

**SOLUTION** \_\_\_\_\_



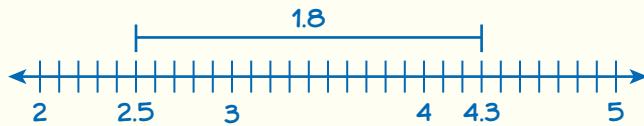
# Refine Adding and Subtracting Positive and Negative Numbers

► Complete the Example below. Then solve problems 1–10.

### Example

What is  $2.5 - 4.3$ ?

Look at how you could use absolute value to find the difference.



On a number line, 2.5 and 4.3 are 1.8 units apart. The distance between two numbers is the same as the absolute value of their difference. So,  $|2.5 - 4.3| = 1.8$ .

Since  $2.5 - 4.3$  has a negative result, the difference is a negative number with an absolute value of 1.8.

**SOLUTION** \_\_\_\_\_

### CONSIDER THIS . . .

Distance on a number line is never negative.

### PAIR/SHARE

Does the method in the Example work for subtracting negative numbers?

## Apply It

- 1 Cece’s dog loses  $1\frac{1}{4}$  lb. Then her dog loses another  $1\frac{1}{8}$  lb. Finally, it gains  $\frac{3}{8}$  lb. What is the total change in her dog’s weight? Show your work.

### CONSIDER THIS . . .

The result would be the same if Cece’s dog lost weight, then gained weight, then lost weight.

**SOLUTION** \_\_\_\_\_

### PAIR/SHARE

Suppose Cece’s dog weighs 38 pounds to start. Does that change your answer? Why?

- 2 What is  $-8.3 - (-5.4)$ ? Show your work.

**CONSIDER THIS ...**

The inverse of subtraction is addition.

**SOLUTION** \_\_\_\_\_

- 3 Which value of  $x$  makes the following statement true?

$$-0.5 - x = \text{a positive number}$$

- A**  $x = 1.5$   
**B**  $x = 0.5$   
**C**  $x = -0.5$   
**D**  $x = -1.5$

**PAIR/SHARE**

How can you check that your answer makes sense?

**CONSIDER THIS ...**

Zero is not a positive or a negative number.

Lulu chose A as the correct answer. How might she have gotten that answer?

**PAIR/SHARE**

What is another value that makes this statement true?

- 4 A submarine 50.2 m below the surface of the ocean goes up 15.6 m. Then it goes down 35.7 m. What is the submarine's new position relative to the surface of the ocean? Show your work.



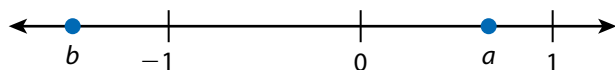
**SOLUTION** \_\_\_\_\_

- 5 Which situation could the expression  $-8 - 10$  represent?
- A An elevator stops at the 8th floor. Then it stops at the 10th floor.
  - B Gabe earned \$8. Then he spent \$10 on a new book.
  - C At a bus stop, 8 people got off and 10 people got on.
  - D The temperature dropped  $8^{\circ}\text{F}$ . Then it dropped another  $10^{\circ}\text{F}$ .
- 6 Without calculating, explain how you can tell if the value of the expression  $-9.45 - (-1.72) - 2.53$  is *positive* or *negative*.
- 7 The value of  $-4\frac{5}{8} - x$  is positive. What are two possible values of  $x$ ? Show your work.

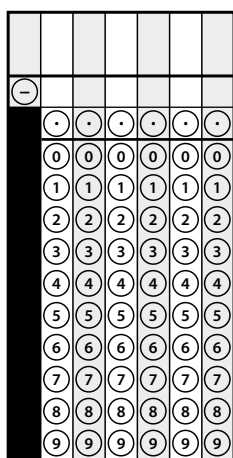
**SOLUTION** \_\_\_\_\_

\_\_\_\_\_

8 Is  $a - b$  a positive number or a negative number? How do you know?



9 Esteban stands on a dock 1.25 yd above the water. A fish swims below Esteban at  $-4.61$  yd from the surface of the water. How many yards apart are Esteban and the fish?



10 **Math Journal** Write a subtraction problem involving two negative decimal numbers. At least one decimal must include hundredths. Explain how to solve your problem.

**✓ End of Lesson Checklist**

**INTERACTIVE GLOSSARY** Write a new entry for *represent*. Write at least one synonym for *represent*.

**SELF CHECK** Go back to the Unit 2 Opener and see what you can check off.

## Explore Multiplying and Dividing with Negative Numbers

Previously, you learned about multiplying integers. In this lesson, you will learn about multiplying and dividing with rational numbers.

► **Use what you know to try to solve the problem below.**

Ryan is washing windows on a skyscraper. He lowers himself six times, going down an equal distance each time. In all, Ryan lowers himself 48 ft. What integer represents the change in Ryan's position each time he lowers himself? What does this integer tell you?

**TRY IT**



**Math Toolkit** grid paper, integer chips, number lines

**DISCUSS IT**

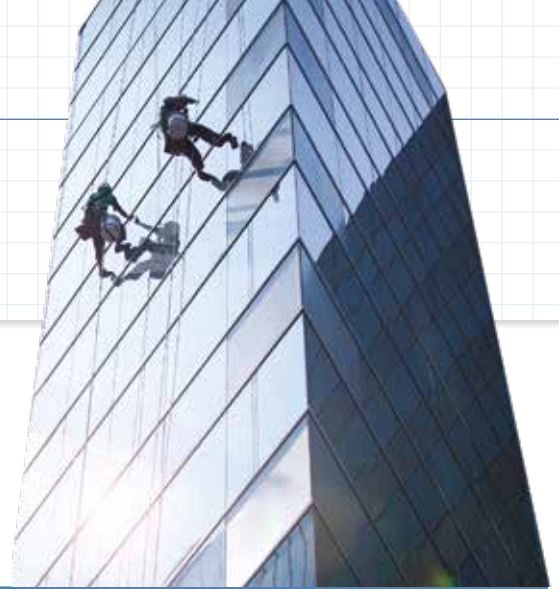
**Ask:** How would you explain what the problem is asking in your own words?

**Share:** The problem is asking . . .



**Learning Targets** SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 8

- Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If  $p$  and  $q$  are integers, then  $-\left(\frac{p}{q}\right) = \frac{(-p)}{q} = \frac{p}{(-q)}$ . Interpret quotients of rational numbers by describing real-world contexts.
- Apply properties of operations as strategies to multiply and divide rational numbers.



## CONNECT IT

- 1 **Look Back** What integer represents the change in Ryan's position each time he lowers himself? How does the integer show that Ryan is going lower?
- 2 **Look Ahead** One way to find the rational number that represents Ryan's change in position each time he lowers himself is to divide. An integer can be divided by any integer except 0. Any **rational number** can be written as the quotient of two integers, where the divisor is not 0. That means every rational number can be written in the form  $\frac{a}{b}$ , where  $a$  and  $b$  are integers and  $b \neq 0$ .
- a. Another way to think of a rational number is as the fraction  $\frac{a}{b}$ . Explain why it makes sense that  $a$  can equal 0, but  $b$  cannot.
- b. How can you write 0.07 in the form  $\frac{a}{b}$ ? How can you write 1.07 in the form  $\frac{a}{b}$ ?
- c. When a rational number is negative, you can express it as a fraction in three different forms. For example, you can write  $-4$  as  $\frac{-4}{1}$ ,  $\frac{4}{-1}$ , and  $-\frac{4}{1}$ .
- Express each fraction above as an expression using the division symbol ( $\div$ ). How does this show that the fractions are equivalent?

- 3 **Reflect** Why is  $\frac{-3}{4}$  a rational number?

## Prepare for Multiplying and Dividing with Negative Numbers

- 1 Think about what you know about fractions and negative numbers. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

Word	In My Own Words	Examples
fraction		
opposite numbers		
reciprocal		

- 2 Doug says that the opposite of  $\frac{-2}{5}$  is  $\frac{5}{-2}$ . Is Doug correct? Explain.



- 3 Tameka pilots a hot air balloon. She lowers the balloon five times, going down an equal distance each time. In all, Tameka lowers the balloon 75 m.
- a. What integer represents the change in the hot air balloon's elevation each time Tameka lowers it? What does this integer tell you? Show your work.

**SOLUTION** \_\_\_\_\_

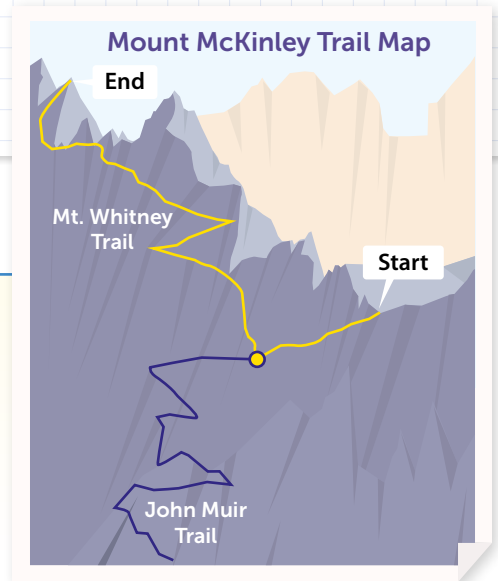
- b. Check your answer to problem 3a. Show your work.



# Develop Multiplying Negative Rational Numbers

► Read and try to solve the problem below.

Mount Whitney Trail starts at an elevation of 8,350 ft above sea level and ends at an elevation of 14,500 ft above sea level. The temperature changes by  $-5.4^{\circ}\text{F}$  for every thousand feet gained in elevation. What is the change in temperature from the starting elevation to the ending elevation of Mount Whitney Trail?



**TRY IT**



**Math Toolkit** grid paper, number lines

**DISCUSS IT**

**Ask:** How do you know your answer is reasonable?

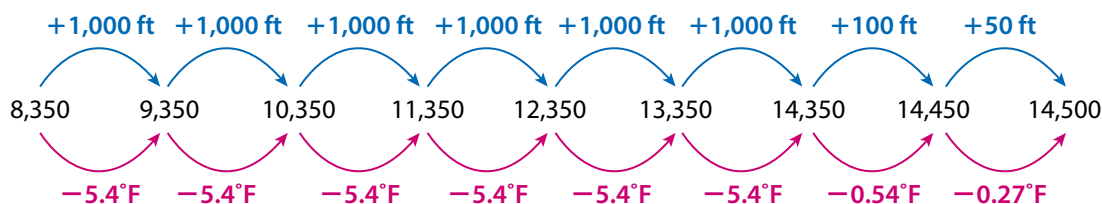
**Share:** My answer is reasonable because . . .

► Explore different ways to multiply positive and negative rational numbers.

Mount Whitney Trail starts at an elevation of 8,350 ft above sea level and ends at an elevation of 14,500 ft above sea level. The temperature changes by  $-5.4^{\circ}\text{F}$  for every thousand feet gained in elevation. What is the change in temperature from the starting elevation to the ending elevation of Mount Whitney Trail?

### Picture It

You can use a diagram to understand the relationship.



### Model It

You can multiply to find the change in temperature.

The change in elevation is  $14,500 - 8,350 = 6,150$  ft.

The temperature decreases  $5.4^{\circ}\text{F}$  every 1,000 ft. That is a rate of  $\frac{-5.4}{1,000}^{\circ}\text{F}$  per foot.

change in temperature = **rate of temperature change**  $\times$  **change in elevation**

$$\begin{aligned}
 &= \frac{-5.4}{1,000}(6,150) \\
 &= \frac{-5.4 \times 6,150}{1,000} \\
 &= -5.4\left(\frac{6,150}{1,000}\right) \\
 &= -5.4(6.15)
 \end{aligned}$$

## CONNECT IT

► Use the problem from the previous page to help you understand how to multiply positive and negative rational numbers.

- 1 How does the **Picture It** model  $-5.4(6.15)$ ?
- 2 What is the temperature change from the beginning to the ending of the trail? What does this number mean in the context of the problem?
- 3 Why does  $-5.4(6.15)$  have the same product as  $-\frac{54}{10} \cdot \frac{615}{100}$ ?
- 4 You can start solving the problem by finding  $-5.4 \times 6$ . How is this similar to finding  $5.4 \times 6$ ? How is this different from finding  $5.4 \times 6$ ?
- 5 How is multiplying negative rational numbers like multiplying negative integers?
- 6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to multiply rational numbers.

**Apply It**

► Use what you learned to solve these problems.

- 7 A peregrine falcon dives for prey. Its elevation changes by an average of  $-11.5$  meters every second. The dive lasts for  $3.2$  seconds. What is the change in the falcon's elevation? What does this mean in the context of the problem? Show your work.



**SOLUTION** \_\_\_\_\_

- 8 Find  $-\frac{1}{9}(-27)$ . Show your work.

**SOLUTION** \_\_\_\_\_

- 9 A freezer in a lab is set so that the temperature changes at a rate of  $-1.6^{\circ}\text{C}$  every hour. What is the change in the temperature after  $4\frac{1}{4}$  h? Show your work.

**SOLUTION** \_\_\_\_\_

## Practice Multiplying Negative Rational Numbers

- Study the Example showing how to multiply negative rational numbers. Then solve problems 1–5.

### Example

What is  $-6\left(-8\frac{1}{2}\right)$ ?

$$-8\frac{1}{2} = -\frac{17}{2}$$

The product of two negative rational numbers is positive.

$$\begin{aligned} -6\left(-8\frac{1}{2}\right) &= -\frac{6}{1}\left(-\frac{17}{2}\right) \\ &= 51 \end{aligned}$$

- 1 a. Show how to solve the problem in the Example by multiplying decimals.
- b. Is your answer to problem 1a *greater than*, *less than*, or *equal to* the answer in the Example? Why?

- 2 Find  $-\frac{3}{5}\left(-1\frac{1}{3}\right)$ . Show your work.

### Vocabulary

#### rational number

a number that can be expressed as a fraction  $\frac{a}{b}$  where  $a$  and  $b$  are integers and  $b \neq 0$ . Rational numbers include integers, fractions, repeating decimals, and terminating decimals.

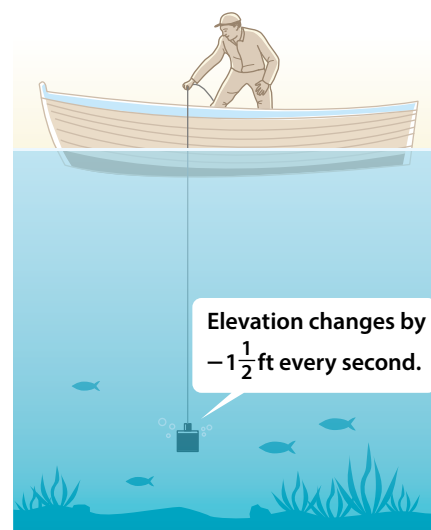
### SOLUTION

- 3 a. Find  $-0.2(4.75)$ . Show your work.

**SOLUTION** \_\_\_\_\_

- b. Explain how you can use your answer to problem 3a to find  $-0.2(-4.75)$ .

- 4 Amare drops a probe into a lake. The elevation of the probe changes by  $-1\frac{1}{2}$  feet every second. The probe takes 50 seconds to reach the bottom of the lake. How deep is the lake? Show your work.



**SOLUTION** \_\_\_\_\_

- 5 Salvador drives 6.5 miles to his aunt's house. For every mile Salvador drives, the amount of gas in the car's gas tank changes by  $-0.04$  gallon. What is the total change in the gallons of gas in the car's tank? Show your work.

**SOLUTION** \_\_\_\_\_

## Develop Dividing Negative Rational Numbers

► Read and try to solve the problem below.

After a flood, a creek's water level changes by  $-2\frac{4}{5}$  ft in  $3\frac{1}{2}$  h.

What is the average change in the creek's water level each hour?



**TRY  
IT**



**Math Toolkit** grid paper, number lines

**DISCUSS IT**

**Ask:** What did you do first to find the change in the water level?

**Share:** First, I . . .



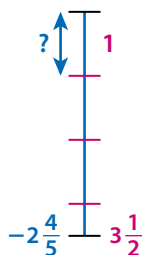
► Explore different ways to divide negative rational numbers.

After a flood, a creek's water level changes by  $-2\frac{4}{5}$  ft in  $3\frac{1}{2}$  h. What is the average change in the creek's water level each hour?

### Picture It

You can use a picture to make sense of the problem.

Water Level (ft)    Time (h)



### Model It

You can divide fractions.

Divide the total change in the level of the water by the number of hours to get the average change in the level each hour.

$$\begin{aligned} -2\frac{4}{5} \div 3\frac{1}{2} &= -\frac{14}{5} \div \frac{7}{2} \\ &= -\frac{14}{5} \cdot \frac{2}{7} \end{aligned}$$

### Model It

You can divide decimals.

$$\begin{aligned} -2\frac{4}{5} &= -2\frac{8}{10} & 3\frac{1}{2} &= 3\frac{5}{10} \\ &= -2.8 & &= 3.5 & -2.8 \div 3.5 \end{aligned}$$



## CONNECT IT

► Use the problem from the previous page to help you understand how to divide positive and negative rational numbers.

- 1 Look at the second **Model It**. Without doing any calculations, explain how you can use  $2.8 \div 3.5$  to find  $-2.8 \div 3.5$ .
- 2 What is the average change in the creek's height each hour? How does each **Model It** help you see if the average change in the creek's height each hour is positive or negative?
- 3 The product of a positive number and a negative number is negative. Explain why the quotient of a negative number and a positive number is negative.
- 4 How is dividing with negative rational numbers like dividing with positive rational numbers? How is it different?
- 5 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand dividing with negative numbers.

## Apply It

► Use what you learned to solve these problems.

- 6 What is  $16.8 \div (-3.5)$ ? Show your work.

### SOLUTION \_\_\_\_\_

- 7 What is  $-\frac{3}{8} \div (-\frac{1}{2})$ ?

A  $-\frac{3}{4}$

B  $-\frac{3}{16}$

C  $\frac{3}{16}$

D  $\frac{3}{4}$

- 8 A helicopter's altitude changes by  $-28\frac{1}{8}$  ft in  $3\frac{3}{4}$  s.  
What is the average change in the helicopter's altitude each second? Show your work.



### SOLUTION \_\_\_\_\_

## Practice Dividing Negative Rational Numbers

- Study the Example showing how to divide with negative rational numbers. Then solve problems 1–5.

### Example

On a winter day, the temperature changes by  $-12.6^{\circ}\text{F}$  in  $2\frac{1}{4}$  h.

What rational number represents the average change in the temperature each hour?

The total change in the temperature is  $-12.6^{\circ}\text{F}$ .

The amount of time is  $2\frac{1}{4}$ , or 2.25, h.

$$-12.6 \div 2.25 = -5.6$$

The number  $-5.6$  represents the average hourly temperature change.

- 1 Explain how to use the Example to find the quotient of  $-12.6$  and  $-2.25$ .
  
  
  
  
  
  
  
  
  
  
- 2 What is  $-6\frac{4}{5} \div \left(-\frac{2}{5}\right)$ ? Show your work.

### SOLUTION

- 3 Paula is scuba diving. Her elevation changes by  $-37\frac{4}{5}$  m in 4.5 min.
- a. What rational number represents the average change in Paula's elevation each minute? Show your work.

**SOLUTION** \_\_\_\_\_

- b. Is Paula going deeper in the water or back toward the surface?  
How do you know?



- 4 What is  $57.2 \div (-10,000)$ ? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 A full bathtub drains at a constant rate. The amount of water in the bathtub changes by  $-4\frac{1}{2}$  gallons in  $\frac{3}{4}$  minute. What is the rate, in gallons per minute, at which the amount of water in the bathtub changes? Show your work.

**SOLUTION** \_\_\_\_\_

## Refine Multiplying and Dividing with Negative Numbers

► Complete the Example below. Then solve problems 1–10.

### Example

What is the product of  $-\frac{3}{8}$ ,  $-\frac{2}{3}$ , and  $-\frac{5}{2}$ ?

Look at how you could show your work using multiplication.

$$\begin{aligned} -\frac{3}{8} \cdot \left(-\frac{2}{3}\right) \cdot \left(-\frac{5}{2}\right) &= \left(-\frac{3}{8} \cdot -\frac{2}{3}\right) \cdot \left(-\frac{5}{2}\right) \\ &= \frac{6}{24} \cdot \left(-\frac{5}{2}\right) \\ &= \frac{1}{4} \cdot \left(-\frac{5}{2}\right) \end{aligned}$$

**SOLUTION** \_\_\_\_\_

### CONSIDER THIS . . .

You can multiply in any order.

### PAIR/SHARE

How would the answer change if  $-\frac{3}{8}$  were  $\frac{3}{8}$ ?

### Apply It

- 1 Noor, Layla, and Diego play a trivia game. Noor's score is  $-2$ . Layla's score is  $\frac{3}{4}$  of Noor's score. Diego's score is  $\frac{2}{3}$  of Layla's score. What is Diego's score? Show your work.

### CONSIDER THIS . . .

You can multiply to find  $\frac{3}{4}$  of a quantity.

**SOLUTION** \_\_\_\_\_

### PAIR/SHARE

How can you find Diego's score another way?

- 2 Yolanda measures the depth of the water in a reservoir. In one week, the depth changes from 2,366.74 ft to 2,354.63 ft. What rational number represents the average change in depth each day? Show your work.

**CONSIDER THIS ...**

Is the change in depth positive or negative?

**SOLUTION** \_\_\_\_\_

- 3 What is  $4.8(-2.5) \div (-0.1)$ ?

- A 1.2  
B -120  
C 120  
D 1,200

Maria chose D as the correct answer. How might she have gotten that answer?

**PAIR/SHARE**

What does the rational number you found mean in the context of the problem?

**CONSIDER THIS ...**

Dividing by a number is the same as multiplying by its reciprocal.

**PAIR/SHARE**

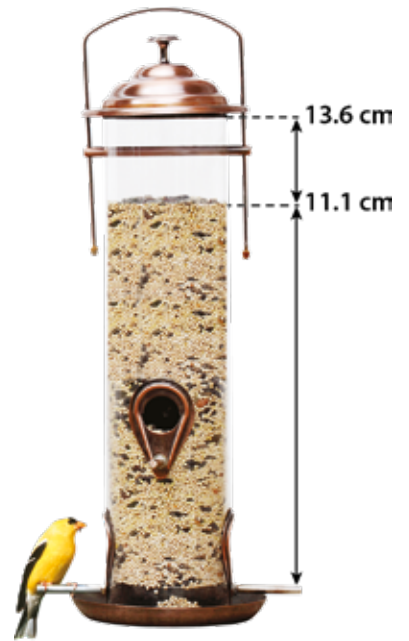
How would the answer be different if you divided by  $-0.01$  instead of  $-0.1$ ?

- 4 What is  $-79.2 \div (-16.5)$ ? Show your work.

**SOLUTION** \_\_\_\_\_

- 5 Without doing any calculations, is  $\left(-\frac{1}{2}\right)^{50}$  *positive* or *negative*? Explain how you know.
- 6 Write three different division expressions that each have a negative quotient. Use at least two of the fractions  $-\frac{1}{2}$ ,  $\frac{4}{5}$ , and  $-3$  in each expression.
- 7 The quotient of  $a$  and  $b$  is positive. Which of the following could be true about  $a$  and  $b$ ? Select all that apply.
- A The product  $ab$  is negative.
  - B The quotient  $b \div a$  is negative.
  - C Both  $a$  and  $b$  are negative.
  - D The quotient  $-b \div a$  is negative.
  - E Both  $a$  and  $b$  are positive.

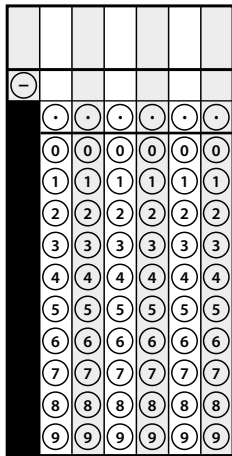
- 8 Kwame fills a bird feeder with seeds. As birds visit the feeder, the height of the seeds changes from 13.6 cm to 11.1 cm over a period of  $6\frac{1}{4}$  h. What is the average change in the height of the seeds each hour? Show your work.



**SOLUTION** \_\_\_\_\_

\_\_\_\_\_

- 9 What is  $-0.3(0.2)(12)$ ?



- 10 **Math Journal** Write a division expression that results in  $-\frac{3}{8}$ .

Explain your thinking.

**✓ End of Lesson Checklist**

- INTERACTIVE GLOSSARY** Find the entry for *rational number*. Add two important things you learned about rational numbers in this lesson.
- SELF CHECK** Go back to the Unit 3 Opener and see what you can check off.