I Can... use different methods, including algebra tiles, number lines, or the additive inverse, to subtract integers.

**Explore** Use Algebra Tiles to Subtract Integers

**Online Activity** You will use algebra tiles to model subtraction of integers, and draw conclusions about the sign of the difference of the two integers.

**Learn** Subtract Integers

To subtract integers, you can use a horizontal or vertical number line.

The horizontal number line models the equation $4 - 9 = -5$. Start at zero. Move right four units to model the integer 4. Then move left nine units to model subtracting 9. The difference is $-5$.

The vertical number line models the equation $4 - 9 = -5$. Start at zero. Move up four units to model the integer 4. Then move down nine units to model subtracting 9. The difference is $-5$.

(continued on next page)
The number lines illustrate the rules for subtracting two integers.

<table>
<thead>
<tr>
<th>Words</th>
<th>Symbols</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>To subtract an integer, add the additive inverse of the integer.</td>
<td>$p - q = p + (-q)$</td>
<td>$4 - 9 = 4 + (-9) = -5$</td>
</tr>
</tbody>
</table>

**Example 1** Subtract Integers

Find $5 - (-7)$.

**Method 1** Use a number line.

- **Go Online** You can use the Web Sketchpad number line.

Start at zero. Move right 5 units to model the integer 5. Then move right 7 units to model subtracting $-7$, which is the same as adding the additive inverse, 7. The sum is 12.

So, $5 - (-7) = 12$.

**Method 2** Use the additive inverse.

$5 - (-7) = 5 + 7$

To subtract $-7$, add the additive inverse of $-7$.

Add $5 + 7$.

So, $5 - (-7) = 12$.

**Check**

Find $11 - (-15)$.

**Talk About It!**

Compare and contrast Method 1 and Method 2.
**Example 2** Subtract Integers

Find $-24 - (-17)$.

$$-24 - (-17) = -24 + 17 \quad \text{To subtract } -17, \text{ add its additive inverse.}$$  
$$= -7 \quad \text{Add.}$$

So, $-24 - (-17) = -7$.

**Check**

Find $-39 - (-24)$.

**Example 3** Subtract Expressions

Evaluate $x - y$ if $x = -23$ and $y = 19$.

$$x - y = -23 - 19 \quad \text{Replace } x \text{ with } -23 \text{ and } y \text{ with } 19.$$  
$$= -23 + (-19) \quad \text{To subtract } 19, \text{ add its additive inverse.}$$  
$$= -42 \quad \text{Add } -23 + (-19).$$

So, when $x = -23$, and $y = 19$, $x - y = -42$.

**Check**

Evaluate $p - q$ if $p = -21$ and $q = 37$.

**Go Online** You can complete an Extra Example online.

**Explore** Find Distance on a Number Line

**Online Activity** You will calculate distance traveled by using a number line to find the difference of the two integers.
Learn  Find the Distance Between Integers

Find the distance between \(-4\) and \(5\).

Go Online  Watch the animation to learn how to find the distance between two integers.

Method 1  Use a number line.

Step 1  Plot the integers on a number line. The animation shows two points at \(-4\) and \(5\).

```
-6  -5  -4  -3  -2  -1  0  1  2  3  4  5  6
```

Step 2  Count the number of units between the two integers.

```
-6  -5  -4  -3  -2  -1  0  1  2  3  4  5  6
```

There are 9 units between \(-4\) and \(5\).

Method 2  Use an expression.

The distance between two integers is equal to the absolute value of their difference.

\[
\text{distance} = |\text{difference of integers}|
\]

Step 1  Write an expression for the distance.

\[
| -4 - 5 |
\]

Step 2  Simplify the expression.

\[
| -4 - 5 | = | 9 |
\]

The distance between \(-4\) and \(5\) is 9 units.

You can also use the expression \( |5-(-4)| \) to represent the distance. Because you find the absolute value of the difference, the order of the integers does not matter. The expressions \( | -4 - 5 | \) and \( | 5 - (-4) | \) are both equal to 9.
**Example 4** Find the Distance Between Integers

**Find the distance between \(-9\) and \(8\).**

**Method 1** Use a number line.

**Go Online** You can use the Web Sketchpad number line.

Start at \(-9\). Move right until you reach 8.

There are \(17\) units between \(-9\) and 8.

**Method 2** Use the absolute value.

To find the distance between integers, you can find the absolute value of their difference.

\[|\,-9 - 8\,| = |\,-9 + (-8)\,|\]

Add the additive inverse of 8.

\[= |\,0\,| \text{ or } \]

Simplify.

So, the distance between \(-9\) and 8 is 17 units.

**Check**

Find the distance between \(-5\) and 9 on the number line.

**Pause and Reflect**

When finding the distance between integers with different signs, which method would you choose to use? Explain.
Example 5 Find the Distance Between Integers

The highest point in California is Mount Whitney with an elevation of 14,494 feet. The lowest point is Death Valley with an elevation of −282 feet.

\[ |14,494 - (-282)| = |14,494 + 282| \]

To subtract −282, add its additive inverse.

\[ = |14,776| \]

Add.

\[ = 14,776 \]

Find the absolute value.

So, the distance between the two points is 14,776 feet.

Check

The top of an iceberg is 55 feet above sea level, while the bottom is 385 feet below sea level. What is the distance between the top and bottom of the iceberg?

Think About It!

Will the distance be greater or less than 14,494 feet?

Talk About It!

Is it reasonable to have a negative answer? Why or why not?

Go Online You can complete an Extra Example online.
Apply The Solar System

The table shows the minimum and maximum temperatures on various celestial objects in the solar system.

<table>
<thead>
<tr>
<th>Celestial Object</th>
<th>Minimum Temperature (°F)</th>
<th>Maximum Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moon</td>
<td>-387</td>
<td>253</td>
</tr>
<tr>
<td>Mars</td>
<td>-225</td>
<td>70</td>
</tr>
<tr>
<td>Mercury</td>
<td>-279</td>
<td>801</td>
</tr>
<tr>
<td>Venus</td>
<td>864</td>
<td>864</td>
</tr>
</tbody>
</table>

Scientists want to send a probe to study the celestial object with the greatest variation in temperature. To which celestial object should they send the probe?

1 What is the task?
Make sure you understand exactly what question to answer or problem to solve. You may want to read the problem three times. Discuss these questions with a partner.

First Time Describe the context of the problem, in your own words. Second Time What mathematics do you see in the problem? Third Time What are you wondering about?

2 How can you approach the task? What strategies can you use?

3 What is your solution?
Use your strategy to solve the problem.

4 How can you show your solution is reasonable?

Write About It! Write an argument that can be used to defend your solution.
Check

The table shows the highest and lowest points of elevation, in relation to sea level, in four countries. Which country in this list has the greatest variation in elevation? the least?

<table>
<thead>
<tr>
<th>Country</th>
<th>Highest Point (ft)</th>
<th>Lowest Point (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>6,083</td>
<td>−1,404</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>4,406</td>
<td>−13</td>
</tr>
<tr>
<td>Sweden</td>
<td>6,903</td>
<td>−8</td>
</tr>
<tr>
<td>Ireland</td>
<td>3,406</td>
<td>−10</td>
</tr>
</tbody>
</table>

Go Online You can complete an Extra Example online.

Foldables It’s time to update your Foldable, located in the Module Review, based on what you learned in this lesson. If you haven’t already assembled your Foldable, you can find the instructions on page FL1.
Practice

Subtract. (Examples 1 and 2)

1. \(9 - (-2)\)  
2. \(-20 - 10\)  
3. \(13 - (-63)\)

4. \(28 - 14\)  
5. \(-10 - 0\)  
6. \(-33 - 33\)

7. \(-18 - (-12)\)  
8. \(-28 - (-13)\)  
9. \(-18 - (-40)\)

10. Evaluate \(a - b\) if \(a = 10\) and \(b = -7\). (Example 3)

11. Evaluate \(x - y\) if \(x = -11\) and \(y = 26\). (Example 3)

12. Find the distance between \(-6\) and \(7\) on a number line. (Example 4)

13. Find the distance between \(-14\) and \(5\) on a number line. (Example 4)

14. The highest and lowest recorded temperatures for the state of Texas are \(120^\circ\) Fahrenheit and \(-23^\circ\) Fahrenheit. Find the range of these extreme temperatures. (Example 5)

Test Practice

15. Open Response  The table shows the starting and ending elevations of a hiking trail. How much greater is the elevation of the ending point than the starting point for the trail?

<table>
<thead>
<tr>
<th>Point on Trail</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Point</td>
<td>180 ft below sea level</td>
</tr>
<tr>
<td>Ending Point</td>
<td>260 ft above sea level</td>
</tr>
</tbody>
</table>
Apply

16. The table shows the maximum and minimum account balances for three college students for one month. Giovanni claimed that he had the least variation (from maximum to minimum) in his account balance that month. Is he correct? Write a mathematical argument to justify your solution.

<table>
<thead>
<tr>
<th>Student</th>
<th>Maximum Balance ($)</th>
<th>Minimum Balance ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>145</td>
<td>−25</td>
</tr>
<tr>
<td>Giovanni</td>
<td>168</td>
<td>15</td>
</tr>
<tr>
<td>Elisa</td>
<td>152</td>
<td>−10</td>
</tr>
</tbody>
</table>

17. The table shows the record high and record low temperatures for certain U.S. states. Which state in the list had the greatest variation in temperature? the least?

<table>
<thead>
<tr>
<th>State</th>
<th>Record High Temperature (°F)</th>
<th>Record Low Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>100</td>
<td>−80</td>
</tr>
<tr>
<td>Idaho</td>
<td>118</td>
<td>−60</td>
</tr>
<tr>
<td>Nevada</td>
<td>125</td>
<td>−50</td>
</tr>
<tr>
<td>Utah</td>
<td>117</td>
<td>−69</td>
</tr>
</tbody>
</table>

18. Use a Counterexample Determine if each statement is true or false. If false, provide a counterexample.

a. Distance is always positive.

b. Change is always positive.

19. Find the Error A student is finding $4 − (−2)$. Find the student's mistake and correct it.

$4 − (−2) = 4 + 2 = 2$

20. Create Write a subtraction expression with a positive and negative integer whose difference is negative. Then find the difference.

21. If you subtract two negative integers, will the difference always, sometimes, or never be negative? Explain using examples to justify your solution.