TOPIC 5

LESSON 5.4b

What's the Difference

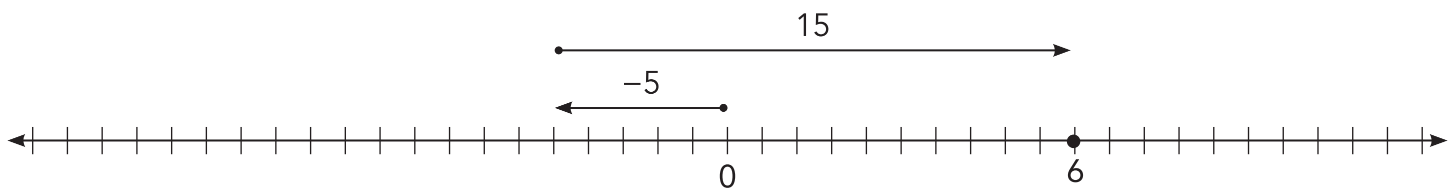
7.NS.1c

Objective Subtracting Integers

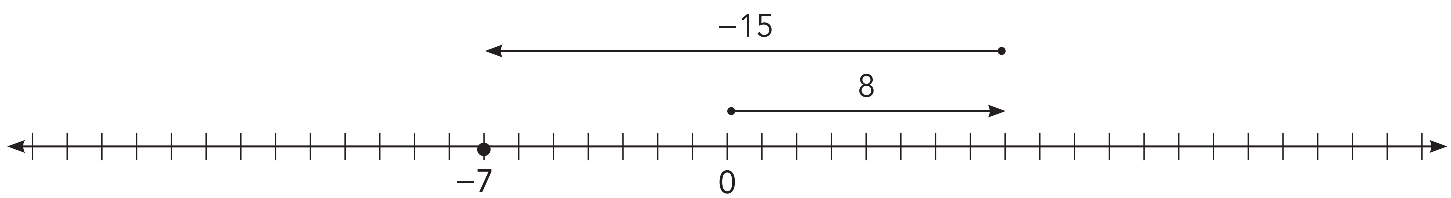
Warm-Up

For each number line model, write the number sentence described by the model and draw a two-color counter model to represent the number sentence.

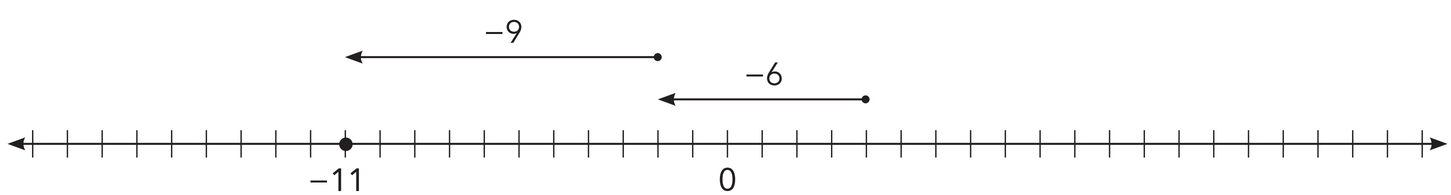
1.



2.

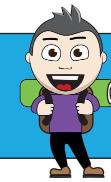


3.



EXPLORE 2

Subtracting Integers with Two-Color Counters

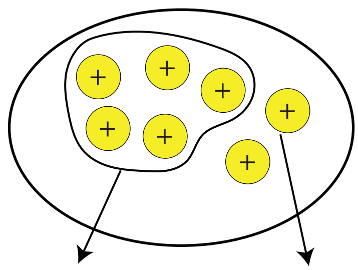


The number line model and the two-color counter model used in the addition of integers can also be used to investigate the subtraction of integers.

WORKED EXAMPLE

Using just positive or just negative counters, you can show subtraction using the "take away" model.

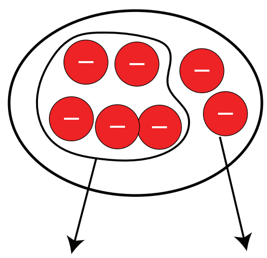
Example 1: 7 – 5
First, start with seven positive counters.



Then, take away five positive counters. Two positive counters remain.

$$7 - 5 = 2$$

Example 2: –7 – (–5)
First, start with seven negative counters.

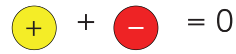


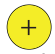
Then, take away five negative counters. Two negative counters remain.

$$-7 - (-5) = -2$$

1. How are Examples 1 and 2 similar? How are these examples different?

To subtract integers using both positive and negative counters, you will need to use zero pairs.

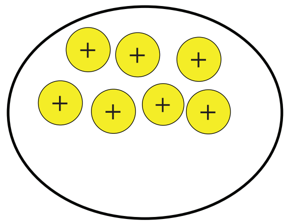


Recall that the value of a  and  pair is zero. So, together they form a **zero pair**. You can add as many pairs as you need and not change the value.

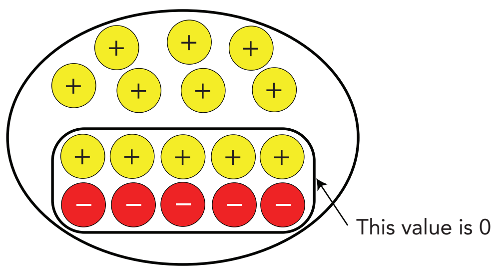
WORKED EXAMPLE

Example 3: 7 – (–5)

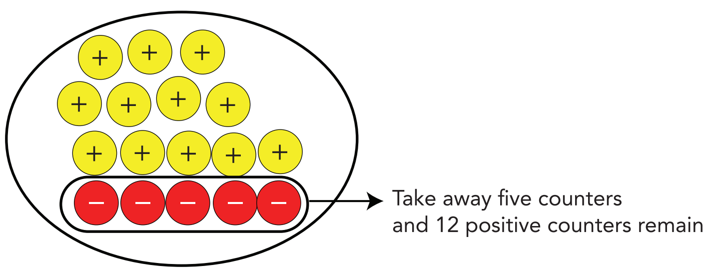
Start with seven positive counters.



The expression says to subtract five negative counters, but there are no negative counters in the first model. Insert five negative counters into the model. So that you don't change the value, you must also insert five positive counters



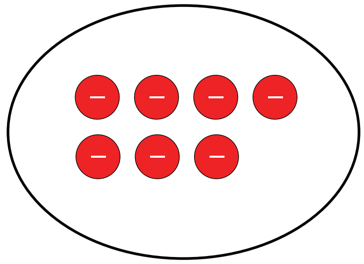
Now, you can subtract, or take away, the five negative counters.



$$7 - (-5) = 12$$

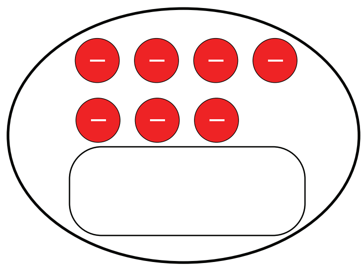
2. Why is the second model equivalent to the original model?

Example 4: $-7 - 5$
Start with seven negative counters.



3. The expression says to subtract five positive counters, but there are no positive counters in the first model.
a. How can you insert positive counters into the model and not change the value?

b. Complete the model.



c. Now, subtract, or take away, the five positive counters. Determine the difference.

4. Draw a representation for each subtraction problem. Then, calculate the difference.

a. $4 - (-5)$

b. $-4 - (-5)$

c. $-4 - 5$

d. $4 - 5$

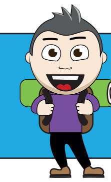
5. How could you model $0 - (-7)$?
a. Draw a sketch of your model. Then, determine the difference.

b. In part (a), does it matter how many zero pairs you add?
Explain your reasoning.

6. Does the order in which you subtract two numbers matter?
Draw models and provide examples to explain your reasoning.

EXPLORE 3

Analyzing Integer Subtraction



You probably have noticed some patterns when subtracting signed numbers on the number line and with two-color counters. Let's explore these patterns to develop a rule.

$-8 - 5 = -13$

$-8 - 4 = -12$

$-8 - 3 = -11$

$-8 - 2 = -10$

$-8 - 1 = -9$

$-8 - 0 = -8$

1. Analyze the number sentences shown.

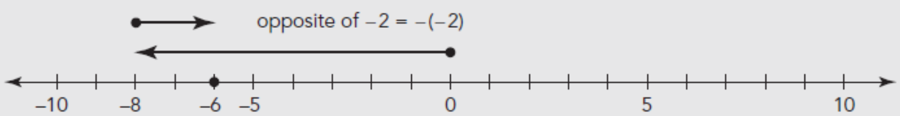
a. What patterns do you see? What happens as the integer subtracted from 28 decreases?

b. From your pattern, predict the answer to −8 − (−1).

Consider the subtraction expression −8 − (−2).

Cara's Method

Start at −8. Since I'm subtracting, you go in the opposite direction of adding (−2), which means I go to the right 2 units. The answer is −6.



Neveah's Method

I see another pattern. Since subtraction is the inverse of addition, you can think of subtraction as adding the opposite number.

$-8 - (-2)$ is the same as $-8 + (+2)$

$-8 + 2 = -6$

2. How is Neveah's method similar to Cara's method?

3. Use Neveah's method to fill in each blank.

10 −2 (−4) = 10 + (_____) = _____

4. Determine each difference.

a. −9 − (−2) = _____

b. −3 − (−3) = _____

c. −7 − 5 = _____

d. 24 − 8 = _____

e. −4 − 2 = _____

f. 5 − 9 = _____

g. −20 − (−30) = _____

h. −10 − 18 = _____

5. Determine the unknown integer in each number sentence.

a. 3 + _____ = 7

b. 2 + _____ = −7

c. _____ + −20 = −10

d. _____− 5 = 40

e. _____ − (−5) = 40

f. _____ + 5 = 40

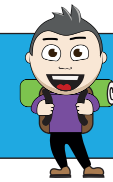
g. 6 + _____ = 52

h. −6 + _____ = 52

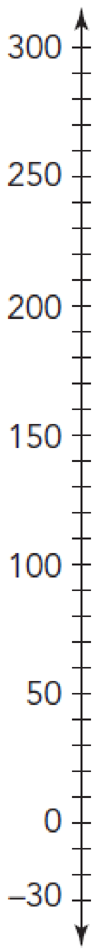
i. −6 + _____ = −52

EXPLORE 4

Distance Between Rational Numbers



Amusement parks are constantly trying to increase the level of thrills on their rides. One way is to make the roller coasters drop faster and farther. A certain roller coaster begins by climbing a hill that is 277 feet above ground. Riders go from the top of that hill to the bottom, which is in a tunnel 14 feet under ground, in approximately 3 seconds!



Determine the vertical distance from the top of the roller coaster to the bottom of the tunnel.

1. Plot the height and depth of the first hill of the roller coaster on the number line.

Consider Christian's and Mya's methods for determining the vertical distance.

Christian

In sixth grade, I learned that you could add the absolute values of each number to calculate the distance.

$$|277| + |-14| = 277 + 14$$

$$= 291$$

The vertical distance is 291 feet.

Mya

I learned in elementary school that the difference between two numbers on a number line can be determined with subtraction. Because absolute value measures distance, I need the absolute value of the difference.

$$|277 - (-14)| = |277 + (+14)|$$
$$= |291|$$
$$= 291$$

The vertical distance is 291 feet.

2. Describe how Christian and Mya used absolute value differently to determine the vertical distance from the top of the roller coaster to the bottom of the tunnel.

3. Carson wonders if order matters. Instead of calculating the distance from the top to the bottom, he wants to calculate the vertical distance from the bottom to the top. Is Carson correct? Determine if Carson is correct using both Christian's strategy and Mya's strategy.

As demonstrated in Mya's strategy, the distance between two numbers on the number line is the absolute value of their difference.
Use Mya's strategy to solve each problem.

4. The first recorded Olympic Games began in 776 BCE. Called the Ancient Olympics, games were held every four years until being abolished by Roman Emperor Theodosius I in 393 CE.

a. Represent the start and end years of the Ancient Olympic Games as integers.

b. Determine the length of time between the start and end of the Ancient Olympic Games.

c. Determine the length of time between the start of the Ancient Olympics and the Modern Olympics, which began in 1896.

d. If you research the ancient calendar, you will learn that there actually was no Year 0. The calendar went from 21 BCE to 1 CE. Adjust your answer from part (c) to account for this.

5. On February 10, 2011, the temperature in Nowata, OK, hit a low of −31°. Over the course of the next week, the temperature increased to a high of 79°. How many degrees different was the low from the high temperature?

Show You KNOW

Determining the Difference

Use what you have learned about adding and subtracting with integers to think about patterns in addition and subtraction.

1. Determine whether these subtraction sentences are always true, sometimes true, or never true. Give examples to explain your thinking.

a. positive 2 positive 5 positive

b. negative 2 positive 5 negative

c. positive 2 negative 5 negative

d. negative 2 negative 5 negative

2. If you subtract two negative integers, will the answer be greater than or less than the number you started with?
Explain your thinking.

Name: ______________________________ Date: ____________ Class: __________

Homework HW

LESSON 5.4b

What's the Difference

Objective Subtracting Integers

Practice

1. Draw both a model using two-color counters and a model using a number line to represent each number sentence. Then, determine the difference.
   a. −8 − (−5)
   b. −4 − 9
   c. 2 − (−8)
   d. 3 − 12
2. Determine each difference without using a number line.
   a. 7 − (−13)
   b. 10 − (−1)
   c. −16 − 3
   d. −9 − 7
   e. −1 − (−2)
   f. −5 − (−5)
   g. 19 − (−19)
   h. −8 − (−8)
   i. 40 − (−20)
   j. −800 − (−300)
3. The highest temperature ever recorded on Earth was 136° F at Al Aziziyah, Libya, in Africa. The lowest temperature ever recorded on Earth was −129° F at Vostok Station in Antarctica. Plot each temperature as an integer on a number line, and use absolute value to determine the difference between the two temperatures.
4. The highest point in the United States is Mount McKinley, Alaska, at about 6773 yards above sea level. The lowest point in the United States is the Badwater Basin in Death Valley, California, at about 87 yards below sea level. Plot each elevation as an integer on a number line, and use absolute value to determine the number of yards between in the lowest and highest points.