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TOPIC

# INTEGERS AND RATIONAL NUMBERS

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Topic Essential Question


How can the properties of operations be used to solve problems involving integers and rational numbers?

Topic Overview

- 1-1 Relate Integers and Their Opposites
- 1-2 Understand Rational Numbers
- 1-3 Add Integers
- 1-4 Subtract Integers
- 1-5 Add and Subtract Rational Numbers
- 1-6 Multiply Integers
- 1-7 Multiply Rational Numbers
- 1-8 Divide Integers
- 1-9 Divide Rational Numbers
- 1-10 Solve Problems with Rational Numbers
- 3-Act Mathematical Modeling: Win Some, Lose Some

Topic Vocabulary

- additive inverse
- complex fraction
- multiplicative inverse
- repeating decimal
- terminating decimal



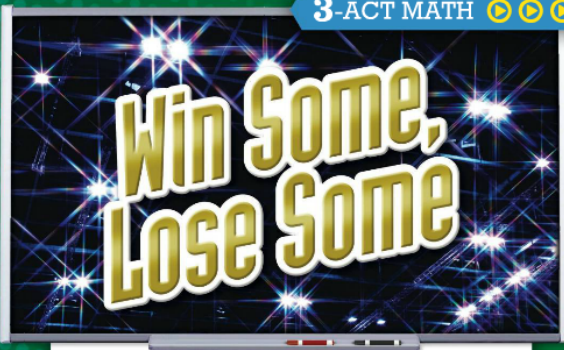
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Lesson Digital Resources

- ▶ **INTERACTIVE ANIMATION** Interact with visual learning animations.
- ▶ **ACTIVITY** Use with *Solve & Discuss It*, *Explore It*, and *Explain It* activities, and to explore Examples.
- ▶ **VIDEOS** Watch clips to support *3-Act Mathematical Modeling Lessons* and *STEM Projects*.
- ▶ **PRACTICE** Practice what you've learned.


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3-ACT MATH ▶▶▶



▶ Win Some, Lose Some

Are you the kind of person who has a lot of knowledge about history, literature, or science? What about pop culture, music, sports, and current events? Some schools have an academic bowl team that competes in tournaments against other schools. The teams are made up of members with strengths in different subject areas. In any quiz competition, it's important to understand the rules and scoring. Think about this during the 3-Act Mathematical Modeling lesson.



Additional Digital Resources

- ▶ **TUTORIALS** Get help from *Virtual Nerd*, right when you need it.
- ▶ **KEY CONCEPT** Review important lesson content.
- ▶ **GLOSSARY** Read and listen to English/Spanish definitions.
- ▶ **ASSESSMENT** Show what you've learned.

- ▶ **MATH TOOLS** Explore math with digital tools.
- ▶ **GAMES** Play Math Games to help you learn.
- ▶ **ETEXT** Interact with your Student's Edition online.

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1 STEM Project

### Did You Know?

**The lowest recorded temperature in the world,  $-136^{\circ}\text{F}$  ( $-93.2^{\circ}\text{C}$ ), occurred in Antarctica.**



**The highest recorded temperature in the world,  $134^{\circ}\text{F}$  ( $56.7^{\circ}\text{C}$ ), occurred in Death Valley, California.**



**The Celsius scale ( $^{\circ}\text{C}$ ) is commonly used for temperature measurement in most of the world.**

**Only a small number of nations, including the United States, regularly use the Fahrenheit scale ( $^{\circ}\text{F}$ ).**



**Windchill, based on the rate of heat loss from exposed skin, can make it feel colder outside than the actual air temperature indicates. Wind chills in some places of the world can dip into the  $-100^{\circ}\text{F}$  range.**



### Your Task: How Cold is Too Cold?

There are many regions of the world with cold temperatures and extreme conditions. How do the inhabitants of these regions adapt and thrive? Do conditions exist that make regions too cold for human living? You and your classmates will explore and describe the habitability of regions with low temperatures.



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Topic 1 STEM Project

## Review What You Know!

GET READY!
1

**Vocabulary**  
Choose the best term from the box. Write it on the blank.

- The \_\_\_\_\_ explains why  $a \times b = b \times a$  and  $a + b = b + a$ .
- The \_\_\_\_\_ of  $-6$  is  $6$ , because it is  $6$  units from zero on the number line.
- The number  $\frac{5}{3}$  is a \_\_\_\_\_ because  $5$  and  $3$  are integers and  $3 \neq 0$ .
- The set of \_\_\_\_\_ consists of the counting numbers, their opposites, and zero.
- The sum of  $(a + b) + c$  is equal to the sum of  $a + (b + c)$  as explained by the \_\_\_\_\_.
- If you evaluate  $n \times (y + z)$  by writing it as  $(n \times y) + (n \times z)$ , you have used the \_\_\_\_\_.

absolute value  
 Associative Property  
 Commutative Property  
 Distributive Property  
 integers  
 rational number

**Add and Subtract Fractions and Decimals**  
Add or subtract.

7.  $2\frac{1}{3} + 6\frac{2}{5}$

9.  $19.86 + 7.091$

8.  $9\frac{1}{10} - 4\frac{3}{4}$

10.  $57 - 10.62$

**Multiply and Divide Fractions and Decimals**  
Multiply or divide.

11.  $4.08 \times 29.7$

13.  $\frac{15}{18} \times 9\frac{1}{5}$

15. Byron has  $1\frac{7}{10}$  kilograms of black pepper. He uses  $\frac{7}{8}$  of the pepper and splits it between 7 pepper shakers. How much pepper will be in each shaker?

Ⓐ  $\frac{119}{80}$  kg
Ⓒ 1.4125 kg

Ⓑ  $\frac{1}{8}$  kg
Ⓓ  $\frac{17}{80}$  kg

12.  $15,183.3 \div 473$

14.  $4\frac{2}{9} \div 1\frac{7}{12}$

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Topic 1 Integers and Rational Numbers
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### Prepare for Reading Success

Use the following questions to help you understand the new ideas in Topic 1.

**Questions Before Reading**

What do I know about integers and rational numbers?

What do I know about fractions and decimals?

What does it mean when two things are opposites?  
How can numbers be opposites?

**Questions During Reading**

Why might a number be positive or negative?

Who uses positive and negative numbers?  
How are integers and rational numbers used in real life?

Where are opposite numbers located on a number line?

**Questions After Reading**

When might I use integers and rational numbers in real life?

Why is it important to know whether a number is positive or negative?

How is adding a positive number to a negative number different from adding two positive numbers or two negative numbers?

**Solve & Discuss It!**

When preparing for a rocket launch, the mission control center uses the phrase "T minus" before liftoff.

...T minus 3, T minus 2, T minus 1, ...

After the rocket has launched, "T plus" is used while the rocket is in flight.

...T plus 1, T plus 2, T plus 3, ...

When does the rocket launch?  
What could "T" represent?

**Reasoning** What integers can you use to represent this situation?

**Lesson 1-1**  
Relate Integers and Their Opposites

**I can...**  
relate integers, their opposites, and their absolute values.



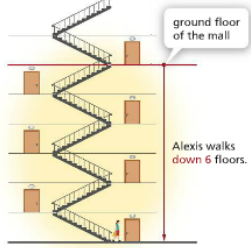
**Focus on math practices**

**Reasoning** How are "T minus 4" and "T plus 4" related?

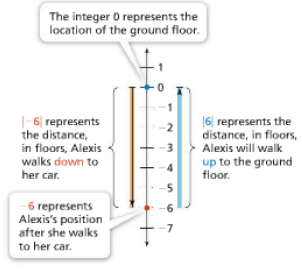
**Essential Question** How are integers and their opposites related?

**EXAMPLE 1** Combine Opposite Quantities to Make 0

Alexis was shopping on the ground floor of the mall when she realized she had left her phone in her car. She walks down 6 floors to her car in the underground parking garage. How far will Alexis walk to get back to the ground floor? Use integers to explain.



Use integers on a number line to represent the situation.



The integer 0 represents the location of the ground floor.

$-6$  represents the distance, in floors, Alexis walks down to her car.

$6$  represents Alexis's position after she walks to her car.

$6$  represents the distance, in floors, Alexis will walk up to the ground floor.

$-6$  and  $6$  are opposites. Opposite quantities combine to make 0.

$-6 + 6 = 0$

Alexis will walk the same distance, 6 floors, in the opposite direction to get back to the ground floor.

**Try It!**

Xavier climbs 9 feet up into an apple tree. What integer represents the direction and how far he will climb to get back down to the ground? What does the integer 0 represent in this situation?

The integer  represents Xavier's climb down.

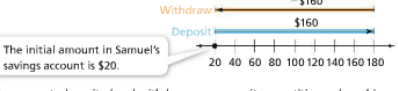
The integer 0 represents .

**Convince Me!** How are the absolute values of opposite integers related?

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**EXAMPLE 2** Combine Opposite Quantities

Samuel has \$20 in his savings account before he makes a deposit of \$160. After 2 weeks, he withdraws \$160. How did Samuel's savings account balance change?



The initial amount in Samuel's savings account is \$20.

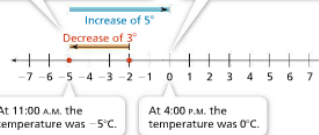
The amounts deposited and withdrawn are opposite quantities and combine to make 0. Samuel's account balance did not change because the amounts deposited and withdrawn combine to make 0.

**Try It!**

The temperature was  $75^\circ$ . At noon, the temperature increased  $7^\circ$ . By evening, the temperature decreased by  $7^\circ$ . How did the temperature change?

**EXAMPLE 3** Represent Change Using Integers

One winter morning, the temperature was  $-2^\circ\text{C}$ . By 11:00 A.M., the temperature had decreased by  $3^\circ$ . At 4:00 P.M., the temperature reached  $0^\circ\text{C}$ . What integer represents the temperature change from 11:00 A.M. to 4:00 P.M.?



Start at  $-2$ . The integer  $-3$  represents the temperature decrease, so move 3 units left. The temperature has a change of  $-3$ .

Next, move 5 units right to show the temperature increase to  $0^\circ\text{C}$ . The temperature has a change of 5.

At 11:00 A.M. the temperature was  $-5^\circ\text{C}$ .

At 4:00 P.M. the temperature was  $0^\circ\text{C}$ .

The integer 5 represents the temperature change from 11:00 A.M. to 4:00 P.M.

**Try It!**

Shaniqua has \$45 in her wallet. She spends \$4 on snacks and \$8 on a movie ticket. What integer represents the change in the amount of money in Shaniqua's wallet? How much money does she have left?

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**KEY CONCEPT**  
An integer,  $n$ , and its opposite,  $-n$ , combine to make 0.

**Do You Understand?**  
1. **Concepts in Context** How are integers and their opposites related?  
**Integers and their opposites are related by...**

2. **Reasoning** In order for an atom to have a zero charge, every proton, which has a charge of  $+1$ , must be matched with an electron which has a charge of  $-1$ . A helium atom has 2 protons and 2 electrons. Explain why a helium atom has a zero charge.  
**A helium atom has a zero charge since each  $+1$  proton pairs up with a  $-1$  electron.**

3. **Model with Math** Explain how to use a number line to show that opposite quantities combine to make 0.  
**A number line can be used to show that opposite quantities combine to make zero by....**

**Do You Know How?**  
4. Marcus dives from the surface of the ocean to  $-18$  feet below sea level. What integer represents Marcus's position relative to the surface? How far does Marcus have to go to return to the surface?  
 **$-18$  represents his location relative to the surface after diving. Marcus has to go  $+18$  meters up to get back to the surface.**

5. The temperature of the water in Emily's hot tub was  $78^\circ\text{F}$  on Sunday. The water temperature changed by  $-3^\circ$  on Monday, and then by  $3^\circ$  on Tuesday. What integer represents the temperature change of the water from Sunday to Tuesday? What was the water temperature on Tuesday?

6. The scores of players on a golf team are shown in the table. The team's combined score was  $-5$ . What was Travis's score?

Golfer	Score
Celia	$-3$
Janine	$0$
Sam	$0$
Ted	$0$
Travis	$+8$

**$+8 + -3 \rightarrow +5$**

$\begin{matrix} -3 \\ 3 \end{matrix} = 0$   
 $\begin{matrix} 1 \\ 4 \end{matrix} \} +5$   
Travis needs to score  $-5$  to get a total team score of  $0$ .

Name: \_\_\_\_\_

**Practice & Problem Solving**

**Leveled Practice** In 7-9, write the integer that represents the situation.

7. Max spent  $\$53$  and now has no money left. He had  $\$53$  before his purchase.

8. The temperature was  $8^\circ\text{F}$ . It dropped so that the temperature was  $0^\circ\text{F}$ .  $-8^\circ\text{F}$  represents the change in temperature.

9. An airplane descended 4,000 feet before landing. The integer that represents how many feet the airplane was above the ground before its descent is  $4,000$ .

10. Carolyn says that point A and point B represent opposite integers.  
a. What is the opposite of the integer represented by point A? By point B?  
**The opposite of A is  $+7$ .**

b. **Construct Arguments** Do you agree with Carolyn? Explain.  
 **$B = +8$   
The opposite of B is  $-8$ .**

11. A football team lost 9 yards during a play. The team had a combined gain or loss of 0 yards after the next play. What integer represents the yards gained or lost on the next play? Show this on the number line.

12. A roller coaster car goes above and below ground. Use the number line to show its changes in height. What is the height of the car at the end of the ride?

13. Dimitri is buying a car. He chooses Option 1 to add a new sound system to his car. What integer represents the change from the base price of the car to its final price?

Dimitri's Car Price Sheet	
Base Price	\$7,000.00
Sale	-\$700.00
Opt. 1	+\$1,400.00
Markdown	-\$1,100.00

14. **Make Sense and Persevere** What values do  $x$  and  $y$  have if  $|x| = 16$ ,  $|y| = 16$ , and when  $x$  and  $y$  are combined they equal 0? Explain your reasoning.

15. Write a situation that can be represented by the opposite of  $-42$ .

16. **Higher Order Thinking** Three friends all live on the same street that runs west to east. Beth lives 5 blocks from Ann. Carl lives 2 blocks from Beth. If the street is represented by a number line and Ann's house is located at 0, what are the possible locations for Carl's house? Assume that each unit on the number line represents 1 block.

**Assessment Practice**

17. Which of these situations can be represented with an integer that when combined with the opposite of  $-9$  makes 0? Select all that apply.

- You walk down 9 flights of stairs.
- You climb up 9 flights of stairs.
- The temperature drops  $9^{\circ}\text{F}$ .
- You spend \$9 on a book.
- You earn \$9 from your job.

18. Which of these situations can be represented by the opposite of 80? Select all that apply.

- An airplane descends 80 m. ↓
- An elevator ascends 80 m. ↑
- The cost of a train ticket drops by \$80. -
- You remove 80 songs from an MP3 player. -
- Suzy's grandmother is 80 years old. +

MOR 80

- 80

