



Lesson 9: Comparing Integers and Other Rational Numbers

Student Outcomes

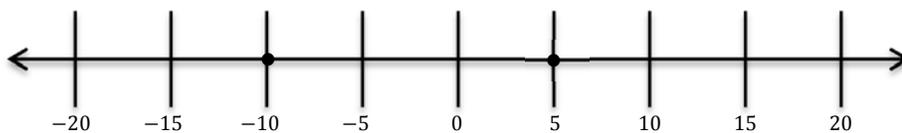
- Students compare and interpret rational numbers' order on the number line, making statements that relate the numbers' location on the number line to their order.
- Students apply their prerequisite knowledge of place value, decimals and fractions to compare integers and other rational numbers.
- Students relate integers and other rational numbers to real world situations and problems.

Classwork

Example 1 (3 minutes): Interpreting Number Line Models to Compare Numbers

Refer to the number line diagram below, which is also located in the student materials. In a whole group discussion, create a real-world situation that relates to the numbers graphed on the number line. Students should contribute suggestions to help the story evolve and come to a final state. Students write the related story in their student materials.

Example 1: Interpreting Number Line Models to Compare Numbers



(Answers may vary.) Every August, the Boy Scouts go on an 8-day 40 mile hike. At the half-way point (20 miles into the hike), there is a check-in station for scouts to check in and register. Thomas and Evan are scouts in 2 different hiking groups. By Wednesday morning, Evan's group has 10 miles to go before they reach the check-in station and Thomas' group is 5 miles beyond the station. Zero on the number line represents the check-in station.

Exercise 1 (7 minutes)

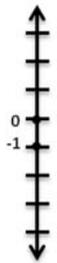
Display the following vertical number line model on the board. Students are to independently interpret the number line model to describe a real world situation involving these two rational numbers. Remind students to compare the numbers and describe their order in their write-up. After allowing adequate time for students to write their solutions, several students share what they wrote with the class. Students in the class determine whether or not the written response correctly relates to the number line model.

Scaffolding:

Provide a story starter for students who are struggling to begin the writing task.

Exercises

1. Create a real-life situation that relates to the points shown in the number line model. In your write-up, be sure to describe the relationship between the values of the two points and how it relates to their order on the number line.



(Answers will vary.)

Alvin lives in Canada and is recording the outside temperature each night before he goes to bed. On Monday night, he recorded a temperature of zero degrees Celsius. On Tuesday night, he recorded a temperature of -1 degrees Celsius. Tuesday night's temperature was colder than Monday night's temperature. Negative one is less than zero, so the associated point is below zero on a vertical number line.

Example 2 (10 minutes)

Students are seated in groups of three or four and each group is given a set of Activity Cards. For each group, photocopy, cut out, and scramble both sheets of Activity Cards that appear at the end of this lesson.

- Each group of students matches each word story card to its related number line card.
- For each number line diagram, students must write a statement relating the numbers' placement on the number line to their order.
- If time permits, the class goes over each answer as a whole group. For each number line diagram, students present their written statement as a verbal statement to the class.
- An example follows:

<p>The Navy Seals are practicing new techniques. The blue submarine is 450 ft. below sea level, while the red submarine is 375 ft. below sea level.</p>	
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- *The blue submarine is farther below sea level than the red one because -450 is to the left of -375 on the number line; it is less than -375 .*

Exercises 2–8 (15 minutes)

Students read each of the following scenarios and decide whether they agree or disagree. They must defend and explain their stance in writing. Allow time for students to share their answers with the class and explain their reasoning. The class should come to a consensus for each one.

MP.2
&
MP.3

Scaffolding:

Provide a set of horizontal and vertical number lines for visual learners to create a number line model for each exercise.

For each problem, determine if you *agree* or *disagree* with the representation. Then *defend your stance* by citing specific details in your writing.

2. Felicia needs to write a story problem that relates to the order in which the numbers $-6\frac{1}{2}$ and -10 are represented on a number line. She writes the following:
 “During a recent football game, our team lost yards on two consecutive downs. We lost $6\frac{1}{2}$ yards on the first down. During the second down our quarterback was sacked for an additional 10 yard loss. On the number line, I represented this situation by first locating $-6\frac{1}{2}$. I located the point by moving $6\frac{1}{2}$ units to the left of zero. Then I graphed the second point by moving 10 units to the left of 0.”
Agree. -10 is less than $-6\frac{1}{2}$ since -10 is to the left of $-6\frac{1}{2}$ on the number line. Since both numbers are negative, they indicate the team lost yards on both football plays, but they lost more yards on the second play.
3. Manuel looks at a number line diagram that has the points $-\frac{3}{4}$ and $-\frac{1}{2}$ graphed. He writes the following related story:
 “I borrowed 50 cents from my friend, Lester. I borrowed 75 cents from my friend, Calvin. I owe Lester less than I owe Calvin.”
Agree. -0.50 and -0.75 both show that he owes money. But, -0.50 is closer to zero, so Manuel does not owe Lester as much as he owes Calvin.
4. Henry located $2\frac{1}{4}$ and 2.1 on a number line. He wrote the following related story:
 “In gym class both Jerry and I ran for 20 minutes. Jerry ran $2\frac{1}{4}$ miles and I ran 2.1 miles. I ran a farther distance.”
Disagree. $2\frac{1}{4}$ is greater than 2.1, since $2\frac{1}{4}$ is equivalent to 2.25. On the number line the point associated with, 2.25 is to the right of 2.1. Jerry ran a farther distance.
5. Sam looked at two points that were graphed on a vertical number line. He saw the points -2 and 1.5. He wrote the following description:
 “I am looking at a vertical number line that shows the location of two specific points. The first point is a negative number, and so it is below zero. The second point is a positive number, and so it is above zero. The negative number is -2 . The positive number is $\frac{1}{2}$ unit more than the negative number.”
Disagree. Sam was right when he said the negative number is below zero, and the positive number is above zero. But 1.5 is $1\frac{1}{2}$ units above zero. And -2 is 2 units below zero. So, altogether that means the positive number is $3\frac{1}{2}$ units more than -2 .
6. Claire draws a vertical number line diagram and graphs two points: -10 and 10. She writes the following related story:
 “These two locations represent different elevations. One location is 10 feet above sea level, and one location is 10 feet below sea level. On a number line, 10 feet above sea level is represented by graphing a point at 10, and 10 feet below sea level is represented by graphing a point at -10 .”
Agree. Zero in this case represents sea level. Both locations are 10 feet from zero, but in opposite directions, so they are graphed on the number line at 10 and -10 .
7. Mrs. Kimble, the sixth grade math teacher, asked the class to describe the relationship between two points on the number line, 7.45 and 7.5, and to create a real-world scenario. Jackson writes the following story:
 “Two friends, Jackie and Jennie, each brought money to the fair. Jackie brought more than Jennie. Jackie brought \$7.45 and Jennie brought \$7.50. Since 7.45 has more digits than 7.5, it would come after 7.5 on the number line, or to the right, so it is a greater value.”
Disagree. Jackson is wrong by saying that 7.45 is to the right of 7.5 on the number line. 7.5 is the same as 7.50, and it is greater than 7.45. When I count by hundredths starting at 7.45, I would say 7.46, 7.47, 7.48, 7.49, and then 7.50. So 7.50 is greater than 7.45, and the associated point falls to the right of the point associated with 7.45 on the number line.

8. Justine graphs the points associated with the following numbers on a vertical number line: $-1\frac{1}{4}$, $-1\frac{1}{2}$, and 1. He then writes the following real-world scenario:
 “The nurse measured the height of three sixth grade students and compared their heights to the height of a typical sixth grader. Two of the students’ heights were below the typical height, and one was above the typical height. The point whose coordinate is 1 represented the student who had a height that was 1 inch above the typical height. Given this information, Justine determined that the student represented by the point associated with $-1\frac{1}{4}$ was the shortest of the three students.”

Disagree. Justine was wrong when she said the point $-1\frac{1}{4}$ represents the shortest of the three students. If zero stands for no change from the typical height, then the point associated with $-1\frac{1}{2}$ is farther below zero than the point associated with $-1\frac{1}{4}$. The greatest value is positive 1. The tallest person is represented by positive one. The shortest person would be represented by $-1\frac{1}{2}$.

MP.2
&
MP.3

Closing (4 minutes)

- How can you use the number line to order a set of numbers? Will graphing the numbers on a vertical rather than horizontal number line change this process?
 - *You can locate and graph the numbers on the number line to determine their order. If you use a vertical number line, their order will be the same as it would be on a horizontal number line, but instead of moving from left to right to go from least to greatest, you would move from bottom to top. To determine the order of a set of numbers, the number that is farthest left (or farthest down on a vertical number line) is the least value. As you move right (or towards the top on a vertical number line), the numbers increase in value. So, the greatest number will be graphed farthest right on a number line (or the highest one on a vertical number line).*
- If two points are graphed on a number line, what can you say about the value of the number associated with the point on the right in comparison to the value of the number associated with the point on the left?
 - *The number associated with the point on the right is greater than the number associated with the point on the left.*
- Which number is larger: -3.4 or $-3\frac{1}{2}$? How will graphing these numbers on a number line help you make this determination?
 - *Whichever number is graphed farthest to the left is the smaller number. In this example, $-3\frac{1}{2}$ would be graphed to the left of -3.4 , so it would be the smaller number. You can compare the numbers to make sure they are graphed correctly by either representing them both as a decimal or both as a fraction. $-3\frac{1}{2}$ is halfway between -3 and -4 . So, if I divide the space into tenths, the associated point would be at -3.5 since $-3\frac{1}{2} = -3\frac{5}{10}$. When I graph -3.4 , it would be 0.1 closer to -3 , so it would be to the right of $-3\frac{1}{2}$. This means -3.4 is larger than $-3\frac{1}{2}$.*

Exit Ticket (6 minutes)

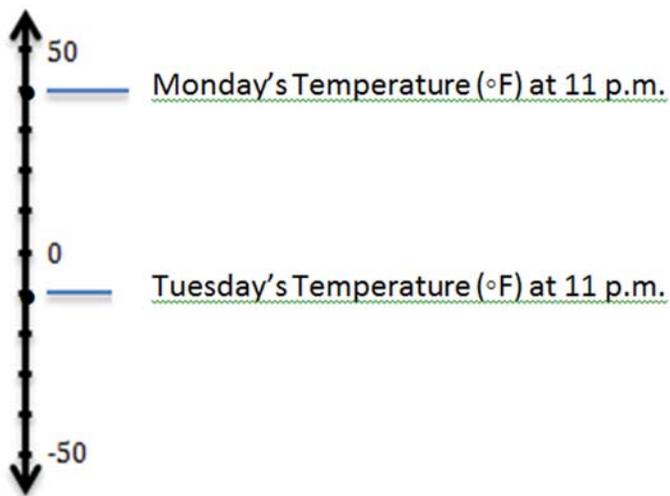
Name _____

Date _____

Lesson 9: Comparing Integers and Other Rational Numbers

Exit Ticket

1. Interpret the number line diagram shown below and write a statement about the temperature for Tuesday compared to Monday at 11:00 p.m.



2. If the temperature at 11:00 p.m. on Wednesday is warmer than Tuesday's temperature, but still below zero, what is a possible value for the temperature at 11:00 p.m. Wednesday?

Exit Ticket Sample Solutions

1. Interpret the number line diagram shown below and write a statement about the temperature for Tuesday compared to Monday at 11:00 p.m.

At 11:00 p.m. the temperature on Monday was about 40 degrees Fahrenheit but, on Tuesday it was -10 degrees. Tuesday's temperature of -10 degrees is below zero, but 40 degrees is above zero. It was much warmer on Monday at 11:00 p.m. than on Tuesday at that time.

2. If the temperature at 11:00 p.m. on Wednesday is warmer than Tuesday's temperature, but still below zero, what is a possible value for the temperature at 11:00 p.m. Wednesday?

A possible temperature for Wednesday at 11:00 p.m. is -3 degrees Fahrenheit, because -3 is less than zero and greater than -10 .

Problem Set Sample Solutions

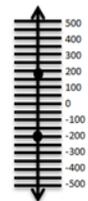
Write a story related to the points shown in each graph. Be sure to include a statement relating the numbers' graphs on the number line to their order.

- 1.



Marcy earned no bonus points on her first math quiz. She earned 4 bonus points on her second math quiz. Zero represents earning no bonus points and 4 represents earning 4 bonus points. Zero is graphed to the left of 4 on the number line; Zero is less than 4.

- 2.



My uncle's investment lost \$200 in May. In June, the investment gained \$150. The situation is represented by the points -200 and 150 on the vertical number line. Negative 200 is below zero and 150 is above zero; -200 is less than 150.

- 3.



I gave my sister \$1.50 last week. This week I gave her \$0.50. The points -1.5 and -0.5 represent the change to my money supply. We know that -1.50 is to the left of -0.50 on the number line; -0.50 is greater than -1.50 .

- 4.



A fish is swimming 7 feet below the water's surface. A turtle is swimming 2 feet below the water's surface. We know that -7 is to the left of -2 on the number line. This means -7 is less than -2 .

- 5.



I spent \$8 on a CD last month. I earned \$5 in allowance last month. -8 and 5 represent the changes to my money last month. -8 is to the left of 5 on a number line. -8 is 3 units farther away from zero than 5 is, which means I spent \$3 more money on the CD than I made in allowance.

6.



Skip, Mark and Angelo were standing in line in gym class. Skip was the third person behind Mark. Angelo was the first person ahead of Mark. If Mark represents zero on the number line, then Skip is associated with the point at -3 and Angelo is associated with the point at 1 . 1 is 1 unit to the right of zero and -3 is 3 units to the left of zero. -3 is less than 1 .

7.



I rode my bike $\frac{3}{5}$ miles on Saturday and $\frac{4}{5}$ miles on Sunday. On a vertical number line, $\frac{3}{5}$ and $\frac{4}{5}$ are both associated with points above zero, but $\frac{4}{5}$ is above $\frac{3}{5}$. This means that $\frac{4}{5}$ is greater than $\frac{3}{5}$.

Activity Cards - Page 1

<p>The Navy Seals are practicing new techniques. The blue submarine is 450 ft. below sea level, while the red submarine is 375 ft. below sea level.</p>		<p>Dolphins love to jump out of the water. Dolly, the dolphin, can jump 5 meters above the water and swim 450 meters below the surface of the water.</p>	
<p>Colorado is known for drastic changes in temperatures. Tuesday morning the temperature was 32°F, but Tuesday night temperature was -3°F.</p>		<p>The high school football team lost 8 yards on first down. On second down, the team gained 5 yards.</p>	
<p>Holly sold lemonade two days in a row. On Saturday, Holly earned \$5.75. On Sunday, Holly earned \$3.25.</p>		<p>In golf, the lowest score wins. Pete's final score was -2 and Andre's final score was -5.</p>	

Activity Cards - Page 2

<p>Teagon earned \$450 last month cutting grass. Xavier spent \$375 on a new computer.</p>		<p>Jayden has earned 3 bonus points completing math extra credit assignments, while Shontelle has earned 32 bonus points.</p>	
<p>Kim and her friend Stacey went to the book store. Stacey spent \$8 on notebooks. Kim spent \$5 on snacks and pencils.</p>		<p>Last month, the stock market dropped $5\frac{3}{4}$ points overall. So far this month, the stock market rose $3\frac{1}{4}$ points.</p>	
<p>At a beach in California, if a person stands in the water they are $\frac{1}{5}$ ft. below sea level. If the person walks onto the beach they are $\frac{2}{5}$ ft. above sea level.</p>		<p>Brittany went to an office supply store twice last week. The first time she made 2 copies that cost \$0.20 each. The second time she did not buy anything, but found 2 dimes in the parking lot.</p>	