Mathematics Instructional Cycle Guide

Add and Subtract Rational Numbers using a Number Line (7.NS.1)

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Connecticut Dream Team teacher

CT CORE STANDARDS

This Instructional Cycle Guide relates to the following *Standards for Mathematical Content* in the *CT Core Standards for Mathematics*:

CCSS.MATH.CONTENT.7.NS.1 *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.*

> **CCSS.MATH.CONTENT.7.NS.1c**
> *Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.*

This Instructional Cycle Guide also relates to the following *Standards for Mathematical Practice* in the *CT Core Standards for Mathematics*:

MP.4. Model with mathematics.
Students apply their knowledge of number lines and integer addition and subtraction to solve problems in everyday life, including finding the change in temperature and the distance between two points.

M.P.2. Reason abstractly and quantitatively.
Students attend to the meaning of the quantities in the problem to make sense of the real-life situation, and are able to abstract the problem and represent it symbolically with a number line and an equation.

WHAT IS INCLUDED IN THIS DOCUMENT?

- A **Mathematical Checkpoint** to elicit evidence of student understanding and identify student understandings and misunderstandings **(page 2)**
- A **Student Response Guide** with examples of student work to support the analysis and interpretation of student work on the Mathematical Checkpoint **(pages 3-6)**
- A **Follow-up Lesson Plan** designed to use the evidence from the student work and address the student understandings and misunderstandings revealed **(pages 7-12)**
- Supporting **Lesson Materials (pages 13 - 20)**
- Precursory **Research and Review of Standard 7.NS.1** and assessment items that illustrate the standard **(pages 21-24)**

HOW TO USE THIS DOCUMENT

1) Before the lesson, administer the ***Temperature Change Checkpoint*** individually to students to elicit evidence of student understanding.
2) Analyze and interpret the student work using the ***Student Response Guide***.
3) Use the next steps or ***Follow-up Lesson Plan*** to support planning and implementation of instruction to address student understandings and misunderstandings revealed by the Mathematical Checkpoint.
4) Make instructional decisions based on the checks for understanding embedded in the follow-up lesson plan.

MATERIALS REQUIRED

- **List needed lesson materials here**

TIME NEEDED

Temperature Change Checkpoint administration: 15 minutes
Follow-Up Lesson Plan: 1 to 2 instructional blocks

Timings are only approximate. Exact timings will depend on the length of the instructional block and needs of the students in the class.

<table>
<tr><th colspan="3">Step 1: Elicit evidence of student understanding</th></tr>
<tr><th colspan="3">Mathematical Checkpoint</th></tr>
<tr><th>Question(s)</th><th colspan="2">Purpose</th></tr>
<tr><td rowspan="2">1. Monique and Matt both solved the following math problem:

If the temperature drops from 7ºF to −17ºF, what is the change in temperature?

• Monique said the change is 24ºF.
• Matt said the change is 10ºF.

Who is correct?
a.) Monique
b.) Matt
c.) neither

Explain the correct answer by writing an <u>equation</u> and showing your work on a <u>vertical number line</u> diagram.

Equation: _____

Vertical Number Line</td><td>CT Core Standard:</td><td>7.NS. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
• 7.NS.1. 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.
○ 7.NS.1c Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (-q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.</td></tr>
<tr><td>Target question addressed by this checkpoint:</td><td>Do students understand how to use a number line diagram to find the distance between a positive and a negative number? Can they:

• Write an equation to represent distance between two signed numbers?
• Use an equation to calculate difference between 2 integers?
• Use a vertical number line to find distance between integers?</td></tr>
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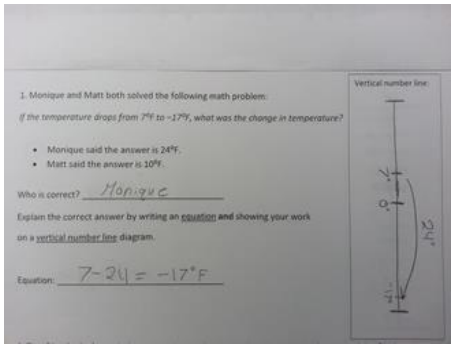
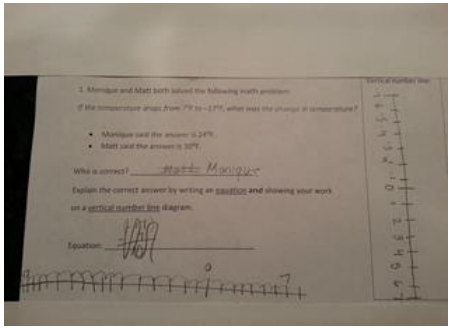
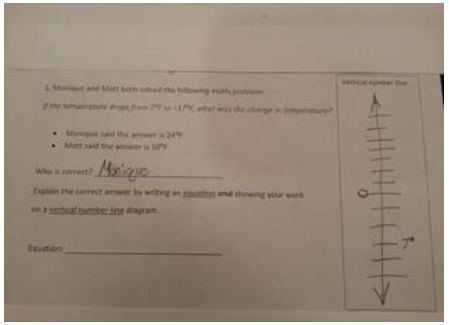
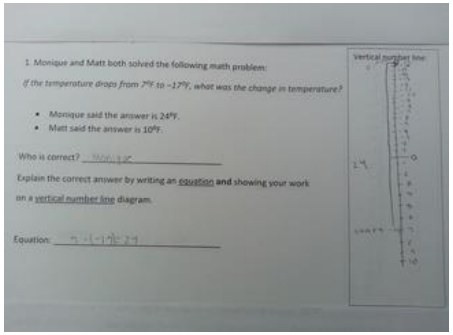
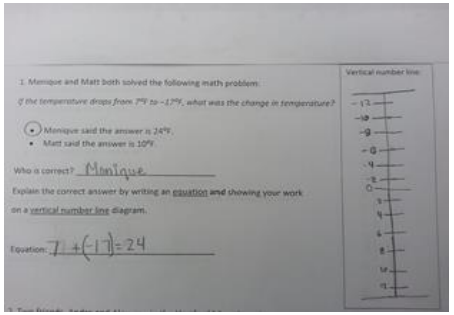
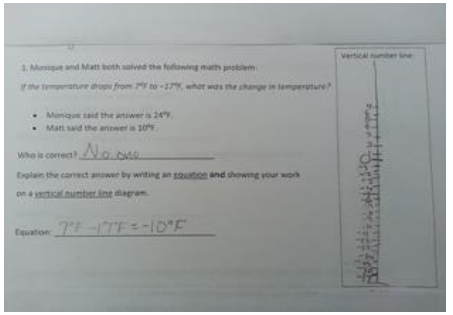
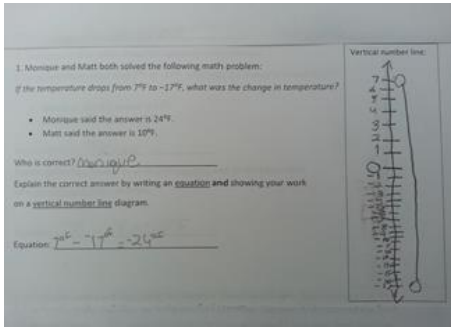
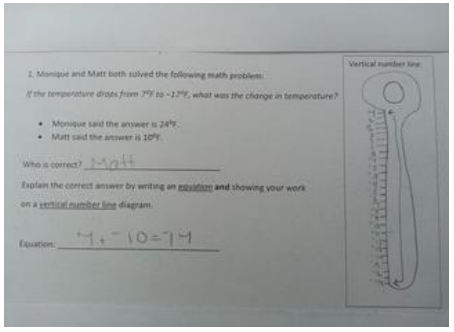
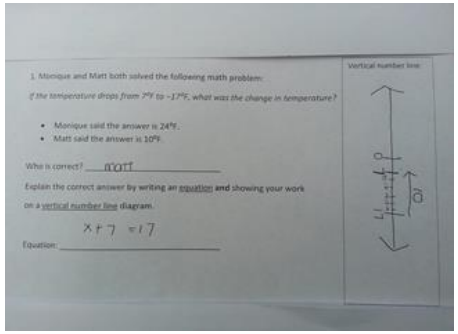
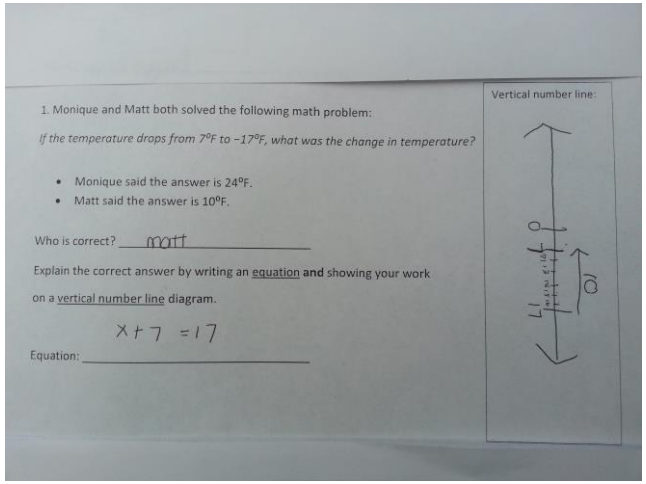
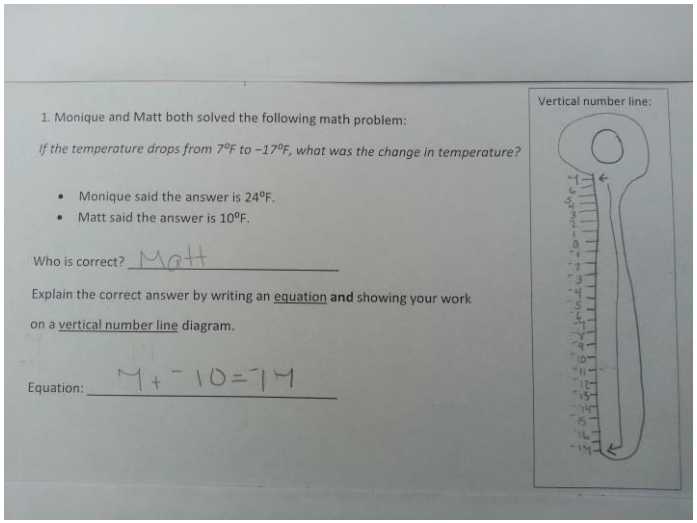
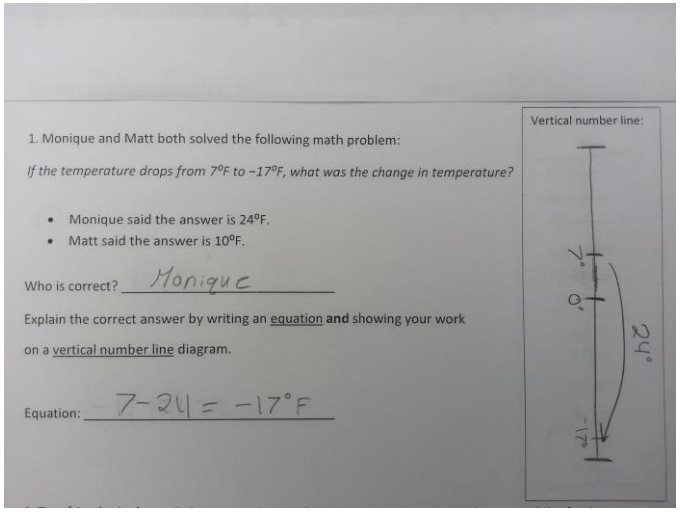
Step 2: Analyze and Interpret Student Work		
Student Response Guide		
Got It	**Developing**	**Getting Started**
		
		
		

Getting Started	
Student Response Example	**Indicators**
	• Student may have made the correct choice of Monique but not have been able to justify their answer with either a number line or an equation. • Student does not understand how to represent the situation with either a vertical number line or an equation. • Student may have incorrectly chosen Matt as the person with the correct solution and justified the choice with incorrect equation and/or number line. • What possible indicators may be included in a student response who has demonstrated minimal understanding of the standard? • What strategies, and representations will or will not be used? What understandings or procedural fluency does the student response reveal? • What undeveloped understandings, misconceptions, and common mistakes may be revealed in the student response to this item?
In the Moment Questions/Prompts	**Closing the Loop (Interventions/Extensions)**
P: Tell me about your equation. Did you solve it? Does the answer make sense with the temperature problem? **Q: Does the solution to your equation match the solution you've chosen as the answer to the given temperature problem? If not, why not?** **P: Look at your vertical number line. Does it look like a thermometer? Are the positive and negative numbers in the right positions?** **Q: Do the numbers on your number line match the numbers in the problem?** **P: Can you count the numbers on a number line between 7 and -17? How many are there?**	• Using black and white (or different colored) interlocking cubes, demonstrate with the students how positive and negative units line up either in a horizontal or vertical direction. • Using the integer cubes, practice finding total units of positive and negative blocks. Relate this to temperature change. • Give students a paper number line that they can turn vertical like a thermometer. • Model using the vertical number line to find change in temperature; relate this to distance on the number line. • http://learnzillion.com/lessons/3082-subtract-integers-using-number-lines • http://learnzillion.com/lessons/677-determine-the-distance-between-integers-by-examining-absolute-value-and-number-lines

Developing	
Student Response Example	**Indicators**
	• Students may select Monique as the student who solved the problem correctly, but may not be able to demonstrate understanding by either writing an equation or showing the temperature drop on a vertical number line. • Students may indicate understanding of distance on a number line by drawing a vertical number line, but does not know how to use the number line to find the drop in temperature. • Students may draw a vertical number line incorrectly, writing negative integers on top and positive integers on the bottom. • Students may or may not be able to correctly represent the situation with an accurate equation. • Students may or may not demonstrate procedural fluency with integer operations, specifically subtraction. •
In the Moment Questions/Prompts	**Closing the Loop (Interventions/Extensions)**
P/Q: Tell me about your equation. Why did you write it in this way? Is there another way to write the equation to represent the problem? **P: Tell me about your vertical number line and where you put the numbers from the problem.** **P/Q: Did you check the solution to your equation? Is it correct?** **Q: How does your equation correctly represent the situation in the problem? Does your answer from your equation match the temperature change represented in your number line?**	• Give students a number line that they can turn vertical like a thermometer. • Model using the vertical number line to find change in temperature; relate this to distance on the number line. • Demonstrate how to translate the temperature change/ distance on a number line as a subtraction problem: in this case, 7 – (-17) = 24 • http://learnzillion.com/lessons/3064-subtract-integers-using-distance-on-a-number-line • http://learnzillion.com/lessons/1030-find-the-distance-between-two-points-using-absolute-value

Got it	
Student Response Example	**Indicators**
	• Students will select Monique as the person who correctly answered the temperature drop problem. • Students will write an equation with integer subtraction that demonstrates understanding of the situation: 7 – (-17) = 24 • Students will draw a vertical number line similar to a thermometer that has the positive integers above zero and the negative integers below zero, and may or may not indicate distance on that number line. • What indicators must be included in an exemplar student response • What strategies, and representations will or will not be used? What understandings or procedural fluency does the student response reveal? • What undeveloped understandings, misconceptions, and common mistakes may be revealed in the student response to this item?
In the Moment Questions/Prompts	**Closing the Loop (Interventions/Extensions)**
P: Tell me about your equation and your number line. How do they represent the solution to the problem? **Q: Is there another equation that would also represent the temperature change problem?** **Q: Why is the answer NOT 10º? How would you explain to someone why this doesn't make sense?** **Q: Can you think of another situation where the same equation and number line could be used to represent the situation?**	• Have students explain their reasoning / justify their solution using their equation and number line. • Have students analyze other equations that would represent the problem and explain the thinking behind those equations. • Have students create alternate situations where they would use subtraction of integers to solve the problem. • **http://learnzillion.com/lessons/1031-subtract-rational-numbers-in-realworld-contexts** • **http://learnzillion.com/lessons/3104-subtract-rational-numbers-using-an-algorithm**

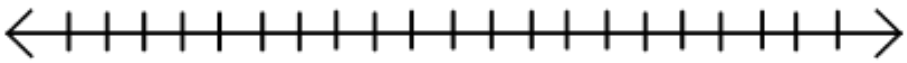
Steps 3 and 4: Act on Evidence from Student Work and Adjust Instruction	
Lesson Objective:	Students will solve a real-world problem that may be explained by writing an integer equation and by drawing a number line to represent the problem.
Content Standard(s):	**7.NS.1** *Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.* **7.NS.1c** *Understand subtraction of rational numbers as adding the additive inverse, p − q = p + (-q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.*
Targeted Practice Standard :	**4. Model with mathematics.** Do students apply their knowledge of integer addition and subtraction and number lines to solve problems in everyday life like finding the change in temperature and distance between two points? **2. Reason abstractly and quantitatively.** Do students attend to the meaning of the quantities in the problem to make meaning of the real-life situation? Are students able to abstract the problem and represent it symbolically with a number line and an equation?

Mathematical Goals	Success Criteria
Understand change in temperature as a subtraction problem that can be represented with an equation or on a vertical number line. *Understand that subtraction of integers as adding the additive inverse.* *Understand how to represent distance between two rational numbers on a number line as the absolute value of their difference.*	*Students will select Monique as the person who solved the problem correctly.* *Students will write an equation that accurately represents the situation, using integer subtraction.* *Students will draw a vertical number line to represent the change in temperature.* *Students will see the relationship between the answer chosen with the equation and the number line they created to justify their answer choice.*

Launch (Probe and Build Background Knowledge)

Purpose: ***Assess and activate background knowledge about integer number lines and distance on a number line.***

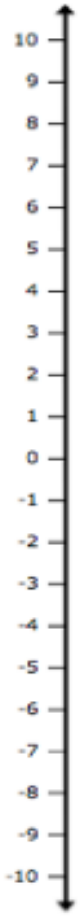
1. Give the students a blank number line (p. 14) and ask them to label the tic marks with the numbers from -10 to +10.



1a) Turn and Talk: Students should compare their number lines with a partner, and come to consensus if the number lines differ. Optional: give partners a red and a green plastic cup – students should put the green cup on top if they agree and the red cup on top if they don't agree and need some help.

1b) Project/show the following number line, and direct the students to compare their number line with the labeled number line (p.15), and make any changes as needed.

2. Give the students another blank number line, and this time tell them to hold it vertically and label the tic marks with the numbers from -10 to +10. If students have difficulty, remind them that a thermometer is an example of a vertical number line.



2a) Turn and Talk: Students should compare their number lines with a partner, and come to consensus if the number lines differ.

2b) Project/show the vertical number line here, and direct the students to compare their number line with the one here, and make any changes as needed.

3. Discuss: In what real-life situations would you use each of these number lines? Have students Think-Pair-Share with a partner or group. Share out with the class.

4. If the students are having difficulty coming up with situations to use horizontal or vertical number lines, consider sharing these situations with them, and having them decide which number line would be most appropriate to use:

a) A diver wants to calculate difference in position relative to the surface of the water when diving.

b) A football coach wants to calculate difference in position on a football field after a series of gains or losses of yards.

c) A Fed-Ex delivery manager wants to calculate differences in distances along a truck delivery route to minimize travel from the distribution center.

d) A scientist wants to calculate difference in temperature when the temperature changes from below freezing to above freezing in an experiment.

5) Discuss: How can you use a number line to calculate distance in each of these situations?

Which operation is indicated when you are calculating distance on a number line? (subtraction)

Instructional Task

Purpose: Students use a horizontal number line to determine the distance between two points in a real-life context. The purpose of this task is to help students connect the distance between points on a number line with the difference between the numbers. Students should already understand that this is true for positive numbers; see 2.MD.B.6, 3.MD.A.1, and 4.MD.A.2. Students should also have experience in earlier grades representing signed numbers on a number line; see 6.NS.C.6. This task assumes that students are familiar with the idea that differences between integers correspond to distances between them on the number line and asks them to analyze a situation involving non-integer quantities.

Engage (Setting Up the Task)

1. Propose the following situation to the class:

Two friends, Andre and Alex, ran in the Hartford Marathon this year. Andre crossed the finish line first. He was 2 $\frac{1}{2}$ feet beyond the finish line when his friend Alex was 7 $\frac{1}{2}$ feet from finishing. At this point, how far apart were they from each other? Use a number line to demonstrate your thinking, and write a number sentence or equation to represent this situation.

2. Students should Turn and Talk within a small group (2-4 students) to consider the following:

- As a team, consider what is going on in the story and retell it in your own words.
- Which number line would you use to help you solve this problem: a vertical or a horizontal number line?
- How could you use the number line to show how far apart the boys were from each other?
- Where would the finish line be on the number line? (Zero)
- Where would each of the boys be on the number line? (Andre is at +$\mathbf{2\frac{1}{2}}$ and Alex is at -$\mathbf{7\frac{1}{2}}$)

3. Students will share out their thinking with the class; the student with the earliest birthday will report out.

4. Explain that students will now work on the marathon question with their group. Students should use the horizontal number line from the Launch, and show the position of each of the two boys on the number line relative to the finish line to indication their position relative to each other in the race, and then solve the problem.

5. To differentiate this task, use whole numbers (2 and -7) instead of rational numbers.

Explore (Solving the Task)

5. Provide students time to work on the marathon task in groups. Circulate to observe, question, and note students who are good candidates to share out responses. Possible questions/prompts to ask as students engage in the task:

Focusing / Probing Questions
As you used your number line to help you solve this problem, what decisions did you make so that you could represent this situation accurately?
Where is the finish line on your number line? Why does this make sense?
How could you use your number line to figure out how far apart the boys were from each other at this point in the race?
Which racer would be on the positive part of the number line? Which would be negative?
What operation would you use in your number sentence/ equation to calculate the distance the boys are apart from each other?
How does your number sentence/ equation relate to each part of the marathon problem?
How does your number line model relate to subtraction?
How does your number line show your solution?
Does your number line model agree with the solution to your number sentence/equation?
Why does your solution make sense? How can you check it?

Advancing Questions
Is zero the only place on the number line that you could use to represent the finish line? Why or why not?
Could you prove your solution using an alternate number sentence/equation? When would that make sense?
Which method is more efficient for you: finding distance on a number line or solving a number sentence/ equation?
Could you change the problem so that the boys were still 10 feet apart, but were different distances away from the finish line?
How could you change this problem so that the boys were 15 feet apart from each other after one finished the race?
Can you think of another situation where distance is calculated on either side of a fixed point?
How can you use the absolute value of the differences to explain your solution?

Elaborate (Discuss Task and Related Mathematical Concepts)

How will you facilitate the sharing of student work and discussion to support students in making mathematical connections?

6. Select groups to share their work. Facilitate a whole class discussion to elicit evidence of student understanding and develop mathematical connections using some of the possible questions below.

- How did the number line help you write a number sentence/equation that would accurately represent the problem?
- Why does 10 (the correct answer) make sense in this problem?
- Why isn't 5 feet a reasonable answer for this situation?

- How can you use the number line to prove that subtraction of a negative number gives the same result as adding the additive inverse ($p - (-q) = p + q$)? **$2\frac{1}{2} - (-7½) = 2\frac{1}{2} + (^{+}7½)$**
- How can you use the absolute value of the difference between the runners to calculate the distance between them? **$\left|2\frac{1}{2} - (-7\frac{1}{2})\right| = \left|-7\frac{1}{2} - 2\frac{1}{2}\right| = 10$ feet**

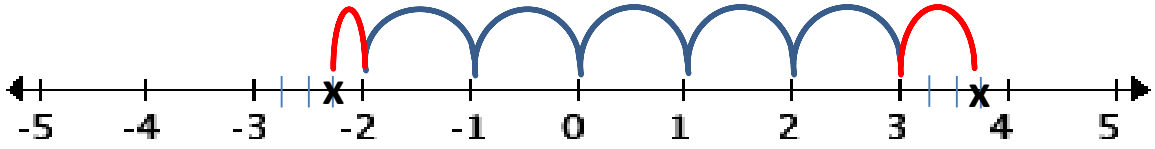
Common Misunderstanding

Purpose: Use the following question as a check for student understanding of the two ways to find the difference between two rational numbers: distance on a number line and solving a subtraction equation. While both methods can give the correct answer, students do not always apply them correctly.

In the process of looking at these two ways of finding the distance between two rational numbers, students are asked to identify and correct common errors when these methods are employed. Use the error in Olivia's solution to facilitate a discussion that finding the difference indicates subtraction, but the absolute value of the difference would be the distance on the number line, which is always positive.

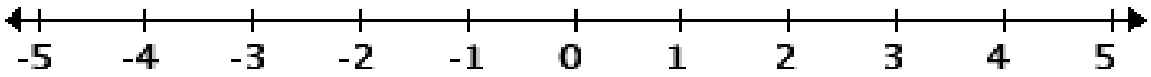
Destiny and Olivia are working on the following math problem: "Find the distance between -2¼ and 3¾ on a number line."

- **Destiny places both numbers on a number line, and counts the units between the numbers. She counts 5 whole units and then adds ¼ and ¾ to account for the additional fractional distances, for a total distance of 6 units.**



- **Olivia finds the distance by writing subtraction equations and solving them two ways: 3¾ – 2¼ = 1½, and 2¼ – 3¾ = 1½ ; Olivia says the distance is 1½ units.**

Which student is correct? Why do you think this? Find and correct any errors in either girl's work.



"What was the error that Olivia made? Think, pair, share – consider what her error was, and what needs to be done to correct the mistake." Allow students to consider Olivia's answer and make the correction. They can consider these errors:

- **Subtracting a positive 2¼ instead of a negative 2¼ when setting up the difference as an equation.**
- **Not understanding that distance is always positive and to find distance, you can find the absolute value of the difference of the integers in any order. (e.g. $\left|-2¼ - 3¾\right| = \left|3¾ - (-2¼)\right| = 6$ feet**

- **Not using the number line to check her answer for reasonableness: when you look at a number line, does 1½ units make sense in this problem?**
- **Not using the additive inverse when solving subtraction problems: $3\frac{3}{4} - (-2\frac{1}{4}) = 3\frac{3}{4} + {}^{+}2\frac{1}{4} = 6$**

This problem could be used to facilitate a discussion about how students could check the reasonableness of their response to a rational number problem by using a number line model. Also, this problem reinforces the idea that the absolute value of the <u>difference</u> between any two numbers is the same as the <u>distance</u> between them on a number line. Also, students should be helped to see how subtracting a negative is the same as adding the additive inverse.

Checking for Understanding

Purpose: Pose the following question as a check for student understanding of subtraction of rational numbers **a.)** as distance on a number line, and **b.)** as adding the additive inverse.

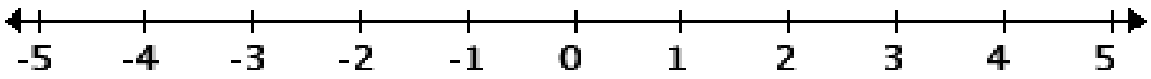
Isaiah and Jerry are working on a math project. After school, they walk to Isaiah's house to get the materials, and then they walk to Jerry's house to work on the project.

Isaiah lives $1\frac{5}{8}$ km <u>east</u> of the school, and Jerry lives $3\frac{1}{4}$ km <u>west</u> of the school.

Represent the relative position of the houses on a number line:

- **the school is at zero**
- **points to the east are represented by positive numbers**
- **points to the west are represented by negative numbers**

Find the distance between the two houses on a number line and verify your solution by writing and solving an equation.



Closure

Purpose: Provide students an opportunity to monitor and reflect on their own understanding of rational numbers in real-life contexts using the following self-assessment, or doing a journal write to reflect on these questions.

"Think about your learning in this activity. Mark on X on the statement that you feel best matches your level of success with your understanding of these tasks."

	With lots of help	With a little help	On my own, but I really can't explain it	Got it! I can explain it to someone else.
I can use a number line to find the distance between 2 integers (4 and -3).				
I can use a number line to find the distance between 2 rational numbers (4¼ and 3¾).				
I can write an equation to find the distance between two rational numbers.				
I can solve an equation to find the difference between two rational numbers.				
I understand why 4− (-3) is the same as 4 + 3.				
I understand how number lines and equations are related.				

After this lesson, I feel like I need more time learning….

Extension Task

Purpose: ***Provide an extension task for those students who are ready to deepen their understanding of using distance on a number line to solve real-life applications. This extension task uses a city grid as the context to calculate distance. Students must write and solve integer subtraction equations (with absolute value when appropriate) to represent distance between two points on a grid.***

Gerry needs to walk from his house to the Town Hall to register his dog, then walk back home.

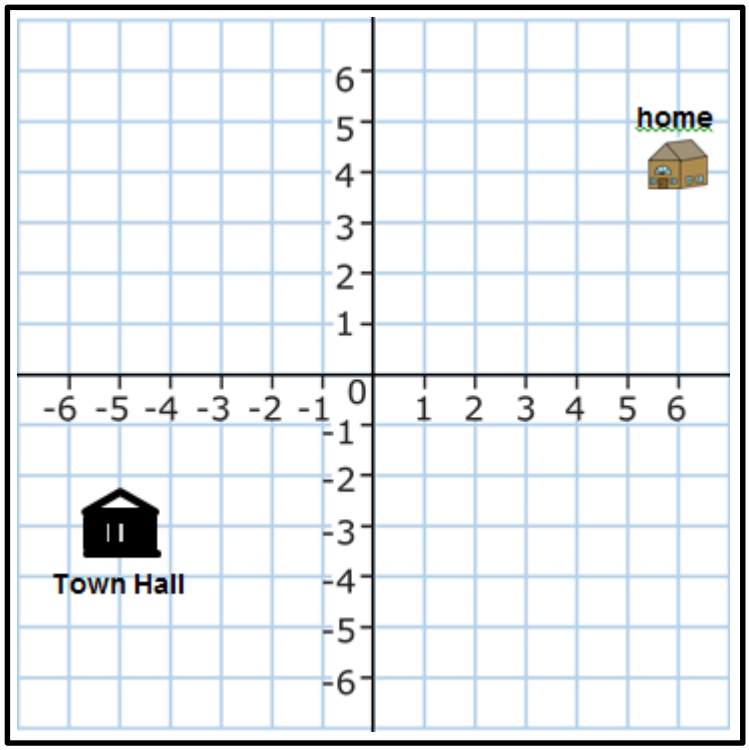
1.) ***Write a series of equations to calculate the total distance Gerry must travel.***

a) Write the equations as ***both*** *subtraction equations* ***and*** *the equivalent equation by adding the additive inverse.*

b) Write the equations using absolute value of the distance, if needed.

2.) Verify your work by using the map to calculate the total distance from home to the City Hall and back. (Each square unit represents one block.)

3.) Then write to explain how finding distance on a map is similar to using a number line to calculate distance.



Travel from home to Town Hall:

Equation on the y-axis: $4 - (-3) = 7$ blocks

$4 + {}^{+}3 = 7$ blocks

Equation on the x-axis: $6 - (-5) = 11$ blocks

$6 + {}^{+}5 = 11$ blocks

Distance home to Town Hall: $7 + 11 = 18$ blocks

Travel from Town Hall to home:

Equation on the y-axis: $|(-3) - 4| = 7$ blocks

$|(-3) + (-4)| = 7$ blocks

Equation on the x-axis: $|(-5) - 6| = 11$ blocks

$|(-5) + (-6)| = 11$ blocks

Distance Town Hall to home: $7 + 11 = 18$ blocks

Total distance is 18 + 18 = 36 blocks

Mathematical Checkpoint: Temperature Change

Monique and Matt both solved the following math problem:

If the temperature drops from 7ºF to −17ºF, what is the change in temperature?

- Monique said the change is 24ºF.
- Matt said the change is 10ºF.

Who is correct?

a.) Monique

b.) Matt

c.) neither

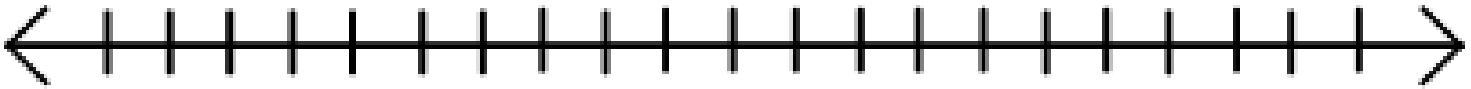
Explain the correct answer by writing an equation **and**

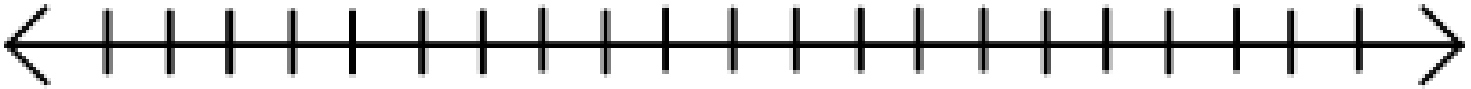
showing your work on a vertical number line diagram:

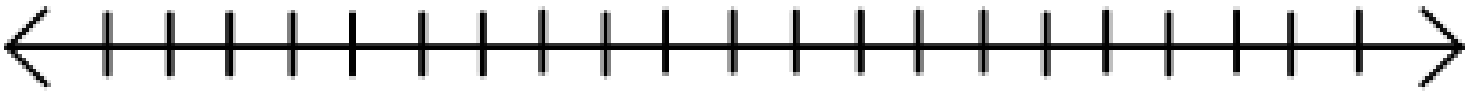
Equation: _____

Vertical Number Line

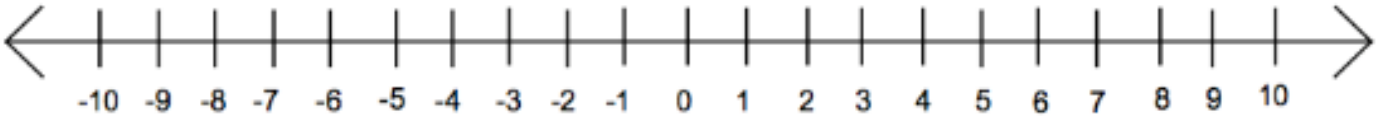
Blank Number Lines (for Launch and Instructional Task)

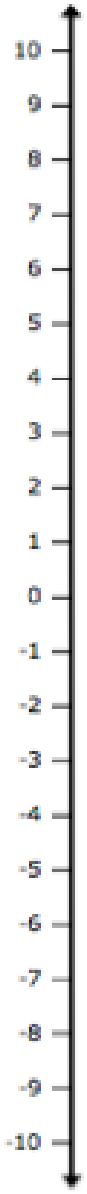






Labeled Number Lines (for Launch)





Instructional Task

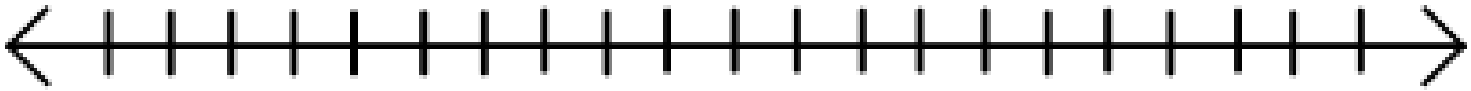
Two friends, Andre and Alex, ran in the Hartford Marathon this year. Andre crossed the finish line first. He was 2 $\frac{1}{2}$ feet beyond the finish line when his friend Alex was 7 $\frac{1}{2}$ feet from finishing.

At this point, how far apart were they from each other?

Use a number line to demonstrate your thinking, and then write a number sentence or equation to represent this situation, and solve it.

As a team, consider what is going on in the story and retell it in your own words.

- Which number line would you use to help you solve this problem: a vertical or a horizontal number line?
- How could you use the number line to show how far apart the boys were from each other?
- Where would the finish line be on the number line?
- Where would each of the boys be on the number line?



Number sentence: _____

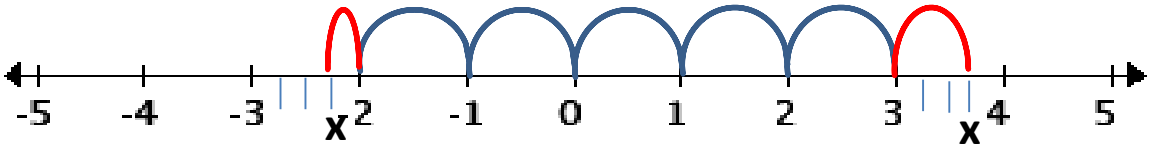
Answer sentence: _____

_____

Common misunderstanding:

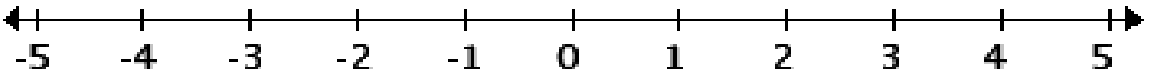
Destiny and Olivia are working on the following math problem: "Find the distance between −2¼ and 3¾ on a number line."

- **Destiny places both numbers on a number line, and counts the units between the numbers. She counts 5 whole units and then adds ¼ and ¾ to account for the additional fractional distances, for a total distance of 6 units.**



- **Olivia finds the distance by writing subtraction equations and solving them two ways: 3¾ – 2¼ = 1½, and -2¼ – 3¾= 1½; Olivia says the distance is 1½ units.**

Which student is correct? Why do you think this? Find and correct any errors in either girl's work.



What was the error that Olivia made?

Think, pair, share – consider what her error was, and what needs to be done to correct the mistake.

Check Up:

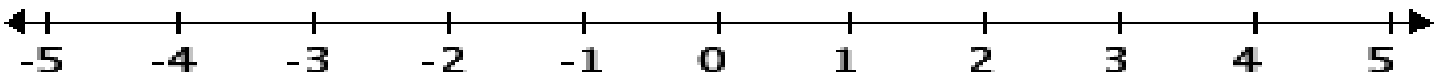
Isaiah and Jerry are working on a math project. After school, they walk to Isaiah's house to get the materials, and then they walk to Jerry's house to work on the project.

Isaiah lives 1⅝ km <u>east</u> of the school, and Jerry lives 3¼ km <u>west</u> of the school.

Represent the relative position of the houses on a number line:

- **the school is at zero**
- **points to the east are represented by positive numbers**
- **points to the west are represented by negative numbers**

<u>Find the distance between the two houses</u> on a number line <u>and</u> verify your solution by writing and solving an equation below.



Equation: _____

Solve It:

Answer sentence: _____

_____

Check Up: **ANSWER KEY**

Isaiah and Jerry are working on a math project. After school, they walk to Isaiah's house to get the materials, and then they walk to Jerry's house to work on the project.

Isaiah lives 1⅝ km <u>east</u> of the school, and Jerry lives 3¼ km <u>west</u> of the school.

Represent the relative position of the houses on a number line:

- **the school is at zero**
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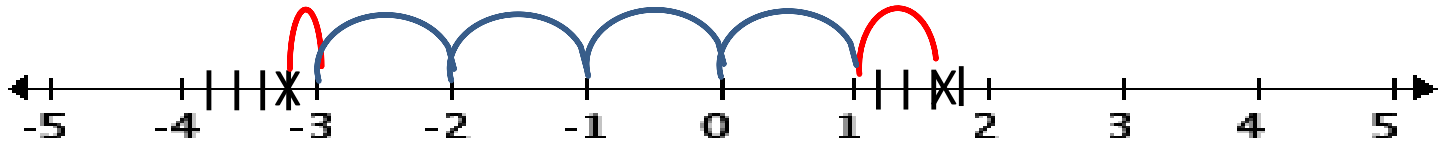


Equation:

$1\frac{5}{8} - (-3\frac{1}{4}) =$

$1\frac{5}{8} + (+3\frac{1}{4}) =$

$1\frac{5}{8} + 3\frac{2}{8} = 4\frac{7}{8}$

Answer sentence: Isaiah's and Jerry's houses are $4\frac{7}{8}$ km from each other.

Student Self-Assessment

Think about your learning in this lesson. Mark on X on the statement that you feel best matches your level of success with your understanding of these tasks. Then complete the following statement:

After this lesson, I feel like I need more time learning _____

_____

	With lots of help	With a little help	On my own, but I really can't explain it	Got it! I can explain it to someone else.
I can use a number line to find the distance between 2 integers (4 and -3).				
I can use a number line to find the distance between 2 rational numbers (4¼ and 3¾).				
I can write an equation to find the distance between two rational numbers.				
I can solve an equation to find the difference between two rational numbers.				
I understand why 4− (-3) is the same as 4 + 3.				
I understand how number lines and equations are related.				

because_____

_____

_____

_____

_____

Extension Task:

Gerry needs to walk from his house to the Town Hall to register his dog, and then walk back home.

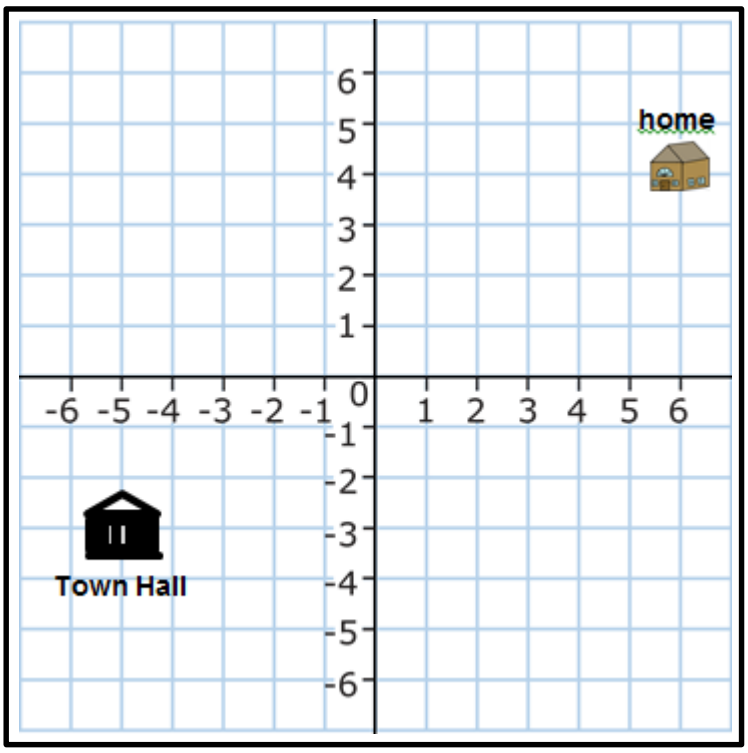
1.) ***Write a series of equations to calculate the total distance Gerry must travel.***

a) *Write the equations as* ***both*** *subtraction equations* ***and*** *the equivalent equation by adding the additive inverse.*

b) *Write the equations using absolute value of the distance, if needed.*

2.) Verify your work by using the map to calculate the total distance from home to the City Hall and back. (Each square unit represents one block.)

3.) Then write to explain how finding distance on a map is similar to using a number line to calculate distance.



Travel from home to Town Hall:

Travel from Town Hall to home:

Total distance:

<table>
<tr><th colspan="2">Research and review of standard</th></tr>
<tr><th>Content Standard(s):</th><th>Standard(s) for Mathematical Practice:</th></tr>
<tr><td>Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

<u>CCSS.MATH.CONTENT.7.NS.A.1</u> 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.

<u>CCSS.MATH.CONTENT.7.NS.A.1.C</u>
Understand subtraction of rational numbers as adding the additive inverse, p - q = p+ (-q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.</td><td>MP.2 Reason Abstractly and Quantitatively
o Represent a given situation symbolically attending to the
meaning of quantities

MP.4 Model with Mathematics
o Apply the mathematics they know to solve problems arising in everyday life, society, and the workplace</td></tr>
<tr><th>Smarter Balanced Claim</th><th>Smarter Balanced Item</th></tr>
<tr><td>Claim 4 – Modeling and Data Analysis
“Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.”</td><td><u>http://www.illustrativemathematics.org/illustrations/591</u>

Aakash, Bao Ying, Chris and Donna all live on the same street as their school, which runs from east to west.
• Aakash lives blocks to the west.
• Bao Ying lives blocks to the east.
• Chris lives blocks to the west.
• Donna lives blocks to the east.
a. Draw a picture or diagram that represents the positions of their houses along the street.
b. Find how far is each house from every other house.
c. Represent the relative position of the houses on a number line, with the school at zero, points to the west represented by negative numbers, and points to the east represented by positive numbers.
d. How can you see the answers to part (b) on the number line? Using the numbers (some of which are positive and some negative) that label the positions of houses on the number line, represent thesedistances using sums or differences.
e. Create a table or list to record the distances between each pair of houses.</td></tr>
<tr><td>CPR Pre-Requisites
(Conceptual Understanding, Procedural Skills, and Representations)

Look at the Progressions documents, Learning Trajectories, LZ lesson library, unpacked standards documents from states, NCTM Essential Understandings</td><td>Conceptual Understanding and Knowledge
• Understand that fractions and mixed numbers can be represented as a point on a number line.
• Understand that positive numbers are greater than zero and negative numbers are less than zero.
• Understand that positive numbers are located to the right of zero on a number line and negative</td></tr>
</table>

Series, NCTM articles, and other professional resources. You'll find links to great resources on your PLC Platform.	numbers are located to the left of zero on a number line. • Understand that distance between two points can be represented on a number line. • Understand absolute value as distance on a number line. • Interpret the magnitude of absolute value for both positive and negative numbers in real-world situations. • Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (-q). **Procedural Skills** • Find fractions and mixed numbers on a number line. • Write an equation that represents a given situation. • Add integers. • Add positive mixed numbers. • Subtract integers by adding the additive inverse. • Find distance by using the absolute value of the difference. **Representational** • Students must be able to create visual representations/models to show integers and/or mixed numbers as points on a number line diagram a given distance from a specific location that represents zero. **Social knowledge** • Know that a mixed number is made up of a whole number and a proper fraction. • Understand that number lines are made up of equally spaced units. • Know that negative numbers are located to the left of zero and positive numbers are located to the right of zero on a number line. • Know that east represents positive distances and west represents negative distances on a number line.

Standards Progression **Look at LearnZillion lessons and expert tutorials, the Progressions documents, learning trajectories, and the "Wiring Document" to help you with this section*		
Grade(s) below	**Target grade**	**Grade(s) above**
3.NF.2 Understand a fraction as a number on a number line; represent fractions on a number line diagram. 6.NS.6.c Find and position integers and other rational numbers on a	7.NS.1.b Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number	8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a

horizontal or vertical number line diagram. 6.NS.7.a Interpret statements of inequality as statements of order for rational numbers in real-world contexts. 6.NS.7.b Write, interpret, and explain statements of order for rational numbers in real-world contexts. 6.NS.7.c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.	and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. *7.NS.1.c Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. 7.NS.1.d Apply properties of operations as strategies to add and subtract rational numbers.	number line diagram, and estimate the value of expressions (e.g., π^2). 8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Common Misconceptions/Roadblocks

What characteristics of this problem may confuse students?

- *Students may not know how to represent distance on a number line by showing fractional units, especially units that may be dissimilar.*
- *Students may not understand that distances west and east of a fixed point can be represented using negative and positive numbers, respectively.*
- *Students may not know how to add/subtract fractions with unlike denominators.*
- *Students may not understand how subtraction of a negative number can be represented as adding the additive inverse (the positive form of that number).*
- *Students may not know how to set up a table or list to represent distances between all the pairs of houses: nine distances need to be calculated*

What are the common misconceptions and undeveloped understandings students often have about the content addressed by this item and the standard it addresses?

- *Students may not understand that distance is always positive, even though we are subtracting units.*
- *Students may not understand that when you take the absolute value of the difference between two numbers, the order of the minuend and subtrahend does not matter.*
- *Students may not be able to relate the understanding of subtraction of negative number as adding the additive inverse to the understanding of absolute value as always being positive.*

What overgeneralizations may students make from previous learning leading them to make false connections or conclusions?

- *Students may believe that subtraction of rational numbers always generates a difference that is smaller than the minuend – just like it does with subtraction of whole numbers.*