Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities

4a. Solve word problems leading to equations of the form $p x+q=r$ and $p(x+$ $q)=r$, where $p, q$, and $r$ are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

For example, the perimeter of a rectangle is 54 cm . Its length is 6 cm . What is its width?
4 b . Solve word problems leading to inequalities of the form $\mathrm{px}+\mathrm{q}>\mathrm{r}$ or $\mathrm{px}+\mathrm{q}<\mathrm{r}$, where $p, q$, and $r$ are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.

For example: As a salesperson, you are paid $\$ 50$ per week plus $\$ 3$ per sale. This week you want your pay to be at least $\$ 100$. Write an inequality for the number of sales you need to make, and describe the solutions.

The admission to a video game arcade is $\$ 1.25$ per person, and it costs $\$ 0.50$ for each game played. Latoya and Donnetta have a total of $\$ 10.00$ to spend. What is the greatest number of games they will be able to play? Use words to explain your steps.

## Guided Instruction

## Essential Question: 7.EE.4b

How can you solve inequalities of the form $p x+q>r$ and $p x+q<r$, where $p$, $q$, and $r$ are specific rational numbers.
In this lesson students will extend what they know about Solving Equations to Solve Inequalities.

| Beginning <br> Inequality | Operation <br> Performed on Both <br> Sides | Results | True <br> or <br> Fals <br> e? |
| :--- | :---: | :--- | :--- |
|  |  |  |  |

$\qquad$

## Solve and Graph the solution. $-3 x+2>17$

$$
\begin{array}{cl}
-3 \mathrm{x}+2>17 & \\
-3 \mathrm{x}+2-2>17-2 & \text { Add }-2 \text { to both sides. } \\
-3 \mathrm{x}>15 & \text { Simplify both sides } \\
\frac{-3 x}{-3}<\frac{15}{-3} & \begin{array}{l}
\text { Divide both sides by }-3 \\
\\
\text { Reverse the direction of the inequality } \\
\text { symbol - whenever you multiply or divide } \\
\mathrm{X}<-5
\end{array} \\
\begin{array}{l}
\text { by a negative number. }
\end{array} \\
\text { Simplify both sides }
\end{array}
$$

The solution $\mathrm{x}<-5$ means that any number less than -5 would make the inequality true.
The open circle at -5 shows
 that the number -5 is not part of the solution.
The solution is $x<-5$

Lesson Objective(s): What mathematical skill(s) and understanding(s) will be developed? Which
Mathematical Practices do you expect students to engage in during the lesson?
7.EE.B.4b Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

MP1: Make sense of problems and persevere in solving them.
MP3: Construct viable arguments and critique the reasoning of others.
MP4: Model with mathematics.
MP5: Use appropriate tools strategically.
MP6: Attend to precision.
MP7: Look for and make use of structure.

Notes: Exactly how will you use the first five minutes of the lesson?

Share
Explain the difference between these symbols. How does it change the meaning of each

Notes: Exactly what summary activity, questions, and discussion will close the lesson and provide a foreshadowing of tomorrow? List the questions.

Have students write an equation or inequality for the following questions:

## Teacher(s):

| mathematical statement? |  |
| :--- | :--- |
| $3+p>7$ | $3+p \geq 7$ |
| $3+p<7$ | $3+p \leq 7$ |
| $3+p=7$ |  |

- If Grant made $\$ 15$ profit, how many miles did he ride?
- How would your equation change if I said Grant needed to make at least \$15 a day, how many miles would he need to ride?

Lesson Tasks, Problems, and Activities (attach resource sheets): What specific activities, investigations, problems, questions, or tasks will students be working on during the lesson? Be sure to indicate strategic connections to appropriate mathematical practices.

Note: This lesson could be a one or two day lesson, depending on the grouping structure and development of group and whole-class discussion.

1. Introduce the scenario: Grant is trying to make money to help pay for college by taking a job with Brian's Bike Taxis of Baltimore. He has an agreement that he will rent the bike for $\$ 35.00$ a night and will charge customers $\$ 3.75$ per mile he rides.
2. Task: Work with your group to determine how many miles he needs to ride in order to make a profit. Each group member must record all problem-solving strategies in the class work section of their notebook. Record ALL attempts that your group explored; do not erase any even if they turn out to be wrong. As a group, choose one strategy that you used to solve the problem and post it on chart paper to share with the class. (Look for evidence of MP1.)
3. Gallery Walk: As the students finish writing their solution on the chart paper, have them hang it on the wall around the room. (Look for evidence of MP4.)

- You will have 10 min to view all of the different ways that your classmates have solved the problem.
- It is your job to comment on their work. Consider giving students post-it notes to comment and leave on each group's work.
- You need to make one accolade. They may have thought of something you did not, they may have explained something really clearly, or some other positive thing you noticed.
- You also need to make a suggestion of one thing the group might want to consider. Maybe something is not very clear or you thought of something that they could add that would strengthen the explanation of their strategy. (Look for evidence of MP3.)

4. Once all groups have completed the gallery walk, have each group take some time to read the accolades and suggestions and make any adjustments they feel are necessary. Then give them a chance to share out their strategy. Once groups have had a chance to describe all their strategies, bring the class together for a whole group discussion. Have students compare the different strategies. Which ones are easiest to understand? Which ones are quickest to complete. Have the students jot down their favorite method, the one they could see themselves using in the future and explain why it is their favorite
5. Pose the following question to the students: Is it possible for Grant to make exactly 16 dollars? Why or why not? Use whatever strategy you would like to solve this problem. (Look for evidence of MP6.)
6. After a few minutes have the students share their thoughts in their groups.
7. Once again bring the class together to discuss the importance of considering context in solving real-world problems.

Teacher(s):
8. Have the students apply their strategy to the following problem: A car rental agency charges Shae's family $\$ 25.00$ plus $\$ 0.10$ per mile that the car is driven. Shae wants to spend less than $\$ 35.00$ on the car rental. How many miles can she drive the rental car?
Evidence of Success: What exactly do I expect students to be able to do by the end of the lesson, and how will I measure student mastery? That is, deliberate consideration of what performances will convince you (and any outside observer) that your students have developed a deepened (and conceptual) understanding.

Students will be able to write equations or inequalities to represent real-world problems and utilize tables, graphs, equations, or inequalities to solve real-world problems. The students' success with the exit ticket will help the teacher to understand the students' comfort with the difference between equations and inequalities. The homework will give the teacher an idea of the level of confidence the students have with this concept.
Notes and Nuances: Vocabulary, connections, common mistakes, typical misconceptions, etc.
Key vocabulary: equation, inequality, at least, more than, exceed, profit
Connections: Students will need to connect to their prior understanding of writing and solving simple equations and inequalities from standards 7.EE. 3 and 7.EE.4a.

Extension: There is a day 3 extensions on the ppt. At this time you will introduce graphing on the graphing calculator. (Look for evidence of MP5.)

Misconceptions: The students will have to address the concept of profit being any amount of money over the start up costs. In order for Grant to make money he will first have to pay his start-up costs

Since we are working with a real-world scenario, the students will have to consider the context of the problem to help them determine the reasonableness of their answer.

Resources: What materials or resources are essential for students to successfully complete the lesson tasks or activities?

Linear Equations PowerPoint
Chart paper
Markers
Graphing calculators

Homework: Exactly what follow-up homework tasks, problems, and/or exercises will be assigned upon the completion of the lesson?

Create a new real-world scenario similar to the ones we completed in class today.
a. Provide at least two different ways that you could solve it.
b. Rewrite the question that you posed so that the solution results in an inequality not an equation.

Lesson Reflections: How do you know that you were effective? What questions, connected to the lesson standards/objectives and evidence of success, will you use to reflect on the effectiveness of this lesson?

How successful are my students in writing equations or inequalities for real-world problems? Are students able to transfer understanding to different scenarios and mathematical problems? How will I use the homework and exit ticket to differentiate upcoming lessons to meet the needs of the
various learners in my class?
7.EE.4b Solve word problems leading to inequalities of the form $p x+q>r$ or $p x+q<r$, where $p, q$, and $r$ are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example, as a salesperson, you are paid $\$ 50$ per week plus $\$ 3$ per sale. This week you want your pay to be at least $\$ 100$. Write an inequality for the number of sales you need to make, and describe the solutions

## Math Best Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically
6. Attend to precision.

## Prior Knowledge

In order for students to be successful, the following skills and concepts need to be maintained:

- Creating inequality statements in order to compare two values
- How to solve one and two step equations in order to transition the same process to inequalities
- An inequality shows a range of possible values not just a single value


## Common Misconceptions

When working with inequalities, students struggle with the idea that the solution is a range of numbers not just a single value. The first few problems may require a discussion about what the graph is truly telling you and how you can choose possible values from the given solution

## Learning Targets

- I can use inequalities to order and demonstrate all possible values that a solution can be given in real life situation?
- I can display inequalities on a number line to provide a visual representation of a given situation?

| Video Tutor | 1. Video: PH Graphing Solutions to One Variable Inequalities |
| :--- | :--- |
|  | 2. Video: PH Writing an Inequality from a Graph |
|  | 3. Video: PH Writing Inequalities <br> 4. Video: PH Solving Inequalities by Addition <br>  <br> Worksheets |

## Task Notes

## Inequalities

## Teacher(s):

$\qquad$
Inequalities are used to show a range of possible values that meet a given criteria. In the following task, students will be creating a visual and algebraic solution to a given situation.

## Review:

An inequality is a math sentence that compares two quantities. Often one of the quantities represented is a variable. Use the following symbols and descriptions to represent each type of inequality.
< means "is less than." $\leq$ _means "is less than or equal to."
$>$ means "is greater than." $\geq$ _means "is greater than or equal to." $\neq$ _means "is not equal to."

## Independent Activity

Learning Target: How could I represent inequality using a variable and a constant? Warm up....

## Question

Answer

1. Nima will spend less than $\$ 25$
2. Derrick ran at least 30 miles last week
3. Emily needs at least $\$ 200$ to buy the TV she wants
4. Marcia volunteers with some friends at a community center. While shopping online for a new television she decides she wants one with at least a 26 in. screen. Using the chart below, write an inequality to show how much money the center will have to spend.

| Television Prices |  |
| :--- | :---: |
| Screen | Price |

Teacher(s):

| Size |  |
| :--- | :--- |
| 22 in. | $\$ 300$ |
| 26 in. | $\$ 330$ |
| 32 in. | $\$ 370$ |
| 40 in. | $\$ 420$ |

a. Write the Inequality: $\qquad$
b. Graph the inequality on the number line.

c. The center has a stand for the television that will hold up to 30 lb of weight. Draw a graph to show how much the television she buys can weigh.


Marcia plans to use money from the community center's savings account to buy a gaming system. There must be $\$ 129$ left in the savings account after she withdraws what she needs.

```
Video Game System Sale This Month Only
                        $250.00
    Selected Extra Games on Sale
        $35.00 Each
```

5. Write and solve an inequality to represent the situation, where $\times$ represents the amount of money the center has in its savings account. What does your solution mean in terms of the problem?
6. Graph the possible values from the solution found in number seven
$\qquad$


The community center rents rooms for an hourly rate, plus a set-up fee.

| Room Rentals |  |  |
| :---: | :---: | :---: |
| Room | Rental Rate Per Hour | Set-up-Fee |
| Main Hall | $\$ 15$ | $\$ 40$ |
| Dining Room | $\$ 12$ | $\$ 80$ |

1. A school group has $\$ 140$ to spend. Write and solve an inequality that represents the cost to rent the main hall, where $h$ represents the number of hours the group can rent the room.
2. The same group is also considering renting the dining room. Write and solve an inequality to represent this situation.
3. Use your solutions from 1 and 2 to justify your selection of which room the group should rent.
$\qquad$

The community center has $\$ 175$ to spend on video games for its new gaming system. Games are on sale for $\$ 35$ each.

1. Write and solve an inequality to represent the number of games the center could buy. Explain your solution in reference to the problem.
2. Graph the solution on a number line.

$\qquad$

The center is considering signing up for an online game-rental service rather than buying the games. The table shows equipment cost and monthly fees for two services.

| Game Rental Services |  |  |
| :---: | :---: | :---: |
| Services | Equipment Cost | Monthly Fee |
| Net Games | $\$ 99$ | $\$ 8$ |
| Anytime Games | $\$ 19$ | $\$ 19$ |

1. Write and solve an inequality that represents the number of months the center could rent games from NetGames with its $\$ 175$. Explain the solution in terms of the problem.
2. Write and solve an inequality to represent the number of months the center could rent games from Anytime Games. Explain the solution in terms of the problem.
3. Use your answers from 1 and 2 to justify which service the community center should purchase.
