5.2 teacher notes

Objectives

- Solve one-step linear inequalities using addition and subtraction.
- Solve one-step linear inequalities using multiplication and division.

Vocabulary

Linear inequality (Lesson 5-1)
Linear equation (Lesson 3-1)
Variable (Lesson 2-1)
Isolate (Lesson 3-1)
Addition (Subtraction) Property of Inequality
Multiplication (Division) Property of Inequality

Prerequisites

Solving equations using the properties of equality

Graphing inequalities

Simplifying expressions with integers

Get Started

- Draw a number line showing the integers from –10 to +10.
- Draw points at –1 and 2.
- Ask, “Can anyone write an inequality that describes the relationship between the two numbers?” –1 < 2.
- Show the addition of 4 to each number by drawing arrows three spaces to the right of each number.
- Ask, “Can anyone write expressions describing what each of these arrows shows?” –1 + 4; 2 + 4
- Draw new points at 3 and 6.
- Ask, “Can anyone write an inequality that describes the two new numbers?” 3 < 6.
- Ask, “What happened to the truth of the inequality when the same number was added to each side?” The inequality remained true.
- Ask “What would happen to the inequality if 4 was only added to –1?” You would get 3 < 2, which is a false statement.

Section 1

Expand Their Horizons

In Section 1, students will apply the skill of using inverse operations to solving inequalities. Discuss that the procedure is the same as it is for solving equations, except when multiplying or dividing an inequality by a negative number.

Check that students' understand the Addition Property of Inequality by having them complete the inequality $4 + a < 8 + a$ with several different values of a, including negative values. For each value, have them simplify the expressions and confirm that the resulting inequality is true.

When using the Addition Property of Inequality to solve inequalities, encourage students to show the step of adding or subtracting the same number from both sides of an inequality.

After solving the inequality $t + 3 > 0$, draw the graph of the solution set ($t > -3$) on the board. Select several values on the number line and demonstrate whether each makes the inequality true. Point out that –3 and all values to its left do NOT make the inequality true, while all the values to the right of –3 do.

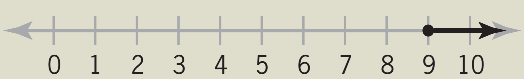
1 When the sign of the inequalities is switched form less than to greater than, remind students that $1 < Q$ can be rewritten as $Q > 1$.

2 Remind students that when the variable term is isolated on the left hand side of the equation, the direction the inequality symbol points shows the direction to shade the number line from the endpoint.

Additional Examples

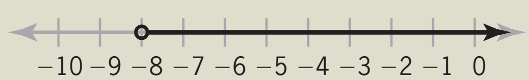
1. Solve and graph.

$$x - 6 \geq 3$$
$$\begin{array}{r} x - 6 \geq 3 \\ \underline{+6} \quad \underline{+6} \\ x \geq 9 \end{array}$$



2. Solve and graph.

$$4 < 12 + x$$
$$\begin{array}{r} 4 < 12 + x \\ \underline{-12} \quad \underline{-12} \\ -8 < x \end{array}$$



Section 2

Expand Their Horizons

In Section 2, if students have trouble with the Multiplication Property of Inequality, have them model an inequality on a number line. Draw a number line from –15 to 15 on the board. Ask for two student volunteers. Have one student stand at –2 and another at 4. Have the other students write the inequality –2 < 4, and point out that the student at –2 is to the **left** of the student at 4. Now, have each student multiply their value by 3, and move to their new location. Again, point out that the order of the students from left to right has not changed (–6 < 12). Now have each student divide their value by –6 and move to his new location. Point out that the order of the students has changed (1 > –2). Use this demonstration to show that multiplying or dividing by a negative number will change the inequality sign.

After reviewing the rule for dividing both sides of an inequality by a negative number, show them the inequality $4x > -12$. Ask whether the inequality will have to be reversed when using an inverse operation to solve. Again, encourage students to write out the step of dividing or multiplying both sides when solving. It may be helpful to develop a special routine as a double-check for reversing the inequality. For example, students can highlight or circle the operation of multiplying and dividing both sides by a negative number, double-checking that the number highlighted is negative before reversing the inequality.

Review with students why multiplying or dividing both sides of an inequality by zero is excluded from the Multiplication and Division Properties of Inequality. Use as examples:

$3 < 10$	$6 > 3$
$3(0) < 10(0)$	$\frac{6}{0} > \frac{3}{0}$
$0 < 0$ (not true)	(division by 0 not defined)

Note that because multiplying both sides of an inequality by zero produces a false statement, and dividing produces a statement using undefined values, operations with zero are excluded from the Multiplication and Division Properties of Inequality.

3 Review with students that dividing by 5 and multiplying by $\frac{1}{5}$ have the same effect.

4 Point out that the inequality symbol is changed as soon as both sides of the inequality are multiplied by –3. Students may want to circle or highlight the symbol in their Guided Notes to help them remember this step.

Connections

When students leave school and enter the working world, they will inevitably have to compose and follow a budget, an endeavor ripe with inequalities. For example, if take-home pay is p and amount spent is s, the smart money manager will ensure that $p \geq s$. In a more complicated example, if p is take-home pay and \$200 is to be set aside for savings, then $p - 200 \geq s$. When a value for p or s is substituted, this inequality can be used to derive information about the spending plan.

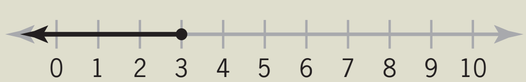
Additional Examples

1. Solve and graph.

$2x \quad -6$

$\frac{2x}{2} \geq \frac{-6}{-2}$

$x \leq 3$

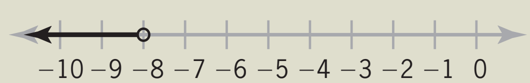


2. Solve and graph.

$\frac{x}{2} < -4$

$2 \cdot \frac{x}{2} < -4 \cdot 2$

$x < -8$



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