

Richmond Public Schools
Curriculum Framework
Grade 8

Strand: Patterns, Functions, and Algebra	
8.18 The student will solve multistep linear inequalities in one variable with the variable on one or both sides of the inequality symbol, including practical problems, and graph the solution on a number line.	
Suggested Pacing	
First Nine Weeks – 5 Instructional Days (including common assessment)	
Related Standards	
<p>Spiral Down</p> <p>7.13 The student will solve one- and two-step linear inequalities in one variable, including practical problems, involving addition, subtraction, multiplication, and division, and graph the solution on a number line.</p> <p>6.14 The student will</p> <ol style="list-style-type: none"> a) represent a practical situation with a linear inequality in one variable; and b) solve one-step linear inequalities in one variable, involving addition or subtraction, and graph the solution on a number line. 	<p>Spiral Up</p> <p>A.5 The student will</p> <ol style="list-style-type: none"> a) solve multi-step linear inequalities in one variable algebraically and represent the solution graphically; b) represent the solution of linear inequalities in two variables graphically; c) solve practical problems involving inequalities; and d) represent the solution to a system of inequalities graphically.
Essential Questions	Common Misconceptions
<p>How does the solution to an equation differ from the solution to an inequality?</p> <p><i>While a linear equation has only one replacement value for the variable that makes the equation true, an inequality can have more than one.</i></p>	<ul style="list-style-type: none"> ● Students need additional practice solving two-step inequalities that include decimals and variables that have negative coefficients. ● Some students do not reverse the inequality sign when dividing by a negative. ● Some students do not apply the inverse property correctly to the constants in an inequality.

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	<ul style="list-style-type: none"> Some students do not understand how the order the inequality is written in (variable, inequality, constant) does matter. ($x > 7$ vs. $7 < x$) (VDOE – Spring 2014 Student Performance Analysis comment)
Understanding the Standard	Essential Knowledge and Skills
<ul style="list-style-type: none"> A multi-step inequality may include, but not be limited to inequalities such as the following: $2x + 1 > \frac{x}{4}$; $-3(2x + 7) \leq \frac{1}{2}x$; $2x + 7 - 5x < 27$; $-5x - (x + 3) > -12$. When both expressions of an inequality are multiplied or divided by a negative number, the inequality sign reverses. A solution to an inequality is the value or set of values that can be substituted to make the inequality true. In an inequality, there can be more than one value for the variable that makes the inequality true. There can be many solutions. (i.e., $x + 4 > -3$ then the solutions is $x > -7$. This means that x can be any number greater than -7. A few solutions might be $-6.5, -3, 0, 4, 25$, etc.) Real-world problems can be modeled and solved using linear inequalities. The properties of real numbers and properties of inequality can be used to solve inequalities, justify solutions, and express simplification. Students should use the following properties, where appropriate, to further develop flexibility and fluency in problem solving (limitations may exist for the values of a, b, or c in this standard). <ul style="list-style-type: none"> Commutative property of addition: $a + b = b + a$. Commutative property of multiplication: $a \cdot b = b \cdot a$. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> Apply properties of real numbers and properties of inequality to solve multi-step linear inequalities (up to four steps) in one variable with the variable on one or both sides of the inequality. Coefficients and numeric terms will be rational. Inequalities may contain expressions that need to be expanded (using the distributive property) or require collecting like terms to solve. Graph solutions to multi-step linear inequalities on a number line. Write verbal expressions and sentences as algebraic expressions and inequalities. Write algebraic expressions and inequalities as verbal expressions and sentences. Solve practical problems that require the solution of a multi-step linear inequality in one variable. Identify a numerical value(s) that is part of the solution set of a given inequality.

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- Associative property of addition: $(a + b) + c = a + (b + c)$.
- Associative property of multiplication: $(a \cdot b) \cdot c = a \cdot (b \cdot c)$.
- Subtraction and division are neither commutative nor associative.
- Distributive property (over addition/subtraction):
 $a \cdot (b + c) = a \cdot b + a \cdot c$ and $a \cdot (b - c) = a \cdot b - a \cdot c$.
- The additive identity is zero (0) because any number added to zero is the number. The multiplicative identity is one (1) because any number multiplied by one is the number. There are no identity elements for subtraction and division.
- Identity property of addition (additive identity property):
 $a + 0 = a$ and $0 + a = a$.
- Identity property of multiplication (multiplicative identity property): $a \cdot 1 = a$ and $1 \cdot a = a$.
- Inverses are numbers that combine with other numbers and result in identity elements
(e.g., $5 + (-5) = 0$; $\frac{1}{5} \cdot 5 = 1$).
- Inverse property of addition (additive inverse property):
 $a + (-a) = 0$ and $(-a) + a = 0$.
- Inverse property of multiplication (multiplicative inverse property): $a \cdot \frac{1}{a} = 1$ and $\frac{1}{a} \cdot a = 1$.
- Zero has no multiplicative inverse.
- Multiplicative property of zero: $a \cdot 0 = 0$ and $0 \cdot a = 0$.
- Division by zero is not a possible mathematical operation. It is undefined.

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<ul style="list-style-type: none"> - Substitution property: If $a = b$, then b can be substituted for a in any expression, equation, or inequality. - Addition property of inequality: If $a < b$, then $a + c < b + c$; if $a > b$, then $a + c > b + c$. - Subtraction property of inequality: If $a < b$, then $a - c < b - c$; if $a > b$, then $a - c > b - c$. - Multiplication property of inequality: If $a < b$ and $c > 0$, then $a \cdot c < b \cdot c$; if $a > b$ and $c > 0$, then $a \cdot c > b \cdot c$. - Multiplication property of inequality (multiplication by a negative number): If $a < b$ and $c < 0$, then $a \cdot c > b \cdot c$; if $a > b$ and $c < 0$, then $a \cdot c < b \cdot c$. - Division property of inequality: If $a < b$ and $c > 0$, then $\frac{a}{c} < \frac{b}{c}$; if $a > b$ and $c > 0$, then $\frac{a}{c} > \frac{b}{c}$. - Division property of inequality (division by a negative number): If $a < b$ and $c < 0$, then $\frac{a}{c} > \frac{b}{c}$; if $a > b$ and $c < 0$, then $\frac{a}{c} < \frac{b}{c}$. 	
Vocabulary	Instructional Activities Organized by Learning Objective
<p>Inequality Multi-step Inequality Inverse Operation Commutative Property of Addition Commutative Property of Multiplication Associative Property of Addition Associative Property of Multiplication Distributive Property (over addition/subtraction) Additive Identity Multiplicative Identity</p>	<p>Virginia Department of Education <u>Solving and Graphing Inequalities</u> – Lesson Plan</p> <p>Textbook <i>Virginia Pre-Algebra</i>, ©2012, Glencoe/McGraw-Hill</p> <ul style="list-style-type: none"> ● Solving Inequalities, page(s) 243 – 249 ● Solving Multi-Step Equations and Inequalities, page(s) 250 – 255 <p>Notes</p>

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<p>Identity Property of addition(additive inverse property) Inverse Property of multiplication(multiplicative inverse property) Multiplicative Property of Zero Substitution Property Addition property of inequality Subtraction property of inequality Multiplication property of inequality Multiplication property of inequality(multiplication by a negative number) Division property of inequality Division property of inequality(division by a negative number) Term Like Terms Solution Verbal expression Algebraic expression</p>	<ul style="list-style-type: none"> ● Inequalities <p>Resources</p> <ul style="list-style-type: none"> ● Print <i>Virginia Coach</i>, NEW SOL Edition, Grade 8, Mathematics Lesson 23 – page 170 (Solve and Graph Linear Inequalities) ● Technology-based <ul style="list-style-type: none"> ○ <i>Exchange.Smarttech.com (SmartBoard)</i> – Inequalities – SMART Notebook Lesson *SMART Board required ○ <i>ExploreLearning.com (Gizmo)</i> – Exploring Linear Inequalities in One Variable and Solving Linear Inequalities in One Variable – Interactive Skill Review *Sign-in required <p>Station Activities</p> <ul style="list-style-type: none"> ● Inequality Foldable - Have students create a foldable, describing characteristics, providing examples, and relationships. ● Inequality Verbal Expression Key Words - Have students highlight key words that are used to characterize the inequalities. ● Inequality Match - Have students match inequality sentences, solutions, and graphs. ● Give students two steps in solving an inequality, then identify the property. ● Inequality Trail (in part): Activity & Recording Sheet ● Foldable and Scavenger Hunt ● Number Line Matching
Assessment	
<p>RPS PowerSchool Unit Test – RPS 8.18 Common Assessment Test ID#:</p> <p>Formative Assessments White Board Checks Kahoot.it Plickers Exit Tickets Graphic Organizers Venn Diagrams</p>	

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Cross-Curricular Connections	Differentiations
<p>English Have students write to an absent student about how to solve a two-step inequality.</p> <p>Engineering Discovery Education: Bridge-Capacity</p>	<ul style="list-style-type: none">● Have students review inequality symbols, using the alligator or Pac Man.● Have students create a number line, then have them indicate which way numbers are greater and less than.● Have students solve one step equations (with equal sign) and graph the solution on a number line. Then change the equal sign to an inequality and discuss the difference. Last have students work on a two-step equation, change the sign, and discuss.● Discuss with students the difference between an open and closed circle and what it means.● Have students list all possible answers to an inequality solution.