**Session Three: Writing Equations**

**Common Core Standards Addressed**

#### Grade 1

#### Represent and solve problems involving addition and subtraction.

[CCSS.Math.Content.1.OA.A.1](http://www.corestandards.org/Math/Content/1/OA/A/1/)  
Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.1

[CCSS.Math.Content.1.OA.A.2](http://www.corestandards.org/Math/Content/1/OA/A/2/)  
Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

#### Understand and apply properties of operations and the relationship between addition and subtraction.

[CCSS.Math.Content.1.OA.B.3](http://www.corestandards.org/Math/Content/1/OA/B/3/)  
Apply properties of operations as strategies to add and subtract.2 *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*

[CCSS.Math.Content.1.OA.B.4](http://www.corestandards.org/Math/Content/1/OA/B/4/)  
Understand subtraction as an unknown-addend problem. *For example, subtract 10 - 8 by finding the number that makes 10 when added to 8.*

#### Add and subtract within 20.

[CCSS.Math.Content.1.OA.C.5](http://www.corestandards.org/Math/Content/1/OA/C/5/)  
Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).

[CCSS.Math.Content.1.OA.C.6](http://www.corestandards.org/Math/Content/1/OA/C/6/)  
Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 - 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

#### Work with addition and subtraction equations.

[CCSS.Math.Content.1.OA.D.7](http://www.corestandards.org/Math/Content/1/OA/D/7/)  
Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 - 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.

[CCSS.Math.Content.1.OA.D.8](http://www.corestandards.org/Math/Content/1/OA/D/8/)  
Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = \_ - 3, 6 + 6 = \_*.

#### Grade 2

#### Represent and solve problems involving addition and subtraction.

[CCSS.Math.Content.2.OA.A.1](http://www.corestandards.org/Math/Content/2/OA/A/1/)  
Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.1

#### Add and subtract within 20.

[CCSS.Math.Content.2.OA.B.2](http://www.corestandards.org/Math/Content/2/OA/B/2/)  
Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers.

#### Work with equal groups of objects to gain foundations for multiplication.

[CCSS.Math.Content.2.OA.C.3](http://www.corestandards.org/Math/Content/2/OA/C/3/)  
Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.

[CCSS.Math.Content.2.OA.C.4](http://www.corestandards.org/Math/Content/2/OA/C/4/)  
Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

#### Grade 3

***Represent and solve problems involving multiplication and division.***

[CCSS.Math.Content.3.OA.A.3](http://www.corestandards.org/Math/Content/3/OA/A/3/)  
Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.1

#### Grade 4

#### Use the four operations with whole numbers to solve problems.

[CCSS.Math.Content.4.OA.A.1](http://www.corestandards.org/Math/Content/4/OA/A/1/)  
Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.

[CCSS.Math.Content.4.OA.A.2](http://www.corestandards.org/Math/Content/4/OA/A/2/)  
Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.1

#### Grade 5

#### Write and interpret numerical expressions.

[CCSS.Math.Content.5.OA.A.1](http://www.corestandards.org/Math/Content/5/OA/A/1/)  
Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

[CCSS.Math.Content.5.OA.A.2](http://www.corestandards.org/Math/Content/5/OA/A/2/)  
Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product*.

#### Grade 6

#### Apply and extend previous understandings of arithmetic to algebraic expressions.

[CCSS.Math.Content.6.EE.A.1](http://www.corestandards.org/Math/Content/6/EE/A/1/)  
Write and evaluate numerical expressions involving whole-number exponents.

[CCSS.Math.Content.6.EE.A.2](http://www.corestandards.org/Math/Content/6/EE/A/2/)  
Write, read, and evaluate expressions in which letters stand for numbers.

[CCSS.Math.Content.6.EE.A.2.a](http://www.corestandards.org/Math/Content/6/EE/A/2/a/)  
Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 - y*.

[CCSS.Math.Content.6.EE.A.2.b](http://www.corestandards.org/Math/Content/6/EE/A/2/b/)  
Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms*.

[CCSS.Math.Content.6.EE.A.2.c](http://www.corestandards.org/Math/Content/6/EE/A/2/c/)  
Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas V = s3 and A = 6 s2 to find the volume and surface area of a cube with sides of length s = 1/2*.

[CCSS.Math.Content.6.EE.A.3](http://www.corestandards.org/Math/Content/6/EE/A/3/)  
Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y*.

[CCSS.Math.Content.6.EE.A.4](http://www.corestandards.org/Math/Content/6/EE/A/4/)  
Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.*.

#### Reason about and solve one-variable equations and inequalities.

[CCSS.Math.Content.6.EE.B.5](http://www.corestandards.org/Math/Content/6/EE/B/5/)  
Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

[CCSS.Math.Content.6.EE.B.6](http://www.corestandards.org/Math/Content/6/EE/B/6/)  
Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

[CCSS.Math.Content.6.EE.B.7](http://www.corestandards.org/Math/Content/6/EE/B/7/)  
Solve real-world and mathematical problems by writing and solving equations of the form *x* + *p* = *q* and *px* = *q* for cases in which *p*, *q* and *x* are all nonnegative rational numbers.

[CCSS.Math.Content.6.EE.B.8](http://www.corestandards.org/Math/Content/6/EE/B/8/)  
Write an inequality of the form *x* > *c* or *x* < *c* to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form *x* > *c* or *x* < c have infinitely many solutions; represent solutions of such inequalities on number line diagrams.

#### Represent and analyze quantitative relationships between dependent and independent variables.

[CCSS.Math.Content.6.EE.C.9](http://www.corestandards.org/Math/Content/6/EE/C/9/)  
Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.

#### Grade 7

#### Use properties of operations to generate equivalent expressions.

[CCSS.Math.Content.7.EE.A.1](http://www.corestandards.org/Math/Content/7/EE/A/1/)  
Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

[CCSS.Math.Content.7.EE.A.2](http://www.corestandards.org/Math/Content/7/EE/A/2/)  
Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*

#### Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

[CCSS.Math.Content.7.EE.B.3](http://www.corestandards.org/Math/Content/7/EE/B/3/)  
Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation*.

#### Grade 8

#### Expressions and Equations Work with radicals and integer exponents.

[CCSS.Math.Content.8.EE.A.1](http://www.corestandards.org/Math/Content/8/EE/A/1/)  
Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3-5 = 3-3 = 1/33 = 1/27.

[CCSS.Math.Content.8.EE.A.2](http://www.corestandards.org/Math/Content/8/EE/A/2/)  
Use square root and cube root symbols to represent solutions to equations of the form *x*2 = *p* and *x*3 = p, where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.

[CCSS.Math.Content.8.EE.A.3](http://www.corestandards.org/Math/Content/8/EE/A/3/)  
Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger.

[CCSS.Math.Content.8.EE.A.4](http://www.corestandards.org/Math/Content/8/EE/A/4/)  
Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology

#### Understand the connections between proportional relationships, lines, and linear equations.

[CCSS.Math.Content.8.EE.B.5](http://www.corestandards.org/Math/Content/8/EE/B/5/)  
Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

[CCSS.Math.Content.8.EE.B.6](http://www.corestandards.org/Math/Content/8/EE/B/6/)  
Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation *y* = *mx* + *b* for a line intercepting the vertical axis at *b*.

#### Analyze and solve linear equations and pairs of simultaneous linear equations.

[CCSS.Math.Content.8.EE.C.7](http://www.corestandards.org/Math/Content/8/EE/C/7/)  
Solve linear equations in one variable.

[CCSS.Math.Content.8.EE.C.7.a](http://www.corestandards.org/Math/Content/8/EE/C/7/a/)  
Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form *x* = *a*, *a* = *a*, or *a* = *b* results (where *a* and *b* are different numbers).

[CCSS.Math.Content.8.EE.C.7.b](http://www.corestandards.org/Math/Content/8/EE/C/7/b/)  
Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

[CCSS.Math.Content.8.EE.C.8](http://www.corestandards.org/Math/Content/8/EE/C/8/)  
Analyze and solve pairs of simultaneous linear equations.

[CCSS.Math.Content.8.EE.C.8.a](http://www.corestandards.org/Math/Content/8/EE/C/8/a/)  
Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

[CCSS.Math.Content.8.EE.C.8.b](http://www.corestandards.org/Math/Content/8/EE/C/8/b/)  
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6*.

[CCSS.Math.Content.8.EE.C.8.c](http://www.corestandards.org/Math/Content/8/EE/C/8/c/)  
Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair*.