**Session Eight: Solving Equations**

**Common Core Standards Addressed**

#### Grade 1

#### 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

#### Grade 3

#### Solve problems involving the four operations, and identify and explain patterns in arithmetic.

[CCSS.Math.Content.3.OA.D.8](http://www.corestandards.org/Math/Content/3/OA/D/8/)  
Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.3

[CCSS.Math.Content.3.OA.D.9](http://www.corestandards.org/Math/Content/3/OA/D/9/)  
Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends*.

#### Grade 4

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

[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

#### 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.

#### Grade 7

#### 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*.

[CCSS.Math.Content.7.EE.B.4](http://www.corestandards.org/Math/Content/7/EE/B/4/)  
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.

[CCSS.Math.Content.7.EE.B.4.a](http://www.corestandards.org/Math/Content/7/EE/B/4/a/)  
Solve word problems leading to equations of the form *px* + *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?*

#### 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

#### 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*.