Lessons - Linear Equations and Inequalities in 1 variable

COURSE: ALGEBRA
Unit 3: Linear Equations and Inequalities in 1 variable
Time Frame for developmental lessons: 15 days
Time Frame for Charter Schools: 17 days

Unit Resources:

Common Core Standards for this Unit

Sample Lesson Sequencing

Unit Chunks:

1. Creating Algebraic Representations
2. Solving Algebraic Representations
3. Equivalent Representations

Essential Qs	Core Math	Unit Resources
How can we represent information symbolically?	**Creating Algebraic Representations** Students will understand how to translate a situation in words to an algebraic representation (expressions, equations, and inequalities) and vice versa. ● describe the relationship between each number or variable in an algebraic representation with the situation in words that it represents ○ determine if an equation/expression accurately portrays a given scenario in words and justify the alignment between the words and algebraic model ○ determine which types of equations can be used to model different situations, including inequality constraints.	**Creating algebraic models from word problems and/or situations:** ● Algebraic Expressions Millionaire: (Online game for practice translating verbal expressions to its algebraic equivalent.) **Evaluate the relationship between quantities in a situation and how to use variables to represent quantities:** ● Speed, Distance, Time (easy intro task, evaluate the relationship between quantities and create a basic equation

	● explain the difference between an equation and an expression ● describe the units of a variable and relationship with other quantities in a situation to create appropriate algebraic models ● understand how to use variables to represent an unknown/changing quantity or a constant to represent a known/unchanging value ● create algebraic representations by appropriately assigning variables and numbers to quantities in a situation and can explain the meaning of each value/term used ○ *Students will understand what each part of the equation represents in relation to the given situation.* ● understand that different types of equations can be used to model different situations. ○ understand how to create an equation from information (verbal, graph, table, etc), ○ understand what absolute value is. *SWBAT describe work by using these terms appropriately and consistently:* domain, range, dependent, independent, expression, equation, inequality, term, variable, unknown, coefficient, constant, initial value, rate of change, linear equation, absolute value, constraint(s), quantity, greater than, greater than or equal to, less than, less than or equal to, at least, at most	relating each quantity) ● Representing Digits (create expressions and grapple with relationships between quantities, factors, and number properties) ● Calendar Patterns (focus on how to use variables to represent quantities and the relationship between quantities to create expressions, could be revisited later in the unit with emphasis on understanding equivalency or Unit 6 with quadratics) ● Crisscross Numbers (very similar to Calendar Patterns, focus on how variables can be used to represent quantities and describing how those variables relate to one another in the context of the situation, could be revisited later in the unit with an emphasis on proving equivalency or revisited in Unit 6 with quadratics) **Recommended resource:** Grace Kelemanik's presentation has some concrete suggestions for how you can support students in constructing representations from a given situation.

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Essential Qs	Core Math	Unit Resources
How do we prove that our solutions to problems are correct?	**Solving Algebraic Representations** Understand solving equations as a process of reasoning and explaining the reasoning. ● solutions for an equation with two variables is the pair of values that make the equation true	**Determine the output or input of a function given one or the other:** ● Number Machines (#3 is a cool extension within reach of Unit 3 content and leads nicely to and possibly worth revisiting during Unit 4) ● Building Units (easy bridge task connecting

	○ the graph of an equation in two variables is the set of all the solutions plotted in the coordinate plane (ex. Possible solutions for x + y = 7 include (1,6), (3,4), (5,5, 1.5)...) ○ given x or y, they can determine the required value of its pair. ● manipulate equations (using two step, multi step, with distributive property, combining like terms, solving with rational numbers) and the language to communicate their reasoning ● an equation with one unknown value can be solved using a variety of methods including: ○ using inverse operations, ○ by inspecting and using the relationship between quantities (eg. for $-12(\frac{1}{7} + x) = 0$ using inverse operations is less than optimal than looking at the structure of the equation and noting that $-\frac{1}{7}$ is the solution because one of -12 and $(\frac{1}{7} + x)$ must be 0). ○ using mental arithmetic, ○ understand that given one specific value, equations can be used to determine two related values (find an input given a desired output or find an output given an input). *Note that this is the extension of the mathematics of Unit 2: Interpreting Function Features, extending patterns using rate of change.* ● construct viable arguments to justify a solution method articulating assumptions, which includes the assumption that the original equation has a solution ● understand what their solutions mean within different contexts. ○ *The difference in the solution set of equations versus inequalities* ○ *The value of the unknown will make the equation balance.* ○ *Students will understand how to manipulate equations in order to solve for a specific quantity* ● how to identify the solutions to the equations and inequality given a set of numbers and know when an inequality has constraints, identify solutions to an equation or inequality given a replacement set ● graphically solve a pair of linear functions f(x) = mx + b and f(x) = c (c is some constant), recognizing that this is substituting c = mx + b *SWBAT describe work by using these terms appropriately and consistently*:	to content from Unit 2, determine in and outputs of an equation that models a situation) ● Pen Pal (also #3 requires to rearrange an equation to isolate a specific variable) **Graphically representing a solution set:** ● Sports Equipment Set (Illustrative Mathematics) ● Number Lines of Inequalities **Using visual models to evaluate an algebraic equation and its solution set:** ● Solving Equations (Illustrative Mathematics) **Recognizes and applies number properties to analyze and define a solution set:** ● Facts in Fruit (nice extension of Mystery Letters by applying understanding about number properties- especially the uniqueness of zero and one, explore relationships between numbers) ● How does the solution change? (Illustrative Mathematics) ● Equations and Formulas (Illustrative Mathematics) ● Magic Pentagon (uses substitution and properties of equality to set up and solve equations) **Making sense of the solution to an algebraic equation in the context of a situation:** ● End-of-year Dinner (create an equation to determine in and outputs, consider situational constraints to appropriately identify a solution) ● Buying a Car (Illustrative Mathematics) ● Banquet Tables (explain the relationship

	expression, equation, inequality, term, solution(s), solution set, solve, simplify, distributive property, distribute, combining like terms, order of operations, inverse operations, balance, equivalent, linear equation, absolute value, factor, sum, difference, product, quotient, greater than, greater than or equal to, less than, less than or equal to, at least, at most	between quantities, create and solve an equation, and consider situational constraints to appropriately identify a solution) ● Party (#3 consider situational constraints on the equation, #5 match the solution set to a graph within the context of the situation) **Analyzing relationships between variables and known quantities to describe a solution set:** ● Sorting Activity (students look at equations and situation and sort them as always, sometimes, never) ● Same Solutions (Illustrative Mathematics) ● Solving Linear Equations in One Variable (MARS, Shell Center)

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Essential Qs	Core Math	Unit Resources
How are different representations related to each other?	**Equivalent Representations** Students will understand that equations describe numbers or relationships and that there may be equivalent representations and descriptions for the number or relationship. ● use substitution to create and manipulate equations with variables on both sides of an equation ● make comparisons between equivalent equations or inequalities ○ uses order of operations and other number properties (distributive property, etc.) to prove that two expressions/equations are equivalent	**Understanding the relationship between expressions to set-up and solve equations:** ● Coupon versus discount (Illustrative Mathematics) ● Sammy's Chipmunk and Squirrel Observations (Illustrative Mathematics) ● Meal Out (good transition task to Unit 4) **Utilize number properties to analyze and compare expressions:** ● Differences (understand value of order of

	○ uses a variety of methods (concrete and abstract) to prove equivalency, for example substitutes a specific value and simplifies ● describe the relationship between expressions in order to appropriately simplify new expressions or solve equations, ● make sense of equivalent expressions/equations in order to extend reasoning to other models/expressions/equations, flexibly understands how numbers and values are organized within an algebraic expression or equation and can create equivalent models ● understand that different types of equations can be used to model different situations. ○ connect linear equations to linear functions *SWBAT describe work by using these terms appropriately and consistently*: term, simplify, distributive property, distribute, combining like terms, order of operations, inverse operations, balance, equivalent, factor, sum, difference, product, quotient	operations, describe impact of properties to compare expressions) ● Calendar Patterns (analyze relationships between quantities to create expressions and evaluate their equivalency, how variables are used to generalize a quantity could require quadratics in Rule #3, possibly revisit in Unit 6) ● Crisscross Numbers (very similar to Calendar Patterns but more proof involved, depending on the expressions created will involve and rely on different number properties, possibly revisit in Unit 6)

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Common Core Learning Standards:

Understand solving equations as a process of reasoning and explain the reasoning

- **A-REI 1** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Perform arithmetic operations on polynomials.

- **A-APR.1** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Solve equations and inequalities in one variable

- **A-REI 3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Represent and solve equations and inequalities graphically.

- **A-REI 11** Explain why the *x*-coordinates of the points where the graphs of the equations *y = f(x)* and *y = g(x)* intersect are the solutions of the equation *f(x) = g(x)*; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f(x)* and/or *g(x)* are linear, ~~polynomial, rational, absolute value, exponential, and~~

~~logarithmic functions.~~

Create equations that describe numbers or relationships.

- **A-CED 1** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear ~~and quadratic functions, and simple rational and exponential~~ functions*.
- **A CED 3** Represent constraints by equations or inequalities, ~~and by systems of equations and/or inequalities~~, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*
- **A CED 4** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R*.

Interpret the structure of expressions.

- **A-SSE.A.1** Interpret expressions that represent a quantity in terms of its context.
  a. Interpret parts of an expression, such as terms, factors, and coefficients. The "such as" listed are not the only parts of an expression students are expected to know; others include, but are not limited to, degree of a polynomial, leading coefficient, constant term, and the standard form of a polynomial (descending exponents).
  b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.

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