Lessons - Linear Equations and Inequalities in 2 variables

COURSE: ALGEBRA
Unit 4: Linear Equations and Inequalities in 2 variables
Time Frame for developmental lessons: 15 days
Time Frame for Charter Schools: 21 days

Unit Resources:

Common Core Standards for this Unit

Sample Lesson Sequencing

Unit Chunks:

1. Creating Algebraic Representations
2. Analyzing and Interpreting Solution Sets
3. Multiple Representations

Essential Qs	Core Math	Unit Resources
How can we apply our knowledge to model real-world situations?	**Creating Algebraic Representations** Students create two or more algebraic representations (expressions, equations, inequalities,tables, and graphs) by understanding and justifying the relationship between quantities in a situation. ● Students should be able to create algebraic representations by appropriately assigning variables and numbers to quantities in a situation and: ○ Describe the relationship between each number or variable in an algebraic representation with the situation in words that it represents, define a variable in terms of a problem (ex. Knowing to start a system problem by defining x as	**Describe relationship between 2 variables using rate of change and identify optimal solution given specific constraints**: ● Fence (excellent ramp task from Unit 2 and 3, #5 asks students to understand the impact of constraints on the solution set) ● Boomerangs (Classroom Challenge (FAL) that can be used to help students think about optimization given constraints)

	the number of legs and y as the number of heads in a room), ○ Justify how the words and algebraic model align, ○ Create equations to represent relationships between quantities defined by verbal expressions. ● Students should understand how to use variables to represent an unknown/changing quantity or a constant to represent a known/unchanging value and use appropriate operations to represent the relationship between quantities/variables/terms. *SWBAT describe work by using these terms appropriately and consistently:* domain, range, expression, equation, inequality, unknown, solution, viable, valid/reasonable, coefficient, constant, initial value, rate of change, solution set, dependent, independent, term, variable, system, system of equations/inequalities, boundary/bounded, conditions/constraints	● Dido and the Foundation of Carthage Dido is tasked with using a leather oxhide to cover as big an area as possible to build a city **Consider the relationship between variables and their constraints given two true statements about how each quantity relates**: ● Nickels & Dimes (*warning* - could be done relatively easily via guess and check so make sure to scaffold or clarify for your students, encourage students to create a pair of equations, 2 tables, or 2 graphs on the same coordinate plane to represent the situation in 2 variables) ● Pete's Numbers (encourage students to create a pair of equations, 2 tables, or 2 graphs on the same coordinate plane to represent the situation in 2 variables, consider how changes parameters impact outcomes) **Compare algebraic representations**: ● Summer Job (extension of Unit 3 content: creating equations and determining an output given an input, in #2 students should articulate and make sense of contextual restrictions on the domain)

Essential Qs	Core Math	Unit Resources
How can we represent and		

analyze our solutions to problems?	**Analyzing & Interpreting Solution Sets** Students should understand that solutions for two variables in two or more equations maintains the validity of the relationship between variables and simultaneously makes all equations true. ● Students should recognize and justify why solutions for a system of equations is the pair of values that make both equations true simultaneously ● Students should recognize and can distinguish when a situation/question has only one vs. many solutions and can justify the distinction using conditions and constraints from the given context/situation. ○ Students should understand that the number of variables and equations will determine the number of possible solutions, when not identity or parallel (ex. 1 linear equation in 1 variable has 1 solution, 1 linear equation in 2 variables has an infinite number of solutions, 2 linear in 2 variables 1 solution, etc...), ○ Students should be able to distinguish between the meaning of different inequality symbols in terms of their graphical representations and meaning in terms of solution sets, including direction of shading and determination of type of boundary line. ● Students should be able to establish a system of equations or inequalities to solve a situation using graphing, substitution, or elimination and students should: ○ Identify a variable in one equation/inequality to isolate so that system can be compared, ○ Know that a solution to any system of equations is equivalent to the intersection point(s) of the graphs of the functions for those equations or relations, the intersection point of multiple graphs means that they share that solution simultaneously (intersection point makes all equations that share it true), ○ Recognize the solution to a system of equation using a table of values and be able to justify the solution, ○ Be able to do this for linear-linear, linear-quadratic, and linear-exponential function pair	**Create systems and analyze how particular parameters impact the solution set:** ● Baseball Jerseys (builds on Unit 2 and 3 content, #4 is the focal point of the task for Unit 4 standards) ● Consumer Sense (interpret key points for comparing situations) **Considering viable solutions for a system of inequalities:** ● Solution Sets (identifying possible points within the solution set, from Illustrative Mathematics) ● Fishing Adventure (creating system of equations and comparing potential solutions, from Illustrative Mathematics) ● Defining Regions Using Inequalities (Classroom Challenge that can be used to uncover how students think about the relationship between the solution space and the constraints) **Strategically substituting equivalent values to solve systems:** ● Juice (very simple introduction to solving a system using substitution) ● Magic Squares (strengthens understanding of the relationship between variables) ● The Family (quantifiably relate various unknown values in a situation, create multiple equations) ● The Basketball Game **Highlighting elimination as an efficient method for solving systems:**

	○ Students should transform linear equations in two variables to set up different solution methods (substitution vs. elimination vs. graphing) ● Students should interpret the solution to an unknown and can apply appropriate units to each variable/solution. ○ Students should know when linear equations and inequalities are used to solve problems in an applied context, the solution must make sense in the context of the original problem ○ Should be able to explain the meaning of solutions found by algebraic abstraction in terms of the context of the problem *SWBAT describe work by using these terms appropriately and consistently:* dependent, independent, equation, inequality, system, system of equations/inequalities, term, variable, unknown, constant, initial value, coefficient, rate of change, viable, valid/reasonable, boundary/bounded, conditions/constraints, solution(s), solution set, simultaneous, intersection, substitution, elimination	● Coffee (read and interpret a graph to create a system of equations, common factor for coefficients makes elimination particularly efficient) ● Party Flags (create a system of equations from a diagram, common factor for coefficients makes elimination particularly efficient) ● Fencing (create a system of equations from words and a diagram, particularly large numbers with common factors for coefficients makes elimination particularly efficient) ●

Essential Qs	Core Math	Unit Resources
How can we represent the same thing in multiple different ways?	**Multiple Representations** Students will represent and solve equations and inequalities graphically and algebraically and can make comparisons between different representations. ● Students should verify solutions by using different methods, and notice that if done correctly, the different methods should produce the same result. ○ Students should solve a system of equations at least two methods and articulate the alignment of each representation.	**Analyzing scenarios using a variety of methods (elimination, graphing, tables substitution, etc.) to best contextualize the solution set:** ● Fibonacci Sequences (compare using elimination and substitution as equally efficient methods, highlight the different sense making with each type of approach) ● The Trip (create equations and solve a system using multiple methods to verify its solution, highlight the use of

	○ Students should use a graphing calculator to check or to graph equations/inequalities. ● Students should know that some representations of a function may be more useful than others depending on how they are used and that different representations of functions can highlight different information about the situation that it models. ● Students should make fluent connections between different representations including graphs, tables, equations/rules, and situations. *SWBAT describe work by using these terms appropriately and consistently*: solution(s), solution set, simultaneous, intersection, substitution, elimination, domain, range, dependent, independent, equation, inequality, system, system of equations/inequalities, term, variable, unknown, constant, initial value, coefficient, rate of change, viable, valid/reasonable, boundary/bounded, conditions/constraints	a table of values) ● Supply & Demand (students write and solve a system of linear equations in a real-world setting using graphs to estimate solutions and equations for determining exact solutions, from Illuminations, NCTM) ● ● Graphing Stories: Time, Air Pressure, Water Volume, Weight of cups, Height of stack, Weight

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Common Core Learning Standards:

Create equations that describe numbers or relationships

- **A-CED 2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **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*.

Solve systems of equations

- **A-REI 5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- **A-REI 6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically

- **A-REI 10** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often

forming a curve (which could be a line).

- **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~~.
- **A-REI 12** Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

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