### Algebra I

#### Relationships between quantities and reasoning and their graphs

- **Topic A**  Introduction to functions studied this year
- **Topic B**  Structures of expressions
- **Topic C**  Solving equations and inequalities
- **Topic D**  System of equations

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#### Content Standards

- **N-Q.1**  Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

- **N-Q.2**  Define appropriate quantities for the purpose of descriptive modeling.

- **N-Q.3**  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

- **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.2**  Create equations in two or more variable 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 $R$.

- **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.

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

- **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.

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| A-REI.6 | 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.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.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. |
| A-SSE.1 | Interpret expressions that represent a quantity in terms of its context. |
| a. Interpret parts of an expression, such as terms, factors, and coefficients. |
| 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 \( P \). |
| A-SSE.2 | Use the structure of an expression to identify ways to rewrite it. For example, see \( x^4 - y^4 \) as \( (x^2)^2 - (y^2)^2 \), thus recognizing it as a difference of squares that can be factored as \( (x^2 - y^2)(x^2 + y^2) \). |
| 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. |

### Video Links

| Lesson 1 Elevation vs. Time 2 | [http://www.mrmeyer.com/graphingstories1/graphingstories2.mov](http://www.mrmeyer.com/graphingstories1/graphingstories2.mov) |
| Lesson 2 Ball rolling | [http://youtu.be/xgODzAwxrx8](http://youtu.be/xgODzAwxrx8) |
| Lesson 2 Professor Splash | [https://youtube.com/watch?v=ZCFBCBuXz-g](https://youtube.com/watch?v=ZCFBCBuXz-g) |
| Lesson 3 Bacteria | [https://www.youtube.com/watch?v=gEwzDydcilWc](https://www.youtube.com/watch?v=gEwzDydcilWc) |

**2016-2017**
### Assessment

Possible Formative Assessments
- Mid-Module Assessment and Rubric
- End-of-Module Assessment and Rubric
- Teacher Created
- Exit Tickets
- SCA’s using Kuta software

Summative Assessment
- District Assessment: 2016-17 D6 AlgI Eureka Module 1 Common Assessment
- Teacher Created Assessment to address other standards

### Instructional Notes

#### Topic A: Introduction to Functions Studied this Year - Graphing Stories

**Problems from Module 5: Lesson 1 Example 1**

**Lesson 1 Graphs of Piecewise Linear Functions (Exploration Lesson)**

Student outcomes:
- Students define appropriate quantities from a situation (a graphing story), choose and interpret the scale and the origin for the graph, and graph the piecewise linear function described in the video. They understand the relationship between physical measurements and their representation on a graph.

  ▪ NOTE states: "The man starts at "30 feet above the ground," which is clearly false. The students have no prior knowledge of the height of a flight/story of a building, which is 10 ft.

**Lesson 2 Graphs of quadratic functions (Exploration Lesson)**

Student outcomes:
- Students represent graphically a nonlinear relationship between two quantities and interpret features of the graph. They understand the relationship between physical quantities via the graph.

  ▪ The lesson introduces function notation, however it is formally defined later in Module 3 Lesson 9.
  ▪ $h(t)$ models height as a function of time while $h(x)$ models the trajectory of the same object. The two functions have some similarities and differences but it is not imperative that students understand these specific differences.
  ▪ If using problem set #4 (c,d), recall Pythagorean Theorem.

**Lesson 3 Graphs of Exponential functions (Exploration Lesson)**

Student Outcomes:
- Students choose and interpret the scale on a graph to appropriately represent an exponential function. Students plot points representing the number of bacteria over time, given that bacteria grow by a constant factor over evenly spaced time intervals.

**Lesson 4 OMIT**
Lesson 5 Two Graphing stories (Exploration Lesson)

Student outcomes:
- Students interpret the meaning of the point of intersection of two graphs and use analytic tools to find its coordinates.
- Students develop the tools necessary to discern units for quantities in real-world situations and choose levels of accuracy appropriate to limitations on measurement. They refine their skills in interpreting the meaning of features appearing in graphs.
- **Students have little prior knowledge of dimensional analysis. An example, traveling 13mph for 6 minutes. This topic is included on the mid-module assessment therefore please address additional examples.

Topic B: The Structure of Expressions

Lesson 6 Algebraic expression distributive properties (Problem Set Lesson)

Student Outcomes:
- Students use the structure of an expression to identify ways to rewrite it.
- Students use the distributive property to prove equivalency of expressions.
  - Make sure you read through the "4-number game" to completely understand before lesson.
  - algebra tiles (2 dimension & 3 dimensions) would be helpful.

Lesson 7 Algebraic Expressions – Commutative/Associative (Socratic Lesson)

Student Outcomes:
- Students use the commutative and associative properties to recognize structure within expressions and to prove equivalency of expressions.
  - Do not skip over the picture representation of the properties - they are referred to in later lessons.
  - Problem set 10 refers to the rules of exponents-may have to review additional examples.

Lesson 8 Adding and subtracting polynomials (Socratic Lesson)

Students Outcomes:
- Students understand that the sum or difference of two polynomials produces another polynomial and relate polynomials to the system of integers; students add and subtract polynomials.
  - The concept of using a polynomial as place value when x = 10 is used throughout module 1.

Lesson 9 Multiplying polynomials (Problem Set Lesson)

Students Outcomes:
- Students understand that the product of two polynomials produces another polynomial; students multiply polynomials.
  - What do you notice about the terms along the diagonals in the rectangle you drew?
• Stress the importance of the area model - see assessment question 8.a.v.

Mid Module Unit Assessment

**Topic C: Solving Equations and Inequalities**

**Lesson 10 True/False equations (Problem Set Lesson)**

**Student Outcomes:**
- Students understand that an equation is a statement of equality between two expressions. When values are substituted for the variables in an equation, the equation is either true or false. Students find values to assign to the variables in equations that make the equations true statements.

  ▪ Important not to skip - lesson makes use of structure and understanding among equivalencies.

**Lesson 11 Solutions sets equations and inequalities (Problem Set Lesson)**

**Student Outcomes:**
- Students understand that an equation with variables is often viewed as a question asking for the set of values one can assign to the variables of the equation to make the equation a true statement. They see the equation as a “filter” that sifts through all numbers in the domain of the variables, sorting those numbers into two disjoint sets: the solution set and the set of numbers for which the equation is false.
- Students understand the commutative, associate, and distributive properties as identities (i.e., equations whose solution sets are the set of all values in the domain of the variables).

  ▪ Important not to skip - concepts are used in future lessons.
  ▪ Introduce set notation.

**Lesson 12 Solution equation (Problem Set Lesson)**

**Student Outcomes:**
- Students are introduced to the formal process of solving an equation: starting from the assumption that the original equation has a solution. Students explain each step as following from the properties of equality. Students identify equations that have the same solution set.

  • Solving quadratics using strategies developed in Lesson 10 & 11.
  • Lesson is about making use of structure with the properties when solving quadratics.

**Lesson 13 Potential Danger (Problem Set Lesson)**

**Student Outcomes:**
- Students learn if-then moves using the properties of equality to solve equations. Students also explore moves that may result in an equation having more solutions than the original equation.
Lesson 14 Solving inequalities (Problem Set Lesson)
Student Outcomes:
- Students learn if-then moves using the addition and multiplication properties of inequality to solve inequalities and graph the solution sets on the number line.
- Example 3 shows why the inequality sign switches direction using the addition property. This concept is referred to in the exit ticket.

Lesson 15 Solution set 2 + equations “and” “or” (Exploration Lesson)
Student Outcomes:
- Students describe the solution set of two equations (or inequalities) joined by either “and” or “or” and graph the solution set on the number line.
- After leading a discussion on compound mathematical statements using "and" and "or", have students think of scenarios that could be modeled using a compound inequality.

Lesson 16 Solving/Graphing inequalities “and” “or” (Problem Set Lesson)
Student Outcomes:
- Students solve two inequalities joined by “and” or “or” and then graph the solution set on the number line.

Lesson 17 Equations involving factored expressions (Socratic Lesson)
Student Outcomes:
- Students learn that equations of the form \((x-a)(x-b) = 0\) have the same solution set as two equations joined by “or”: \(x-a = 0\) or \(x-b = 0\). Students solve factored or easily factorable equations.
  - This is not a time for teaching factoring. The solutions are more common sense. Factoring is taught in Module 4.

Lesson 18 Equations variable in denominator (Problem Set Lesson)
Student Outcomes:
- Students interpret equations like \(1/x = 3\) as two equations, \(1/x = 3\) and \(x \neq 0\), joined by “and.” Students find the solution set for this new system of equations.
  - They are calling the restriction in domain as a compound inequality and writing a system of equations.

Lesson 19 Renaming formulas (Problem Set Lesson)
Student Outcomes:
- Students learn to think of some of the letters in a formula as constants in order to define a relationship between two or more quantities, where one is in terms of another, for example holding \(V\) in \(V = IR\) as constant and finding \(R\) in terms of \(I\).
Lesson 20-21 Solution set equations/inequalities with two variables (Problem Set Lesson)
Student Outcomes:
- Students recognize and identify solutions to two-variable equations. They represent the solution set graphically. They create two-variable equations to represent a situation. They understand that the graph of the line $ax + by = c$ is a visual representation of the solution set to the equation $ax + by = c$.
- Students recognize and identify solutions to two-variable inequalities. They represent the solution set graphically. They create two-variable inequalities to represent a situation.
- Students understand that a half-plane bounded by the line $ax + by = c$ is a visual representation of the solution set to a linear inequality, such as $ax + by < c$. They interpret the inequality symbol correctly to determine which portion of the coordinate plane is shaded to represent the solution.
- Opening exercise on lesson 20 and lesson 21 is crucial.

Lesson 22-23 Solution set similar equations/inequalities (Problem Set Lesson, Exploration Lesson)
Student Outcomes:
- Students identify solutions to simultaneous equations or inequalities; they solve systems of linear equations and inequalities either algebraically or graphically.
- Students create systems of equations that have the same solution set as a given system.
- Students understand that adding a multiple of one equation to another creates a new system of two linear equations with the same solution set as the original system. This property provides a justification for a method to solve a system of two linear equations algebraically.
- High School has not taught elimination method in the past but needs to incorporate elimination in this lesson for simple systems.

Lesson 24 Application system equations/inequalities (Exploration Lesson)
Student Outcomes:
- Students use systems of equations or inequalities to solve contextual problems and interpret solutions within a particular context.

- Light version of linear programming.

Topic D: Creating equations to solve problems
If behind leave this topic out

Lesson 25 Solving problem in 2 ways (Modeling Cycle Lesson)
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Student Outcomes:
- Students investigate a problem that can be solved by reasoning quantitatively and by creating equations in one variable.
- Students compare the numerical approach to the algebraic approach.

Lesson 26-27 Recursive challenge problems (Modeling Cycle Lesson)
Student Outcomes:
- Students learn the meaning and notation of recursive sequences in a modeling setting.
- Following the modeling cycle, students investigate the *double and add 5* game in a simple case in order to understand the statement of the main problem.
- Students learn the meaning and notation of recursive sequences in a modeling setting.
- Students use recursive sequences to model and answer problems.
- Students create equations and inequalities to solve a modeling problem.
- Students represent constraints by equations and inequalities and interpret solutions as viable or non-viable options in a modeling context.
  - The recursive definition is only used in this lesson. Explicit/General definitions are NOT referred to in this lesson.
  - (Explicit/General definition of sequences is covered in Module 3 Topic A).
  - The restriction in domain starts to be addressed with recursive definition.
  - Be careful that students do not develop the misunderstanding that recursive definitions are not just doubling and adding five.

Lesson 28 Federal income tax (Modeling Cycle Lesson)
Student Outcomes:
- Students create equations and inequalities in one variable and use them to solve problems.
- Students create equations in two or more variables to represent relationships between quantities and graph equations on coordinate axes with labels and scales.
- Students represent constraints by inequalities and interpret solutions as viable or non-viable options in a modeling context.
  - This lesson addresses a Colorado Academic Standard for Personal Financial Literacy although it is not CCSS.

End of Module Assessment week of October 13