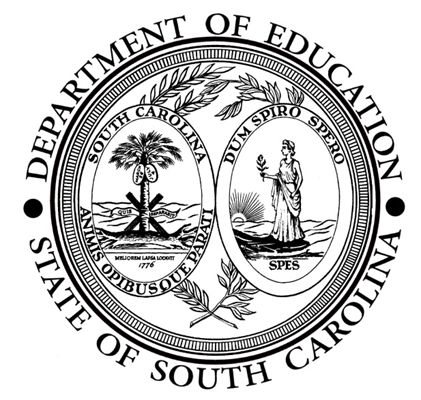
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| Office of Standards and Learning  July 2020 - DRAFT |

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| South Carolina Department of Education |
| South Carolina College- and Career-Ready Standards for Mathematics |
| Foundations in Algebra Support Document |



The mathematics support documents have been created by teachers for teachers. This is a working document. Based on feedback from classroom application, revisions will continue. During 2019-2020, a team of teachers from 31 districts developed units of instruction. These units are not intended to be a pacing guide. The strategies in the units are not all-inclusive for specific content instruction. Tasks within the units of instruction are not presented in a particular order, but are numbered for ease of reference.

**Mathematical Process Standards:** The South Carolina College- and Career-Ready (SCCCR) Mathematical Process Standards demonstrate the ways in which students develop conceptual understanding of mathematical content and apply mathematical skills. As a result, the SCCCR Mathematical Process Standards should be integrated within the SCCCR Content Standards for Mathematics for each grade level and course. Since the process standards drive the pedagogical component of teaching and serve as the means by which students should demonstrate understanding of the content standards, the process standards must be incorporated as an integral part of overall student expectations when assessing content understanding.

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| 1. **Make sense of problems and persevere in solving them.**    1. Relate a problem to prior knowledge.    2. Recognize there may be multiple entry points to a problem and more than one path to a solution.    3. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem.    4. Evaluate the success of an approach to solve a problem and refine it if necessary. | 1. **Use a variety of mathematical tools effectively and strategically.** 2. Select and use appropriate tools when solving a mathematical problem. 3. Use technological tools and other external mathematical resources to explore and deepen understanding of concepts. |
| 1. **Reason both contextually and abstractly.**    1. Make sense of quantities and their relationships in mathematical and real-world situations.    2. Describe a given situation using multiple mathematical representations.    3. Translate among multiple mathematical representations and compare the meanings each representation conveys about the situation.    4. Connect the meaning of mathematical operations to the context of a given situation. | 1. **Communicate mathematically and approach mathematical situations with precision.**    1. Express numerical answers with the degree of precision appropriate for the context of a situation.    2. Represent numbers in an appropriate form according to the context of the situation.    3. Use appropriate and precise mathematical language.    4. Use appropriate units, scales, and labels. |
| 1. **Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.** 2. Construct and justify a solution to a problem. 3. Compare and discuss the validity of various reasoning strategies. 4. Make conjectures and explore their validity. 5. Reflect on and provide thoughtful responses to the reasoning of others. | 1. **Identify and utilize structure and patterns.** 2. Recognize complex mathematical objects as being composed of more than one simple object. 3. Recognize mathematical repetition in order to make generalizations. 4. Look for structures to interpret meaning and develop solution strategies. |
| 1. **Connect mathematical ideas and real-world situations through modeling.** 2. Identify relevant quantities and develop a model to describe their relationships. 3. Interpret mathematical models in the context of the situation. 4. Make assumptions and estimates to simplify complicated situations. 5. Evaluate the reasonableness of a model and refine if necessary. |  |

| **Unit 1** | **Unit 2** | **Unit 3** | **Unit 4** | **Unit 5** | **Unit 6** |
| --- | --- | --- | --- | --- | --- |
| [Relationships Between Quantities and Expressions](#Unit1Notes) | [Reasoning with Linear Equations and Inequalities](#Unit2Notes) | [Modeling and Analyzing Quadratic Functions](#Unit3Notes) | [Modeling and Analyzing Exponential Functions](#Unit4Notes) | [Comparing and Contrasting Functions](#Unit5Notes) | [Describing Data](#Unit6Notes) |
| **Standards** | **Standards** | **Standards** | **Standards** | **Standards** | **Standards** |
| FA.NRNS.1\*  FA.NRNS.2\*  FA.NRNS.3  FA.NQ.1\*  FA.NQ.2\*  FA.NQ.3\*  FA.ASE.1\*  FA.ACE.1\*  FA.ACE.2\*  FA.ACE.4\*  FA.AREI.1\*  FA.AREI.3\*  FA.AREI.10\* | FA.ACE.2\*  FA.AREI.3  FA.AREI.5  FA.AREI.6\*  FA.AREI.6a  FA.AREI.6b  FA.AREI.10\*  FA.AREI.11\*  FA.AREI.12\*  FA.FIF.1\*  FA.FIF.1a  FA.FIF.1b  FA.FIF.1c  FA.FIF.2\*  FA.FIF.4\*  FA.FIF.5\*  FA.FIF.7\*  FA.FIF.8\*  FA.FIF.9\* | FA.NRNS.1\*  FA.ACE.1\*  FA.ACE.2\*  FA.ACE.4\*  FA.AREI.1\*  FA.FBF.3\*  FA.FIF.1\*  FA.FIF.1a  FA.FIF.1b  FA.FIF.1c  FA.FIF.2\*  FA.FIF.4\*  FA.FIF.5\*  FA.FIF.7\*  FA.FIF.8\*  FA.FIF.8a  FA.FIF.9\* | FA.FLQE.1\*  FA.ACE.1\*  FA.ACE.2\*  FA.FBF.3\*  FA.FIF.1a  FA.FIF.1b  FA.FIF.1c  FA.FIF.2\*  FA.FIF.4\*  FA.FIF.5\*  FA.FIF.7\*  FA.FIF.8\* | FA.FLQE.1\*  FA.FLQE.1a  FA.FLQE.3\*  FA.FLQE.5\*  FA.FBF.3\*  FA.FIF.1\*  FA.FIF.1a  FA.FIF.1b  FA.FIF.1c  FA.FIF.2\*  FA.FIF.4\*  FA.FIF.5\*  FA.FIF.7\*  FA.FIF.9\* | FA.FLQE.5\*  FA.SPID.5\*  FA.SPID.6\*  FA.SPID.7\*  FA.SPID.8\*  FA.SPMJ.1\*  FA.SPMJ.2\*  FA.SPMD.4\*  FA.SPMD.5\*  FA.SPMD.6\* |

| Unit 1  Relationships Between Quantities and Expressions | Unit 2  Reasoning With Linear Equations and Inequalities | Unit 3  Modeling and Analyzing Quadratic Functions |
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| [Content Standards With Clarifying Notes](#Unit1Notes)  [New Academic Vocabulary](#Unit1Voc)  [Prior Knowledge](#Unit1Prior)  [Subsequent Knowledge](#Unit1Subsequent)  [Relationship Among Standards](#Unit1Relationship)  [Resource Links](#Unit1Resources)  [Task 1: Sums & Products of Rational & Irrational Numbers](#Unit1Task1)  [Task 2: Intro to Rational Exponents & Radicals](#Unit1Task2)  [Task 3: One-Variable Equations & Inequalities BINGO](#Unit1Task3)  [Task 4: Dimensional Analysis](#Unit1Task4)  [Task 5: Blue](#Unit1Task5)print Drawing | [Content Standards With Clarifying Notes](#Unit2Notes)  [New Academic Vocabulary](#Unit2Voc)  [Prior Knowledge](#Unit2Prior)  [Subsequent Knowledge](#Unit2Subsequent)  [Relationship Among Standards](#Unit2Relationship)  [Resource Links](#Unit2Resources)  [Task 1: What is a function?](#Unit2Task1)  [Task 2: Identifying and Comparing Key Features of Linear Functions in Multiple Representations](#Unit2Task2)  [Task 3: Linear Functions in the Real World](#Unit2Task3)  [Task 4: Stained Glass Window Linear Functions](#Unit2Task4)  [Task 5: Graphing Linear Inequalities in two variables](#Unit2Task5)  [Task 6: Systems of Equations](#Unit2Task6) | [Content Standards With Clarifying Notes](#Unit3Notes)  [New Academic Vocabulary](#Unit3Voc)  [Prior Knowledge](#Unit3Prior)  [Subsequent Knowledge](#Unit3Subsequent)  [Relationship Among Standards](#Unit3Relationship)  [Resource Links](#Unit3Resources)  [Task 1: Object Drop](#Unit3Task1)  [Task 2: Flying Fowl Challenge](#Unit3Task2)  [Task 3: Equivalent forms of a Quadratic Function](#Unit3Task3)  [Task 4: Linear and Quadratic Functions](#Unit3Task4)  [Task 5: Comparing, Factoring, and Completing the Square of Quadratic Functions](#Unit3Task5)  [Task 6: Which quadratic equation will work?](#Unit3Task6)  [Task 7: Size](#Unit3Task7) Optimization  [Task 8: Solving for the squared variable](#Unit3Task8) |

| Unit 4  Modeling and Analyzing Exponential Functions | Unit 5  Comparing and Contrasting Functions | Unit 6  Describing Data |
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| [Content Standards With Clarifying Notes](#Unit4Notes)  [New Academic Vocabulary](#Unit4voc)  [Prior Knowledge](#Unit4Prior)  [Subsequent Knowledge](#Unit4Subsequent)  [Relationship Among Standards](#Unit4Relationship)  [Resource Links](#Unit4Resources)  [Task 1: Intro to Exponential Graphs](#Unit4Task1)  [Task 2: Analyzing Exponential Functions](#Unit4Task2) | [Content Standards With Clarifying Notes](#Unit5Notes)  [New Academic Vocabulary](#Unit5Voc)  [Prior Knowledge](#Unit5Prior)  [Subsequent Knowledge](#Unit5Subsequent)  [Relationship Among Standards](#Unit5Relationship)  [Resource Links](#Unit5Resources)  [Task 1: Graphing Stories](#Unit5Task1)  [Task 2: Comparing and Contrasting Functions: Linear Vs Exponential](#Unit5Task2)  [Task 3: Linear, Quadratics, and Exponential Card Sort](#Unit5Task3) | [Content Standards With Clarifying Notes](#Unit6Notes)  [New Academic Vocabulary](#Unit6voc)  [Prior Knowledge](#Unit6Prior)  [Subsequent Knowledge](#Unit6Subsequent)  [Relationship Among Standards](#Unit6Relationship)  [Resource Links](#Unit6Resources)  [Task 1: Linear Regression](#Unit6Task1)  [Task 2: Two-Way Tables-Walking or Biking to Work](#Unit6Task2)  [Task 3: What are the Odds of That Happening?](#Unit6Task3)  [Task 4: Survey Sampling Project](#Unit6Task4)  [General Course Resources](#GeneralCourseResources)  [References](#References) |

| **Unit 1 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.NRNS.1\* Rewrite expressions involving simple radicals and rational exponents in different forms.   + Apply properties of exponents to write equivalent expressions that include simple radicals (e.g., square roots and cube roots) and integer exponents.   + Expand properties of exponents to write equivalent expressions that include rational exponents. * FA.NRNS.2\* Use the definition of the meaning of rational exponents to translate between rational exponent and radical forms.   + Convert expressions with fractional exponents to equivalent radical forms and vice-versa. * FA.NRNS.3 Explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.   + Use the property of set closure to include rational and irrational numbers under addition and multiplication. * FA.NQ.1\* Use units of measurement to guide the solution of multi-step tasks. Choose and interpret appropriate labels, units, and scales when constructing graphs and other data displays.   + Convert units of measure, as appropriate (e.g., using like units to compare or combine lengths), to solve multi-step performance tasks.   + Apply dimensional analysis to convert units of measure.   + Analyze the context of problems to determine the appropriate unit(s) of measure.   + Select and interpret appropriate units of measure when solving real-world contexts involving formulas. * FA.NQ.2\* Label and define appropriate quantities in descriptive modeling contexts.   + Identify the variables or quantities from data displayed in a given model (e.g., text, graph, picture, or algebraic formula)   + Select the appropriate unit of measure for variables or quantities presented in a given model. * FA.NQ.3\* Choose a level of accuracy appropriate to limitations on measurement when reporting quantities in context.   + Report solutions to problems with the appropriate level of accuracy, and with precision if necessary, for the unit of measure given in the context of the problem and/or the measuring tool used. * FA.ASE.1\* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.   + Limit to linear expressions for Unit 1; expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Rational functions are taught in Intermediate Algebra Unit 5.   + Recognize that an algebraic expression can be composed of multiple terms and represent unknown real number value(s).   + Simplify or factor complicated expressions by combining like terms or extracting the Greatest Common Monomial (factor) to show equivalent expressions (e.g., is equivalent to). * FA.ACE.1\* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.   + Limit to linear in Unit 1   + Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Rational functions are taught in Intermediate Algebra Unit 5.   + Use real-world contexts to generate and solve equations and inequalities in one variable.   + Analyze solutions for their meaning and rationale within the given context.   + Interpreting solutions includes solutions graphed on a number line. * FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.   + Limit to linear and introduce the terms *direct* *variation* and *indirect/inverse variation* in Unit 1.   + Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Rational functions are not taught in Foundations in Algebra; they are introduced late in the Intermediate Algebra (unit 5) course and extended in Algebra 2.   + Understand that linear equations define the relationship between two variables.   + Generate and graph equations to represent the relationship between two variables.   + Use appropriate labels, units, and scales to represent the relationship of two variables in a given real-world context. * FA.ACE.4\* Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.   + Apply the properties and operations of real numbers to solve for a specified variable (e.g., solve a linear equation in standard form and for y; and include other formulas from a variety of disciplines). * FA.AREI.1\* Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original.   + State the property or operation being applied that explains why each step of solving an equation generates an equivalent equation.   + Verify by substitution that the variable’s solution in the last step solves the equation for the given problem. * FA.AREI.3\* Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.   + Apply the properties and operations of real numbers to equations and inequalities to solve for a specified variable (e.g., solve for x in ax + by = c; solve the slope-intercept equation for b; solve for m). * FA.AREI.10\* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.   + Use algebraic and graphical formats to justify that the set of solutions is a one-to-one relationship, which can be graphed with ordered pairs (i.e., domain, range). |

| **Unit 1 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Compound Inequalities (*notation only*) * Direct Variation * Index (Root) * Indirect/inverse Variation * Polynomial * Radical * Radicand * Rational Exponents |

| **Unit 1 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| In earlier grades, students have developed conceptual knowledge and have had the opportunity to learn how to:   * Understand and apply the constant of proportionality (7.RP.2). * Determine and apply the constant rate of change (8.F.3; 8.F.4). * Understand the relationship between independent and dependent variables (6.EEI.9; 8.F.1). * Be able to evaluate square and cubic roots, and recognize perfect and non-perfect squares as rational and irrational correspondingly (8.EEI.2). * Transform and apply the Pythagorean Theorem particularly as it relates to rational and irrational squares (8.EEI.2a, b, and d). * Understand fundamental concepts of functions, including one-to-one relationships, particularly as communicated as domain to range within ordered pairs (8.F.1). * Understand and apply the properties of exponents (8.EEI.1). * Graph the solution of one variable inequality on the number line (7.EEI.4c). * Understand that slope is a rate of change from one quantity in relation to another quantity within real world and mathematical situations (8.EEI.5b). * Understand the critical attributes of linear and nonlinear functions (8.F.3). * Represent linear functions, particularly in the form of through table, equation, and graphical form, and identify value and meanings of slope/rate and y-intercept/initial value as found within real-world and mathematical situations (8.F.3, 8.F.4, 8.F.5, 8.EEEI.6). * Solve for a single variable in a multiple variable equation and inequalities in real-world and mathematical situations (8.EEEI.7a and d). * Generate and graph linear equations (8.F.1c and e; 8.F.4b; 8.F.5). * Understand and apply the properties of operations, equality, and inequality (7.EEI.4a. 7.EEI.4b, 7.EEI.4c, 7.EEI.4d). |

| **Unit 1 Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
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| * Foundations in Algebra Unit 1 develops one- and two-variable linear equation concepts (FA.ASE.1\*; FA.ASE.2\*). The course will: * Apply and expand to include quadratic (Foundations in Algebra 1 Unit 3: Modeling and Analyzing Quadratic Functions) and exponential equations (Foundations in Algebra 1 Unit 4: Modeling and Analyzing Exponential Functions). * Recognize an early form of factoring as to identify and extract the greatest common numeric or algebraic term, such as *2x + 4y* can be represented as *2(x+2y)* (FA. ACE.4\*; FA.ASE.1\*; FA.ASE.2\*). * Extend to factor and simplify polynomials, specifically quadratics (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions). * Simplify or factor complicated expressions by combining like terms or extracting the Greatest Common Monomial (factor) to show equivalent expressions (FA.ASE.1\*). * Apply primarily to common monomial factoring (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions). * Foundations in Algebra 1 Unit 1 graphs one-variable inequalities on a number-line (FA.FIF.5\*). The course will: * Extend as a possible means to express the domain and range in compound inequality notation in future units. * Compare functions’ graphical, symbolic, or tabular forms (FA.NQ.2\*; FA.AREI.10\*). * Use the application of the functions’ graphical, symbolic, or tabular form, particularly to measure the average rate of change (FA.FIF.6\* in Foundations in Algebra 1 Units 2, 3, 4, and 5). * Foundations in Algebra 1 Unit 1 introduces direct and indirect variation in linear applications (FA.ACE.2\*). The course will: * Expand the study of linear relationships (Intermediate Algebra Unit 2: Reasoning with Linear Equations and Inequalities). * Foundations in Algebra 1 Unit 1 simplifies radicals and rationalizes denominators involving square roots and extending to cube roots as appropriate (FA.NRNS.1\*). The course will: * Apply simplifying and solving literal equations, and rationalizing will be applied in subsequent course of Geometry, such as applications with triangles (Geometry Unit 5: Right Triangles and Trigonometry). * Foundations in Algebra 1 Unit 1 defines, rewrites and explores the relationship between rational exponents and simple radicals, and the relationship of irrational numbers as subset of the entire real number systems (FA.NRNS.1\*; FA.NRNS.2\*; FA.NRNS.3\*). The course will: * Develop skills found within finding square roots, completing the square, applying the quadratic formula and factoring of quadratic functions using other methods (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions). * Foundations in Algebra 1 Unit 1 rewrites and simplifies simple radicals (FA.NRNS.1\*). The course will: * Extend, such as simplifying square roots and rationalizing a denominator (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions). * Foundations in Algebra 1 Unit 1 develops fluency in variable manipulation (FA.ACE.4\*). The course will: * Solve for specified variables and substitute equivalent algebraic value(s) to rewrite functions of linear equations (Unit 2; Reasoning with Linear Equations and Inequalities) and quadratic functions (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions) and to compare such functions (Foundations in Algebra 1 Unit 5: Comparing and Contrasting Functions). * Foundations in Algebra 1 Unit 1 writes equations of linear functions with two variables (FA.ACE.2\*). The course will: * Extend the point-slope form and its various applications (Unit 2: Reasoning with Linear Equations and Inequalities); * Expand to quadratics (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions) and exponential functions (Unit 4: Modeling and Analyzing Exponential Functions). * Foundations in Algebra 1 Unit 1 develops fluency of polynomial operations and foundational knowledge of algebraic terms and polynomial expressions (FA.AAPR.1\*). The course will: * Promote linear applications (Foundations in Algebra Unit 2: Reasoning with Linear Equations and Inequalities), quadratic applications and factoring (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions), and other functions in units to follow. * Foundations in Algebra 1 Unit 1 develops understanding of functions in two variables and the variables’ relationship expressed in table, equation and graphical forms (FA.AREI.10\*). The course will: * Connect linear functions (Foundations in Algebra Unit 2: Reasoning with Linear Equations and Inequalities), quadratic functions (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions), and exponential functions (Foundations in Algebra Unit 4: Modeling and Analyzing Exponential Functions) as students begin to use function notation. * Foundations in Algebra 1 Unit 1 (and Grade 8) limits the algebraic form of a linear function to. The course will: * Apply function notationin subsequent units and courses. |

| **Unit 1 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
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| The standards in Unit 1 provide the foundational knowledge for concepts developed in Foundations in Algebra in subsequent units. Students will interpret the structure of expressions, equations, and inequalities involving one or more variables and solve problems related to unit analysis. Students will construct meaning from the relationships among variables, including direct and indirect variation, through real-world contexts and through algebraic, verbal, graphic, and tabular models. Tasks will progress from simple equations and inequalities to complex equations in two or more variables. Real-world contexts, relevant to STEM-related or other career fields, will engage students in mathematical practices while applying properties and performing operations with quantities involving given units of measure. Measurement units in these contexts may require conversions, which will require students to focus on precision and accuracy. Students will write, graph, and solve linear equations or inequalities to represent the relationship between independent and dependent variables. Graphing relationships will require students to use appropriate labels, units, and scales on axes. They will employ logic and reasoning to interpret and explain the meaning of a solution or a set of solutions. From solving linear equations or inequalities in one-variable to rewriting or solving a formula involving two or more variables, students will fluently solve for given variables. Investigation of compound inequalities (written, symbolic, and number line graphing) will empower students to express domain and range using compound inequality notation. The properties of rational and irrational numbers and operations with polynomials are included as a preparation for working with quadratic functions. Students will simplify radicals and rationalize denominators involving square roots and extend to cube roots as appropriate. |

| **Resources**  [Return to Table of Contents](#TableofContents) |
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| **Activity Resources**   1. EngageNY: [Algebra 1 Module 1](https://www.engageny.org/resource/algebra-i-module-1) 2. Khan Academy: [Introduction to Algebra](https://www.khanacademy.org/math/algebra/introduction-to-algebra) 3. Math Open Reference [Math Open Reference](http://www.mathopenref.com/index.html) 4. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Assessing 21st Century Mathematics](http://map.mathshell.org/) 5. Math Open Reference: [Lines On Coordinate Plane](http://www.mathopenref.com/coordlineintro.html) 6. Math Open Reference: [Slope-Intercept](http://www.mathopenref.com/linearexplorermxb.html) 7. Shodor: [Slope-Intercept Slider](http://www.shodor.org/interactivate/activities/SlopeSlider/?version=1.5.0_06&browser=MSIE&vendor=Sun_Microsystems_Inc.) 8. NCTM Illuminations (NCTM membership required for access): [Bathtub Water Levels (Slope-Intercept: Negative Slope)](http://illuminations.nctm.org/Lesson.aspx?id=1469) 9. Inside Mathematics: [Performance Assessment Tasks](http://www.insidemathematics.org/performance-assessment-tasks) 10. Illustrative Mathematics Task: [Powers of 11](https://www.illustrativemathematics.org/content-standards/HSA/APR/A/1/tasks/1654) 11. Illustrative Mathematics: [Cash Box](https://www.illustrativemathematics.org/content-standards/HSA/CED/A/tasks/462) 12. Illustrative Mathematics: [Equations and Formulas](https://www.illustrativemathematics.org/content-standards/HSA/CED/A/4/tasks/393) 13. Illustrative Mathematics: [Reasoning with Linear Inequalities](https://www.illustrativemathematics.org/content-standards/HSA/REI/A/1/tasks/807) 14. Illustrative Mathematics: [Rewriting Equations](https://www.illustrativemathematics.org/content-standards/HSA/CED/A/4/tasks/1828) 15. Illustrative Mathematics: [Same Solutions](https://www.illustrativemathematics.org/content-standards/HSA/REI/A/tasks/613) 16. Illustrative Mathematics: [Traffic Jam](https://www.illustrativemathematics.org/content-standards/HSN/Q/A/tasks/84) 17. Illustrative Mathematics: [Animal Populations](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/1/tasks/436) 18. Illustrative Mathematics: [Delivery Trucks](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/1/tasks/531) 19. Illustrative Mathematics: [Delivery Trucks](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/1/tasks/1343) (this is a different approach) 20. Illustrative Mathematics: [Equivalent Expressions](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/2/tasks/87) 21. Illustrative Mathematics: [Mixing Candies](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/1/tasks/389) 22. Illustrative Mathematics: [Seeing Dots](https://www.illustrativemathematics.org/content-standards/HSA/SSE/A/2/tasks/21) 23. Illustrative Mathematics: [Calculating the Square Root of 2](https://www.illustrativemathematics.org/content-standards/HSN/RN/B/tasks/764) 24. Illustrative Mathematics: [Checking a Calculation of a Decimal Point](https://www.illustrativemathematics.org/content-standards/HSN/RN/A/2/tasks/1220) 25. Illustrative Mathematics: [Evaluating a Special Exponential Expression](https://www.illustrativemathematics.org/content-standards/HSN/RN/A/1/tasks/1823) 26. Illustrative Mathematics: [Evaluating Exponential Expressions](https://www.illustrativemathematics.org/content-standards/HSN/RN/A/1/tasks/1866) 27. Illustrative Mathematics: [Operations with Rational and Irrational Numbers](https://www.illustrativemathematics.org/content-standards/HSN/RN/B/3/tasks/690) 28. Illustrative Mathematics: [Rational or Irrational?](https://www.illustrativemathematics.org/content-standards/HSN/RN/A/2/tasks/608) 29. Illustrative Mathematics: [Sums of Rational and Irrational Numbers](https://www.illustrativemathematics.org/content-standards/HSN/RN/B/3/tasks/1817) 30. New Zealand Maths: [It Sounds Like Mah Jong](http://nzmaths.co.nz/resource/it-sounds-mah-jong) |
| **Dictionaries, Calculators, and Templates (Graphs, Graphic Organizers)**   1. A Maths Dictionary for Kids (Requires Adobe Flash Player): [Math Charts](http://www.amathsdictionaryforkids.com/mathsCharts.html) 2. A Maths Dictionary for Kids: [Math Dictionary](http://www.amathsdictionaryforkids.com/) 3. Desmos: [Graphing Tool](https://www.desmos.com) 4. Math Open Reference:  [Calculator](http://www.mathopenref.com/calculator.html) 5. Web 2.0: [Calculator](http://web2.0calc.com/)   Also see [General Course Resources](#GeneralCourseResources) |
| **Teaching Strategies**   1. Creative Educator: [Authentic Tasks - Write a Great Authentic Task](http://creativeeducator.tech4learning.com/v01/articles/Writing_a_Great_Authentic_Task) 2. Creative Educator: [Project-Based Learning](http://creativeeducator.tech4learning.com/v01/articles/Success_Begins_with_Effective_Design) 3. Illustrative Mathematics: [Illustrative Mathematics Homepage](https://www.illustrativemathematics.org/) 4. Math Video Instructional Development Source: [Authentic Contexts](http://fcit.usf.edu/mathvids/strategies/ac.html) 5. Power Up What Works: [Math Strategies that Work Research](http://powerupwhatworks.org/resource/research-math-practices) |

| **Course/Grade:**Foundations in Algebra  **Unit:** 1 | **Task Title:** Task 1: Sums & Products of Rational & Irrational Numbers  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.NRNS.3: Explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. FA.NRNS.1: Rewrite expressions involving simple radicals and rational exponents in different forms. |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 3c. Make conjectures and explore their validity. 6a. Express numerical answers with the degree of precision appropriate for the context of a situation. 4d. Evaluate the reasonableness of a model and refine if necessary. |
| **Materials and Resources** | **Unit 1 Task 1 Resource:** Sums and Products of Rational and Irrational Numbers |
| **Task Description** | 1. Have students begin with a small group discussion on the topic “Is a rational number?”  2. Have students work through the first 3 tables on the Sums & Products of Rational & Irrational Numbers task.  3. Have a class discussion on what they noticed when finding sums.  4. Have students work through the second 3 tables for multiplication.  5. Have a class discussion on what they noticed when finding products. |
| **Equitable Access** | Students can choose values they are comfortable with or are willing to challenge themselves with. |
| **Mathematical Vocabulary** | Rational Numbers Irrational Numbers |
| **Student Reflection** | What values have you tried that may have disproven your theory? Describe an example in which a rational number is used in real-life. Describe an example in which an irrational number is used in real-life. |

| **Unit 1 Task 1 Resource: Sums and Products of Rational and Irrational Numbers**  [Return to Table of Contents](#TableofContents) |
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| **Find the SUM of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Rational Number | Rational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the sum of two rational numbers?**  **Find the SUM of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Rational Number | Irrational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the sum of a rational number and an irrational number?**  **Find the SUM of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Irrational Number | Irrational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the sum of two irrational numbers?**  **Find the PRODUCT of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Rational Number | Rational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the product of two rational numbers?**  **Find the PRODUCT of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Rational Number | Irrational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the product of a rational number and an irrational number?**  **Find the PRODUCT of the pairs of numbers. Then create your own values and check the result.**   |  |  |  |  | | --- | --- | --- | --- | | Irrational Number | Irrational Number | Result | Rational (Q) Result or Irrational (Irr.) Result?? | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  |   **What do you notice about the product of two irrational numbers?**  **Do you notice a pattern in certain results? What might it be?**  **Final Summary:**  Summarize what you found to be true about sums and products of rational and irrational numbers.  Will the sums and products of rational and irrational numbers *always* have the same results? Explain your reasoning.  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 1 | **Task Title:**  Task 2: Intro to Rational Exponents & Radicals  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.NRNS.1: Rewrite expressions involving simple radicals and rational exponents in different forms. FA.NRNS.2: Use the definition of the meaning of rational exponents to translate between rational exponent and radical forms. |
| **Mathematical Process Standards Addressed** | 7b. Recognize mathematical repetition in order to make generalizations. 7c. Look for structures to interpret meaning and develop solution strategies. 4a. Identify relevant quantities and develop a model to describe their relationships. 1. Make sense of problems and persevere in solving them. 3c. Make conjectures and explore their validity. 3d. Reflect on and provide thoughtful responses to the reasoning of others. 4d. Evaluate the reasonableness of a model and refine if necessary. |
| **Materials and Resources** | **Unit 1 Task 2 Resource:** Rational Exponents and Radicals |
| **Task Description** | 1. Inquiry task (page 1): Students will fill in the table with exponents, expanded form, simplified value, and rational exponent form for the values listed and create two of their own. Students will then write a potential rule for exponents and radicals. This is a good place for class discussion on the rules they have found. 2. Students will use the potential rules they have found to complete the questions on page 2. 3. Students will answer the reflection questions on page 3. This is a good place for class discussion after students have reflected. |
| **Equitable Access** | Problem #0 is a model example of the task. Students may use a calculator to calculate values, as necessary. This activity may be used individually or in small groups. The open-ended questions #7 & #8 allow for students to choose their own values. If students are having difficulty with #11 & #14, a review of properties of exponents may be necessary. |
| **Mathematical Vocabulary** | Rational Exponent Square Root Cube Root nth Root Radical Form Index |
| **Student Reflection** | What was the main idea that you learned with this task? What is at least one question you have concerning this task? Where do you see this concept being used in real life? |

| **Unit 1 Task 2 Resource: Rational Exponents and Radicals**  [Return to Table of Contents](#TableofContents) |
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| **Directions:** Fill in the blanks for problems 1-6. For problems 7 & 8, create your own exponent and fill in the subsequent blanks.   |  | **Exponent** | **Expanded Form** | **Simplified Value** | **Rational Exponent Form** | **Radical Expanded Form** | **Radical Form** | | --- | --- | --- | --- | --- | --- | --- | | #0 |  |  | 16 |  |  |  | | #1 |  |  |  |  |  |  | | #2 |  |  |  |  |  |  | | #3 |  |  |  | 10 |  |  | | #4 |  |  | 64 |  |  |  | | #5 |  |  |  |  |  |  | | #6 |  |  |  |  |  |  | | #7 |  |  |  |  |  |  | | #8 |  |  |  |  |  |  |   **Write a potential rule that shows the relationship between the exponent and the rational exponent form.**  **Write a potential rule that shows the relationship between Rational Exponent Form to Radical Form.**  **Using your above rules, simplify the following expressions to rational exponent form.**  9.  10.  11.  **Using your above rules, simplify the following expressions to radical form.**  12.  13.  14.  **Reflection:**   1. **Explain what you learned from completing this task?**      1. **Write at least one question or wonder you have concerning this task?** 2. **Where do you see this concept being used in real life?**   *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 1 | **Task Title:** Task 3: One-Variable Equations & Inequalities BINGO  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.ACE.4: Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines. FA.AREI.1: Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original. FA.AREI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. FA.ACE.1: Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to linear; quadratic; exponential with integer exponents.) |
| **Mathematical Process Standards Addressed** | 1c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem. 7b. Recognize mathematical repetition in order to make generalizations. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2d. Connect the meaning of mathematical operations to the context of a given situation. 3a. Construct and justify a solution to a problem. 4b. Interpret mathematical models in the context of the situation. |
| **Materials and Resources** | **Unit 1 Task 3:** Linear Equations and Inequalities Bingo |
| **Task Description** | 1. Open with discussion of prior knowledge of solving one-variable equations & inequalities and solving for a specified variable.  2. Students will complete the Bingo activity by completing at least one complete row or column (no diagonals allowed). Teacher should monitor work as students’ progress through the activity. Students should work through all problems on a separate sheet of paper to make their learning visible.  3. Students should keep track of which questions they have completed. |
| **Equitable Access** | Students may be grouped to facilitate student achievement. Teacher may adjust/suggest certain problems for students to try. Students may be asked to create their own problems modeled after any row or column and create an answer key. Students could be put in groups of 5 and each person in a group completes 1 row (or column). Then students can share their process with each other to complete the page. |
| **Mathematical Vocabulary** | Compound Inequality Literal Equation Linear Equation |
| **Student Reflection** | Which question was the most challenging? Why? Which question could you teach to another student?  How would you do this? |

| **Unit 1 Task 3: Linear Equations and Inequalities Bingo** [**Return to Table of Contents**](#TableofContents) |
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|  | **M** | **A** | **T** | **H** | **O** |
| --- | --- | --- | --- | --- | --- |
| **B** | Solve    for x. | Graph the compound inequality written | Write a 2-step equation that produces the equivalent answer as to the equation | The sum of three consecutive integers is 84. Find the smallest of the three integers. | Solve |
| **I** | Graph the compound inequality written | Write a 3-step equation that produces the equivalent answer as to the equation | A house-painting company charges $376 plus $12 per hour. Another painting company charges $280 and $15 per hour additionally. How long is a job for which both companies will charge the same amount? | Solve | Solve  for b |
| **N** | Write a 2-step equation that produces the equivalent answer as to the equation | Bobby went to the garden center. He purchased a pot that costs $35 and 4 bundles of flowers to put in the pot. The total cost was $80 before tax. What was the cost of each bundle of flowers? | Solve | Solve  for G. | Write the compound inequality for the graph shown  A close up of a antenna  Description automatically generated |
| **G** | Samuel went shopping at a department store. He bought a pair of jeans for $26.78 and 4 t-shirts. His total bill was $42.38 before tax. Create an equation this model this situation. What was the price of each tank top? | Solve | Solve   for B. | Graph the compound inequality written | Write an equation with variables on both sides produces the equivalent answer as to the equation |
| **O** | Solve | Solve   for W. | Write the compound inequality for the graph shown  A close up of a logo  Description automatically generated | Write a 2-step equation that produces the equivalent answer to the equation | Maya has $600 in a savings account at the beginning of the summer. She wants to have $250 in the account at the end of the summer. How much can she spend per week to meet her goal? |

*(SCDE, 2019)*

| **Course/Grade:**Foundations in Algebra  **Unit:** 1 | **Task Title:** Task 4: Dimensional Analysis  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.NQ.1: Use units of measurement to guide the solution of multi-step tasks. Choose and interpret appropriate labels, units, and scales when constructing graphs and other data displays. |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2d. Connect the meaning of mathematical operations to the context of a given situation. 3c. Make conjectures and explore their validity. 1d. Evaluate the success of an approach to solve a problem and refine it if necessary. 3d. Reflect on and provide thoughtful responses to the reasoning of others. 6. Communicate mathematically and approach mathematical situations with precision. |
| **Materials and Resources** | Chart paper for each group.  Conversion Table Reference Sheet  Dimensional Analysis Task |
| **Task Description** | 1. Students will brain dump any conversions they know (give 2-3 minutes for this) (i.e. 12 in = 1foot, 100 cm = 1 m)  2. Students will be paired up to compare conversions that they found.  3. Students will go to groups of 4 to further compare conversions found and place it on chart paper.  4. Groups will do a gallery walk to compare their findings to other groups.  5. Students will complete the conversion table reference sheet.  6. Students will complete problems 1-5 on the Dimensional Analysis sheet and then reflect on #6. Class discussion with #6.  7. Students will complete problems 7-11.  8. Students will hypothesize how they would convert unit rates. Class discussion with #12.  9. Students will complete problems 13-16. |
| **Equitable Access** | Have manipulatives available for different conversions (rulers, fake coins, scales, wet measures, dry measures, etc.) |
| **Mathematical Vocabulary** | Dimensional Analysis |
| **Student Reflection** | What did you see on someone else’s chart that was not on yours? What did you not see on anyone else’s chart that was on yours? Where would you need to use some of these conversions? Why might this skill be important? |

| **Unit 1 Task 4 Resource: Unit Conversion Reference Sheet**  [Return to Table of Contents](#TableofContents) |
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| **Customary (Empirical) Measures**  Length Measures  1 foot (ft.) = \_\_\_\_\_ inches (in.)  1 yard (yd.) = \_\_\_\_\_ ft.  1 mile (mi) = \_\_\_\_\_\_\_ ft.  Weight Measures  1 pound (lb.) = \_\_\_\_\_ ounces (oz.)  1 ton = \_\_\_\_\_\_\_ lb.  Dry Measures  1 tablespoon (tbsp..) = \_\_\_\_\_ teaspoons (tsp)  1 cup (c) = \_\_\_\_ tbsp. = \_\_\_\_\_\_\_ oz.  1 pint = \_\_\_\_\_ c  1 quart = \_\_\_\_\_ pints  1 gallon = \_\_\_\_\_ qts = \_\_\_\_\_ pts = \_\_\_\_ c = \_\_\_\_\_ oz  Money  1 dollar = \_\_\_\_\_\_ quarters = \_\_\_\_\_\_ dimes = \_\_\_\_\_\_ nickels = \_\_\_\_\_\_ pennies  **SI Units**  Length Measures  1 kilometer (km) = \_\_\_\_\_\_\_ meter (m)  1 m = \_\_\_\_\_\_\_ centimeter (cm) = \_\_\_\_\_\_\_millimeter (mm)  Weight Measures  1 kilogram (kg) = \_\_\_\_\_ grams (g)  1 g = \_\_\_\_\_\_\_ milligrams (mg)  Liquid Measures  1 Liter (L) = \_\_\_\_\_ milliliters (mL) = \_\_\_\_\_\_\_ cubic centimeters (cc)  Time Measures  1 minute = \_\_\_\_\_ seconds  1 hour = \_\_\_\_\_ mins  1 day = \_\_\_\_\_hrs.  1 week = \_\_\_\_\_ days  1 year = \_\_\_\_\_ months = \_\_\_\_\_ weeks = \_\_\_\_\_ days  *(SCDE, 2019)* |

| **Unit 1 Task 4 Resource: Dimensional Analysis**  [Return to Table of Contents](#TableofContents) |
| --- |
| 1. Convert 2 feet into inches      1. Convert 121 inches into feet 2. Convert 300 seconds to minutes 3. Convert 25 kilograms to grams      1. Convert 34 nickels to dollars   **Reflection (1-5):**   1. Explain the process you used to convert between units? Was the procedure done the same way each time? 2. Convert 14 miles to feet      1. Convert 6 gallons to cups. 2. Convert $10 to quarters. 3. Convert 4 tablespoons to teaspoons      1. Convert 1 year to seconds.   **Reflection (7-11):**   1. Using your understanding of unit conversions, explain how you might convert a unit rate (e.g. miles per hour, meters per second) to a different unit rate (e.g. miles per hour to feet per second)? 2. Convert 88 feet per second to miles per hour.      1. Convert 50 meters per second to kilometers per hour. 2. Convert 100 milliliters per second to liters per hour. 3. Convert 3003 miles per hour to feet per second.   *(SCDE, 2019)* |

| **Course/Grade:** Foundations of Algebra  **Unit:** Unit 1 | **Task Title:** Task 5: Relationships between quantities and expressions  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.NQ.2\* Label and define appropriate quantities in descriptive modeling contexts.  FA.NQ.3\* Choose a level of accuracy appropriate to limitations on measurement when reporting quantities in context. |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  2. Reason both contextually and abstractly.  4. Connect mathematical ideas and real-world situations through modelling.  5. Use a variety of mathematical tools effectively and strategically.  6. Communicate mathematically and approach mathematical situations with precision.  7. Identify and utilize structure and patterns. |
| **Materials and Resources** | Graph Paper  Rulers  Calculators |
| **Task Description** | Students will create a blueprint of their dream bedroom. Students should scale their room so it fits on graph paper and should give the scale they used as a key. Students should first plan by creating a rough draft prior to creating their final design on graph paper. The following items must be included in the bedroom: door, window(s), bed, dresser, desk, chair and closet. Since it is their dream bedroom, students may add other items if they wish. All room and furnishing measurements should be accurate and realistic and may require students to research the standard sizes of beds, desks, dressers, walk in closets, doors, windows, etc. |
| **Equitable Access** | Students can work in small groups to assist with measurements or drawing.  Students have the flexibility to design their room as simple or as complicated as they wish. |
| **Mathematical Vocabulary** | Scale |
| **Student Reflection** | Have students Connect, Extend, Challenge  Connect: What did you learn today that connected to what you already know?  Extend: What new ideas did you learn today?  Challenge: What new questions or wonders do you have? |

| **Unit 2 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.   + Limit to linear in Unit 2. Expands to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4. Rational functions are not taught in Intermediate Algebra Unit 5.   + Understand that linear equations define the relationship between two variables, and graph equations to represent that.   + Write an equation of a line given a point and slope, both algebraic in model and application.   + Write an equation of a line given at least two points, both algebraic in model and application. * F A.AREI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.   + Apply the properties and operations of real numbers to equations and inequalities to solve for a specified variable (e.g., to solve a slope-intercept equation or point-slope equation for x or another specified variable; or for *b*).   + Apply the properties and operations of real numbers to the standard form of a linear equation to find the x-intercept, the y-intercept, or the slope of the function. * FA.AREI.5 Justify that the solution to a system of linear equations is not changed when one of the equations is replaced by a linear combination of the other equation.   + Define *system of equations* and *solution of a system*.   + Multiply by the same number on both sides of the equal sign to produce equivalent equations.   + Replace one equation with the sum of that equation and a multiple of the other to create a system with the same solutions as the original equation.   + Substitute the common solution (if there is one) into a system to validate every equation. * FA.AREI.6\* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables.   + Determine the approximate solution to a system of linear equations by graphing both equations and estimating the point of intersection.   + Solve a system of linear equations algebraically (by substitution or elimination/linear combinations) to find an exact solution.   + Explain why some linear systems have no solutions and identify linear systems that have no solutions.   + Explain why some linear systems have infinitely many solutions and identify linear systems that have infinitely many solutions.   + Understand that linear systems can be solved multiple ways and that one method might be more efficient than others. (e.g., and *suggests* the graphing or substitution method, and suggests the substitution method).   + Graph the linear equations of a system to determine if the system has one, none, or infinitely many common solutions (points of intersection).   + Manipulate the equations within a linear system algebraically (through substitution or elimination) to determine the common solution, if any exists.   + Verify by substitution that the variables’ solutions solve the original equations. * F A.AREI.6a Solve systems of linear equations using the substitution method.   + Solve and verify the exact solution of a system of equations using substitution. * FA.AREI.6b Solve systems of linear equations using linear combination.   + Eliminate a variable algebraically to find an exact solution for a system of linear equations.   + Verify by substitution that the variable’s solutions solve the original equations. * FA.AREI.10\* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.   + Verify that any point on a graph will result in a true equation when their coordinates are substituted into the equation. * FA.AREI.11\* Solve an equation of the form graphically by identifying the coordinate(s) of the point(s) of intersection.   + Understand that the point of intersection, , on the graph of a system of equations, and , represents a solution to both equations.   + Infer that since and , by the substitution property.   + Verify that the x-coordinate of the points of intersection for and are also the solutions for *.*   + Use a graphing calculator to determine the approximate solutions to a system of equations and . * FA.AREI.12\* Graph the solutions to a linear inequality in two variables.   + Graph a linear inequality on a coordinate plane, resulting in a boundary line (solid or dashed) and a shaded half-plane. * FA.FIF.1a Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.   + Define a function as a relation in which each input (domain) has exactly one output (range).   + Determine whether a graph, table, or set of ordered pairs represents a function.   + Determine whether stated rules (both numeric and nonnumeric) produce ordered pairs that represent a function. * FA.FIF.1b Represent a function using function notation and explain that denotes the output of function that corresponds to the input .   + Introduce the function notation to represent the output or range values of a function.   + Understand that represents the corresponding output of the function when is an element of the input of a function. * FA.FIF.1c Understand that the graph of a function labeled as is the set of all ordered pairs that satisfy the equation .   + Explain the relationship between the graph of and the graph of the equation . * FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.   + Decode function notation and explain how the output of a function is matched to its input. (e.g., the function squares the input, triples the square, and adds five to produce the output).   + Use order of operations to evaluate a function for a given domain (input) value.   + Analyze the input and output values of a function based on a problem situation.   + Identify the real numbers that are not in the domain of a function.   + Recognize that the domain may change depending upon the context of problem. * FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.   + Limit to linear in Unit 2. Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Convert a table, graph, set of ordered pairs, or description into function notation by identifying the rule used to turn inputs into outputs and writing the rule. * FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.   + Limit to linear in Unit 2. Expand to quadratic in Unit 3 and exponential in Unit 4.   + Analyze the input and output values of a function based on a problem situation.   + Identify the numbers that are not in the domain of a function recognizing that the domain may change depending upon context of problem.   + Write the domain and range in various formats (e.g., compound inequalities and interval notation). * FA.FIF.6\* Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.   + Limit to linear in Unit 2. Expand to quadratic in Intermediate Algebra Unit 4 and exponential in Unit 6.   + Explain the relationship between the average rate of change and the slope formula .   + Calculate the average rate of change of a function.   + Compare the rates of change of two or more functions. * FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.   + Limit to linear in Unit 2. Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Identify that the parent function for linear functions is the line .   + Identify the point-slope form of a linear function as .   + Graph a line in point-slope form and use the graph to show where the starting point and the slope are represented on the graph.   + Identify the slope-intercept form of a linear function as .   + Graph a line in slope-intercept form and use the graph to show where the y-intercept and the slope are represented on the graph.   + Explain the effects of change of slope *m* and y -intercepton linear functions. * FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function.   + Limit to linear in Unit 2. Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Identify the point-slope form of a linear function as .   + Identify the slope-intercept form of a linear function as .   + Identify the standard form of a linear function as .   + Use definitions of-intercept and -intercept to find the intercepts of a standard form line.   + Relate the constants A, B, and C to the values of the -intercept, -intercept, and slope. * FA.FIF.9\* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.   + Limit to linear in Unit 2. Expand to quadratic in Foundations in Algebra Unit 3 and exponential in Unit 4.   + Use equations, verbal descriptions, graphs, and tables to analyze the relationship between quantities or the properties of two functions. |

| **Unit 2 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Average Rate Of Change * Boundary * Combinations Method * Function Notation ( *notation for* ) * Half-Plane * Interval * Linear Inequality * Point-Slope Form * Relation * Standard Equation Form (*for linear functions*) * Substitution Property |

| **Unit 2 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| In earlier grades/units, students have developed conceptual knowledge and have had the opportunity to learn how to:   * Extend previous understandings of Order of Operations (7.EEI.3). * Expand foundational knowledge of inequality solution sets, including compound equalities (6). * Understand function concepts, including one-to-one domain to range, particularly as communicated within ordered pairs (8.F.1). * Apply linear functions (particularly in the form of through table, equation, and graphical form, and identify value and meanings of slope/rate and y-intercept/initial value as found within real-world and mathematical situations (8.F.3; 8.F.4; 8.F.5; 8.EEEI.6). * Extend Grade 8’s conceptual knowledge of linear functions and expand the definition of linear function, which was limited to, to include function notation. * Solve for a variable in a multiple variable equation or inequality in real-world and mathematical situations (Foundations in Algebra 1 Unit 1 - FA.ACE.1\*; FA.ACE.2\*; FA.ACE.4\*). * Investigate the concept of linear systems through graphs or algebraic (substitution and elimination) methods. * Understand when one, none, and infinitely many solutions arise through application or inspection of linear systems (8.EEI.7b and c; 8.EEI.8). Unit 2 in Foundations in Algebra will scaffold this specific concept to improve mastery and extend understanding of linear systems and their solution sets. For example, in Foundations in Algebra, the difficulty of the solution of a linear system (e.g. non-integer answers) may increase, such as expected in standard FA.AREI.11. The additional standards in Unit 2 of Foundations in Algebra makes linear systems more rigorous than when introduced in Grade 8. * Understand and write the concept of inequalities from and within real-world and mathematical situations (7.NS.4b). |

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| **Unit 2 Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
| * Foundations in Algebra Unit 3 extends the notion of a function to a new function family - quadratics. Unit 3 includes creating one and two variable quadratic equations extended from Foundations in Algebra Unit 1, which explored the relationships among variables (Foundations in Algebra Unit 1: Relationships Between Quantities and Expressions) (FA.ASE.1; FA.ASE.2). Functional relationships will be extended to a third function family, exponential (Foundations in Algebra Unit 4: Modeling and Analyzing Exponential Functions). * Foundations in Algebra 1 Unit 3 deepens knowledge of linear functions through graphical, symbolic, or tabular forms and how to measure the average rate of change (FA.FIF.6). This unit will: * Apply the functions’ graphical, symbolic, or tabular form, particularly to measure the average rate of change (FA.FIF.6\* in Algebra 1   Units 3, 4, and 5).   * Foundations in Algebra Unit 1 (FA.ACE.4) requires fluent variable manipulation and empowers students in Foundations in Algebra Unit 2 to rewrite functions of equations (FA.ACE.2\*; FA.AREI.3). This unit will: * Extend to rewrite quadratic functions (Foundations in Algebra 1 Unit 3: Modeling and Analyzing Quadratic Functions) and to compare such functions (Foundations in Algebra Unit 5: Comparing and Contrasting Functions) by solving for and substituting equivalent algebraic value(s). * Foundations in Algebra Unit 1 (FA.AAPR.1) involves the development of foundational knowledge regarding algebraic terms and polynomial expressions and the properties of operations applied to polynomials. In Foundations in Algebra Unit 2, algebraic fluency of these concepts deepens and broadens while studying linear applications. This unit will: * Extend to quadratic applications and factoring (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions) and other functions in subsequent units. * Foundations in Algebra Unit 2 explores linear function relationships in two variables expressed in table, equation and graphical forms (FA.AREI.10). This unit will: * Evolve as students explore quadratic (Foundations in Algebra Unit 3: Modeling and Analyzing Quadratic Functions), exponential (Foundations in Algebra 1 Unit 4: Modeling and Analyzing Exponential Functions), and other function relationships expressed in table, equation and graphical forms. * Foundations in Algebra Unit 2 applies function notation(FA1.FIF.1\*). This unit will: * Extend function notation in all subsequent units and courses. * Foundations in Algebra Unit 2 integrates linear systems and linear inequality graphing, lending towards extension of linear inequality systems (FA.AREI.12\*). This unit will: * Develop linear inequality systems formally in Intermediate Algebra and linear programming in   Algebra 2.   * Foundations in Algebra Unit 2 develops skills with writing equations of lines (FA.FIF.7\*; FA.FIF.8\*). This unit will: * Extended in Geometry to build on this foundation, particularly when writing equations of lines that are parallel and perpendicular (G.GGPE.5\*) and proving properties of quadrilaterals using coordinates. |

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| **Unit 2 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
| The standards of Unit 2 expand students’ prior knowledge of functions, specifically linear functions. Students learn function notation, analyze concepts of domain and range, and explore linear relationships through graphic, tabular, and algebraic representations. Students will identify the critical attributes of linear functions (e.g., rate of change, intercepts, domain, and range) and understand that arithmetic sequences are linear functions.    Students explore output values for particular input values to evaluate expressions; and find inputs that yield a given output when solving equations. Questions about when two functions have the same value for the same input lead to equations, whose solutions can be visualized from the intersection of their graphs (Bainbridge).  As students further extend their prior knowledge of systems of linear functions and whether or not they have one, none, or infinitely many common solutions (8.EEI.7), they transfer conceptual understandings to apply other algebraic methods of solving (i.e., substitution, combination, and elimination). Students study the relationships between variables and linear functions and linear inequalities in tabular, graphing, and algebraic formats and in real world and mathematical situations. Students also graph two-variable linear inequalities in preparation for subsequent courses. They communicate their understanding of the solution sets of inequalities in algebraic, verbal, and graphic representations. Unit 2 limits standards FA.ACE.2\* and FA.FIF.4\* through FA.FIF.9 to their linear function applications. This conceptual knowledge, however, is foundational for studies in subsequent units applied to quadratic functions (Foundations in Algebra Unit 3) and exponential functions (Foundations in Algebra Unit 4). |

| **Unit 2 Resources**  [Return to Table of Contents](#TableofContents) |
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| 1. Algebra 1 Lessons WCCUSD: [Evaluating Linear Functions](http://www.wccusd.net/Page/3224) 2. Algebra 1 Lessons WCCUSD: [Evaluating Functions Graphically and Algebraically](http://www.wccusd.net/Page/3224) 3. Algebra 1 Lessons WCCUSD: [Evaluating Linear Functions](http://www.wccusd.net/Page/3224) 4. Algebra 1 Lessons WCCUSD: [Evaluating Functions Graphically and Algebraically](http://www.wccusd.net/Page/3224) 5. Algebra 1 Lessons WCCUSD: [Average Rate of Change](http://www.wccusd.net/Page/3224) 6. Algebra 1 Lessons WCCUSD: [Discovering Slope](http://www.wccusd.net/Page/3224) 7. Khan Academy: Linear Function Graphing Videos on [Relationships Discussion](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/v/interpreting-linear-graphs), [Slope Discussion](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/v/slope-example), [Equations Example 1](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/v/exploring-linear-relationships), and [Equations Example 2](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/v/application-problem-with-graph) 8. Algebra 1 Lessons WCCUSD: [Slope-Intercept Sort](http://www.wccusd.net/Page/3224) 9. Algebra 1 Lessons WCCUSD: [Discovering Slope](http://www.wccusd.net/Page/3224) 10. Algebra 1 Lessons WCCUSD: [Point-Slope Application Problems](http://www.wccusd.net/Page/3224) 11. Khan Academy: [Introduction To Point-Slope Video](https://www.khanacademy.org/math/algebra/two-var-linear-equations-and-intro-to-functions/point-slope/v/idea-behind-point-slope-form) 12. Khan Academy: [Writing Equation Of A Line Given In Point-Slope Given Two Points](https://www.khanacademy.org/math/algebra/two-var-linear-equations-and-intro-to-functions/point-slope/v/point-slope-and-slope-intercept-form-from-two-points) 13. Algebra 1 Lessons WCCUSD: [Three Forms of an Equation of a Line](http://www.wccusd.net/Page/3224) 14. Open Middle: [Write A Linear Function](http://www.openmiddle.com/write-a-linear-function/) 15. Algebra 1 Lessons WCCUSD: [Point-Slope Application Problems](http://www.wccusd.net/Page/3224) 16. Algebra 1 Lessons WCCUSD: [Shifting Linear Equations in Function Notation](http://www.wccusd.net/Page/3224) 17. Algebra 1 Lessons WCCUSD: [Discovering Slope of a Line in Standard Form](http://www.wccusd.net/Page/3224) 18. EngageNY: [Creating Systems Of Equations](https://www.engageny.org/resource/algebra-i-module-1-topic-c-lesson-23) 19. MathEdPage: [Systems With Teacher Notes And Applications](http://www.mathedpage.org/middle-school/pdf/systems.pdf) 20. Algebra 1 Lessons WCCUSD: [Graphing Systems](http://www.wccusd.net/Page/3224) 21. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Maximizing Profit - Online Lesson Plan](http://map.mathshell.org/lessons.php?unit=9205&collection=8) 22. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Maximizing Profit](http://map.mathshell.org/lessons.php?unit=9205&collection=8) 23. Algebra 1 Lessons WCCUSD: [Solving a System by Substitution](http://www.wccusd.net/Page/3224) 24. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Solving Linear Equations In Two Variables - Online Lesson Plan](http://map.mathshell.org/lessons.php?unit=9235&collection=8) 25. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Solving Linear Equations In Two Variables](http://map.mathshell.org/download.php?fileid=1730) 26. EngageNY: [Graphing Inequalities with Two-Variables](https://www.engageny.org/resource/algebra-i-module-1-topic-c-lesson-21) 27. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Representing Inequalities Graphically - Online Lesson Plan](http://map.mathshell.org/lessons.php?unit=9265&collection=8) 28. Illustrative Mathematics: [Accurately Weighing Pennies I](https://www.illustrativemathematics.org/content-standards/HSA/REI/C/6/tasks/761) 29. Illustrative Mathematics: [Collinear Points](https://www.illustrativemathematics.org/content-standards/HSA/REI/D/10/tasks/1066) 30. Illustrative Mathematics: [Estimating a Solution Via Graphs](https://www.illustrativemathematics.org/content-standards/HSA/REI/C/6/tasks/761) 31. Illustrative Mathematics: [Find a System](https://www.illustrativemathematics.org/content-standards/HSA/REI/C/6/tasks/1363) 32. Illustrative Mathematics: [Fishing Adventures 3](https://www.illustrativemathematics.org/content-standards/HSA/REI/D/12/tasks/644) (systems of linear inequalities) 33. Illustrative Mathematics: [Pairs of Whole Numbers](https://www.illustrativemathematics.org/content-standards/HSA/REI/C/6/tasks/1363) 34. Illustrative Mathematics: [Solution Sets](https://www.illustrativemathematics.org/content-standards/HSA/REI/D/12/tasks/1205) (systems of linear inequalities) 35. Illustrative Mathematics: [Solving Two Equations in Two Unknowns](https://www.illustrativemathematics.org/content-standards/HSA/REI/C/5/tasks/1903) 36. Illustrative Mathematics: [Taxi](https://www.illustrativemathematics.org/content-standards/HSA/REI/D/10/tasks/243) 37. New Zealand Maths: [Renting a Car](http://nzmaths.co.nz/resource/renting-car) 38. Illustrative Mathematics: [10000 is Half of 2000](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/1897) 39. Illustrative Mathematics: [Cell Phones](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/634) 40. Illustrative Mathematics: [Domains](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/635) 41. Illustrative Mathematics: [Function Notation I](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/598) 42. Illustrative Mathematics: [Hoisting the Flag I](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/2085) 43. Illustrative Mathematics: [Hoisting the Flag II](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/2084) 44. Illustrative Mathematics: [How is the Weather?](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/649) 45. Illustrative Mathematics: [Interpreting the Graph](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/tasks/636) 46. Illustrative Mathematics: [Laptop Battery Charge](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/1559) 47. Illustrative Mathematics: [Mathemafish Population](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/686) 48. Illustrative Mathematics: [Pizza Place Promotion](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/tasks/578) 49. Illustrative Mathematics: [Playing Catch](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/2087) 50. Illustrative Mathematics: [Points on a Graph](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/630) 51. Illustrative Mathematics: [Random Walk I](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/626) 52. Illustrative Mathematics: [Random Walk II](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/664) 53. Illustrative Mathematics: [Temperature Change](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/1500) 54. Illustrative Mathematics: [The Customers](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/624) 55. Illustrative Mathematics: [The High School Gym](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/6/tasks/577) 56. Illustrative Mathematics: [The Parking Lot](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/588) 57. Illustrative Mathematics: [Warming and Cooling](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/639) 58. Illustrative Mathematics: [Words-Tables-Graphs](https://www.illustrativemathematics.org/content-standards/HSF/IF/B/4/tasks/2089) 59. Illustrative Mathematics: [Yam in the Oven](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/2/tasks/625) 60. Illustrative Mathematics: [Your Father](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/589) 61. Illustrative Mathematics Task: [Do Two Points Always Determine a Linear Function?](https://www.illustrativemathematics.org/content-standards/HSF/IF/A/1/tasks/377) 62. Open Middle problem - [Write a Linear Function](http://www.openmiddle.com/write-a-linear-function/) 63. Inside Mathematics: [Performance Assessment Tasks](http://www.insidemathematics.org/performance-assessment-tasks) |

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| **Dictionaries, Calculators, and Templates (Graphs, Graphic Organizers)**   1. A Maths Dictionary for Kids (Requires Adobe Flash Player): [Math Charts](http://www.amathsdictionaryforkids.com/mathsCharts.html) 2. A Maths Dictionary for Kids: [Math Dictionary](http://www.amathsdictionaryforkids.com/) 3. Desmos: [Graphing Tool](http://desmos.com) 4. Math Open Reference:  [Calculator](http://www.mathopenref.com/calculator.html) 5. Web 2.0: [Calculator](http://web2.0calc.com/)   Also see [General Course Resources](#GeneralCourseResources) |
| **Teaching Strategies**   1. Creative Educator: [Authentic Tasks - Write a Great Authentic Task](http://creativeeducator.tech4learning.com/v01/articles/Writing_a_Great_Authentic_Task) 2. Creative Educator: [Project-Based Learning](http://creativeeducator.tech4learning.com/v01/articles/Success_Begins_with_Effective_Design) 3. Illustrative Mathematics: [Illustrative Mathematics Homepage](https://www.illustrativemathematics.org/) 4. Math Video Instructional Development Source: [Authentic Contexts](http://fcit.usf.edu/mathvids/strategies/ac.html) 5. Power Up What Works: [Math Strategies that Work Research](http://powerupwhatworks.org/resource/research-math-practices) |

| **Course/Grade:**Foundations in Algebra  **Unit:** 2 | **Task Title:** Task 1: What is a function?  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA. FIF.1a: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. FA. FIF.5 Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. |
| **Mathematical Process Standards Addressed** | 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2b. Describe a given situation using multiple mathematical representations. 3c. Make conjectures and explore their validity. 4a. Identify relevant quantities and develop a model to describe their relationships.  4b. Interpret mathematical models in the context of the situation, |
| **Materials and Resources** | Construction Paper  Scissors  Glue  **Unit 2 Task 1 Resource:** What is a Function? (Student Document) |
| **Task Description** | 1). Have students reflect on the following questions:   * How might a relation between 2 sets of numbers be represented? * Compare and contrast a relation and a function. Are all functions classified as relations? Are all relations classified as functions? * What makes a relation NOT a function?   2). Class discussion of possible answers to the previous questions.  3). Students will complete the “What is a function?” card sorting task.   * Students will sort the cut-out cards into two groups (Functions or Not a function) * Students will create their own relations for #11 & #12. (See student document for specific directions.) * Students will paste them into the appropriate category   4). When finished, students will complete the reflection portion of the task. |
| **Equitable Access** | Students are completing this task individually; however, they may question their peers about their thinking while teacher is facilitating student achievement.  Students can gain ideas from peers and critique their peers’ work while completing the task.  Students are asked to create their own function and non-function relation. |
| **Mathematical Vocabulary** | Relation Function Domain  Range |
| **Student Reflection** | reflection |

| **Unit 2 Task 1 Resource: What is a Function? (Student Document)**  [Return to Table of Contents](#TableofContents) |
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| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | A close up of a logo  Description automatically generated1) | 2)  Zach charges his neighbors $40 to cut grass plus $5 per hour for the use of his own equipment. | 3) Test Scores   | **Test** | **Score** | | --- | --- | | 1 | 95 | | 2 | 64 | | 2 | 67 | | 3 | 85 | | 4 | 88 | | | 4)   | **Time (hours)** | **Temperature (oF)** | | --- | --- | | 1 | -2 | | 4 | 7 | | 7 | 16 | | 10 | 25 | | 13 | 34 | | A picture containing racquetball, athletic game, sport  Description automatically generated5)  Domain:  Range: | 6) Relationship Statuses  table | | 7)  A guidance counselor at NHS is creating an excel spreadsheet of the input of GPAs and an output of students. | A graph comparing the number of marbles to their weight.  Description automatically generated8)  Domain:  Range: | 9)  A graph of the absolute equation value on the coordinate plane.Domain:  Range: | | 10)  A picture containing looking, white  Description automatically generated Domain:  Range: | 11) | 12) |   **What is a function?**  **Directions:**   * Choose a piece of construction paper. * Turning it horizontally fold it in half. * Label the left side **Function** and the right side **Not a Function**. * Cut out the 12 cards and glue or tape them under the appropriate category * For numbers 11 and 12, create a relation that is a function and a relation that is not a function. * For numbers 5, 8, 9, and 10. Identify the domain and range of the graph.   **Reflect:**   * Choose any nonverbal relation and create a real life scenario that could represent the relation.  | Relation # | | --- |  * Choose 2 relations that are not a function and explain how the relation might be transformed to make it a function.  | Relation # | Relation # | | --- | --- |  * Choose 2 relations that are functions and represent them 2 different ways.  | Relation # | | | --- | --- | | 1) | 2) |  | Relation # | | | --- | --- | | 1) | 2) |   *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 2 | **Task Title:** Task 2: Identifying and Comparing Key Features of Linear Functions in Multiple Representations.  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FIF.4 Interpret key features of a function that models the relationship between quantities when given in graphical form or tabular form. Sketch the graph of a function from a verbal description showing key features. Limit to linear.  FA.FIF.9 Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. Use equations, verbal descriptions, graphs, and tables to analyze the relationship between quantities or the properties of two functions. Limit to linear functions.  FA. FIF.5 Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 1c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem. 1d. Evaluate the success of an approach to solve a problem and refine it if necessary. 2a. Make sense of quantities and their relationships in mathematical and real-world situations.  2b. Describe a given situation using multiple mathematical representations.  2c. Translate among multiple mathematical representations and compare the meanings each representations conveys about the situation.  3d. Reflect on and provide thoughtful responses to the reasoning of others.  4a. Identify relevant quantities and develop a model to describe their relationships.  4b. Interpret mathematical models in the context of the situation.  4d. Evaluate the reasonableness of a model and refine if necessary. 6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | Sticky Notes  Markers (Optional)  Multiple Function Representations document  Chart paper (Optional)  Ruler |
| **Task Description** | This task is designed to be completed once all key features of linear functions have been taught. The purpose of this task is for students to explore multiple representations of linear functions and compare the key features in different forms.  1). Within a team/group, have students create a list of key features that could be used to describe linear functions. (e.g. Positive/negative slope, y-intercept, domain/range, intercepts, etc.)  2). Go around the room to share responses. If the students have the same response as another group, have them place a check or star by their response. If they do not have the response, have them add it to their list. Keep going around the room until all possible key features of linear functions have been mentioned. (Optional: Have a student write the key features on chart paper or on the board as they are stated.)  3). Using a jigsaw strategy in teams of 4, each student in the group will receive a table of values, graph or a verb description for a linear function (A, B, C, or D from the multiple representations document). On a sticky note, students will individually identify the key features for their linear function in a set amount of time.  4). When the timer (2-3 minutes) goes off, each student in the group will discuss their key features one at a time. The other team members will listen and write the key features on a sticky note for that function. Once the student has finished, the other students in the team/group can ask questions, critique, or add to their key features.  5). Repeat step 4, until all members have shared their key features.  6). Students will then place their sticky notes on its corresponding function onto the multiple representations document.  7). On the other side of the document, students will reflect upon and compare the four linear functions in multiple representations. See Comparing Functions document. |
| **Equitable Access** | Students are completing part of this task individually; however, they may question their peers about their thinking while the teacher is facilitating student achievement.  Students can gain ideas from peers and critique their peers’ work while completing the task.  Students are asked to create a graph of their own given restrictions.  Students are able to justify why each function is different from the others. |
| **Mathematical Vocabulary** | Linear Function Slope/Rate of Change  Intercepts Slope-Intercept Form Domain Range Function notation |
| **Student Reflection** | Two Stars and a Wish  Choose two of the following: I enjoyed… I learned… I used… I wrote/said/read… I’m proud of myself because… Choose one of the following: I would like… …was difficult because.... I tried to use… I would like help with… |

| **Unit 2 Task 2 Resource: Multiple Representations and Comparing Functions**  [Return to Table of Contents](#TableofContents) |
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| **Key Features of Linear Functions in Multiple Representations**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Function A**  A close up of a map  Description automatically generated | **Function B**   |  |  | | --- | --- | | **-2** | **-4** | | **-1** | **-1** | | **0** | **2** | | **1** | **5** | | **2** | **8** | | **3** | **11** | | **4** | **14** | | | **Function C**  Write a function and sketch its graph of that represents Sally making $7.00 per hour working at Food Lion each week. Sally cannot work over 10 hours each week.  Coordinate gridWhat are other key features to your graph? | **Function D**  Sketch a graph of a linear function that is continuous, has a negative slope, and crosses the y-axis at -3.    Coordinate gridWhat are other key features to your graph? |   **Comparing Key Features of Linear Functions**  Using functions A-D, answer the following questions.  1). What are the slopes of functions A and B? Explain which, A or B, has a steeper slope.  2). Given *f(-10)* for both functions B and D, which function produces the greatest y-value.  3). How might the line of differ from function A?  4). How might the line of differ from function D?  5). Compare and contrast all four functions. Give a reason why each function has characteristics that differ from the other three.   | Function A doesn’t belong because… | Function B doesn’t belong because… | | --- | --- | | Function C doesn’t belong because… | Function D doesn’t belong because… |   *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 2 | **Task Title:** Task 3: Linear Functions in the Real World  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.AREI.10 Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. Verify that any point on a graph will results in a true equation when their coordinates are substituted into the equation.  FA.FIF.1 Extend previous knowledge of a function to apply to general behavior and features of a function. a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. b. Represent a function using function notation and explain that (𝑥) denotes the output of function 𝑓 that corresponds to the input 𝑥. c. Understand that the graph of a function labeled as 𝑓 is the set of all ordered pairs (𝑥,) that satisfy the equation 𝑦=(𝑥) FA. FIF.2 Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation. FA.FIF.5 Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2b. Describe a given situation using multiple mathematical representations. 2c. Translate among multiple representations and compare the meanings each representation conveys among the situation.  3a. Construct and justify a solution to a problem. 4b. Interpret mathematical models in the context of the situation. 4d. Evaluate the reasonableness of a model and refine if necessary. 6b. Represent numbers in an appropriate form according to the context of the situation.  6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | Real World Discussion for Class Discussion (Teacher Document)  Linear Functions in the Real World (Student document)  Ruler  Graph Paper  Markers (Optional) |
| **Task Description** | For this task, students are expected to know how to write an equation given a real world situation, create a table of values, graph a linear equation, and identify the domain and range of a relation.  1). Post the following real world scenario on the board and have students write an equation in two variables that represents the situation. Also, have them define their variables.   * Tyson charges his neighbors $20 to cut grass plus $5 per hour for the use of his equipment and fuel.   2). Have students share their equations and variables with a partner. Call upon a student to share their response aloud.  3). Using the student’s equation, discuss with the class how equations can be written in function notation for ease of comprehending what the variables represent.  4). Connect function notation to students’ prior knowledge of creating a table of values, graphing, solutions, and domain and range. This can be done through discussion or have the students use their examples.  5). Discuss why some numbers in the domain and range are excluded because this is a real world situation and how the domain and range might be affected if the context of the situation changes.  6). Have students complete the Linear Functions in the Real World document. |
| **Equitable Access** | Students are working individually but yet collaboratively with peers to generate ideas while the teacher is facilitating student achievement.  Students can gain ideas from peers and critique their peers’ work during class discussion and completing the task.  Students may be asked to create their own real life scenario and write the function that represents it. |
| **Mathematical Vocabulary** | Function Notation Table of values  Input & Output variables Independent & Dependent variables Domain and Range Solutions |
| **Student Reflection** | 1) How was the idea of function notation connected to what you already knew? 2) What new ideas extended or pushed your thinking in a new direction? 3) What is still challenging or confusing to you?  4) What questions, wonderings, or puzzles do you now have because of this confusion or challenge? |

| **Unit 2 Task 3 Resource: Linear Functions in the Real World**  [Return to Table of Contents](#TableofContents) |
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| **Linear Functions in the Real World**  **Read the given scenario and complete a-h.**  Christina earned $3.00 an hour plus $55.00 in tips waitressing at Pizza Hut last week.  a). Write an equation in function notation to represent the total money Christina earned last week.  b). Choose five possible values for the number of hours Christina worked. Create a table of values that represents the amount of money she earned depending on the number of hours she worked for the five values you chose. \*\*Don’t forget to label your input and output variables in the table.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |   c). On the back, graph the function using appropriate labels, units, and scales.  d). Which quadrants are valid to the scenario? Explain your reasoning.  e). Using your graph identify two other solutions to the function. Verify the solutions by substituting them into the function.   | Solution:  Verify: | Solution:  Verify: | | --- | --- |   f). Identify the function’s domain and range based on all possible values for this scenario.   | Domain: | Range: | | --- | --- |   g). Using the same hourly salary and amount of tips earned, how might the domain and range change if the minimum number of hours Christina could work is 6 per week and the maximum number of hours is 12 per week?  h). Create your own real life scenario and write a function to represent the situation. Define the variables.  *(SCDE, 2019)* |

| **Course/Grade:** Foundations in Algebra  **Unit:** 2 | **Task Title:** Task 4: Stained Glass Window Linear Functions  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.) FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form .) FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to linear; quadratic; exponential.)  a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. |
| **Mathematical Process Standards Addressed** | 1c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem. 5a. Select and use appropriate tools when solving a mathematical problem. 7b. Recognize mathematical repetition in order to make generalizations. 6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | **Unit 2 Task 4 Resource:** Stained Glass Window Activity (1 copy per student)  1 full paged graph (4 quadrant) per person |
| **Task Description** | Students will create 12 equations for the lines specified in the prompt below and then graph the 12 equations to create a stained glass window effect.  Extension: Students could then transfer the design to parchment paper to create a working stained glass window. |
| **Equitable Access** | Students can use simple values or more intricate numbers to use for the slope and y-intercept of the lines.  Students could draw the lines first (based on the directions of specific lines) and then find the equations. |
| **Mathematical Vocabulary** | Slope-Intercept Form  Point-Slope Form  Standard Form  Parallel Lines  Perpendicular Lines |
| **Student Reflection** | * Explain how the equations you wrote could be changed to create larger pieces in the stained glass. * Explain which, if any, of the equations you wrote and graphed satisfy multiple criteria below. * Which of your lines had the greatest steepness? * Which of your lines had the smallest y-intercept? |

| **Unit 2 Task 4 Resource: Stained Glass Window Activity**  [Return to Table of Contents](#TableofContents) |
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| **Stained Glass Window Project**  **Directions:**   * Create one equation for each of the below criteria, resulting in 12 total equations. * Graph the 12 lines that correspond to the equations you wrote on a sheet of graph paper. * Label each line with the number at one end. * Finish your unique stained glass window by coloring each section created by your lines.      |  | | --- | | 1. A Vertical Line | | 1. A Horizontal Line | | 3 & 4. Two lines that are parallel (but not horizontal or vertical). | | 5 & 6. Two lines that are perpendicular (but not horizontal or vertical). | | 1. A line that goes through the origin. | | 1. A line that has a negative slope. | | 1. A line that is in point-slope form. | | 1. A line that is in standard form. | | 11-12. Two additional lines of your choosing. | |

| **Course/Grade:**Foundations in Algebra  **Unit:** 2 | **Task Title:** Task 5: Graphing Linear Inequalities in two variables.  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.AREI.12 Graph the solutions to a linear inequality in two variables. Graph a linear inequality on a coordinate plane, resulting in a boundary line (solid or dashed) and a shaded half-plane. |
| **Mathematical Process Standards Addressed** | 1d. Evaluate the success of an approach to solve a problem and refine it if necessary. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 3d. Reflect on and provide thoughtful responses to the reasoning of others. 4d. Evaluate the reasonableness of a model and refine if necessary. 6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | Student Task Sheet  Dry erase boards  Dry ease markers  Chart paper  Sticky notes |
| **Task Description** | 1) Write y = 3x – 4 and y < 3x – 4 on the board. Have students list what they notice and what they wonder.  2) Have a class discussion through sharing the students’ thoughts/ideas about what they notice and what they wonder.  3) Instruct the students to graph the line y = 3x – 4 on a dry erase board. Have students discuss the characteristics of the line they graphed.  4) How does the line give information regarding the solutions to the equation? (Guide students to realizing that all the solutions to the equation are the ordered pairs that make up the line.)  5) Ask students to explain the meaning of “y is less than 3x – 4”? Students should compare and contrast the equation and the inequality.  6) What are possible solutions for the inequality and how would the solutions be graphed differently from the equation? Have students transform their graph of the linear equation into the graph of the linear inequality.  6) Teacher will guide writing/graphing linear inequalities through a class discussion. See document for example problem.  7) Students will then be given another scenario. They will work collaboratively with a partner or team to complete all parts to the problem. See document for example problem. Have students transfer work to chart paper.  8) When students are done, have them place their chart paper on the wall. Students can do a gallery walk and use sticky notes to make comments and suggestions on their peers’ work.  9) Have students return to their work to refine as needed. |
| **Equitable Access** | Students are collaboratively working with peers while teacher is facilitating student achievement.  Students can gain ideas from peers and critique their peers’ work during the gallery walk. |
| **Mathematical Vocabulary** | Linear Inequalities  Boundary Line Half Plane |
| **Student Reflection** | 1). What was the main idea you learned today? Use mathematical vocabulary and be specific. 2). What is something you are struggling with or have questions about? 3). How could the ideas from today’s lesson be used in real life? |

| **Unit 2 Task 5 Resource: Graphing Linear Inequalities in Two-Variables**  [Return to Table of Contents](#TableofContents) |
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| **Graphing Linear Inequalities in Two-Variables**  **Guided Practice:**  You received a $20 gift card to Family Video for your birthday. New release movies cost $4 to rent and all other movies cost $2. How many movies of each type can you rent?   1. Define variables for the situation. 2. Write a linear inequality to describe the situation. 3. Graph the inequality. (Discuss shading limitations for domain/range) 4. Give at least two combinations of movies you can rent. 5. Using one of your combinations, state the number of new release and standard movies you would rent.   **Team/Partner Practice:**  The state fair is in town and you have earned $50 from babysitting. If each ride costs $2.50 and each game costs $2 to play, how many of each can you participate in during your visit?   1. Define variables for the situation. 2. Write a linear inequality to describe the situation. 3. Graph the inequality. (Discuss shading limitations for domain/range) 4. Give at least two combinations of the number of rides and games you would participate in. 5. Using one of your combinations, state the number of rides and games you would participate in.   Now it’s your turn! Create a linear inequality that represents a real-life scenario. Solve the inequality and explain the meaning of your solutions in terms of your scenario.  *(SCDE, 2019)* |

| **Course/Grade:** Foundation Of Algebra  **Unit:** 2 | **Task Title:** Task 6: Systems of Equations  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.AREI.5\* Justify that the solution to a system of linear equations is not changed when one of the equations is replaced by a linear combination of the other equation.  FA.AREI.6\* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables.  FA.AREI.6 a. Solve systems of linear equations using the substitution method.  FA.AREI.6 b. Solve systems of linear equations using linear combination.  FA.AREI.11 Solve an equation of the form (𝑥)=𝑔(𝑥) graphically by identifying the 𝑥-coordinate(s) of the point(s) of intersection of the graphs of 𝑦=𝑓(𝑥) and 𝑦=𝑔(𝑥). (Limit to linear; quadratic; exponential.)  FA.ASE.1\* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  2. Reason both contextually and abstractly.  a. Make sense of quantities and their relationships in mathematical and real-world situations.  b. Describe a given situation using multiple mathematical representations.  d. Connect the meaning of mathematical operations to the context of a given situation.  3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.  a. Construct and justify a solution to a problem.  b. Compare and discuss the validity of various reasoning strategies.  4. Connect mathematical ideas and real-world situations through modeling.  a. Identify relevant quantities and develop a model to describe their relationships.  b. Interpret mathematical models in the context of the situation.  6. Communicate mathematically and approach mathematical situations with precision.  7. Identify and utilize structure and patterns.  c. Look for structures to interpret meaning and develop solution strategies. |
| **Materials and Resources** | **Unit 2 Task 6 Resource:** Systems Inquiry Learning  **Unit 2 Task 6 Resource:** Writing Systems Practice |
| **Task Description** | * + 1. Students should complete the Systems Inquiry Learning as an introduction to the unit.     2. Students should complete the Writing Systems Practice at the end of the unit.     3. The students will be set up in multiple stations (group students heterogeneously) around the room. The students will be given a word problem in each station with the following prompts.  1. Solve using a method that you have learned in class. 2. Verify solution using a second method. 3. Discuss with your group methods that are easier/more efficient and why/why not.   Whole Group Discussion: Did you use the same methods on all systems? Why/why not? |
| **Equitable Access** | Addressed in task description and reflection.  Activity could be cut into strips and given to groups individually to complete. |
| **Mathematical Vocabulary** | Graphing  Substitution  Elimination  Consistent  Inconsistent  Dependent  Independent  Parallel  Perpendicular  Intersecting |
| **Student Reflection** | * Turn in the worksheet including your reflection. * What does it mean to solve a system of equations? * When given a system of equations to solve, what factors contribute to the method you would choose to solve the system? * Is it easy to graph a system that has very large or small rational numbers? Explain your reasoning. * When would it be more efficient to solve a system using a graphing calculator? * Give three examples of systems that would be easiest solved using each of the methods and explain your reasoning. (Graphing, elimination, substitution) * Create a real world word problem that would require a system of equations to solve. |

| **Unit 2 Task 6 Resource: Systems Inquiry Learning**  [Return to Table of Contents](#TableofContents) |
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| A picture containing text  Description automatically generated  **I NOTICE**  **I WONDER**  You are required to:   1. Write the equations for the above four lines. 2. Create and graph a system of equations that intersect at a given point. 3. Create two equations that have different slopes but the same y-intercepts and graph them. 4. Create two equations that have the same slope but different y-intercept and graph them. 5. Create two equations that will have more than one solution. Justify that your equations have more than one solution. 6. Create a system of equations that when graphed produce parallel lines. Justify the lines are parallel. What is the solution for this system? 7. Create a system of equations that when graphed produce perpendicular lines. Justify the lines are perpendicular. |

*(SCDE, 2019)*

| **Unit 2 Task 6 Resource: Writing Systems Practice**  [Return to Table of Contents](#TableofContents) |
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| **Write the equations for each system and find the requested information.**  1. The sum of two numbers is 24. One number is 8 less than the other number. Let x and y be the two numbers. What are the two numbers?  2. John has a total of 18 nickels and dimes. He has 6 more nickels than dimes. Let n stand for nickels and d stand for dimes. How many nickels and dimes does John have?  3. The sum of Trent and Josh’s ages is 54. Josh is 8 years older than Trent. Let j stand for Josh and t stand for Trent. How old is Josh and Trent?  4. The perimeter of a rectangle is 164 units. The length is 8 less than twice the width. Let w stand for width and l stand for length. What is the length and width of the rectangle?  5. Verizon Wireless charges $20 for a device connection fee plus $10 for each GB of data. T-Mobile charges $50 for the device connection fee with unlimited data. When will the two companies charge the same amount?  6. Tickets to a movie cost $7.25 for adults and $5.50 for students. A group of friends purchased 8 tickets for $52.75. Let a stand for adult tickets and s stand for student tickets. How many adult tickets and students tickets were purchased?  7. Diana has $150 in her savings account and is depositing $50 each month. Sarah has $250 in her savings account and depositing $25 each month. How many months will it take for Diana and Sarah to have the same amount in their savings account?  8. The JV softball team is made up of 7th and 8th graders. There are a total of 20 players on the team. There are 6 more 8th graders than 7th graders. Let x stand for 7th graders and y stand for 8th graders. How many 7th graders are on the team? How many 8th graders are on the team?  *(SCDE, 2019)* |

| **Unit 3 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.ACE.1\* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to linear; quadratic; ~~exponential with integer exponents~~.)   + Identify the variable quantities in real-world contexts.   + Use context to choose the applicable algebraic model (linear equation, linear inequality, or quadratic equation).   + Write, solve, and interpret the solution of an equation or inequality. * FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)   + Identify the variables and quantities in real-world contexts.   + Use context to choose the applicable algebraic model (e.g., linear, quadratic).   + Write and graph equations in two or more variables, and interpret relationships among variables. * FA.ACE.4\* Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.   + Isolate variables to rewrite equations and formulas in equivalent forms. * A1.AREI.1\* Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original.   + Apply order of operations and inverse operations to solve equations.   + Construct an argument to justify a solution process.   + Demonstrate that the solution of the equation solves the equations created for each step of the process. * FA.FBF.3\* Describe the effect of the transformations *f(x)*, *f(x) + k*, *f(x + k)*, and combinations of such transformations on the graph of *y = f(x)* for any real number *k*. Find the value of *k* given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; ~~exponential with integer exponents;~~ vertical shift and vertical stretch.) (Limit to linear and quadratic in unit 3; expands to exponential with integer exponents in units 4 and 5).   + Explain why *f(x) + k* translates the original graph of *f(x)* up *k* units and why *f(x) - k* translates the original graph of *f(x)* down *k* units.   + Explain why *f(x + k)* translates the original graph of *f(x)* left *k* units and why *f(x - k)* translates the original graph of *f(x)* right *k* units.   + Describe the transformation that changed a graph of *f(x)* into a different graph when given pictures of the pre-image and the image.   + Determine the value of k given a graph of a transformed function.   + Graph the listed transformations when given a graph of f(x) and a value of k [f(x) 土 k, f(x 土 k) and f(x 土 k) 土 k].   + Generate and compare examples of functions with different *k* values. * FA.FIF.1\* Extend previous knowledge of a function to apply to general behavior and features of a function. * FA.FIF.1a Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.   + Define a function as a relation in which each input (domain) has exactly one output (range).   + Determine if a graph, table, or set of ordered pairs represents a function.   + Determine if stated rules (both numeric and nonnumeric) produce ordered pairs that represent a function. * FA.FIF.1b Represent a function using function notation and explain that *f(x)* denotes the output of function *f* that corresponds to the input *x*.   + Recognize that when *x* is an element of the input of a function, *f(x)* represents the corresponding output of the function. * FA.FIF.1c Understand that the graph of a function labeled as *f* is the set of all ordered pairs *(x, y)* that satisfy the equation *y = f(x)*.   + Explain that the graph of *f* is the graph of the equation *y = f(x)*. * FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.   + Decode function notation and explain how the output of a function is matched to its input. (e.g., The function *f(x) =* 3x2 - 5 squares the input, triples the square, and subtracts five to produce the output).   + Use order of operations to evaluate a function for a given domain (input) value.   + Analyze the input and output values of a function based on the context of a problem.   + Identify the real numbers that are not in the domain of a function.   + Recognize that the domain might change depending upon the context of problem. * FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; ~~end behavior and periodicity~~. (Limit to linear; quadratic; ~~exponential.~~) (Limit to linear and quadratic in unit 3; expands to exponential with integer exponents in units 4 and 5.)   + Connect this content to the content of A1.AREI.4\*.   + Create a graph that matches the description and shows all of the key features of the function, if applicable, the y-intercept, x-intercept(s), increasing interval, decreasing interval, relative minimum, relative maximum, and symmetry.   + Explain the meaning of all the key features included in a graph or verbal description. * FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; ~~exponential.~~) (Limit to linear and quadratic in unit 3; expands to exponential with integer exponents in units 4 and 5).   + Analyze the input and output values of a function in algebraic, graphic, tabular, and verbal forms. * FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; ~~exponential only in the form~~ ~~.)~~   + Explain that the parent function for a quadratic function is the parabola *f(x) = x2.*   + Explain that the minimum or maximum of a quadratic is called the vertex.   + Identify whether the vertex of a quadratic will be a minimum or maximum by looking at the equation.   + Find the y-intercept of a quadratic by substituting 0 for *x* and evaluating the function.   + Estimate the vertex of a quadratic by evaluating different values of *x*.   + Use calculated values while looking for a maximum or minimum to decide if the quadratic has x-intercepts.   + Estimate the x-intercepts of a quadratic by evaluating different values of *x*.   + Graph a quadratic using evaluated points.   + Use technology to graph a quadratic and to find precise values for the x-intercept(s) and the maximum or minimum. * FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to linear; quadratic; exponential.)   + Equations, verbal descriptions, graphs, and tables provide insight into the relationship between quantities.   + Explain that there are three forms of quadratic functions: standard form and vertex form.   + Explain that standard form is *f(x) = ax2 + bx + c*.   + Explain that the vertex form is *f(x) = a(x-h)2 + k.*   + Explain that the graph of all these forms is a parabola.   + Use the x-intercepts of a quadratic function to find the axis of symmetry.   + Use the axis of symmetry of a quadratic to find the vertex of a parabola.   + Identify the line of symmetry and vertex of a quadratic written in vertex form.   + Sketch the graph of a parabola written in vertex form.   + Determine if a quadratic written in vertex form has x-intercepts by looking at the equation.   + Use algebra to find the x-intercepts of a quadratic written in vertex form.   + Demonstrate that the standard and vertex forms of the same quadratic function produce the same values for the x-intercepts, the y-intercept, and the vertex.   + Write the function that describes a parabola in all three forms when given a graph with the x-intercepts, y-intercept, and vertex labeled. * FA.FIF.8a Use ~~the process of~~ factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. (Note: FA.FIF.8a is not a Graduation Standard.)   + Use the given factored form to find the zeros of a quadratic function.   + Use the given vertex form of a quadratic to find the extreme values and symmetry.   + Emphasis should be given to the real-world context of a problem situation and to the meaning of the zeros and extreme values in the real-world.   + The processes of factoring and completing the square will be addressed in Intermediate Algebra Unit 4. * FA.FIF.9\* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; ~~exponential.~~) (Limit to linear and quadratic in unit 3; expands to exponential with integer exponents in units 4 and 5.)   + Provide insight into the properties of linear and quadratic functions by comparing different representations of two functions. |

| **Unit 3 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Axis of symmetry * Inspection * Parabola * Quadratic equation * Quadratic expression * Radicand * Roots of a quadratic * Square root method * Standard form of a quadratic equation * Translate * Vertex * Vertex form * y-axis symmetry * Zero of a function * Zeros |

| **Unit 3 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| * FA.ASE.1 included creating one and two variable linear equations in Unit 1; this standard is now applied and extended to a new function family, quadratic, in this (Unit 3). * In Unit 1, rewriting simple expressions with radicals provided foundation for quadratic solutions with rational and irrational square roots. * FA.ACE.4 requires fluent variable manipulation and empowers students to rewrite functions as equations. * Student understanding of function relationships, as seen in FA.AREI.10 for functions in two variables, can be expressed in tabular, algebraic (equation), and graphical forms. * Previous student exposure to linear functions was established in Units 1 and 2, particularly the function notation of *f(x)* and how that relates to understanding of function concepts including 1-to-1 domain to range, particularly as communicated within ordered pairs. * In grade 8, students examined the properties of rigid transformations (rotations, reflections, and translations); reflections and translations will be re-examined with the parent function, *f(x)* = x2, a parabola rather than geometric figures. (8.GM.1) * Student understanding of the geometric concept of symmetry from middle school will be applied to parabolas; symmetry appears in the graph of a parabola as well as the numerical/tabular representation of a quadratic function. A parabola has a vertical line of symmetry that can be expressed as a vertical line (non-function), and the maximum/minimum of the parabola is the vertex and is a point on the line of symmetry. |

| **Unit 3 Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
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| * Unit 5 compares and contrasts the graphs of linear, quadratic and exponential functions. * Unit 5 compares and contrasts the rates of change of linear, quadratic and exponential functions. * Unit 5 compares and contrasts the key features of the graphs of linear, quadratic, and exponential functions (domain, range, y-intercept, zeros, intervals of increase/decrease, axis of symmetry, vertex, end behavior, etc.). |

| **Unit 3 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
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| The standards in Unit 3 focus on quadratic functions, equations, and applications of quadratic functions. Students will determine if a relation is a quadratic function by analyzing information gathered from tables, graphs, and expressions. They will explore variable rate of change and determine how the rate of change for a quadratic function differs from the rate of change for a linear function. Unit 3 explores critical attributes of quadratic functions, including finding the vertex and axis of symmetry of the graph of a polynomial function; using the graph, table, or solutions to the quadratic expressed in vertex form to identify the zeros; and determining if the vertex is the maximum or minimum value of the function. Access to a variety of technologies, such as graphing utilities, spreadsheets, and computer algebra systems, to solve problems will support mastery of these standards. This unit guides students to recognize the quadratic parent function 2, and to understand how a transformation of the parent function can stretch the graph, compress the graph, reflect the graph, or translate the graph left, right, up, or down. Through contextual examples and models of objects that are thrown in the air and allowed to fall subject to the force of gravity, students will deepen their conceptual understanding to interpret quadratic functions and their solutions. They will determine the circumstances in which the square root of both sides of an equation can be taken to solve for an unknown.  In this unit, students will:   * Explore quadratic functions, equations, and applications, * Model quadratic equations through quadratic functions using a vertical motion model, * Find the vertex of the graph of a quadratic function, * Apply the vertex form of a quadratic function to find real solutions of quadratic equations, and * Explain how the graph of a quadratic function is a transformation of the parent function *f(x)* = x2. |

| **Unit 3 Resources**  [Return to Table of Contents](#TableofContents) |
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| **Activity Resources**   1. Better Lesson: [Simplify and Rewrite Radicals as Rational Exponents and Vice Versa](http://betterlesson.com/lesson/571695/simplify-and-rewrite-radicals-as-rational-exponents-and-vice-versa) 2. Better Lesson: [Solving Equations](http://betterlesson.com/lesson/446484/solving-equations) 3. Transforming the graph of the quadratic parent function 2   [Introduction to Quadratics](https://drive.google.com/file/d/1s2xC-rr9W5wqYZ0UzsMvlPuDdEGILA4Z/view?usp=sharing)   1. Algebra 1 Lessons WCCUSD: [Exploring Quadratic Graphs](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/ExploringQuadraticGraphsV3.pdf) 2. Khan Academy: [Transforming the Graphs of Quadratic Functions](https://www.khanacademy.org/math/algebra/quadratics/transforming-quadratic-functions/v/shifting-and-scaling-parabolas) 3. Khan Academy: [Graphing Quadratic Functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations) 4. EngageNY: [Introduction to Quadratic Function and Graphing](https://www.engageny.org/resource/algebra-i-module-1-topic-lesson-2) 5. CoolMath: [Graphing Quadratics (Parabolas](http://www.coolmath.com/algebra/11-graphing-quadratics-parabolas)) 6. Algebra 1 Lessons WCCUSD: [Key Features of Graphs](http://www.wccusd.net/Page/3224) 7. Khan Academy: [Different Forms of Quadratic Functions and the Features They Reveal](https://www.khanacademy.org/math/algebra/quadratics/features-of-quadratic-functions/v/rewriting-a-quadratic-function-to-find-roots-and-vertex) 8. Algebra 1 Lessons WCCUSD: [Three Forms of a Quadratic Function: Matching Quadratic Functions](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/ThreeFormsOfQuadraticFunctionsLessonV1.pdf) 9. Khan Academy: [Features of Quadratic Functions](https://www.khanacademy.org/math/algebra/quadratics/features-of-quadratic-functions/v/quadratic-functions-2) 10. Khan Academy: [Quadratic Equations and Functions](https://www.khanacademy.org/math/algebra/quadratics) 11. Better Lessons: [Modeling With Quadratic Functions](http://betterlesson.com/lesson/558828/modeling-with-quadratic-functions) 12. Algebra 1 Lessons WCCUSD: [Quadratics - Matching Game](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/MatchgameQuadractics.pdf) 13. Algebra 1 Lessons WCCUSD: [Quadratic Equations - What We Know](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/QuadEquMultRepsWhatWeKnowV5.pdf) 14. Cliff Notes: [Algebra 1](http://www.cliffsnotes.com/study-guides/algebra/algebra-i) 15. Concord Consortium: [Graphing Quadratic Equations](http://concord.org/stem-resources/graphing-quadratic-equations) 16. EngageNY: [Algebra 1](https://www.engageny.org/resource/algebra-i-module-1-topic-lesson-2) 17. Illustrative Mathematics: [High School Content Lesson Index](https://www.illustrativemathematics.org/content-standards/HS) 18. Khan Academy: [Algebra 1](https://www.khanacademy.org/math/algebra) 19. LearnZillion: [Algebra Math Video Lessons](https://learnzillion.com/resources/75023-algebra-math-video-lessons) 20. Math Open Reference: [Math Subject Topic List](http://www.mathopenref.com) 21. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Classroom Challenges (Formative Assessment Lessons)](http://map.mathshell.org/background.php) 22. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Guide for Teachers and Administrators](http://map.mathshell.org/guides/map_cc_teacher_guide.pdf) 23. Monterey Institute: [Algebra 1: An Open Course (Part 2)](http://moodle.montereyinstitute.org/course/view.php?id=3) 24. Monterey Institute: [Algebra 1: An Open Course - Unit 10 – Quadratic Functions](http://www.montereyinstitute.org/courses/Algebra1/PD10_RESOURCE/Algebra%20I_PD_U10_InstrGuide_v1.1.pdf) 25. Quia: [Mathematics Shared Activities](http://www.quia.com/shared/mathematics/) 26. West Contra Costa Unified School District: [Algebra 1 Lessons](http://www.wccusd.net/Page/3224) 27. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Building Functions](http://map.mathshell.org/tasks.php?unit=HN07&collection=9) 28. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Formative Assessment Lesson - Generalizing Patterns: Table Tiles](http://map.mathshell.org/lessons.php?collection=8&unit=9200) 29. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Formative Assessment Lesson - Representing Quadratic Functions Graphically](http://map.mathshell.org/lessons.php?collection=8&unit=9245) 30. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Formative Assessment Lesson - Sorting Equations and Identities](http://map.mathshell.org/lessons.php?collection=8&unit=9210) 31. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Summative Assessment Task - Sorting Functions](http://www.map.mathshell.org/tasks.php?collection=9&unit=HA16) |
| **Dictionaries, Calculators, and Templates (Graphs, Graphic Organizers)**   1. A Maths Dictionary for Kids (Adobe Flash Player Required): [Explicit Vocabulary Building](http://www.amathsdictionaryforkids.com/dictionary.html) 2. A Maths Dictionary for Kids (Adobe Flash Player Required): [Math Charts Printable Resources](http://www.amathsdictionaryforkids.com/mathsCharts.html) 3. Desmos: [Online Graphing Calculator with Many Pre-Made Activities](https://www.desmos.com/) 4. [Math Open Reference](http://www.mathopenref.com/calculator.html): [Calculator](http://www.mathopenref.com/calculator.html) 5. Texas Instruments: [Texas Instruments Algebra 1 Graphing Calculator Activities](https://education.ti.com/en/84activitycentral/us/algebra-i) 6. Web 2.0: [Scientific Calculator](http://web2.0calc.com/) |
| **Teaching Strategies**   1. Creative Educator: [Authentic Tasks - Write a Great Authentic Task](http://creativeeducator.tech4learning.com/v01/articles/Writing_a_Great_Authentic_Task) 2. Creative Educator: [Project-Based Learning](http://creativeeducator.tech4learning.com/v01/articles/Success_Begins_with_Effective_Design) 3. Illustrative Mathematics: [Illustrative Mathematics Homepage](https://www.illustrativemathematics.org/) 4. Math Video Instructional Development Source: [Authentic Contexts](http://fcit.usf.edu/mathvids/strategies/ac.html) 5. Power Up What Works: [Math Strategies that Work Research](http://powerupwhatworks.org/resource/research-math-practices) |

| **Course/Grade:** Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 1: Object Drop  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.FBF.3\* Describe the effect of the transformations , and combinations of such transformations on the graph of for any real number . Find the value of given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)  FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)  FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.)  FA.SPID.6\* Using technology, create scatter plots and analyze those plots to compare the fit of linear, quadratic, or exponential models to a given data set. Select the appropriate model, fit a function to the data set, and use the function to solve problems in the context of the data. |
| **Mathematical Process Standards Addressed** | 2 a. Make sense of quantities and their relationships in mathematical and real-world situations.  2 d. Connect the meaning of mathematical operations to the context of a given situation.  3 a. Construct and justify a solution to a problem 3 c. Make conjectures and explore their validity. 4 b. Interpret mathematical models in the context of the situation.  5 b. Use technological tools and other external mathematical resources to explore and deepen understanding of concepts. 6 d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | 2 stopwatches per group  Graph paper  Water Balloons (At least 10 per group) or any droppable object  Recording Device  **Unit 3 Task 1 Resource:** Student Document |
| **Task Description** | 1. Students will time the drops from various heights to determine if a quadratic model is the best fit. 2. Students will calculate the estimated times using the gravitational quadratic equation. 3. Students will plot the data on a coordinate plane to find the trend of the data. Students could use a graphing calculator or online program ([Desmos](http://www.desmos.com)). Students can submit their data and graph from Desmos.   Note: Table for collecting data and reflection questions are below. |
| **Equitable Access** | Students will make conjectures about times for heights exceeding the stadium height (400 feet, 1000 feet, etc.).  Students can scale down the heights to 1 foot, 2 feet, etc. if the stadium is unavailable. |
| **Mathematical Vocabulary** | Quadratic equation  Vertex  Zeros  Translate  Scatter Plot  Regression |
| **Student Reflection** | Students will reflect upon the experiment to compare differences in expected times and actual times. Students will reflect on any possible errors during the experiment and how the errors might affect their results. |

| **Unit 3 Task 1 Resource: Student Document**  [Return to Table of Contents](#TableofContents) |
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| **Object Drop Experiment**  In your group of 4, assign the following roles to each person: 1 person to drop the object, 1 person to film each drop, and 2 people to time the drop. You should switch positions as you progress through the experiment to allow each person to experience a different role. \* In a group of 3, assign only one person to time the drop.  **Enter the average of the two times in the table below. Do not fill in the last column until instructed.**     |  |  |  | | --- | --- | --- | | **Height** | **How long DID it take?** | **How long SHOULD it take?** | | 1 foot |  |  | | 5 feet |  |  | | 10 feet |  |  | | 15 feet |  |  | | 20 feet |  |  | | 25 feet |  |  | | 30 feet |  |  | | 40 feet |  |  | | 50 feet |  |  | | 75 feet |  |  | | 100 feet |  |  |   **Go to Desmos.com to input the data and find the best regression for the data (linear, exponential, or quadratic).**  1. What model best fits the data, linear, exponential or quadratic?   1. Write the regression equation for the best fit model. 2. Now use to find the estimated time for each drop height. **Record this information in the last column of the table above.**   **Reflective questions:**   1. Compare and contrast the calculated prediction times and the timed outcomes? 2. Were the predicted times and timed outcomes correlated as you would have expected? Explain. 3. Without using the formula, what time would you predict for 400 feet? 1000 feet? Use the formula to check your prediction. Explain how accurate you were in making your prediction. |

| **Course/Grade:** Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 2: Flying Fowl Challenge  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.ASE.1\* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions. (Limit to linear; quadratic; exponential.) FA.FBF.3\* Describe the effect of the transformations, and combinations of such transformations on the graph of for any real number . Find the value of given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.) FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)  FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.)  FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form.) |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world relationships.  2d. Connect the meaning of mathematical operations to the context of a given situation.  3b. Compare and discuss the validity of various reasoning strategies. 3c. Make conjectures and explore their validity. 4b. Interpret mathematical models in the context of the situation.  4d. Evaluate the reasonableness of a model and refine if necessary.  6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | Graph Paper, Coloring Materials  [Will it Hit the Hoop?](https://teacher.desmos.com/activitybuilder/custom/56e0b6af0133822106a0bed1) |
| **Task Description** | This task is intended for students to complete after they have been introduced to graphing quadratic functions. This task should take approximately 2 class periods to complete.  Students will create a 2- dimensional landscape in the first quadrant of a coordinate plane. The landscape must include a catapult and at least 3 enemies located in different regions of the landscape. (The picture should be creative and visually pleasing.)  The students will write and graph quadratic functions to represent the path from the catapult the flying fowl will take to hit the enemies.  Students must show all of their initial planning (sketches, possible equations, etc.) on a separate sheet of paper, to be submitted with the final picture.  Students must list the following key features for each of the three quadratic functions: domain and range, vertex, intervals of increase and decrease, axis of symmetry, and zeros.  **Final Product:**   * Creative picture on graph paper that shows the catapult, the location of at least 3 enemies, the three quadratic functions that will eliminate the enemies and the graphs of the quadratic functions that represent the flying fowl path. * Initial sketches of landscape, equations, graphed paths, etc. * List of key features for each of the three final quadratic graphs. (domain and range, vertex, intervals of increase and decrease, axis of symmetry, and zeros) |
| **Equitable Access** | Students can use the Desmos Activity [Will it Hit the Hoop?](https://teacher.desmos.com/activitybuilder/custom/56e0b6af0133822106a0bed1) to explore quadratic functions and their graphs prior to drawing the landscape.  Students can create a landscape as complex or simple as possible to aim for the enemies.  Students may be asked to write the quadratic functions in different forms (standard, vertex, intercept)  Students may be asked to write two quadratic functions to defeat each enemy. |
| **Mathematical Vocabulary** | Vertex  Zeros  Quadratic Function  Intercepts  Axis of Symmetry  Parabola |
| **Student Reflection** | Students will document their process for finding quadratic functions to defeat the enemies.  Students will document any commonalities in the quadratic functions they write and determine why some portions of the quadratic functions remain the same, while other portions change.  Students should reflect on what portion of the equation causes the fowl to launch higher and what portion of the equation causes the fowl to travel a farther horizontal distance. |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 3: Equivalent forms of a Quadratic Function  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 2b. Describe a given situation using multiple mathematical representations. 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 7c. Look for structures to interpret meaning and develop solution strategies. |
| **Materials and Resources** | Task assignment sheet  Pencil  Graphing calculator  Graph paper |
| **Task Description** | This task will allow students to look at a quadratic function and compare the different equivalent forms.  Students will fill in the missing quadratic function components of the table. Students will draw graphs on graph paper.  Students will translate from one quadratic form to another and compare the properties of functions. |
| **Equitable Access** | Students will complete the table based on what they know about each quadratic form. |
| **Mathematical Vocabulary** | Standard form Vertex form Intercept (factored) form |
| **Student Reflection** | See bottom of Task assignment. |

| **Unit 3 Task 3 Resource: Comparing Different Representations of a Quadratic Function**  [Return to Table of Contents](#TableofContents) |
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| **Comparing Different Representations of a Quadratic Function**  Complete the missing components related to the different forms of a quadratic function. The quadratic parent function is given.   |  | **Verbal (words)** | **Algebraic** | **Form: standard, intercept, vertex** | **Tabular (Table)** | **Graph** | **Other**  **(key features: zeroes, extreme values, symmetry, vertex)** | | --- | --- | --- | --- | --- | --- | --- | | **1** | The quantity y is the same as the quantity x squared |  | Standard | | x | y | | --- | --- | | 0 | 0 | | 1 | 1 | | 2 | 4 | | -1 | 1 | | -2 | 4 | | A picture containing racquetball  Description automatically generated | Axis of symmetry: x = 0, Vertex & minimum at (0,0)  Zero at  x = 0 | | **2** |  |  |  |  |  |  | | **3** |  |  |  |  |  |  | | **4** |  |  |  |  |  |  | | **5** |  |  |  | table |  |  | | **6** |  |  |  |  | A picture containing man  Description automatically generated |  |   **Reflection:**  1. Explain any commonalities between quadratic equations written in standard form, vertex form and factored form.  2. Which form allows you to more easily identify key features? Explain your reasoning.  3. Explain why it is important to know all three forms for a quadratic equation. (Why do all three forms exist?)  4. Create a quadratic function in any form and translate it into its other two equivalent forms.  5. Which form did you use to create your initial equation? Why did you start with this form?  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 4: Linear and Quadratic Functions  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.FIF.9\* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 3a. Construct and justify a solution to a problem. 3b. Compare and discuss the validity of various reasoning strategies. 1. Make sense of problems and persevere in solving them. 4b. Develop a model to describe relationships. 6. Communicate mathematically and approach mathematical situations with precision. 7c. Look for structures to interpret meaning and develop strategies. |
| **Materials and Resources** | [Functions Task](https://www.map.mathshell.org/tasks.php?unit=HA07&collection=9): ruler, graph paper (if needed) |
| **Task Description** | This task was designed to be completed after students have an understanding of quadratic functions and their graphs. This task, not including discussion, should take no more than 20 minutes.  1. Each student should receive a Functions Task hand-out (see above link). The task will have eight points on a graph. Students will find one linear function and one quadratic function that, between them, pass through exactly four points each (all the points will be used for one function or the other).  2. After completing the task individually, the students will pair/share with at least one person, then compare results in a small group, and lastly share out with the entire class.  3. Students will complete a reflection after the task and collaboration is finished. |
| **Equitable Access** | Students will use what they know about coordinate graphs to determine which points on a coordinate grid line up to make a linear function and a quadratic function. |
| **Mathematical Vocabulary** | coordinate pairs linear function parabola quadratic function vertex vertex form |
| **Student Reflection** | Explain the process you used to determine the linear function? Explain the process you used to determine the quadratic function? List at least one question or wonder you have about writing the linear function from its graph? List at least one question or wonder you have about writing the quadratic function from its graph? Create your own set of ordered pairs that represent a linear and a quadratic function. |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 5: Comparing, Factoring, and Completing the Square of Quadratic Functions.  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FIF.8a\* (Note: FA.FIF.8a is not a Graduation Standard.) a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. |
| **Mathematical Process Standards Addressed** | 2b. Describe a given situation using multiple mathematical representations. 2c. Translate among multiple mathematical representations and compare the meanings each representation conveys about the situation. 3a. Construct and justify a solution to a problem. 1. Make sense of problems and persevere in solving them. 4a. Interpret mathematical models in the context of the situation. 6. Communicate mathematically and approach mathematical situations with precision. |
| **Materials and Resources** | Task assignment  Graphing calculator  Graph paper (if needed) |
| **Task Description** | This task should take students approximately 45 minutes to complete. 1. Students will work independently to complete the task, then pair/share, small group share and then whole group discussion with students facilitating. 2. The teacher will facilitate the task while the students work to determine solutions for quadratic functions using factoring and completing the square. |
| **Equitable Access** | Students will use their knowledge about factoring quadratics and completing the square to compare the processes. After working independently, sharing in pairs and small groups should help to gain missing information or gaps.  Students may be asked to write the functions in standard form as well. |
| **Mathematical Vocabulary** | Factoring Completing the square Zeroes Extreme values Symmetry |
| **Student Reflection** | Reflection: 1. Compare and explain the processes of factoring versus completing the square. 2. How do you determine if a quadratic equation can be factored to solve? 3. Explain when completing the square might be more efficient than factoring when solving a quadratic equation. |

| **Unit 3 Task 5 Resource: Factoring Versus Completing the Square**  [Return to Table of Contents](#TableofContents) |
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| **Factoring versus Completing the Square**  Determine the **zeroes,** **extreme values** and **symmetry** for each quadratic function. (#1 and #2)   | 1. Factored  (x + 2) (x – 1) = 0 | Graph (sketch to show symmetry) | | --- | --- |  | 2. Complete the square  (vertex form)  (x – 2)2 – 16 = 0 | Graph (sketch to show symmetry) | | --- | --- |   Use the processes of factoring and completing the square for each. If not factorable, explain why.   1. A baseball is thrown straight up, from 2 m above the ground, with a velocity of 10 m/s. This situation is modeled by the function , where *t* is the time in seconds and *h(t)* is the height in meters.   Complete the below table by factoring, completing the square and graphing and then answer questions #4 and #5.   | Factor | Complete the square | Graph (sketch to show symmetry) | | --- | --- | --- |  1. Determine when the ball hits the ground. What key feature determines when the ball hits the ground? 2. What is the maximum height the ball reaches? What key feature determines the maximum height? 3. Are there any other key features that give information about the ball’s motion/path/position?   *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 6: Which quadratic equation will work?  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation. FA.FIF.1\* Extend previous knowledge of a function to apply to general behavior and features of a function. a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. b. Represent a function using function notation and explain that (𝑥) denotes the output of function 𝑓 that corresponds to the input 𝑥. c. Understand that the graph of a function labeled as 𝑓 is the set of all ordered pairs (𝑥,) that satisfy the equation 𝑦=(𝑥). FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.) |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 3a. Construct and justify a solution to a problem. 1. Make sense of problems and persevere in solving them. 4. Connect mathematical ideas and real-world situations through modeling. 6. Communicate mathematically and approach mathematical situations with precision. |
| **Materials and Resources** | Assignment Task  Graphing calculator (if needed)  Graph paper  Large sheet of paper |
| **Task Description** | This task was designed to be completed after students understand quadratic functions and their graphs. The task should take one class period.  Students can complete this task individually or in pairs.  Students will share ideas and discuss how to write quadratic equations. |
| **Equitable Access** | Students can work in pairs to support one another and collaborate. The teacher will facilitate and guide each pair. Students could be asked to post their results for a gallery walk. |
| **Mathematical Vocabulary** | Quadratic equation Domain Range Zeros Function Notation |
| **Student Reflection** | 1. Describe how you derived the quadratic equations you created. 2. Compare and contrast the quadratic equations. List similarities and differences. |

| **Unit 3 Task 6 Resource: Quadratic Functions in the Real World**  [Return to Table of Contents](#TableofContents) |
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| **Quadratic Functions in the Real World**  **Read the below scenario and complete a-h.**  You jump into a deep pool of water from a diving board that is 20 feet above the pool.  a). Create a function in function notation that might represent this scenario.  b). Choose five possible values for your time in seconds. Create a table of values that represents your height in feet. \*\*Label the input and output variables in the first column.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |   c). On the back, graph the function using appropriate labels, units, and scales.  d). Which quadrant(s) are valid to the scenario? Explain your answer.  e). Use your graph to identify two additional points on the graph. Algebraically verify your points satisfy the function.   | Solution:  Verify: | Solution:  Verify: | | --- | --- |   f). Identify the function’s domain and range in terms of this real world example.   | Domain: | Range: | | --- | --- |   g). Suppose you decide to jump from a lower level (pool-side), how might the domain and range change.  h). Create your own real life scenario and write a function to represent the situation. Define your variables.  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 7: Size Optimization  [Return to Table of Contents](#TableofContents) |
| --- | --- |
| **State Standards Addressed** | FA.ACE.1\*: Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to linear; quadratic; exponential with integer exponents.) FA.AREI.1\*: Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original. |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2d. Connect the meaning of mathematical operations to the context of a given situation. 1. Make sense of problems and persevere in solving them. 3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others. 4. Connect mathematical ideas and real-world situations through modeling. 6. Communicate mathematically and approach mathematical situations with precision. |
| **Materials and Resources** | Assignment task problem or sheet |
| **Task Description** | This task is designed for students who understand solving quadratic equations and inequalities without a linear term. This task is designed as a bell-ringer or warm-up activity.  Students will write and solve an equation or inequality for the two questions provided.  Students should make connections between quadratic equations and quadratic inequalities. |
| **Equitable Access** | Students could work in pairs to support creating a quadratic equation or inequality from a given scenario. The students will work together writing and solving the quadratic equation or inequality to come up with the best possible solution(s). |
| **Mathematical Vocabulary** | Quadratic equation Quadratic inequality |
| **Student Reflection** | 1. What did you find most challenging when creating the equation or inequality for the scenario? 2. Explain how you knew the scenario represented an inequality and not an equation? 3. Create your own real-world scenario to model a quadratic equation. How would you reword the same scenario to change your model from a quadratic equation to a quadratic inequality? Explain how your solutions would differ for the inequality and equation. |

| **Unit 3 Task 7 Resource: Size Optimization**  [Return to Table of Contents](#TableofContents) |
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| **Size Optimization**  **Directions:** Write a quadratic equation or inequality in one variable to represent each of the statements below. Solve each equation or inequality and determine if your solution(s) are reasonable.  A company is designing dice to fit inside a game box. Each face of a die must have an area of 4 square inches. What is the side length of the die?  A shipping company is designing a square box. The minimum area of each side is 25 square inches. What are the possible side lengths of the box if the side lengths must be in increments of ½ inch?  Compare and contrast the algebraic models.  What do you notice?  What do you wonder?  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 3 | **Task Title:** Task 8: Solving for the squared variable  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.ACE.4\* Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines |
| **Mathematical Process Standards Addressed** | 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 6c. Use appropriate and precise mathematical language. 1. Make sense of problems and persevere in solving them. 3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others. |
| **Materials and Resources** | Task sheet or problems  Whiteboards (if available)  Dry erase markers (if available) |
| **Task Description** | This task is designed to be completed prior to students being introduced to solving equations with exponents (i.e. warm-up/bell ringer). Students will work independently to determine what they remember about equality properties and solving equations and formulas.  After the warm-up, students will collaborate in pairs to compare their strategies for solving the formulas for the indicated variables.  This task focuses on formulas with a squared variable. |
| **Equitable Access** | Students will use prior knowledge to solve a variety of equations using the properties of equality. |
| **Mathematical Vocabulary** | Literal equations formulas squared square root |
| **Student Reflection** | 1. Compare and contrast your method of solving the formulas with your peers’ strategies. 2. Explain at least one additional method for solving each formula other than the method you used. |

| **Unit 3 Task 8 Resource: Solving for the Squared Variable**  [Return to Table of Contents](#TableofContents) |
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| **Below are literal equations and formulas that arise in a variety of disciplines. Solve each literal equation or formula for the specified variable.**  1. Surface Area of a cube 2. Volume of a cylinder, for r  , for *s*  , for *r*  3. Mass-Energy Equivalence 4. Volume of a square pyramid  , for c , for *s*  *Reflection*  1. What prior knowledge helped you solve each equation? List specific examples from the problems above.  2. Explain, in terms of real world applications, why it is important to know how to solve a formula for an unknown variable.  *(SCDE, 2019)* |

| **Unit 4 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.FLQE.1\* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval.   + Identify situations that display equal ratios of change over equal intervals and can be modeled with exponential functions.   + Distinguish between situations modeled with linear functions and with exponential functions when presented with a real-world problem. * FA.FLQE.1a Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. *(Note: FA.FLQE.1a is not a Graduation Standard.)*    + Prior knowledge of linear functions should be utilized to activate learning of exponential functions, however the focus of this unit should be on exponential relationships that grow by multiples. * FA.ACE.1\* Create and solve equations ~~and inequalities~~ in one variable that model real-world problems involving linear, quadratic, ~~simple rational,~~ and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to ~~linear; quadratic;~~ exponential with integer exponents.)   + Identify the variables and quantities represented in a real-world problem.   + Decide which model best represents a real-world problem (linear model, quadratic or exponential model).   + Write the equation that best models the problem.   + Solve the equation.   + Interpret the solution in the context of the problem. * FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)   + Identify the variable and quantities represented in a real-world problem.   + Decide which model best represents a real-world problem (linear model, quadratic, or exponential model).   + Write the equation that best models the problem.   + Establish coordinate axes using appropriate scale and label the axes.   + Graph equations on coordinate axes with appropriate labels and scales. * FA.FBF.3\* Describe the effect of the transformations,,, and combinations of such transformations on the graph of for any real number . Find the value of given the graphs and write the equation of a transformed parent function given its graph. (Limit to ~~linear; quadratic;~~ exponential with integer exponents; vertical shift and vertical stretch.)   + Explain why translates the original graph of up units and why translates the original graph of down units.   + Explain why translates the original graph of left units and why translates the original graph of right units.   + Describe the transformation that changed a graph of into a different graph when given pictures of the pre-image and the image.   + Determine the value of given a graph of a transformed function.   + Graph the listed transformations when given a graph of and a value of   + Generate and compare examples of functions with different values. * FA.FIF.1 Extend previous knowledge of a function to apply to general behavior and features of a function. * FA.FIF.1a Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.   + Define a function as a relation in which each input (domain) has exactly one output (range).   + Determine if a graph, table, or set of ordered pairs represents a function.   + Determine if stated rules (both numeric and nonnumeric) produce ordered pairs that represent a function. * FA.FIF.1b Represent a function using function notation and explain that denotes the output of function *f* that corresponds to the input .   + Recognize that when *x* is an element of the input of a function, represents the corresponding output of the function. * FA.FIF.1c Understand that the graph of a function labeled as *f* is the set of all ordered pairs (*x, y*) that satisfy the equation .   + Explain that the graph of *f* is the graph of the equatio*n*. * FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.   + Decode function notation and explain how the output of a function is matched to its input. (e.g., The function  multiplies 2 input number of times and adds five to produce the output).   + Use order of operations to evaluate a function for a given domain (input) value.   + Analyze the input and output values of a function based on the context of a problem.   + Identify the real numbers that are not in the domain of a function.   + Recognize that the domain might change depending upon the context of problem. * FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)   + Create a graph that matches the description and shows all of the key features of the function, if applicable, the y-intercept, x-intercept(s), increasing interval, decreasing interval, relative minimum, relative maximum, and symmetry.   + Explain the meaning of all the key features included in a graph or verbal description. * FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.)   + Analyze the input and output values of a function in algebraic, graphic, tabular, and verbal forms. * FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; ~~relative maximums and minimums; symmetries~~; and end behavior ~~and periodicity~~. Graph simple cases by hand and use technology for complicated cases. (Limit to ~~linear; quadratic~~; exponential only in the form .)   + Explain that the parent function for exponentials iswhere *b* is a positive number.   + Determine the domain, range, and end behavior (horizontal asymptote) of an exponential function when viewing its graph.   + Classify exponential functions in function notations as growth or decay.   + Substitute convenient values for *x* to generate a table and graph of an exponential function. * FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to ~~linear; quadratic~~; exponential.)   + Distinguish between exponential functions that model exponential growth and exponential decay.   + Interpret the components of an exponential function in the context of a problem ( describes a quantity that was initially 5 and increases 22.5% every three years). |

| **Unit 4 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Common ratio * Compound interest * Constant percent rate * End-behavior * Exponential decay * Exponential function * Exponential growth * Half-life * Horizontal asymptote * Labels * Percent rate of change * Principal * Properties of exponents * Scale |

| **Unit 4 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| In earlier grades, students developed conceptual knowledge and had the opportunity to learn how to:   * Represent any point on the coordinate plane by its coordinates (5.G.1b). * Write and evaluate numerical expressions involving whole-number exponents and positive rational number bases using the Order of Operations (6.EEI.1). * Extend previous understanding of Order of Operations to solve multi-step real-world and mathematical problems involving rational numbers (7.EEI.3). * Understand and apply the laws of exponents (i.e. product rule, quotient rule, power to a power, product to a power, quotient to a power, zero power property, negative exponents) to simplify numerical expressions that include integer exponents (8.EEI.1). * Extend concepts of linear equations and inequalities in one variable to more complex multi-step equations and inequalities in real-world and mathematical situations (8.EEI.7). * Solve linear equations and inequalities with rational number coefficients that include the use of the distributive property, combining like terms, and variables on both sides (8.EEI.7a). * Understand that a function assigns to each input exactly one output (8.F.1a). * Relate inputs (𝑥-values or domain) and outputs (𝑦-values or range) to independent and dependent variables (8.F.1b). * Translate among the multiple representations of a function, including mappings, tables, graphs, equations, and verbal descriptions (8.F.1c). * Determine if a relation is a function using multiple representations, including mappings, tables, graphs, equations, and verbal descriptions (8.F.1d). * Graph a function from a table of values. Understand that the graph and table both represent a set of ordered pairs of that function (8.F.1e). * Investigate the differences between linear and nonlinear functions using multiple representations (i.e. tables, graphs, equations, and verbal descriptions) (8.F.3). * Recognize that the graph of a linear function has a constant rate of change (8.F.3b). * Understand that the slope is the constant rate of change and the 𝑦-intercept is the point where 𝑥 = 0 (8.F.4a). * Construct a function in slope-intercept form that models a linear relationship between two quantities (8.F.4c). * Analyze and describe attributes of graphs of functions (e.g., constant, increasing/decreasing, linear/nonlinear, maximum/minimum, discrete/continuous) (8.F.5a). * Sketch the graph of a function from a verbal description (8.F.5b). * Write a verbal description from the graph of a function with and without scales (8.F.5c). * Measuring commonly used objects and choosing proper units for measurement are part of the mathematics curriculum prior to high school. In high school, students experience a broader variety of units through real–world situations and modeling, along with the exploration of the different levels of accuracy and precision of the answers. Note: Students may not realize the importance of unit conversion in conjunction with computation when solving problems involving measurement. Since today’s calculating devices often display 8 to 10 decimal places, students frequently express answers to a much greater degree of precision than is required.   Earlier in Foundations in Algebra, students developed conceptual knowledge and had the opportunity to learn how to:   * Create and solve equations in one variable that model real-world problems involving linear (Unit 1) and quadratic (Unit 3), students will now extend their knowledge of equations to exponential situations (FA.ACE.1\*). * Create equations in two or more variables to represent linear (Unit 1 and Unit 2) and quadratic (Unit 3) relationships between quantities. As well as, graph the equations on coordinate axes using appropriate labels, units, and scales (FA.ACE.2\*). * Describe the effect of the transformations of a quadratic/parabolic parent graph (Unit 3) and write the equation of a transformed quadratic/parabolic parent function given its graph (FA.FBF.3\*). * Extend previous knowledge of a linear (Unit 2) and quadratic (Unit 3) function to apply to general behavior and features of a function (FA.FIF.1). * Evaluate linear (Unit 2) and quadratic (Unit 3) functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation (FA.FIF.2\*). * Interpret key features of a function that models the linear (Unit 2) and quadratic (Unit 3) relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features (FA.FIF.4\*). * Relate the domain and range of a linear (Unit 2) and quadratic (Unit 3) function to its graph and to the quantitative relationship it describes (FA.FIF.5\*). * Graph functions from their linear (Unit 2) and quadratic (Unit 3) symbolic representations. Indicate key features (FA.FIF.7\*). * Translate between different but equivalent forms of a linear (Unit 2) and quadratic (Unit 3) function equation to reveal and explain different properties of the function. (FA.FIF.8\*). |

| **Unit 4 Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
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| * Foundations Unit 4 compares and contrasts linear and exponential relationships (FA.FLQE.1\*).   + Will be readdressed in greater depth to include quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FLQE.1\*). * Foundations Unit 4 explores data in different representations while encouraging students to draw conclusions and to interpret and determine the reasonableness of solutions for linear, quadratic, and exponential functions (FA.ACE.1\*).   + Will be extended into Systems of Equations/Inequalities in Intermediate Algebra Unit 2 (IA.ACE.1\*). * Foundations Unit 4 applies related knowledge of linear and quadratic equations and the laws of exponents to construct and solve simple exponential equations; as well as (FA.ACE.2\*).   + Will be extended into Systems of Equations/Inequalities in Intermediate Algebra Unit 2 (IA.ACE.2\*). * Foundations Unit 4 provides opportunities to use technology appropriately to explore and experiment with variations of a function, specifically exponential models (e.g. the effect of replacing by , , , and for specific values of (both positive and negative), to determine the effects on the graph (FA.FBF.3\*).   + Will be readdressed in Comparing and Contrasting Functions Unit 5 (FA.FBF.3\*) and several more times in Intermediate (IA.FBF.3\*) as students deepen their understanding of parent functions. * Foundations Unit 4 extends previous knowledge of functions and function notation (FA.FIF.1\*).   + Will be readdressed in greater depth to include linear and quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FIF.1\*). * Foundations Unit 4 employs function notation to solve real-world exponential situations (FA.FIF.2\*).   + Will be readdressed in greater depth to include linear and quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FIF.2\*). * Foundations Unit 4 deepens conceptual understanding of key features of functions including intercepts; asymptotes; intervals where functions are increasing, decreasing, constant, positive, or negative; and end behavior (FA.FIF.4\*).   + Will be readdressed in greater depth to include linear and quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FIF.4\*). * Foundations Unit 4 expands foundational knowledge for identifying the relationship between variables (domain and range) through contextual conditions as well as algebraic, tabular, or graphic representations of variables (FA.FIF.5\*).   + Will be readdressed in greater depth to include linear and quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FIF.5\*). * Foundations Unit 4 extends and deepens understanding of functions so that they can recognize and explain how behaves at different domain intervals (e. g. x approaches 0, , , approaches positive or negative infinity, growth or decay by a constant percent rate) for any function (FA.FIF.7\*).   + Will be readdressed in greater depth to include linear and quadratic relationships in Comparing and Contrasting Functions Unit 5 (FA.FIF.7\*). * Foundations Unit 4 utilizes the multiple forms of function equations to determine and create explanations for properties of the function (FA.FIF.8\*).   + Will be extended into Radical and Rational Functions in Intermediate Algebra Unit 5 (IA.FIF.8\*). |

| **Unit 4 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
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| The standards in Unit 4 expand prior knowledge of integer exponents and focus on exponential functions, equations, and their applications. Applying knowledge of exponential functions and knowledge acquired in Units 2 (linear functions) and 3 (quadratic functions), students determine whether a function is exponential, linear, or quadratic.  Students use exponential function notation to model a variety of contexts and use context to interpret functions in specific applications. Students graph exponential functions, identify key features (intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; asymptotes; end behavior) and use appropriate technology to investigate multiplicative change in exponential functions and increase conceptual understanding. Analysis of graphs, verbal descriptions, and tables support students in creating symbolic representations of exponential functions to model a relationship between two quantities. Through manipulating k, students examine the effects on the graph of the parent function,, by replacing with , , , and for specific values of k (both positive and negative). As the unit progresses, students compare exponential models, solve exponential equations, interpret the solutions of exponential functions, and find the value of k when given exponential graphs. |

| **Unit 4 Resources**  [Return to Table of Contents](#TableofContents) |
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| **Activity Resources**   1. Algebra 1 Lessons WCCUSD: [Exponential Functions - Writing Exponential Functions Based on Data: An Introductory Lesson](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/ExponentialFunctionsIntro201516v1.pdf) 2. Dan Meyer: [Domino Skyscraper](http://mrmeyer.com/threeacts/dominoskyscraper/) 3. Dan Meyer: [Incredible Shrinking Dollar](http://mrmeyer.com/threeacts/shrinkingdollar/) 4. Gizmos: [Drug Doses](https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&resourceID=525) 5. Gizmos: [Dye Elimination](https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=516) 6. NCTM Illuminations (NCTM Membership required): [One Grain of Rice](http://illuminations.nctm.org/Lesson.aspx?id=2497) 7. Illustrative Mathematics: [Decaying Dice- Investigation](https://www.illustrativemathematics.org/content-standards/tasks/2130) 8. Illustrative Mathematics: [Last Person Standing - Investigation](https://www.illustrativemathematics.org/content-standards/tasks/2119) 9. Illustrative Mathematics: [The Bank Account](https://www.illustrativemathematics.org/content-standards/tasks/390) 10. Illustrative Mathematics: [Valuable Quarter - Investigation](https://www.illustrativemathematics.org/content-standards/tasks/1421) 11. Khan Academy: [Introduction to Exponential Functions](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/v/exponential-growth-functions) 12. Khan Academy: [How to Model a Real-World Context with an Exponential Function](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/constructing-basic-exponential-models/v/modeling-ticket-fines-with-exponential-function) 13. LearnZillion: [Explore Exponential Growth by Folding Paper](https://learnzillion.com/lesson_plans/579) 14. LearnZillion: [Write an Exponential Decay Function](https://learnzillion.com/lesson_plans/7993#fndtn-lesson) 15. LearnZillion: [Write an Exponential Growth Function](https://learnzillion.com/lesson_plans/5773) 16. SAS Curriculum Pathways: [Applications of Exponential Functions](https://www.sascurriculumpathways.com/portal/Launch?id=5064) 17. SAS Curriculum Pathways: [Properties of Exponents](https://www.sascurriculumpathways.com/portal/Launch?id=5061) 18. Zona Land Education: [Exponential Functions](http://zonalandeducation.com/mmts/functionInstitute/exponentialFunctions/exponentialFunctions.html) 19. Illustrative Mathematics: [Boiling Water - Investigation](https://www.illustrativemathematics.org/content-standards/tasks/1592) 20. Illustrative Mathematics: [Finding Linear and Exponential Models](https://www.illustrativemathematics.org/content-standards/tasks/1910) 21. Illustrative Mathematics: [Do Two Points Always Determine an Exponential Function?](https://www.illustrativemathematics.org/content-standards/tasks/567) 22. Khan Academy: [How to Construct Linear and Basic Exponential Functions From a Table of Values](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/v/constructing-linear-and-exponential-functions-from-data) 23. Khan Academy: [How to Construct Linear and Exponential Functions From Their Graphs](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/v/constructing-linear-and-exponential-functions-from-graph) 24. Khan Academy: [How to Distinguish Between Linear and Exponential Models](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/comparing-exponential-and-polynomial-functions/v/linear-exponential-models) 25. LearnZillion: [Determining if a Relationship Between Two quantities is Exponential](https://learnzillion.com/lesson_plans/6241) 26. LearnZillion: [Distinguish between Linear and Exponential Functions by Examining Intervals](https://learnzillion.com/lesson_plans/4995) 27. Mathematics Assessment Project: [Representing Linear and Exponential Growth](http://map.mathshell.org/download.php?fileid=1732) 28. Illustrative Mathematics: [Carbon 14 Dating](https://www.illustrativemathematics.org/content-standards/tasks/758) 29. LearnZillion: [Create and Solve Exponentials using Functions](https://learnzillion.com/lesson_plans/7404) 30. LearnZillion: [Determine Population using an Exponential Model](https://learnzillion.com/lesson_plans/6763) 31. Zona Land Education: [Compound Interest](http://zonalandeducation.com/mmts/functionInstitute/exponentialFunctions/compoundInterest.html) 32. Algebra 1 Lessons WCCUSD: [Solving Exponential Equations](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/SolveExponentialEquationsv1.pdf) 33. NCTM Illuminations (NCTM Membership required): [Predicting Your Financial Future](http://illuminations.nctm.org/Lesson.aspx?id=2765) 34. LearnZillion: [Create and Solve Exponentials using a Table of Values](https://learnzillion.com/lesson_plans/7413) 35. LearnZillion: [Solve Exponential Equations using Properties of Exponents](https://learnzillion.com/lesson_plans/4811) 36. Monterey Institute: [Introduction to Exponential Functions (Text)](http://www.montereyinstitute.org/courses/DevelopmentalMath/COURSE_TEXT2_RESOURCE/U18_L1_T1_text_container.html) 37. Monterey Institute (Requires Adobe Flash Player): [Introduction to Exponential Functions (Video & Lesson)](http://www.montereyinstitute.org/courses/DevelopmentalMath/U18L1T1_RESOURCE/index.html) 38. Khan Academy: [Solving Basic Exponential Models](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/solving-basic-exponential-models) 39. Algebra 1 Lessons WCCUSD: [Graphing Exponential Functions](http://www.wccusd.net/Page/3224) 40. Gizmos: [Introduction to Exponential Functions](https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=135) 41. Illustrative Mathematics: [Identifying Exponential Graphs - Investigation](https://www.illustrativemathematics.org/content-standards/tasks/2115) 42. LearnZillion: [Construct an Exponential Model to Approximate Data by Using Technology](https://learnzillion.com/lesson_plans/108) 43. LearnZillion: [Shift Exponential and Logarithmic Functions](https://learnzillion.com/lesson_plans/6116#fndtn-lesson) (Great Visual - Stop Lesson Prior to Logarithms) 44. LearnZillion: [Determine the End Behavior of an Exponential](https://learnzillion.com/lesson_plans/8577) 45. LearnZillion: [Model Exponential Growth - Drawing Graphs and Writing Equations](https://learnzillion.com/lesson_plans/8194) 46. Zona Land Education: [Transform](http://zonalandeducation.com/mmts/functionInstitute/exponentialFunctions/transform2ToTheX/transform2ToTheX.html) 47. Gizmos: [Exponential Growth and Decay](https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=105) 48. Khan Academy: [How to Graph an Exponential Function Given its Formula](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/graphs-of-basic-exponential-functions/v/graphing-exponential-functions) 49. LearnZillion: [Create and Graph Exponentials Using Functions](https://learnzillion.com/lesson_plans/6955) 50. LearnZillion: [Graph an Exponential Function](https://learnzillion.com/lesson_plans/6535#fndtn-description) 51. LearnZillion: [Graph Exponential Decay Functions](https://learnzillion.com/lesson_plans/5925) 52. LearnZillion: [Graph Exponential Growth Functions](https://learnzillion.com/lesson_plans/7119) 53. LearnZillion: [Understanding Exponential Functions by Graphing](https://learnzillion.com/lesson_plans/941) 54. SAS Curriculum Pathways: [Graphing Exponential Functions](https://www.sascurriculumpathways.com/portal/Launch?id=5063) 55. Khan Academy: [Construct Basic Exponential Functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-functions-from-tables-graphs/v/writing-exponential-functions) 56. Khan Academy: [Construct Exponential Functions Given the Graph](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/e/construct-basic-exponential-functions-from-table-or-graph) 57. Khan Academy: [Distinguish Between Linear and Exponential Models](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/comparing-exponential-and-polynomial-functions/e/understanding-linear-and-exponential-models) 58. Illustrative Mathematics: [Allergy Medication- Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/2125) 59. Illustrative Mathematics: [Boom Town - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/2126) 60. Illustrative Mathematics: [Exponential Parameters - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/2116) 61. Illustrative Mathematics: [Exponential Growth Versus Linear Growth](https://www.illustrativemathematics.org/content-standards/tasks/366) 62. Illustrative Mathematics: [Linear or Exponential?](https://www.illustrativemathematics.org/content-standards/tasks/629) 63. Illustrative Mathematics: [Solving Problems with Linear and Exponential Models - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/1911) 64. Mathematics Assessment Project: [Linear and Exponential Models](http://map.mathshell.org/tasks.php?unit=HN08&collection=9) 65. Mathematics Assessment Project: [Multiplying Cells](http://www.map.mathshell.org/tasks.php?collection=9&unit=HA20) 66. SAS Curriculum Pathways: [Applications of Exponential Functions (Practice Tab)](https://www.sascurriculumpathways.com/portal/Launch?id=5064) 67. SAS Curriculum Pathways: [Properties of Exponents (Practice Tab)](https://www.sascurriculumpathways.com/portal/Launch?id=5061) 68. Monterey Institute (Requires Adobe Flash Player): [Introduction to Exponential Functions (Practice & Review Tabs)](http://www.montereyinstitute.org/courses/DevelopmentalMath/U18L1T1_RESOURCE/index.html) 69. Illustrative Mathematics: [DDT-cay- Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/2128) 70. Illustrative Mathematics: [Predicting the Past - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/2127) 71. Illustrative Mathematics: [Uranium 238 - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/1909) 72. Illustrative Mathematics: [Exponential Functions](https://www.illustrativemathematics.org/content-standards/tasks/351) 73. Khan Academy: [Graphs of Basic Exponential Functions](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/graphs-of-basic-exponential-functions/e/graphs-of-basic-exponential-functions) 74. Quia: [Exponential Graphs](http://www.quia.com/pa/32878.html?AP_rand=296736147) 75. SAS Curriculum Pathways: [Graphing Exponential Functions (Practice Tab)](https://www.sascurriculumpathways.com/portal/Launch?id=5063) 76. Quia: [Exponential Decay Functions Quiz](http://www.quia.com/quiz/4000842.html?AP_rand=1384353979) 77. Quia: [Exponential Growth Functions Quiz](http://www.quia.com/quiz/4000841.html?AP_rand=199367152) |
| **Application Resources (Downloadable Lessons, Video, Applets, and Online Algebra Notes)**   1. Gizmos: [Resource Catalog](https://www.explorelearning.com/index.cfm?method=cResource.dspResourceCatalog#grades) 2. GoalBook: [Tool Kit](https://goalbookapp.com/toolkit-info/) 3. NCTM Illuminations (NCTM Membership required): [Resources For Teaching Math](http://illuminations.nctm.org) 4. Illustrative Mathematics: [High School Content Lesson Index](https://www.illustrativemathematics.org/content-standards/HS) 5. Khan Academy: [Algebra 1 - Introduction to Exponential Functions](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions) 6. LearnZillion: [Algebra Math Video Lessons](https://learnzillion.com/resources/75023-algebra-math-video-lessons) 7. Mathematics Assessment Resource Service: [Classroom Challenges (Formative Assessment Lessons)](http://map.mathshell.org/background.php) 8. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Guide for Teachers and Administrators](http://map.mathshell.org/guides/map_cc_teacher_guide.pdf) 9. PBS Learning Media: [Mathline](http://www.pbslearningmedia.org/search/?q=&selected_facets=supplemental_curriculum_hierarchy_nodes%3A1184&selected_facets=) 10. Quia: [Mathematics Shared Activities](http://www.quia.com/shared/mathematics/) 11. SAS Curriculum Pathways: [SAS Algebra 1 Course](https://www.sascurriculumpathways.com/portal/mobile/algebra1/start.html) – Unit 4 12. West Contra Costa Unified School District: [Algebra 1 Lessons](http://www.wccusd.net/Page/3224) 13. Zona Land Education: [Index of Zona Land Education Topics](http://zonalandeducation.com/theIndex/theIndex.html) |
| **Dictionaries, Calculators, and Templates**   * + - 1. Alcula: [Online Linear Regression Calculator](http://www.alcula.com/calculators/statistics/linear-regression/)       2. Zona Land Education: [Compound Interest Calculator](http://zonalandeducation.com/mmts/functionInstitute/exponentialFunctions/compoundInterest.html#calculator) |

| **Course/Grade:** Foundations of Algebra.  **Unit:** Unit 4 | **Task Title:** Task 1: Intro to Exponential Graphs  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FLQE.1\* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval.  a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.  FA.ACE.1\* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to linear; quadratic; exponential with integer exponents.)  FA.ACE.2\* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.) |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  a. Relate a problem to prior knowledge.  2. Reason both contextually and abstractly. a. Make sense of quantities and their relationships in mathematical and real-world situations.  3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.  c. Make conjectures and explore their validity.  d. Reflect on and provide thoughtful responses to the reasoning of others.  4. Connect mathematical ideas and real-world situations through modeling.  a. Identify relevant quantities and develop a model to describe their relationships.  b. Interpret mathematical models in the context of the situation.  6. Communicate mathematically and approach mathematical situations with precision.  b. Represent numbers in an appropriate form according to the context of the situation. |
| **Materials and Resources** | [Polygraph: Exponentials](https://teacher.desmos.com/polygraph/custom/56c3947ce3a0912c0a942de0)  [Match my Exponential](https://teacher.desmos.com/activitybuilder/custom/5aaad32fb74c9051fb578bd9)  [Avi and Benita's Repair Shop](https://teacher.desmos.com/activitybuilder/custom/56c7457e11c7724106e683b1) |
| **Task Description** | There are several activities included in the materials and resources that may take several days if done in entirety. Included are introduction, practice, and application.   1. Hook students by completing the Polygraph: Exponentials activity to spark mathematical rich vocabulary conversation. This activity serves an introduction to graphing exponential functions. 2. Follow up with a lesson on graphing basic exponential functions and comparing them to linear functions. 3. Students will practice using the Match my Exponential Activity. 4. Expand their learning through application with the Exponential activity titled Avi and Benita’s Repair Shop. 5. Students will complete a journal reflection on what they have learned about graphing exponential functions. They will also compare and contrast linear and exponential functions. |
| **Equitable Access** | There are multiple entry points to this activity depending on the ability of the students. All activities are not required and students will benefit whether they complete one or all of the activities. Match my Exponential has been strategically placed between the other two activities as a scaffold. |
| **Mathematical Vocabulary** | Increasing  Decreasing  Rate  Asymptote  Curve  Y-intercept |
| **Student Reflection** | Students will complete a journal reflection on what they have learned about graphing exponential functions. They will also compare and contrast linear and exponential functions.   1. Describe the shape of an exponential graph. Use the terms increasing and/or decreasing within your description and explain any numerical values that will never exist on the graph. 2. Which function, linear or exponential, grows faster over time? Explain your reasoning. 3. Create a linear and exponential function. Include a graph for each and a table of values. Compare and contrast your graphs. |

| **Course/Grade:** Foundations of Algebra  **Unit:** Unit 4 | **Task Title:** Task 2: Analyzing Exponential Functions  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FBF.3\* Describe the effect of the transformations, and combinations of such transformations on the graph of for any real number . Find the value of given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)  FA.FIF.1 Extend previous knowledge of a function to apply to general behavior and features of a function.  a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.  b. Represent a function using function notation and explain that denotes the output of function that corresponds to the input .  c. Understand that the graph of a function labelled as is the set of all ordered pairs that satisfy the equation .  FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation  FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)  FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.)  FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form.)  FA.FIF.8\* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem.  2. Reason both contextually and abstractly.  a. Make sense of quantities and their relationships in mathematical and real-world situations.  b. Describe a given situation using multiple mathematical representations  4. Connect mathematical ideas and real-world situations through modelling.  a. Identify relevant quantities and develop a model to describe their relationships.  6. Communicate mathematically and approach mathematical situations with precision.  c. Use appropriate and precise mathematical language.  d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | [Exponential Bingo](https://drive.google.com/file/d/1sB4lijIucHC8W46oo1U24Zt_bjleg_Qj/view?usp=sharing) |
| **Task Description** | * Students will complete the Exponential Bingo Activity. * There are multiple ways that this activity can be used (group, pairs, individual) and completed (as an assessment, as an instructional tool, as a project, as a review, etc...) * Only vertical or horizontal bingos are allowed. |
| **Equitable Access** | Multiple options for student choice on Exponential Bingo |
| **Mathematical Vocabulary** | Stretch, Compress, Transformations, Vertical and Horizontal Shift, X-intercept, Y-intercept, Decrease, Increase, Domain, Range, Growth, Decay, Compound Interest, Exponential Model |
| **Student Reflection** | Create an Exponential Bingo Row of your own and trade it with a partner to complete. |

| **Unit 4 Task 2 Resource: Exponential Bingo**  [Return to Table of Contents](#TableofContents) |
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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | **M** | **A** | **T** | **H** | **O** | | **B** | Create a foldable using the appropriate vocabulary describing all possible transformations on the parent function.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><msup><mn>2</mn><mi>x</mi></msup></math>  Include the following transformations:  Reflection  Vertical Stretch  Vertical Compression  Vertical Translation Up  Vertical Translation Down  Horizontal Translation Left  Horizontal Translation Right | Find the total value of the investment after 3 years.  $1,500 at 7% compounded quarterly for 3 years. | |  |  | | --- | --- | | -1 | 2/3 | | 0 | 2 | | 1 | 6 | | 2 | 18 | | 3 | 54 |  * Use the table of values to write an exponential model * State the domain and range * State the x- and y-intercepts * State the intervals of increasing and decreasing | equationGraph the function, describe its transformations, and find the x- and y-intercepts. | A population of 800 beetles is growing each month at a rate of 5%. Write an equation that expresses the number of beetles at time x. Find the approximate population of beetles in 8 months. | | **I** | picture   * Use the graph to write an exponential model * State the domain and range * State the x- and y-intercepts * Find the intervals of increase and decrease | Create an animation or video using appropriate vocabulary describing all possible transformations on the parent function.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><msup><mn>3</mn><mi>x</mi></msup></math>  Include the following transformations:  Reflection  Vertical Stretch  Vertical Compression  Vertical Translation Up  Vertical Translation Down  Horizontal Translation Left  Horizontal Translation Right | Find the total value of an investment after 2 years if you initially deposit $130 at 9.4% interest compounded monthly. | A computer’s value declines by 7% each year. Sally bought a computer for $800 in 2005. Write an equation and determine the value of the computer in 2009. | Graph the function and describe the transformations. State the x- and y-intercepts.  equation | | **N** | Graph the function and describe the transformations. State the x- and y-intercepts.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><mn>3</mn><mo>&#xB7;</mo><msup><mn>2</mn><mi>x</mi></msup><mo>-</mo><mn>4</mn></math> | A $10,000 car depreciates 10% per year. Find the value of the car after 8 years. | Write an exponential function that contains at least 3 transformations. State the parent function and explain each of the transformations. Graph both the parent function and the transformed function. | Find the total value of an investment after 3 years with an initial deposit of $1,500 and a monthly compounded interest of 7%. | graph   * Use the graph to write an exponential model * State the domain and range * State the x- and y-intercepts * Find the intervals of increase and decrease | | **G** | Find the total value of an investment after 3 years with an initial deposit of $7,300 and semiannual compounded interest of 7%. | table   * Use the table of values to write an exponential model * State the domain and range * State the x- and y-intercepts * Find the intervals of increase and decrease | A town with a population of 3200 people, grows at a rate of 25% every year. Find the population of the city after 10 years. | Create a visual of your choice describing your knowledge of exponential transformations.  Be sure to include:  Reflections  Vertical Stretches  Vertical Compressions  Vertical Translations Up  Vertical Translations Down  Horizontal Translations Left  Horizontal Translations Right | Graph the function and describe the transformations. State the x- and y-intercepts.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><mo>-</mo><mn>1</mn><mo>&#xB7;</mo><msup><mfrac><mn>1</mn><mn>2</mn></mfrac><mrow><mi>x</mi><mo>-</mo><mn>3</mn></mrow></msup></math> | | **O** | A city with a population of 100,000 has a pollution problem. The population is decreasing in size 2% annually (every year). Find the population of the city after 100 years. | Find the total value of an investment after 4 years with an initial deposit of $21,000 and a quarterly compounded interest of 13.6%. | Graph the function and describe the transformations. State the x- and y-intercepts.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><msup><mn>3</mn><mrow><mi>x</mi><mo>+</mo><mn>1</mn></mrow></msup><mo>-</mo><mn>4</mn></math> | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | x | -2 | -1 | 0 | 1 | 2 | | y | 1/8 | 1/2 | 2 | 8 | 32 |  * Use the table to write an exponential model * State the domain and range * State the x- and y-intercepts * Find the intervals of increase and decrease | Write a song and perform it for the class using appropriate vocabulary describing all possible transformations on the parent function.  <math xmlns="http://www.w3.org/1998/Math/MathML"><mi>f</mi><mfenced><mi>x</mi></mfenced><mo>=</mo><msup><mn>4</mn><mi>x</mi></msup></math>  Be sure to include:  Reflections  Vertical Stretches  Vertical Compressions  Vertical Translations Up  Vertical Translations Down  Horizontal Translations Left  Horizontal Translations Right | |

| **Unit 5 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.FLQE.1\* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval.   + Define linear function and exponential function * FA.FLQE.1a Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. *(Note: FA.FLQE.1a is not a Graduation Standard.)*   + Demonstrate that a linear function has a constant rate of change (slope).   + Demonstrate that an exponential function has a constant multiplier (common ratio) over equal intervals. * FA.FLQE.3\* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or more generally as a polynomial function.   + Use graphs or tables to compare the output values of linear, quadratic, and exponential functions.   + Estimate the intervals for which the output of one function is greater than the output of another function when given a table or graph.   + Use technology to find the point at which the graphs of two functions intersect.   + Use the points of intersection to precisely describe the intervals for which the output of one function is greater than the output of another function.   + Use graphs or tables to compare the rates of change of linear, quadratic, and exponential functions.   + Explain why exponential functions eventually have greater output values than linear and quadratic functions by comparing simple functions of each type. * FA.FLQE.5\* Interpret the parameters in a linear ~~or exponential~~ function in terms of the context. (Limit to linear.)   + Identify the names and definitions of parameters and in the linear function .   + Explain the meaning (using appropriate units) of the slope of a line when the line models a real-world relationship.   + Explain the meaning (using appropriate units) of the y-intercept of a line when the line models a real-world relationship. * FA.FBF.3\* Describe the effect of the transformations , , ~~,~~ and combinations of such transformations on the graph of for any real number . Find the value of given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.) * Explain why translates the original graph of up units and why translates the original graph of down units. * Describe the transformation that changed a graph of into a different graph when given pictures of the pre-image and the image. * Determine the value of given a graph of a transformed function. * Graph the listed transformations when given a graph of and a value of * Generate and compare examples of functions with different values. * FA.FIF.1\* Extend previous knowledge of a function to apply to general behavior and features of a function. * FA.FIF.1a Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. * Define a function as a relation in which each input (domain) has exactly one output (range). * Determine if a graph, table, or set of ordered pairs represents a function. * Determine if stated rules (both numeric and nonnumeric) produce ordered pairs that represent a function. * FA.FIF.1b Represent a function using function notation and explain that denotes the output of function that corresponds to the input . * Recognize that when is an element of the input of a function, represents the corresponding output of the function. * FA.FIF.1c Understand that the graph of a function labeled as is the set of all ordered pairs that satisfy the equation . * Explain that the graph of *f* is the graph of the equation . * FA.FIF.2\* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation. * Use order of operations to evaluate a function for a given domain (input) value. * Analyze the input and output values of a function based on the context of a problem. * Identify the real numbers that are not in the domain of a function. * Recognize that the domain might change depending upon the context of problem. * FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior ~~and periodicity~~. (Limit to linear; quadratic; exponential.) * Create a graph that matches the description and shows all of the key features of the function, if applicable, the y-intercept, x-intercept(s), increasing interval, decreasing interval, relative minimum, relative maximum, and symmetry. * Explain the meaning of all the key features included in a graph or verbal description. * FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.) * Analyze the input and output values of a function in algebraic, graphic, tabular, and verbal forms. * FA.FIF.7\* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior ~~and periodicity~~. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form .) * Explain that the parent function for exponentials is where is a positive number. * Determine the domain, range, and end behavior (horizontal asymptote) of an exponential function when examining the graph. * Classify exponential functions in function notation as growth or decay. * Substitute convenient values for to create a table and graph of an exponential function. * FA.FIF.9\* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; exponential.) * Provide insight into the properties of linear, quadratic, and exponential functions by comparing different representations of two functions. |

| **Unit 5 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Parameter * Parent Function * Transformation * Vertical Shift/Translation |

| **Unit 5 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| In earlier grades, students have developed conceptual knowledge and have had the opportunity to learn how to:   * Understand and apply the laws of exponents (i.e. product rule, quotient rule, power to a power, product to a power, quotient to a power, zero power property, negative exponents) to simplify numerical expressions that include integer exponents (8.EEI.1). * Extend concepts of linear equations and inequalities in one variable to more complex multi-step equations and inequalities in real-world and mathematical situations (8.EEI.7). * Solve linear equations and inequalities with rational number coefficients that include the use of the distributive property, combining like terms, and variables on both sides (8.EEI.7a). * Understand that a function assigns to each input exactly one output (8.F.1a). * Relate inputs (𝑥-values or domain) and outputs (𝑦-values or range) to independent and dependent variables (8.F.1b). * Translate among the multiple representations of a function, including mappings, tables, graphs, equations, and verbal descriptions (8.F.1c). * Determine if a relation is a function using multiple representations, including mappings, tables, graphs, equations, and verbal descriptions (8.F.1d). * Graph a function from a table of values. Understand that the graph and table both represent a set of ordered pairs of that function (8.F.1e). * Investigate the differences between linear and nonlinear functions using multiple representations (i.e. tables, graphs, equations, and verbal descriptions) (8.F.3). * Recognize that the graph of a linear function has a constant rate of change (8.F.3b). * Understand that the slope is the constant rate of change and the 𝑦-intercept is the point where 𝑥 = 0 (8.F.4a). * Construct a function in slope-intercept form that models a linear relationship between two quantities (8.F.4c). * Analyze and describe attributes of graphs of functions (e.g., constant, increasing/decreasing, linear/nonlinear, maximum/minimum, discrete/continuous) (8.F.5a). * Sketch the graph of a function from a verbal description (8.F.5b). * Write a verbal description from the graph of a function with and without scales (8.F.5c). * Measuring commonly used objects and choosing proper units for measurement are part of the mathematics curriculum prior to high school.   Furthermore, earlier during Foundations in Algebra, students developed conceptual knowledge and had the opportunity to learn how to:   * Distinguish between situations that can be modeled with linear functions or exponential functions (Unit 4) (FA.FLQE.1\*). * Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals (Unit 4) (FA.FLQE.1a). * Interpret the meanings of coefficients of linear relationships (Unit 1) based on their real-world contexts (FA.ASE.1\*). * Describe the effect of the transformations of a quadratic (Unit 3)/exponential (Unit 4) parent graph and write the equation of a transformed quadratic/exponential parent function given its graph (FA.FBF.3\*). * Extend previous knowledge of a linear (Unit 2), quadratic (Unit 3), and exponential (Unit 4) function to apply to general behavior and features of a function (FA.FIF.1). * Evaluate linear (Unit 2), quadratic (Unit 3), and exponential (Unit 4) functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation (FA.FIF.2\*). * Interpret key features of a function that models the linear (Unit 2), quadratic (Unit 3), or exponential (Unit 4) relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features (FA.FIF.4\*). * Relate the domain and range of a linear (Unit 2), quadratic (Unit 3), or exponential (Unit 4) function to its graph and to the quantitative relationship it describes (FA.FIF.5\*). * Graph functions from their linear (Unit 2), quadratic (Unit 3), or exponential (Unit 4) symbolic representations. Indicate key features of the graphs (FA.FIF.7\*). * Compare properties of two linear (Unit 2) or quadratic (Unit 3) functions given in different representations (FA.FIF.9\*). |

| **Unit 5 Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
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| * Foundations Unit 5 compares and contrasts linear and exponential relationships (FA.FLQE.1\*).   + Will be needed in order to analyze scatterplots to apply a linear, quadratic or exponential model of best fit next unit (Unit 6) (FA.SPID.6\*). * Foundations Unit 5 creates opportunities for students to utilize tables and graphs to observe linear, quadratic, and exponential growth (FA.FLQE.3\*).   + Will be essential to the analysis of bivariate categorical data using two-way tables in the Describing Data Unit 6 (FA.SPID.5\*). * Foundations Unit 5 interprets the parameters of a linear function in terms of the context (FA.FLQE.5\*).   + Will be crucial when asked to interpret the meaning of the slope and intercept(s) in the context of a real-world problem during Unit 6 (FA.SPID.7\*).   + Will, also, be extended to understanding exponential parameters in Intermediate Algebra Unit 6 (IA.FLQE.5\*). * Foundations Unit 5 explores the appropriate use of technology to experiment with variations of linear, quadratic and exponential functions (e.g. the effect of replacing by , , and for specific values of (both positive and negative), to determine the effects on the graph (FA.FBF.3\*).   + Will be readdressed several more times in Intermediate Algebra (Units 1, 4, 5, and 6) as students continue to deepen their understanding of the nature of parent functions and extend into horizontal shifts (IA.FBF.3\*). * Foundations Unit 5 extends previous knowledge of functions and function notation (FA.FIF.1\*) and employs function notation to solve real-world linear, quadratic and exponential situations (FA.FIF.2\*).   + Will be utilized (almost exclusively) to express a function throughout the remainder of the student’s mathematics coursework. * Foundations Unit 5 connects conceptual understanding of key features of linear, quadratic and exponential functions including intercepts; asymptotes; extrema; intervals where functions are increasing, decreasing, constant, positive, or negative; and end behavior (FA.FIF.4\*).   + Will be readdressed in Intermediate Algebra Quadratics (Unit 4) and Exponential (Unit 6) (IA.FIF.4\*).   + Will be extended to radical/rational functions in Intermediate Algebra Unit 5 (IA.FIF.4\*). * Foundations Unit 5 expands foundational knowledge for identifying the relationship between variables (domain and range) through contextual conditions as well as algebraic, tabular, or graphic representations of variables (FA.FIF.5\*).   + Will be readdressed in Intermediate Algebra Quadratics (Unit 4) and Exponential (Unit 6) (IA.FIF.4\*).   + Will be extended to radical/rational functions in Intermediate Algebra Unit 5 (IA.FIF.4\*). * Foundations Unit 5 extends and deepens understanding of functions so that they can recognize and explain how behaves at different domain intervals for any function (FA.FIF.7\*).   + Will be extended to include piecewise/absolute value functions in Intermediate Algebra Unit 1 and radical/rational functions in Intermediate Algebra Unit 5 (IA.FIF.7\*). * Foundations Unit 5 asks students to compare properties of functions given in different representations (FA.FIF.9\*). * Will be investigated further during Intermediate Algebra Unit 1 for absolute value/piece-wise functions and again in Unit 4 for quadratic relationships (IA.FIF.9\*). |

| **Unit 5 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
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| Many of the standards taught in Unit 5 have previously been addressed during Foundations in Algebra Units 1, 2, 3, and 4. The purpose of revisiting these standards is to dig deeper into the similarities and differences of linear, quadratic and exponential functions. Constructing, comparing, distinguishing between, interpreting and analyzing linear, quadratic and exponential situations in context will expand students’ conceptual understanding of these relationships. The application of these parent function graphs and utilization of function notation are essential to success in future mathematics coursework. Special emphasis should be given to proving that linear functions have additive change while exponential functions have multiplicative change; observing that exponential growth will ultimately exceed linear/quadratic growth; and interpretation of the real-world parameters of a linear function; as these are the only three standards that have not been previously addressed in Foundations in Algebra. |

| **Unit 5 Resources**  [Return to Table of Contents](#TableofContents) |
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| **Activity Resources**   1. BetterLesson: [Interpret the Parameters in a Linear Function (52 Lesson Plans)](http://betterlesson.com/common_core/browse/675/ccss-math-content-hsf-le-b-5-interpret-the-parameters-in-a-linear-or-exponential-function-in-terms-of-a-context?from=domain_core_lesson_count) 2. BetterLesson: [Recognize Situations in Which One Quantity Changes at a Constant Rate Per Unit (19 Lesson Plans)](http://betterlesson.com/common_core/browse/678/ccss-math-content-hsf-le-a-1b-recognize-situations-in-which-one-quantity-changes-at-a-constant-rate-per-unit-interval-relative-t?from=domain_core_lesson_count) 3. KhanAcademy: [Modeling with Linear Functions and Equations](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/e/constructing-linear-functions-word-problems) 4. LearnZillion: [Compare Linear and Non-Linear Functions](https://learnzillion.com/lesson_plans/8701) 5. LearnZillion: [Prove that Linear Functions Grow by Equal Differences over Equal Intervals](https://learnzillion.com/lesson_plans/5537-prove-that-linear-functions-grow-by-equal-differences-over-equal-intervals) 6. Math Education Page: [Make These Designs](http://www.mathedpage.org/calculator/make-these/index.html) 7. Musing Mathematically: [Relation Stations](http://musingmathematically.blogspot.ca/2013/02/relation-stations.html) 8. National Math + Science Initiative: [Fill It Up, Please – Part III](http://www.nms.org/Portals/0/Docs/FreeLessons/Fill%20It%20Up,%20Please%20-%20Part%20III.pdf) 9. SAS Curriculum Pathways: [3-1: Comparing Rates of Change (Get Ready, Learn & Review)](https://www.sascurriculumpathways.com/portal/Launch?id=5041) 10. Algebra 1 Lessons WCCUSD: [Quadratics - Matching Game](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/MatchgameQuadractics.pdf) 11. Algebra 1 Lessons WCCUSD: [Quadratic Equations - What We Know](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/QuadEquMultRepsWhatWeKnowV5.pdf) 12. Better Lessons: [Modeling With Quadratic Functions](http://betterlesson.com/lesson/558828/modeling-with-quadratic-functions) 13. DY/Dan: [Will It Hit the Hoop?](http://blog.mrmeyer.com/2010/wcydwt-will-it-hit-the-hoop/) 14. Desmos: [Will It Hit the Hoop?](https://teacher.desmos.com/activitybuilder/custom/56e0b6af0133822106a0bed1) 15. LearnZillion: [Create Quadratic Functions](https://learnzillion.com/lesson_plans/6948) 16. Mathalicious: [Fall of Javert](http://www.mathalicious.com/lessons/the-fall-of-javert) 17. Musing Mathematically: [Connecting Quadratic Representations](http://musingmathematically.blogspot.ca/2015/05/connecting-quadratic-representations.html) 18. Finding Ways: [When I Got Them to Beg!](http://fawnnguyen.com/got-beg/) 19. BetterLesson: [Recognize Situations In Which a Quantity Grows or Decays by a Percent Rate Per Unit (16 Lesson Plans)](http://betterlesson.com/common_core/browse/680/ccss-math-content-hsf-le-a-1c-recognize-situations-in-which-a-quantity-grows-or-decays-by-a-constant-percent-rate-per-unit-inter?from=domain_core_container) 20. KhanAcademy: [How to Construct Linear or Exponential Functions From a Table or a Graph](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/v/constructing-linear-and-exponential-functions-from-data) 21. LearnZillion: [Prove Exponential Functions Grow by Equal Factors over Equal Intervals](https://learnzillion.com/lesson_plans/5552-prove-exponential-functions-grow-by-equal-factors-over-equal-intervals) 22. Monterey Institute: [Introduction to Exponential Functions](http://www.montereyinstitute.org/courses/DevelopmentalMath/U18L1T1_RESOURCE/index.html) (Flash required) 23. Algebra 1 Lessons WCCUSD: [Comparing Linear and Quadratic Functions](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/CompareLinearAndQuadraticFunctionsV1.pdf) 24. Better Lesson: [Distinguish Between Situations That Can Be Modeled with Linear, Exponential and Quadratic Functions (78 Lesson Plans)](http://betterlesson.com/common_core/browse/671/ccss-math-content-hsf-le-a-1-distinguish-between-situations-that-can-be-modeled-with-linear-functions-and-with-exponential-funct?from=domain_core_lesson_count) 25. BetterLesson: [Linear, Exponential, or Quadratic? (Lesson Plan)](http://betterlesson.com/lesson/551284/linear-exponential-or-quadratic) 26. CK-12: [Linear, Exponential, and Quadratic Models (by Table Values)](http://www.ck12.org/algebra/Linear-Exponential-and-Quadratic-Models/lesson/Linear-Exponential-and-Quadratic-Models/?referrer=featured_content) 27. Dan Meyer: [Double Sunglasses](http://threeacts.mrmeyer.com/doublesunglasses/) 28. Dan Meyer: [Pixel Pattern](http://threeacts.mrmeyer.com/pixelpattern/) 29. NCTM Illuminations (NCTM Membership required): [Modeling Orbital Debris Problems](http://illuminations.nctm.org/Lesson.aspx?id=1386) 30. Illustrative Mathematics: [Do Two Points Always Determine a Linear Function?](https://www.illustrativemathematics.org/content-standards/tasks/377) 31. Illustrative Mathematics: [Identifying Functions](https://www.illustrativemathematics.org/content-standards/tasks/238) 32. Illustrative Mathematics: [Population and Food Supply](https://www.illustrativemathematics.org/content-standards/tasks/645) 33. Illustrative Mathematics: [What Functions Do Two Graph Points Determine?](https://www.illustrativemathematics.org/content-standards/tasks/376) 34. KhanAcademy: [How to Compare the Growth of an Exponential Model and a Quadratic Model](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/comparing-exponential-and-polynomial-functions/v/comparing-exponentials-quadratics) 35. KhanAcademy: [How to Distinguish Between Linear and Exponential Models](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/comparing-exponential-and-polynomial-functions/v/linear-exponential-models) 36. LearnZillion: [Determine Which of 2 Growing Quantities Will Eventually Exceed the Other](https://learnzillion.com/lesson_plans/7985-determine-which-of-2-growing-quantities-will-eventually-exceed-the-other) 37. LearnZillion: [Distinguish Between Linear and Exponential Functions by Examining Intervals](https://learnzillion.com/lesson_plans/4995) 38. LearnZillion: [Distinguish Between Linear and Quadratic Expressions](https://learnzillion.com/lesson_plans/6431) 39. LearnZillion: [Distinguish Between Linear Functions and Exponential Functions](https://learnzillion.com/resources/72425-distinguish-between-linear-functions-and-exponential-functions) 40. Mathematics Assessment Project: [Table Tiling](http://map.mathshell.org/tasks.php?unit=HE11&collection=9&redir=1) 41. PBS Learning Media: [Comparing Exponential, Quadratic and Linear Functions](http://www.pbslearningmedia.org/resource/mgbh.math.f.grapher/comparing-exponential-quadratic-and-linear-functions/) 42. SAS Curriculum Pathways: [9-4: Linear, Exponential, and Quadratic Models (Get Ready, Learn & Review)](https://www.sascurriculumpathways.com/portal/Launch?id=6016) 43. Sophia: [Comparing Linear, Quadratic, and Exponential Functions](https://www.sophia.org/tutorials/comparing-linear-quadratic-and-exponential-functio--5) 44. YummyMath: [Done with the leaves…now for the snow](http://www.yummymath.com/2014/done-with-the-leaves-now-for-the-snow/) 45. YummyMath: [Snow Days](http://www.yummymath.com/2013/snow-days/) 46. KhanAcademy: [Functions and Function Notation](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-functions-and-function-notation/v/understanding-function-notation-example-1) 47. Illustrative Mathematics: [The Customers](https://www.illustrativemathematics.org/content-standards/tasks/624) 48. Illustrative Mathematics: [Points on a Graph (using Function Notation)](https://www.illustrativemathematics.org/content-standards/tasks/630) 49. Illustrative Mathematics: [Using Function Notation](https://www.illustrativemathematics.org/content-standards/tasks/598) 50. Zona Land Education: [The Function Institute](http://zonalandeducation.com/mmts/functionInstitute/functionInstitute.html) 51. Algebra 1 Lessons WCCUSD: [Evaluating Functions (Linear Function)](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/EvaluatingLinearFunctions.pdf) 52. Algebra 1 Lessons WCCUSD: [Evaluating Functions Graphically and Algebraically](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/EvaluatingFunctionsFIF2.pdf) 53. LearnZillion: [Write and Evaluate Linear and Exponential Functions by Modeling](https://learnzillion.com/lesson_plans/438) 54. Mathematics Assessment Project: [Interpreting Functions](http://map.mathshell.org/tasks.php?unit=HN06&collection=9&redir=1) 55. Monterey Institute: [Evaluating Functions](http://www.montereyinstitute.org/courses/DevelopmentalMath/U17L2T1_RESOURCE/index.html) (Flash required) 56. SAS Curriculum Pathways: [Applications of Exponential Functions (Learn & Review)](https://www.sascurriculumpathways.com/portal/Launch?id=5064) 57. Algebra 1 Lessons WCCUSD: [Graphing Family of Function](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/GraphingFamilyFunctionsV4.pdf) 58. Algebra 1 Lessons WCCUSD: [Families of Functions Sort](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/FamiliesOfFunctionsSortV2.pdf) 59. CK-12: [Linear, Exponential, and Quadratic Models: Bernoulli Effect PLIX (Play-Learn-Interactive-Xplore)](http://www.ck12.org/assessment/tools/geometry-tool/plix.html?eId=MAT.ALG.940&questionId=55c12c5dda2cfe5c4f021a9c&artifactID=2114549&backUrl=http%3A//www.ck12.org/algebra/Linear-Exponential-and-Quadratic-Models/%23interactive) 60. Gizmos: [Exploring Exponential Graphs](https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=134) 61. LearnZillion: [Graph Quadratic Functions](https://learnzillion.com/lesson_plans/6948) 62. Monterey Institute: [Graphing Types of Functions](http://www.montereyinstitute.org/courses/DevelopmentalMath/U17L2T2_RESOURCE/index.html) (Flash required) 63. Algebra 1 Lessons WCCUSD: [Shifting Linear Equations in Function Notation](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/ShiftingLinearEquationsInFunctionNotationV3.pdf) 64. KhanAcademy: [Shifting and Reflecting Functions](https://www.khanacademy.org/math/algebra2/manipulating-functions/shifting-functions/v/shifting-and-reflecting-functions) 65. LearnZillion: [Vertically Translate Quadratic Equations](https://learnzillion.com/lesson_plans/6942-vertically-translate-quadratic-equations) 66. LearnZillion: [Understand Vertical Scaling of Quadratic Equations](https://learnzillion.com/lesson_plans/7597-understand-vertical-scaling-of-quadratic-equations) 67. Mathematics Assessment Project: [Building Functions](http://map.mathshell.org/tasks.php?unit=HN07&collection=9&redir=1) 68. Zona Land Education: [Function Transformations](http://zonalandeducation.com/mmts/functionInstitute/functionTransformations/functionTransformations.html) 69. Algebra 1 Lessons WCCUSD: [Key Features of Graphs](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/KeyFeaturesOfGraphsv1.pdf) 70. Graphing Stories: [15 Second Graphs](http://graphingstories.com/) 71. NCTM Illuminations (NCTM Membership required): [How Should I Move?](http://illuminations.nctm.org/Lesson.aspx?id=2792) 72. KhanAcademy: [Comparing Features of Functions](https://www.khanacademy.org/math/algebra2/advanced-functions/comparing-features-of-functions/v/comparing-features-of-functions-2-example-1) 73. KhanAcademy: [End Behavior and Graphs of Basic Exponential Functions](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/graphs-of-basic-exponential-functions/v/graphing-exponential-functions) 74. KhanAcademy: [Features of Quadratic Graphs](https://www.khanacademy.org/math/algebra/quadratics/features-of-quadratic-functions/v/quadratic-functions-2) 75. KhanAcademy: [Introduction to the Domain and Range of a Function](https://www.khanacademy.org/math/algebra/algebra-functions/domain-and-range) 76. LearnZillion: [Graph Quadratic Functions and Show Intercepts, Maxima, Minima, Axis of Symmetry, and Vertex](https://learnzillion.com/resources/72763-graph-quadratic-functions-and-show-intercepts-maxima-and-minima) 77. Monterey Institute: [Finding Domain and Range](http://www.montereyinstitute.org/courses/DevelopmentalMath/U17L2T3_RESOURCE/index.html) 78. College Preparatory Mathematics (CPM): [Linear, Quadratics, and Exponential Tables](http://pdfs.cpm.org/state_supplements/Linear_Quadratic_Exponential_Tables.pdf) 79. CK-12: [Linear, Exponential and Quadratic Models (Practice)](https://www.ck12.org/c/algebra/identifying-linear-exponential-and-quadratic-models/) 80. NCTM Illuminations (NCTM Membership required): [Modeling Orbital Debris Problems – Assessment + Extensions Tab](http://illuminations.nctm.org/Lesson.aspx?id=1386) 81. Illustrative Mathematics: [Choosing an Appropriate Growth Model](https://www.illustrativemathematics.org/content-standards/tasks/1594) 82. KhanAcademy: [Construct Basic Exponential Functions From a Table or a Graph](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-growth-and-decay/e/construct-basic-exponential-functions-from-table-or-graph) 83. KhanAcademy: [Distinguish Between Linear and Exponential Growth From Tables](https://www.khanacademy.org/math/algebra2/exponential-growth-and-decay-alg-2/distinguishing-between-linear-and-exponential-growth/e/distinguish-between-linear-and-exponential-growth-from-tables) 84. KhanAcademy: [Distinguish Between Linear and Exponential Models](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/comparing-exponential-and-polynomial-functions/e/understanding-linear-and-exponential-models) 85. KhanAcademy: [Find the Linear Function that Models a Real-World Relationship](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-linear-functions-modeling/e/constructing-linear-functions-word-problems) 86. LearnZillion: [Quiz: Linear and Non-Linear Relationships](https://learnzillion.com/lesson_plans/10826) 87. Mathalicious: [Xbox Xponential](http://www.mathalicious.com/lessons/xbox-xponential) 88. Mathematics Assessment Project: [Modeling Population Growth – Having Kittens](http://map.mathshell.org/lessons.php?collection=8&unit=9100) 89. Mathematics Assessment Project: [Representing Linear & Exponential Growth](http://map.mathshell.org/lessons.php?collection=8&unit=9240) 90. SAS Curriculum Pathways: [3-1: Comparing Rates of Change (Practice & Quiz)](https://www.sascurriculumpathways.com/portal/Launch?id=5041) 91. Illustrative Mathematics: [Braking Distance](https://www.illustrativemathematics.org/content-standards/tasks/586) 92. KhanAcademy: [Evaluate Functions From their Formula](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-functions-and-function-notation/e/functions_1) 93. KhanAcademy: [Write Function Rules From Equations](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/8th-functions-and-function-notation/e/functions-from-equations) 94. Mathematics Assessment Project: [Functions](http://map.mathshell.org/tasks.php?collection=9&unit=HA07) 95. Mathematics Assessment Project: [Representing Functions of Everyday Situations](http://map.mathshell.org/lessons.php?unit=9260&collection=8) 96. SAS Curriculum Pathways: [Applications of Exponential Functions (Practice & Quiz)](https://www.sascurriculumpathways.com/portal/Launch?id=5064) 97. Finding Ways: [Des-man](http://fawnnguyen.com/des-man/) 98. NCTM Illuminations (NCTM Membership required): [How Should I Move? – Assessment + Extensions Tab](http://illuminations.nctm.org/Lesson.aspx?id=2792) 99. Illustrative Mathematics: [Comparing Graphs of Functions - Performance Task](https://www.illustrativemathematics.org/content-standards/tasks/1829) 100. Illustrative Mathematics: [Warming and Cooling](https://www.illustrativemathematics.org/content-standards/tasks/639) 101. KhanAcademy: [Domain and Range from Graph](https://www.khanacademy.org/math/algebra/algebra-functions/domain-and-range/e/domain_and_range_0.5) 102. KhanAcademy: [Graphs of Basic Exponential Functions](https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/graphs-of-basic-exponential-functions/e/graphs-of-basic-exponential-functions) 103. KhanAcademy: [Shift Functions](https://www.khanacademy.org/math/algebra2/manipulating-functions/shifting-functions/e/shift-functions) 104. LearnZillion: [Quiz: Graphing Quadratic Relationships](https://learnzillion.com/lesson_plans/10874) 105. Quia: [Graphs of Functions (Matching or Concentration Game)](https://www.quia.com/jg/459664.html) 106. BetterLesson: [Construct and Compare Linear, Quadratic, and Exponential Models and Solve Problems](http://betterlesson.com/common_core/browse/1992/ccss-math-content-hsf-le-linear-quadratic-exponential-models?from=megamenu_domain) (All Plans Include Assessment Ideas) 107. NCTM Illuminations (NCTM Membership required): [Modeling Orbital Debris Problems](http://illuminations.nctm.org/Lesson.aspx?id=1386) 108. SAS Curriculum Pathways: [9-4: Linear, Exponential, and Quadratic Models (Practice & Quiz)](https://www.sascurriculumpathways.com/portal/Launch?id=6016) |
| **Application Resources (Downloadable Lessons, Video, Applets, and Online Algebra Notes)**   1. BetterLesson: [Construct and Compare Linear, Quadratic, and Exponential Models and Solve Problems](http://betterlesson.com/common_core/browse/1992/ccss-math-content-hsf-le-linear-quadratic-exponential-models?from=megamenu_domain)    * + 1. CK-12: [Linear, Exponential and Quadratic Models](http://www.ck12.org/algebra/Linear-Exponential-and-Quadratic-Models/lesson/Linear-Exponential-and-Quadratic-Models/?referrer=featured_content)        2. Gizmos: [Resource Catalog](https://www.explorelearning.com/index.cfm?method=cResource.dspResourceCatalog#grades)        3. Il NCTM Illuminations (NCTM Membership required): [Resources For Teaching Math](http://illuminations.nctm.org)        4. Illustrative Mathematics: [High School Content Lesson Index](https://www.illustrativemathematics.org/content-standards/HS)        5. KhanAcademy: [Algebra 1](https://www.khanacademy.org/math/algebra)        6. KhanAcademy: [Functions – Linear, Quadratic and Exponential Models](https://www.khanacademy.org/commoncore/grade-HSF-F-LE)        7. LearnZillion: [Algebra Math Video Lessons](https://learnzillion.com/resources/75023-algebra-math-video-lessons)        8. Math Education Page: [Start Page](http://www.mathedpage.org)        9. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Classroom Challenges (Formative Assessment Lessons)](http://map.mathshell.org/background.php)        10. Mathematics Assessment Project – Mathematics Assessment Resource Service: [Guide for Teachers and Administrators](http://map.mathshell.org/guides/map_cc_teacher_guide.pdf)        11. PBS Learning Media: [Mathline](http://www.pbslearningmedia.org/search/?q=&selected_facets=supplemental_curriculum_hierarchy_nodes%3A1184&selected_facets=)        12. Quia: [Mathematics Shared Activities](http://www.quia.com/shared/mathematics/)        13. SAS Curriculum Pathways: [SAS Algebra 1 Course](https://www.sascurriculumpathways.com/portal/mobile/algebra1/start.html) – Unit 9        14. Sophia: [Algebra I Topics](https://www.sophia.org/subjects/algebra-1)        15. West Contra Costa Unified School District: [Algebra 1 Lessons](http://www.wccusd.net/Page/3224)        16. Zona Land Education: [Index of Zona Land Education Topics](http://zonalandeducation.com/theIndex/theIndex.html) |

| **Course/Grade:** Foundations of Algebra  **Unit:** 5 | **Task Title:** Task 1: Graphing Stories  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)  FA.FIF.5\* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  a. Relate a problem to prior knowledge.  2. Reason both contextually and abstractly.  a. Make sense of quantities and their relationships in mathematical and real-world situations.  b. Describe a given situation using multiple mathematical representations.  4. Connect mathematical ideas and real-world situations through modelling.  a. Identify relevant quantities and develop a model to describe their relationships.  b. Interpret mathematical models in the context of the situation.  6. Communicate mathematically and approach mathematical situations with precision.  c. Use appropriate and precise mathematical language.  d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | **Unit 5 Task 1 Resource:** Graphing Stories Inquiry Learning  [Graphing Stories Classroom Activity](https://teacher.desmos.com/activitybuilder/custom/58797d35d81a612605304b1f)  [Khan Academy: Interpreting a Graph](https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-linear-equations-functions/linear-nonlinear-functions-tut/v/interpreting-a-graph-exercise-example) |
| **Task Description** | * Hook students using the attached inquiry learning (IL) prompt and have them list their Notices and Wonders. When students are finished, have them collaborate their responses within their groups. * Groups will now create a story for the graph. The below questions can be used before, during or after as an extension of student learning.   ***Additional Questions to Extend Learning***   1. *Describe the different line segments within the graph in terms of slope and rate of change.* 2. *Describe what the negative y-values mean in terms of distance.* 3. *Explain the difference between a positive slope and negative slope in terms of distance and time.*  * Have a whole class group discussion to summarize the IL and to revisit vocabulary. * Have students complete the Graphing Stories Desmos Classroom Activity * Use the teacher guide to help with pacing and whole class questioning. |
| **Equitable Access** | Have students who are struggling with graphing watch the Khan Academy video before completing the Desmos Activity. |
| **Mathematical Vocabulary** | Domain  Range  Discrete  Continuous  Increasing  Decreasing  Constant  Function |
| **Student Reflection** | Reflect on your original IL graph noticing and wonderings. On the back of your paper describe the graph using mathematical vocabulary. Explain how your interpretation of the graph has changed as you’ve progressed through this activity. Record your reflections on a sticky note and place it on the graph. The students will have a gallery walk to read responses. |

| **Unit 5 Task 1 Resource: Graphing Stories Inquiry Learning**  [Return to Table of Contents](#TableofContents) |
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| Image containing graph for Unit 5 Lesson 1 resource  Take 5 minutes to individually list 3 things that you notice and wonder.  **I Notice:** **I Wonder:**   1. 1.      1. 2.      1. 3.   Collaborate with your group for 5 minutes to discuss your notices and wonders.  Work within your group for 10 minutes to develop a real life story for the graph. Be sure to include rate of change within your story to explain the different line segments. Be prepared to share your story with the class.  **Group Story** |

| **Course/Grade:** Foundations of Algebra  **Unit:** Unit 5 | **Task Title:** Task 2: Comparing and Contrasting Functions: Linear Versus Exponential  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FLQE.1\* Distinguish between situations that can be modelled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval. (Note: FA.FLQE.1a is not a Graduation Standard.)  FA.FLQE.1a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.  FA.FLQE.3\* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or more generally as a polynomial function.  FA.FLQE.5\* Interpret the parameters in a linear or exponential function in terms of the context. (Limit to linear.)  FA.FIF.4\* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)  FA.FIF.9\* \* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; exponential.) |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  d. Evaluate the success of an approach to solve a problem and refine it if necessary.  2. Reason both contextually and abstractly.  a. Make sense of quantities and their relationships in mathematical and real-world situations.  b. Describe a given situation using multiple mathematical representations.  c. Translate among multiple mathematical representations and compare the meanings each representation conveys about the situation.  3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.  c. Make conjectures and explore their validity.  d. Reflect on and provide thoughtful responses to the reasoning of others.  4. Connect mathematical ideas and real-world situations through modelling.  a. Identify relevant quantities and develop a model to describe their relationships.  b. Interpret mathematical models in the context of the situation.  6. Communicate mathematically and approach mathematical situations with precision.  c. Use appropriate and precise mathematical language.  d. Use appropriate units, scales, and labels.  7. Identify and utilize structure and patterns.  b. Recognize mathematical repetition in order to make generalizations. |
| **Materials and Resources** | Graphing paper, candy (5 bags) or any other appropriate items  Comparing & Contrasting Linear & Exponential Functions |
| **Task Description** | Learners are required to carry out an experiment and come up with a graph. One will produce a linear graph and the other an exponential. This task is to introduce the power of exponentials. The class will then discuss the wonder and notices of why the two graphs are different and what makes them different. |
| **Equitable Access** | The activity can be modified to use a graphing calculator or a table of values that doubles the dependent values.  This activity can also be used to show exponential decay by starting with a set amount (i.e. 100 pieces) and then reducing by one or two (linear) and halving (exponential) each interval. |
| **Mathematical Vocabulary** | Tables  Rate of Change  Exponential function  Exponential growth  Initial amount  growth rate  growth factor |
| **Student Reflection** | * Think of a situation in real life where this knowledge would be useful. Describe this real life situation. * What did you learn today that connected to what you already knew? * What new ideas did you learn today? * What questions or wonders do you still have after today’s lesson? |

| **Unit 5 Task 2 Resource: Linear Versus Exponential Functions Activity**  [Return to Table of Contents](#TableofContents) |
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| ***Linear Versus Exponential Functions Activity***  **First Experiment**  Your group will add one additional piece of candy every 10 seconds. Place your candy on the graph paper provided in a line for each time increment.   |  |  | | --- | --- | | Time (seconds) | Pieces of candy | | 0 | 1 | | 10 |  | | 20 |  | | 30 |  | | 40 |  | | 50 |  | | 60 |  | | 70 |  | | 80 |  | | 90 |  |   **Questions**   1. What does the graph look like? 2. What is the equation that represents the function? 3. What would happen if you were to add 2 pieces of candy each interval? 3 pieces of candy?   **Second Experiment**  Now, your group will double the number of candy pieces every 10 seconds. Place your candy on the graph paper provided in a line for each time split.   |  |  | | --- | --- | | Time (seconds) | Number of pieces of candy | | 0 | 1 | | 10 |  | | 20 |  | | 30 |  | | 40 |  | | 50 |  | | 60 |  | | 70 |  | | 80 |  | | 90 |  |   **Questions**  What does the graph look like?  What was the initial value? What is the rate of growth?  What would happen if you were to triple the pieces of candy each interval?  Compare the graphs/tables of both experiments. What do you notice and wonder about them?  What do you think will happen after 300 seconds for each experiment?  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 5 | **Task Title:** Task 3: Linear, Quadratics, and Exponential Card Sort  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.FBF.3 Describe the effect of the transformations (𝑥), (𝑥)+𝑘, 𝑓(𝑥+𝑘), and combinations of such transformations on the graph of 𝑦=𝑓(𝑥) for any real number 𝑘. Find the value of 𝑘 given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.) FA. FIF.1 Extend previous knowledge of a function to apply to general behavior and features of a function. a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. b. Represent a function using function notation and explain that (𝑥) denotes the output of function 𝑓 that corresponds to the input 𝑥. c. Understand that the graph of a function labeled as 𝑓 is the set of all ordered pairs (𝑥,) that satisfy the equation 𝑦=(𝑥). FA.FIF.2 Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation. FA.FIF.5 Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.) FA.FIF.7 Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form 𝑦=𝑎𝑥+𝑘.) |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 2b. Describe a given situation using multiple mathematical representations.  2c. Translate among multiple mathematical representations and compare the meanings each representation conveys about the situation.  3c. Make conjectures and explore their validity. 3d. Reflect on and provide thoughtful responses to the reasoning of others.  4a. Identify relevant quantities and develop a model to describe their relationships.  4b. Interpret mathematical models in the context of the situation. 6b. Represent numbers in an appropriate form according to the context of the situation. 6c. Use appropriate and precise mathematical language.  6d. Use appropriate units, scales, and labels.  7b. Recognize mathematical repetition in order to make generalizations. |
| **Materials and Resources** | Scissors  [Comparing Functions](https://drive.google.com/file/d/1FRUsxnbPYFDAz4IQhLdOdnBHBw-5h0FZ/view?usp=sharing) |
| **Task Description** | 1) Working individually or within teams, students should study the three graphs on the Comparing Linear, Quadratic and Exponential Functions document.  2) After students have had time to study the graphs, they should attempt to complete the attached table for the three graphs. They will classify the graphs as linear, quadratic or exponential, write a scenario that could correspond to each graph, make a table of values for each graph and then attempt to write the equation for each graph.  3) Students will then use the task cards from the Linear, Quadratic, Exponential Function Card Sort document to respond to the inquiries in each box. (Students can cut the cards out or leave them as a sheet.) After documenting responses in each box, students should classify the equation, table, graph or verbal description as a linear, quadratic or exponential representation. (There will be 8 cards remaining when they are finished responding to the 12 questions.)  4) Students will classify the remaining 8 task cards as linear, quadratic or exponential examples and justify their responses verbally or mathematically.  5) Students will complete the student reflection to finish the activity. |
| **Equitable Access** | Students can work individually or in pairs/teams.  If students cannot complete all portions of the first task, they can move on to the next task and return after they have a better understanding of the different representations. Students could be given the opportunity to complete a portion of the boxes within the sorting activity instead of all 12 or complete enough to create one linear and one horizontal line. There are an equal number of function types within the task, so it is open to completing the task in multiple way. Students can gain ideas from peers and critique their peers’ work while completing the task.  Students are asked to create their own multiple representations of functions.  Multiple pathways in classifying the multiple representations to the functions. |
| **Mathematical Vocabulary** | Linear Function Exponential Function Quadratic Function Table of Values Solution Points Domain  Range Increasing interval Decreasing interval Function Notation |
| **Student Reflection** | Two Stars and a Wish (Responses should be content specific – cite evidence)  Students should choose two of the below:  I enjoyed… I learned… I used… I wrote/said/read… I’m proud of myself because… Choose one -  I would like… …was difficult because.... I tried to use… I would like help with… |

| **Unit 5 Task 3 Resource: Comparing Functions**  [Return to Table of Contents](#TableofContents) |
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| **Comparing Linear, Quadratic and Exponential Functions**  Example to use to generate class discussion on the different types of functions.  Graph of time and productivity  **Comparing Linear, Quadratic and Exponential Functions**   | **Graph** | **Type of Function**  **(Linear, Exponential, Quadratic)** | **Real World Situation Example** | **Table of Values** | **Equation** | | --- | --- | --- | --- | --- | | **Red** |  |  |  |  | | **Green** |  |  |  |  | | **Blue** |  |  |  |  |   **Linear, Quadratic, and Exponential Function Card Sort**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **A Rocket Fired**  Graph for Card A | **B**  *f(x)* = 20x + 50 | **C**  For Maria’s 8th birthday, her aunt gave her 160 pieces of candy. Maria loves candy so she ate half the bag on the first day. To make her candy last, she decided to eat half of what is left each day until it is gone. | | **x** | ***f(x)*** | | --- | --- | | 4 | 130 | | 5 | 150 | | 6 | 170 | | 7 | 190 |   **D** | | **d** | ***c(d)*** | | --- | --- | | 0 | 160 | | 1 | 80 | | 2 | 40 | | 3 | 20 | | 4 | 10 |   **E** | | **F T-Shirt Launch**  Graph for Card F | **G Maria’s Candy Bag**  Graph for Card G | **H**  *h(t)* = -5*t2* + 10*t* + 20 | **I March Madness**  Graph for Card I | **J**  *c(d)* = 160( | | **K**  y = 64( | **L**  The NHS cheerleaders launch T-shirts into the crowd at every home football game. | **M**  *f(x)* = 5x + 55 | **N**  Shy joins the YMCA for $20.00 a month in addition to a $50 membership fee. | | **t** | ***h(t)*** | | --- | --- | | 0 | -4 | | .5 | -5.25 | | 1 | -6 | | 1.5 | -6.26 | | 2 | -6 |   **O** | | **P**  graph | **Q**  *h(t)* = -16*t*2 + 48*t* + 6 | | **x** | **y** | | --- | --- | | 0 | 64 | | 1 | 32 | | 2 | 0 | | 3 | -32 | | 4 | -64 |   **R** | **S** A rocket is fired from the top of a barn 20 yards above the ground. It takes the rocket approximately 3 seconds to hit the ground. | **T** During March madness (NCAA basketball tournament), at the end of each round, half of the teams are eliminated. |   **Linear, Quadratic, and Exponential Function Card Sort**  Cut out cards A-T and glue them into the appropriate boxes below. (Eight cards will not be used.) Classify each of the cards glued into each box as a linear, quadratic, or exponential function.   | 1) Describe the transformations for the function on **card** **M** from its parent function, *f(x)* = x. | 2) For the function on **card F**, how far above the ground was the T-shirt before it was launched? Use appropriate units. | 3) Mathematically justify that point (2, 16) is a solution for the function on **card K**. | | --- | --- | --- | | 4) Identify the domain and range for the function on **card N**. How might the domain and range change if it cost Shy $5 per month and a $20 membership fee to join the YMCA? | 5) For the function on **card A**, approximately how many seconds did it take for the rocket to hit the ground? | 6) Describe a situation that could model the table of values on **card E**. | | 7) Which of the five written descriptions on the other cards could be modeled by the graph on **card P**? Justify your answer. | 8) Describe a scenario that could represent the function on **card J**. | 9) Identify two points that fall on the graph of the function on **card H**. Explain your reasoning. | | 10) Identify the domain and range for the graph representing Maria’s candy on **card G**. | 11) Describe a situation that could model the table of values on **card D**. | 12) State the y-intercept for the function on **card Q**. What might this intercept mean in terms of a real world problem? |   **Linear, Quadratic, and Exponential Function Card Sort**  Use the unused eight cards to identify the type of function represented on each card. (Linear, Quadratic or Exponential) Justify your answer for each.  table  *(SCDE, 2019)* |

| **Unit 6 Content Standards with Clarifying Notes**  *Open bullets indicate clarifying notes.*  [Return to Table of Contents](#TableofContents) |
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| * FA.FLQE.5\* Interpret the parameters in a linear or exponential function in terms of the context. (Limit to linear.) * Identify names and definitions of *m* and *b* in the function *f(x) = mx + b*. * Describe the meaning of the slope of a line that models a real-world situation (use appropriate units). * Describe the meaning of the y-intercept and other points of a line that models a real-world situation (use appropriate units). * Identify and model a real-world situation that has a linear relationship. * FA.SPID.5\* Analyze bivariate categorical data using two-way tables and identify possible associations between the two categories using marginal, joint, and conditional frequencies. * Read and interpret data displayed in a two-way frequency table. * Write a summary of data that is displayed by a two-way frequency table. * Use percentages of ratios in two-way table to calculate marginal, joint and conditional relative frequencies. * Recognize patterns in the data and explain implications of relative frequencies based on the context of the original problem. * Choose and create appropriate diagrams of marginal, joint, and conditional distributions. * Compare conditional and marginal percentages to describe the relationship between two variables. * FA.SPID.6\* Using technology, create scatterplots and analyze those plots to compare the fit of linear, quadratic, or exponential models to a given data set. Select the appropriate model, fit a function to the data set, and use the function to solve problems in the context of the data. * Identify the correct model (linear, quadratic, and exponential) that should be used to fit a set of data. * Sketch the function of best fit onto the scatterplot. * Recognize whether a linear or exponential model is increasing or decreasing. * Utilize a graphing calculator or appropriate technology to produce a scatterplot and the function of best fit. * Use function of best fit to predict values of a real world set of data. * FA.SPID.7\* Create a linear function to graphically model data from a real-world problem and interpret the meaning of the slope and intercept(s) in the context of the given problem. * Interpret the meaning of the slope in terms of the unit rate. * Interpret the meaning of the y-intercept in terms of the units stated in the data. * FA.SPID.8\* Using technology, compute and interpret the correlation coefficient of a linear fit. * Understand that the correlation coefficient only applies to quantitative variables and linear models of best fit. * Define the correlation coefficient as a measure of the "goodness of a linear fit" (significance) that is inclusively between -1 and 1. * Utilize a graphing calculator or other appropriate technology to compute the correlation coefficient of a linear model. * Explain the meaning of the correlation coefficient and determine whether the linear model is a good fit for the data (significance). * Determine the direction (sign) and the magnitude (strength) of the linear model using the correlation coefficient. * FA.SPMJ.1\* Understand statistics and sampling distributions as a process for making inferences about population parameters based on a random sample from that population * Recognize that the sample distribution is a subset of the population, such that it is sizeable enough to make an inference about ultimate parameters of the population. * FA.SPMJ.2\* Distinguish between experimental and theoretical probabilities. Collect data on a chance event and use the relative frequency to estimate the theoretical probability of that event. Determine whether a given probability model is consistent with experimental results. * Experimental probability is the ratio of the number of times an event occurs to the total number of trials or times the activity is performed. * Theoretical probability is the number of ways that the event can occur, divided by the total number of outcomes. * Collect data on the number of times an event occurs after a series of trials. Calculate the resulting experimental probability. * After conducting chance event experiment; compare results to theoretical probability. * Calculate basic probabilities, including compound events and events with or without replacement. * FA.SPMD.4\* Use probability to evaluate outcomes of decisions by finding expected values and determine if decisions are fair. * Utilize probability to analyze the results of a process and decide if it resulted in a fair decision. * FA.SPMD.5\* Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions. * Utilize probability to create a method for making a fair decision. * FA.SPMD.6\* Analyze decisions and strategies using probability concepts. * Evaluate data to determine whether or not the best decision was made. * Consider all available strategies to determine and defend a strategy to recommend. |

| **Unit 6 New Academic Vocabulary**  [Return to Table of Contents](#TableofContents) |
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| * Conditional Relative Frequency * Correlation Coefficient * Function of Best Fit * Joint Relative Frequency * Marginal Relative Frequency * Population Parameter * Q-Points * Quantitative Variable * Significance * Statistical Inference |

| **Unit 6 Prior Knowledge Required**  [Return to Table of Contents](#TableofContents) |
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| In earlier grades, students have developed conceptual knowledge and have had the opportunity to learn how to:   * Differentiate between statistical and non-statistical questions (6.DS.1). * Use center, spread, and shape to describe the distribution of a set of data collected to answer a statistical question (6.DS.2). * Describe numerical data sets in relation to their real-world context (6.DS.5). * Investigate concepts of random sampling (7.DSP.1). * Draw inferences about a population by collecting multiple random samples of the same size to investigate variability in estimates of the characteristic of interest (7.DSP.2). * Investigate the concept of probability of chance events (7.DSP.5). * Investigate the relationship between theoretical and experimental probabilities for simple events (7.DSP.6). * Apply the concepts of theoretical and experimental probabilities for simple events (7.DSP.7). * Extend the concepts of simple events to investigate compound events (7.DSP.8). * Investigate bivariate data (8.DSP.1). * Draw an approximate line of best fit on a scatter plot that appears to have a linear association and informally assess the fit of the line to the data points (8.DSP.2). * Find an approximate equation for the line of best fit using two appropriate data points, interpret the slope and intercept, solve problems using the equation (8.DSP.3). * Investigate bivariate categorical data in two-way tables, and interpret data in two-way tables using relative frequencies (8.DSP.4). * Apply concepts of slope and y-intercept to graphs, equations, and proportional relationships (8.EEI.6). * Investigate the differences between linear and nonlinear functions (8.F.3).   Earlier during Foundations in Algebra, students developed conceptual knowledge and had the opportunity to learn how to:   * Create equations in two or more variables to represent relationships between the quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.) (FA.ACE.2\* Units 1, 2, 3, & 4). * Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; exponential.)(FA.FIF.9\* Unit 5). * Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval (FA.FLQE.1\* Unit 5). |

| **Unit 6** **Subsequent Knowledge**  [Return to Table of Contents](#TableofContents) |
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| * Foundations Unit 6 interprets the parameters of a linear function in terms of a real-world context (FA.FLQE.5).   + This will be extended to exponential functions in Intermediate Algebra Unit 6 (IA.FLQE.5). * Foundations Unit 6 analyzes bivariate categorical data using marginal, joint and conditional frequencies (FA.SPID.5\*).   + this will also be addressed in Probability and Statistics Unit 1 (PS.SPID.5\*) * Foundations Unit 6 uses technology to create scatterplots, fit a function to the data and compute correlation coefficients of a linear fit (FA.SPID.6\*; FA.SPID.8\*).   + This will be readdressed in Probability and Statistics Unit 4 (PS.SPID.6\*; PS.SPID.8\*) * Foundations Unit 6 creates linear functions to graphically model data from a real-world problem and analyzes the meaning of the slope and intercept(s) (FA.SPID.7\*).   + This will also be addressed in Probability and Statistics Unit 4 (PS.SPID.7\*). * Foundations Unit 6 makes inferences about population parameters based on a random sample from that population (FA.SPMJ.1\*).   + This will also be addressed in Probability and Statistics Unit 7 (PS.SPMJ.1\*). * Foundations Unit 6 compares data from experimental probabilities to that of the theoretical probability (FA.SPMJ.2\*).   + This will also be addressed in Probability and Statistics Unit 6 (PS.SPMJ.2\*). * Foundations Unit 6 uses probabilities to evaluate the fairness of decisions (FA.SPMD.4\*; FA.SPMD.5\*; FA.SPMD.6\*).   + This will also be addressed in Probability and Statistics Unit 7 (PS.SPMD.4\*; PS.SPMD.5\*; PS.SPMD.6\*). |

| **Unit 6 Relationship Among Standards**  [Return to Table of Contents](#TableofContents) |
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| The standards in Foundations in Algebra Unit 6 are connected by the data analysis themes of inferences, implications and predictions. The unit begins by having students use single variable statistics to make inferences. Thus, leading the way for simulations to compare theoretical and experimental probabilities in order to make predictions. Then, using probability to evaluate and make fair decisions. Next, students will be able to make predictions and implications to data using bivariate tables. Students must review, connect and apply many of the standards from the prior units to utilize linear, quadratic and exponential ideas to create regression equations. Finally, the important linear concepts of slope and y-intercepts are readdressed using real-world regression situations. |

| **Unit 6 Resources**  [Return to Table of Contents](#TableofContents) |
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| **Activity Resources**   1. LearnZillion: [Distinguish Between Population and Sample](https://learnzillion.com/lesson_plans/5774-distinguish-between-population-and-sample) 2. Stat Trek: [Population vs Sample](http://stattrek.com/sampling/populations-and-samples.aspx) 3. Statistics How To: [Difference Between a Statistic and a Parameter](http://www.statisticshowto.com/how-to-tell-the-difference-between-a-statistic-and-a-parameter/) 4. LearnZillion: [Determine Population and Parameter from a Statistical Question](https://learnzillion.com/lesson_plans/6496-determine-population-and-parameter-from-a-statistical-question) 5. LearnZillion: [Take a Simple Random Sample](https://learnzillion.com/lesson_plans/4871-take-a-simple-random-sample) 6. LearnZillion: [Take a Random Sample](https://learnzillion.com/lesson_plans/7329-take-a-random-sample) 7. Khan Academy: [Reasonable Samples](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-population-sampling/v/reasonable-samples) 8. University of North Carolina of Wilmington: [Aquarius Lesson Plan](http://www.uncw.edu/ed/aquarius/documents/2012/Kyle%20Miller-9-12%20Math.docx) 9. Khan Academy: [Comparing Theoretical to Experimental Probabilities](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-theoretical-and-experimental-probability/v/comparing-theoretical-to-experimental-probabilites) 10. Online Math Learning: [Theoretical Probability and Experimental Probability](http://www.onlinemathlearning.com/theoretical-probability.html) 11. Khan Academy: [Making Predictions with Probability](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-theoretical-and-experimental-probability/v/making-predictions-with-probability) 12. Khan Academy: [Constructing Probability Models from Data](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-theoretical-and-experimental-probability/v/constructing-probability-model-from-observations) 13. NCTM Illuminations (NCTM Membership required):  [Stick or Switch](https://illuminations.nctm.org/Lesson.aspx?id=1399) 14. NCTM Illuminations (NCTM Membership required): [Will the Best Candidate Win?](http://illuminations.nctm.org/Lesson.aspx?id=2539) 15. NCTM Illuminations (NCTM Membership required): [Explorations With Chance: Is It Fair](https://illuminations.nctm.org/Lesson.aspx?id=1145) 16. Khan Academy: [Picking Fairly](https://www.khanacademy.org/math/probability/probability-and-combinatorics-topic/decisions-with-probability/v/probability-decisions) 17. Mathalicious: [Three Shots](http://www.mathalicious.com/lessons/three-shots) 18. HotMath: [Using Probabilities to Make Fair Decisions](http://hotmath.com/hotmath_help/topics/using-probabilities-to-make-fair-decisions.html) 19. Math Is Fun: [Bivariate Data](https://www.mathsisfun.com/definitions/bivariate-data.html) 20. Study.com:  [Joint, Marginal & Conditional Frequencies](http://study.com/academy/lesson/joint-marginal-conditional-frequencies-definitions-differences-examples.html) 21. Texas Instruments: [Creating a Scatter Plot Using TI-83/84 Family](https://epsstore.ti.com/OA_HTML/csksxvm.jsp?nSetId=100484) 22. PurpleMath: [Scatterplots and Regressions - Page 1](http://www.purplemath.com/modules/scattreg.htm) 23. SlideShare: [Calculating a Correlation Coefficient and Scatter Plot using Excel](http://www.slideshare.net/sandradnicks/calculating-a-correlation-coefficient-and-scatter-plot-using-excel) 24. Excel Easy: [Excel Scatter Chart](http://www.excel-easy.com/examples/scatter-chart.html) 25. LearnZillion: [Fit a Linear Regression to a Set of Data using Spreadsheets and Graphing Technology](https://learnzillion.com/lesson_plans/71) 26. Illustrative Mathematics: [Basketball Bounces Collaborative Investigation](https://www.illustrativemathematics.org/content-standards/tasks/1089) 27. NCTM Illuminations (NCTM Membership required): [Shrinking Candles, Running Water, Folding Boxes](https://illuminations.nctm.org/Lesson.aspx?id=1211) 28. Khan Academy: [Comparing Models to Fit Data](https://www.khanacademy.org/math/probability/regression/prob-stats-scatter-plots/v/comparing-models-to-fit-data) 29. PurpleMath: [Scatterplots and Regressions](http://www.purplemath.com/modules/scattreg2.htm) 30. LearnZillion: [Select a Statistical Regression Line](https://learnzillion.com/lesson_plans/7679) 31. LearnZillion: [Model Real-World Bivariate Data By Using A Quadratic Regression Function](https://learnzillion.com/lesson_plans/646) 32. LearnZillion: [Model Real-World Bivariate Data By Using An Exponential Regression Function](https://learnzillion.com/lesson_plans/647) 33. LearnZillion: [Find Correlation Coefficient using Technology](https://learnzillion.com/lesson_plans/4722) 34. University of North Carolina of Wilmington: [Correlation and Line of Best Fit](http://www.wccusd.net/cms/lib03/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/CorrelationLineBestFit.pdf) 35. EngageNY: [Interpreting Correlation](https://www.engageny.org/file/52171/download/algebra-i-m2-topic-d-lesson-19-teacher.pdf?token=ocSSvdV7WZFdreIplihHbhpELRB35wHsa7Ne3gJ-RR4) 36. Math Is Fun: [Correlation](https://www.mathsisfun.com/data/correlation.html) 37. Algebra 1 Lessons WCCUSD: [Correlation and Line of Best Fit](https://www.wccusd.net/cms/lib/CA01001466/Centricity/domain/60/lessons/algebra%20i%20lessons/CorrelationLineBestFit.pdf) 38. LearnZillion: [Interpret the Slope and Intercept of a Regression Line](https://learnzillion.com/lesson_plans/78) 39. LearnZillion: [Understand and Interpret the Slope of a Regression Line](https://learnzillion.com/lesson_plans/7098) 40. NCTM Illuminations (NCTM Membership required):: [Exploring Linear Data](https://illuminations.nctm.org/Lesson.aspx?id=1189) 41. NCTM Illuminations (NCTM Membership required):: [Barbie Bungee](https://illuminations.nctm.org/Lesson.aspx?id=2157) 42. LearnZillion: [Solve Problems Using Linear Regression](https://learnzillion.com/lesson_plans/5291) 43. Illustrative Mathematics: [Hand Span and Height Collaborative Activity](https://www.illustrativemathematics.org/content-standards/SP/8/A/1/tasks/1097) 44. Shmoop: [Probability and Statistics Sample Assignments](http://www.shmoop.com/common-core-standards/ccss-hs-s-ic-1.html) 45. Shmoop: [Sampling Methods](http://www.shmoop.com/math-shack/stat-prob/sampling-methods-2/) 46. Amazing Space: [Galaxy Hunter: A Cosmic Photo Safari](http://amazing-space.stsci.edu/resources/explorations/ghunter/home.html) 47. Sophia: [CCSS Math Standard S-IC.1 Practice](https://www.sophia.org/ccss-math-standard-9-12sic1-pathway) 48. LearnZillion (Subscription Required): [Performance Task S-IC.1](https://learnzillion.com/resources/16112) 49. LearnZillion (Subscription Required): [School Dress Code Performance Task](https://learnzillion.com/resources/16139) 50. Illustrative Mathematics: [School Advisory Panel Performance Task](https://www.illustrativemathematics.org/content-standards/HSS/IC/A/1/tasks/186) 51. Illustrative Mathematics: [Why Randomize? Performance Task](https://www.illustrativemathematics.org/content-standards/HSS/IC/A/1/tasks/191) 52. Illustrative Mathematics: [Strict Parents Performance Task](https://www.illustrativemathematics.org/content-standards/HSS/IC/A/1/tasks/122) 53. Illustrative Mathematics: [Musical Preferences Performance Task](https://www.illustrativemathematics.org/content-standards/HSS/IC/A/1/tasks/123) 54. Illustrative Mathematics: [Mr. Briggs’s Class Likes Math Performance Task](https://www.illustrativemathematics.org/content-standards/SP/7/A/1/tasks/974) 55. Illustrative Mathematics: [How Many Buttons? Performance Task](https://www.illustrativemathematics.org/content-standards/SP/7/C/7/tasks/1022) 56. Illustrative Mathematics: [Rolling Dice Performance Task](https://www.illustrativemathematics.org/content-standards/SP/7/C/7/tasks/1216) 57. Monterey Institute: [Project-Based Learning Activity: What are the Chances of That?](http://www.montereyinstitute.org/courses/Algebra1/U12PROJECT_RESOURCE/index.html) 58. Khan Academy: [Making Predictions with Probability](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-theoretical-and-experimental-probability/e/using-probability-to-make-predictions) 59. Khan Academy: [Probability Models](https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-probability-statistics/cc-7th-theoretical-and-experimental-probability/e/probability-models) 60. Khan Academy: [Using Probability to make Fair Decisions](https://www.khanacademy.org/math/probability/probability-and-combinatorics-topic/decisions-with-probability/e/using-probability-to-make-fair-decisions) 61. Monterey Institute (Adobe Flash Player Required): [Extending and Applying Concepts: Probability Game Design](http://www.montereyinstitute.org/courses/Algebra1/U12SIM_RESOURCE/index.html) 62. Illustrative Mathematics: [Birds’ Eggs Performance Task](https://www.illustrativemathematics.org/content-standards/SP/8/A/1/tasks/41) 63. Illustrative Mathematics: [Texting and Grades 1 Performance Task](https://www.illustrativemathematics.org/content-standards/SP/8/A/1/tasks/975) 64. Khan Academy: [Trends in Categorical Data](https://www.khanacademy.org/math/probability/statistical-studies/categorical-data/e/trends-in-categorical-data) 65. Khan Academy: [Constructing Scatter Plots](https://www.khanacademy.org/math/probability/regression/prob-stats-scatter-plots/e/constructing-scatter-plots) 66. Khan Academy: [Fitting Quadratic and Exponential Functions to Scatter Plots](https://www.khanacademy.org/math/probability/regression/prob-stats-scatter-plots/e/fitting-functions-to-scatter-plots) 67. Mathopolis: [Correlation Practice Set](http://www.mathopolis.com/questions/q.php?id=3072&site=1&ref=/data/correlation.html&qs=3072_3776_8757_8758_8759_8760_3080_3081_3810_3811) 68. Khan Academy: [Eyeballing the line of Best Fit](https://www.khanacademy.org/math/probability/regression/regression-correlation/e/plotting_the_line_of_best_fit) 69. Khan Academy: [Estimating Slope of Line of Best Fit](https://www.khanacademy.org/math/probability/regression/regression-correlation/e/linear-models-of-bivariate-data) 70. Illustrative Mathematics: [US Airports Assessment Variation Performance Task](https://www.illustrativemathematics.org/content-standards/SP/8/A/3/tasks/1370) 71. Illustrative Mathematics: [Animal Brains Performance Task](https://www.illustrativemathematics.org/content-standards/SP/8/A/1/tasks/1520) |
| **Application Resources (Downloadable Lessons, Video, Applets, and Online Algebra Notes)**   1. Algebra-Class: [Algebra Examples Index](http://www.algebra-class.com/algebra-examples.html) 2. EngageNY: [Algebra 1 Module 1](https://www.engageny.org/resource/algebra-i-module-1) 3. Excel Easy: [Excel Data Analysis](http://www.excel-easy.com/data-analysis.html) 4. Hot Math: [Review Topic Index](http://hotmath.com/hotmath_help/topics/index_hotmath_review.html) 5. Illustrative Mathematics: [High School Content Lesson Index](https://www.illustrativemathematics.org/content-standards/HS) 6. [Khan Academy:](http://mathbitsnotebook.com/Algebra1/LinearEquations/LELiteralEquationPractice.html) [Introduction to Algebra](https://www.khanacademy.org/math/algebra/introduction-to-algebra) 7. Khan Academy: [Probability and Statistics](https://www.khanacademy.org/math/probability) 8. LearnZillion: [High School Statistics and Probability](https://learnzillion.com/resources/75068-high-school-statistics-and-probability) 9. Mathalicious: [Lessons](http://www.mathalicious.com/lessons) 10. Math Is Fun: [Math Resource Index](https://www.mathsisfun.com/) 11. NCTM Illuminations (NCTM Membership required): [Resources for Teaching Math](https://illuminations.nctm.org/Lessons-Activities.aspx) 12. Online Math learning: [An Introduction to Mathematical Statistics](http://www.onlinemathlearning.com/statistics.html) 13. Online Math Learning: [An Introduction to Probability](http://www.onlinemathlearning.com/math-probability.html) 14. Purple Math: [Index of Lessons](https://www.purplemath.com/modules/index.htm) 15. SAS Curriculum Pathways: [SAS Algebra 1 Course](https://www.sascurriculumpathways.com/portal/mobile/algebra1/start.html) 16. Slide Share: [Lesson Search](http://www.slideshare.net/) 17. Stat Trek: [Teach Yourself Statistics](http://stattrek.com/tutorials/statistics-tutorial.aspx) 18. Statistics How To: [Probability and Statistics Topic Index](http://www.statisticshowto.com/probability-and-statistics/) 19. Study.com: [High School Lesson Index](http://study.com/academy/level/high-school.html) 20. Texas Instruments: [Classroom Activities](https://education.ti.com/en/us/activity/search/subject) 21. University of North Carolina of Wilmington: [Aquarius Lesson Plans](http://www.uncw.edu/ed/aquarius/index.html) |
| **Dictionaries, Calculators, and Templates**   1. Alcula: [Online Linear Regression Calculator](http://www.alcula.com/calculators/statistics/linear-regression/) 2. A Maths Dictionary for Kids: [Math Charts](http://www.amathsdictionaryforkids.com/mathsCharts.html) (Flash required) 3. A Maths Dictionary for Kids: [Math Dictionary](http://www.amathsdictionaryforkids.com/) 4. Math Open Reference:  [Calculator](http://www.mathopenref.com/calculator.html) 5. My HRW Classroom: [Graphing Calculator Online](https://my.hrw.com/math06_07/nsmedia/tools/Graph_Calculator/graphCalc.html) (Flash required) 6. UniVideo Math Teacher: [Download Free Virtual TI Calculator Online](http://videomathteacher.com/free-resources/free-downloadable-math-calculators/download-free-virtual-ti-calculator-online/) 7. Wabbitemu: [TI Calculator Emulator](https://wabbit.codeplex.com/) |
| **Teaching Strategies**   1. Creative Educator: [Authentic Tasks - Write a Great Authentic Task](http://creativeeducator.tech4learning.com/v01/articles/Writing_a_Great_Authentic_Task) 2. Creative Educator: [Project-Based Learning](http://creativeeducator.tech4learning.com/v01/articles/Success_Begins_with_Effective_Design) 3. Illustrative Mathematics: [Illustrative Mathematics Homepage](https://www.illustrativemathematics.org/) 4. Math Video Instructional Development Source: [Authentic Contexts](http://fcit.usf.edu/mathvids/strategies/ac.html) 5. Power Up What Works: [Math Strategies that Work Research](http://powerupwhatworks.org/resource/research-math-practices) |

| **Course/Grade:** Foundations Of Algebra.  **Unit:** 6 | **Task Title:** Task 1: Linear Regression  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.SPID.6\* Using technology, create scatter plots and analyze those plots to compare the fit of linear, quadratic, or exponential models to a given data set. Select the appropriate model, fit a function to the data set, and use the function to solve problems in the context of the data.  FA.SPID.7\* Create a linear function to graphically model data from a real-world problem and interpret the meaning of the slope and intercept(s) in the context of the given problem.  FA.SPID.8\* Using technology, compute and interpret the correlation coefficient of a linear fit. |
| **Mathematical Process Standards Addressed** | 1. Make sense of problems and persevere in solving them.  b. Recognize there may be multiple entry points to a problem and more than one path to a solution.  c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem.  2. Reason both contextually and abstractly.  a. Make sense of quantities and their relationships in mathematical and real-world situations.  b. Describe a given situation using multiple mathematical representations.  3. Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.  b. Compare and discuss the validity of various reasoning strategies.  4. Connect mathematical ideas and real-world situations through modeling.  c. Make assumptions and estimates to simplify complicated situations.  d. Evaluate the reasonableness of a model and refine if necessary.  5. Use a variety of mathematical tools effectively and strategically.  6. Communicate mathematically and approach mathematical situations with precision. |
| **Materials and Resources** | Scatter Plot Document  [Average Cost of College](https://studentloanhero.com/average-cost-of-college-statistics/)  Linear Regression and Scatter Plot with Technology Document  [TI-83 Instructions](http://cnx.org/contents/d0ba1833-f0d2-4195-8765-3c436745f0fb@11) |
| **Task Description** | This task should take between 2-3 days.   1. Hook students by completing the Scatter Plots IL 2. Follow up with a lesson on procedures of linear regression in the TI 83+ and Desmos Calculator. 3. Students should read the article “Average Cost of College” and discuss as a class. 4. Have students complete the Linear Regression Research Project with a partner. |
| **Equitable Access** | Students can complete the regression equations using a calculator or Desmos Calculator. Students can graph the equations and scatter plots using graphing calculator, Desmos Calculator, or pencil/paper.  Students also have the option to research various types of colleges of their choice.  Different characteristics could be chosen to make the task relevant to all students (i.e. height/weight of football players, |
| **Mathematical Vocabulary** | Linear Regression, prediction, scatter plot, correlation coefficient, slope, slope intercept form |
| **Student Reflection** | Included in Resources |

| **Unit 6 Task 1 Resource: Scatter Plots Inquiry Task**  [Return to Table of Contents](#TableofContents) |
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| Scatter Plot for Scatter Plots Inquiry Lesson  I Notice……………       I Wonder…………. |

| **Unit 6 Task 1 Resource: Scatter Plots and Linear Regression with Technology**  [Return to Table of Contents](#TableofContents) |
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| **Scatter Plots and Linear Regression**  **with Technology**   * **Topic:** Working with a partner, find historical data on tuition costs and use that information to predict future tuition costs. * **Data:** Find data for the following  1. Public College tuition costs for 5 different years. Create ordered pairs and a table of values to represent the data (year, cost). Partner 1 2. Private college tuition costs for 5 different years. Create ordered pairs and a table of values to represent the data (year, cost). Partner 2 3. Take a screenshot of the data used and insert into your Google Doc.  * **Scatterplots:** Create a scatter plot (using Desmos Calculator) for each set of data (public-partner 1 and private-partner 2). * **Equations:** Calculate the linear regression equation (y=mx+b) for each set of data and provide an **explanation of the slope** (rate at which tuition costs are rising). Determine the correlation coefficient and describe the meaning. Graph the linear regression equations with the scatter plots using Desmos Calculator. * **Predictions:** Predict tuition costs using the linear regression equations.  1. Cost for you to attend a public-partner 1 and private college-partner 2 in 2022. 2. Cost for a 5 year old to attend a public-partner 1 and private college-partner 2 in 2032.  * **Article:** Do you agree or disagree with the article? Explain your position in at least 2 complete sentences. * **Requirements:** All data should be submitted electronically using a shared Google Document and Desmos Calculator.   **Research Project Rubric**  **Scatter Plots and Linear Regression**  **Data:**  Public School (10) \_\_\_\_\_\_\_\_\_\_\_\_\_\_  Private School (10) \_\_\_\_\_\_\_\_\_\_\_\_\_\_  Hard Copy of Data (5) \_\_\_\_\_\_\_\_\_\_\_\_\_  **Scatter Plots and Graphs:** Graphed correctly, clearly labeled graphs, neat and legible.  Public School Plot and Graph(15)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Private School Plot and Graph(15)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Equations:**  Public School Linear Regression Equation (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Explanation of slope and correlation coefficient(5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Private School Linear Regression Equation (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_  Explanation of slope and correlation coefficient(5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Predictions:**  Public School You (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Public School 5 year Old (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Private School You (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Private School 5 year Old (5) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Article:**  Agree/Disagree/Why? (5)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Total Points Earned out of 100:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

| **Course/Grade:**Foundations in Algebra  **Unit:** 6 | **Task Title:** Task 2: Two-Way Tables-Walking or Biking to Work  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.SPID.5\*: Analyze bivariate categorical data using two-way tables and identify possible associations between the two categories using marginal, joint, and conditional frequencies. |
| **Mathematical Process Standards Addressed** | 1c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 6a. Express numerical answers with the degree of precision appropriate for the context of a situation. 4a. Identify relevant quantities and develop a model to describe their relationships. |
| **Materials and Resources** | Teacher Notes: Two-way tables: [Walking and bicycling to work (Teacher Version)](https://www2.census.gov/programs-surveys/sis/activities/math/mm-1_teacher.pdf)  Student Activity: Two-way tables: [Walking and bicycling to work (Student Version)](https://www2.census.gov/programs-surveys/sis/activities/math/mm-1_student.pdf) |
| **Task Description** | 1. Students will make data observations of the number of persons who walk or bike to work in Cambridge, MA and Columbia, SC.  2. Students will calculate the relative frequencies of each value (as a percentage).  3. Students will calculate the conditional relative frequencies by row and by column.  4. Students will draw conclusions based on the data. |
| **Equitable Access** | Students could be asked to find other data comparing Charleston, SC to Columbia, SC. Instead of writing the news article, students could present their findings as a TV news report. |
| **Mathematical Vocabulary** | Bivariate Data Joint Relative Frequency Marginal Relative Frequency Conditional Relative Frequency Two-way Table |
| **Student Reflection** | What important data might be missing? Is this an accurate reflection of all persons who do not drive to work? |

| **Course/Grade:**Foundations in Algebra  **Unit:** 6 | **Task Title:** Task 3: What are the Odds of That Happening?  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.SPMJ.2\*: Distinguish between experimental and theoretical probabilities. Collect data on a chance event and use the relative frequency to estimate the theoretical probability of that event. Determine whether a given probability model is consistent with experimental results. |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 2a. Make sense of quantities and their relationships in mathematical and real-world situations. 3a. Construct and justify a solution to a problem. 3c. Make conjectures and explore their validity. 4c. Make assumptions and estimates to simplify complicated situations. 6b. Represent numbers in an appropriate form according to the context of the situation. 7b. Recognize mathematical repetition in order to make generalizations. |
| **Materials and Resources** | Coins (or another two-sided object)  Dice (6 sided, 20 sided, etc.)  Bag with colored balls/marbles/other sortable objects  What are the Odds of That Happening? Activity |
| **Task Description** | Students will complete the “What are the Odds of That Happening?” Activity. It is a 3-part activity starting with flipping a coin, then rolling a die, and finally working with marbles to determine the probabilities of events. |
| **Equitable Access** | Students can be partnered to work together on this activity. Students can be asked to increase the number of trials |
| **Mathematical Vocabulary** | Conditional Probability Experimental Probability Theoretical Probability |
| **Student Reflection** | What would be the outcome if we change the number of sides of a die from 6 to another value (e.g. 20)? What would happen if we added a new color to the bag of marbles? |

| **Unit 6 Task 3 Resource: What are the Odds of That Happening?**  [Return to Table of Contents](#TableofContents) |
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| Flip a coin 10 times and record your results below (heads or tails)   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |   What is the experimental probability of getting heads after flipping 10 times?  Flip a coin 50 times and record your results below (heads or tails).   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |   What is the experimental probability of getting heads after flipping 50 times?  Were your two results the same? Explain why or why not.  With an elbow/table partner, compare your results of the two coin experiments. What do you notice? What do you wonder?  Now take a 6-sided die and roll it 20 times and record your results below.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |   What is the experimental probability of getting each number on the die after 20 rolls?   | 1 | 2 | 3 | 4 | 5 | 6 | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |   What is the sum of all the probabilities? Is the sum what you expected? Explain your reasoning.  Now roll the die 60 times and record your results.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |   What is the experimental probability of getting each number on the die after 60 rolls?   | 1 | 2 | 3 | 4 | 5 | 6 | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |   What do you notice about the probabilities of the die experiment?  What do you think would happen if we were to flip the coin or roll the die millions of times?  What is the theoretical probability of a coin landing heads on one flip?  What is the theoretical probability of a die landing on any specific number?  With the bag of marbles, list the number of marbles by color.   | Red |  | | --- | --- | | Blue |  | | Green |  | | Yellow |  | | Orange |  |   What is the theoretical probability of each color drawn randomly?   | Red |  | | --- | --- | | Blue |  | | Green |  | | Yellow |  | | Orange |  |   If a red marble is drawn first and NOT replaced, what is the probability of drawing each color?   | Red |  | | --- | --- | | Blue |  | | Green |  | | Yellow |  | | Orange |  |   If a blue marble is drawn first and NOT replaced, what is the probability of drawing each color?   | Red |  | | --- | --- | | Blue |  | | Green |  | | Yellow |  | | Orange |  |   If an orange marble is drawn first and IS replaced, what is the probability of drawing each color?   | Red |  | | --- | --- | | Blue |  | | Green |  | | Yellow |  | | Orange |  |   What do you notice about the probabilities for these events? Explain your notice.  Explain the difference between experimental probabilities and theoretical probabilities.  *(SCDE, 2019)* |

| **Course/Grade:**Foundations in Algebra  **Unit:** 6 | **Task Title:** Task 4: Survey Sampling Project  [Return to Table of Contents](#TableofContents) |
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| **State Standards Addressed** | FA.SPMJ.1\*: Understand statistics and sampling distributions as a process for making inferences about population parameters based on a random sample from that population. FA.SPMD.4\*: Use probability to evaluate outcomes of decisions by finding expected values and determine if decisions are fair. FA.SPMD.5\*: Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions. FA.SPMD.6\*: Analyze decisions and strategies using probability concepts. |
| **Mathematical Process Standards Addressed** | 1a. Relate a problem to prior knowledge. 1b. Recognize there may be multiple entry points to a problem and more than one path to a solution. 1d. Evaluate the success of an approach to solve a problem and refine it if necessary. 2b. Describe a given situation using multiple mathematical representations. 3a. Construct and justify a solution to a problem. 3c. Make conjectures and explore their validity. 4a. Identify relevant quantities and develop a model to describe their relationships. 4d. Evaluate the reasonableness of a model and refine if necessary. 5b. Use technological tools and other external mathematical resources to explore and deepen understanding of concepts. 6b. Represent numbers in an appropriate form according to the context of the situation. 6c. Use appropriate and precise mathematical language. 6d. Use appropriate units, scales, and labels. |
| **Materials and Resources** | Survey Project Document |
| **Task Description** | Students will complete the survey project  This project will take multiple days to collect the data, organize the data, and present the data. |
| **Equitable Access** | Students can choose a topic of their interest. Students are able to receive assistance at any point of the project. |
| **Mathematical Vocabulary** | Relative Frequency Population Parameter Random Sample Cluster Sample Systematic Sample Stratified Sample Quantitative Variable Qualitative Variable Ogive Significance |
| **Student Reflection** | Students will reflect throughout the project on how their data effects the population. How could this research be used to make changes to the world around you? |

| **Unit 6 Task 4 Resource: Survey Project**  [Return to Table of Contents](#TableofContents) |
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| **Objective:** Students will be able to conduct a survey using appropriate statistical methods and analyze the data.  **Procedures:**   1. Choose a meaningful survey question. Then define the population from which you will take your sample. 2. State and explain the method you will use to find the sample. Describe how this method will work for your particular situation.    1. Random    2. Systematic    3. Stratified    4. Cluster 3. State the categories of your variables.    1. Quantitative or qualitative    2. If quantitative: discrete or continuous 4. Conduct your survey with at least 50 people, following your chosen method for finding the sample. 5. Organize your results in a frequency distribution. 6. If quantitative variable:    1. Find mean, median, and mode of your data.    2. Display data with one of these graphs: frequency histogram, frequency polygon, or ogive. Draw a box and whisker plot for your data, labeling Q1, Q2, Q3, and the minimum and maximum. 7. If qualitative variable:    1. Draw a pie graph of your results.    2. Find the mode.    3. Find the probability of each event happening. (part/whole) 8. All projects need a concluding summary (1-2 paragraphs) describing what your results mean for your situation and what you can assume about the population based on your survey. You will also need to describe what you learned from doing this project. 9. Students will organize their findings into a visual representation to present to the class. Included in the presentation, describe what decisions you would make about the findings for your population.   **Presentation of Material:**  Students will display their project so that others can read and understand how they collected and analyzed their results. Appropriate display methods include PowerPoint, poster board or tri-fold board, a movie, program, or a written report.  Students will also present their survey and findings to the class on a predetermined day. Students may use their PowerPoint, poster, board, movie, or Word document to present the material.  **Suggested Grading:**  Students will be graded throughout the project with short rubrics and be given the opportunity to redo parts that are unsatisfactory.  The final grade will be determined using this rubric:   * Deadlines met throughout project with appropriate part of project completed at time (25 points)   + Deadline 1: Collection of survey data   + Deadline 2: Data organization (charts, graphs, etc.)   + Deadline 3: Final presentation   + All deadlines met on time (25 points)   + 2 of 3 met on time (15 points)   + 1 of 3 met on time (7 points) * Final results are accurate and correct (35 points)   + -5 for each incorrect answer or graph * Material is presented in an appropriate manner and is well organized, neat, and attractive (25 points) * Student presents findings to class, dressed appropriately, and shows understanding of material (15 points)   *(SCDE, 2019)* |

| **General Course Resources**  [Return to Table of Contents](#TableofContents) |
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| * Texas Instruments: [Texas Instruments Algebra 1 Graphing Calculator Activities](https://education.ti.com/en/84activitycentral/us/algebra-i) * Explore Learning: [Gizmos Online Simulations](https://www.explorelearning.com/) * Quizizz: [Search and/or create practice examples](https://quizizz.com/admin) * Khan Academy: [Videos, Exercises, & Assessments](https://www.khanacademy.org/) * Algebra Lab: [Algebra 1 Practice](http://www.algebralab.org) * Inside Mathematics: [Performance Assessment Tasks](http://www.insidemathematics.org/performance-assessment-tasks) * Illustrative Mathematics: [Activities For All Levels](https://www.illustrativemathematics.org/content-standards) * Robert Kaplinksy: [Problem-Based Learning Activities](http://robertkaplinsky.com/lessons/) * Desmos: [Online Graphing Calculator with Many Pre-Made Activities](https://www.desmos.com/) * Desmos Activities: [Classroom Activities](https://teacher.desmos.com) * Problem-Attic: [Sample Problem](http://www.problem-attic.com/) * Jefferson Lab: [Practice Tests from Virginia for All Levels of Mathematics](http://education.jlab.org/solquiz/) * Problem Attic: [Sample Problems](http://www.problem-attic.com/) * Graph Free: [Graph Free](http://www.graphfree.com/) |

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