Audubon Public Schools

Fundamentals of High School Math

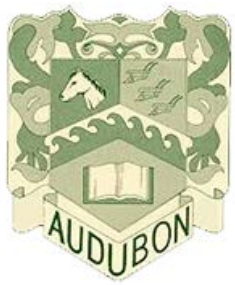
Curriculum Guide

Developed by:

Mrs. Kelly Rowello

August 15, 2018

Table of Contents



Course Description

Fundamentals of High School Math

Fundamentals of High School Math covers many of the traditional topics of Algebra I, including a review of the real number system, lines & slopes, solving equations & inequalities, exponents & exponential functions, and other algebraic topics. The course has a strong emphasis of technology through instruction and prepares students to critically think through complex real-world applications. Through Fundamentals of High School Math, students will begin to prepare for the State-mandated PARCC Algebra I exam, which will be taken the following school year. This course is the first year of a two year course, students successfully completing Fundamentals of High School Math will continue to Algebra I.

Overview / Progressions

Overview	Standards for Mathematical Content	Unit Focus	Standards for Mathematical Practice
Unit 1 Linear Equations and Inequalities	● N.Q.A.1 ● N.Q.A.2 ● A.SSE.A.1 ● A.CED.A.1 ● A.CED.A.4 ● A.REI.A.1 ● A.REI.B.3	● Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters ● Create linear equations and inequalities in one variable and use them to solve problems ● Explain the reasoning behind solving equations ● Use units and quantitative reasoning to solve problems ● Interpret the structure of expressions ● Rearrange formulas to highlight a variable of interest	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning. of others. MP.4 Model with mathematics.
Unit 2 Modeling with Linear Equations, Functions, and Inequalities	● N.Q.A.1 ● A.CED.A.2 ● A.REI.D.10 ● A.REI.D.12 ● F.IF.A.1	● Understand how to represent linear relationships on a coordinate plane	

	• F.IF.A.2 • F.IF.B.4 • F.IF.B.5 • F.IF.B.6 • F.BF.A.1 • F.BF.B.4 • F.LE.B.5 • S.ID.B.6 • S.ID.C.7 • S.ID.C.8 • S.ID.C.9	• Interpret key features of a graph to write and solve linear equations • Understand the concepts of a function and use function notation to represent linear functions • Build a function that models a relationship between two quantities • Analyze functions using different representations • Interpret functions that arise in applications in terms of the context • Represent data on two quantitative variables on a scatter plot and describe how the variables are related • Build inverse functions	MP.5 Use appropriate tools strategically.. MP.6 Attend to precision. MP.7 Look for and make use of structure. MP.8 Look for and express regularity in repeated reasoning.
Unit 3 Solving Systems of Linear Equations, Functions, and Inequalities	• A.CED.A.3 • A.REI.C.5 • A.REI.C.6 • A.REI.D.11 • A.REI.D.12	• Solve linear systems of equations algebraically • Solve linear systems of equations graphically • Use technology to analyze/approximate the	

		solution to a system of linear equations ● Solve a system of linear inequalities graphically ● Create a system of linear equations or inequalities to represent a situation and use it to solve problems	
Unit 4 Exponential Equations and Functions	● A.SSE.A.1 ● A.SSE.B.3 ● F.IF.B.4 ● F.IF.B.5 ● F.IF.B.6 ● F.IF.C.7 ● F.IF.C.9 ● F.BF.A.1 ● F.LE.A.1 ● F.LE.A.2 ● F.LE.A.3 ● F.LE.B.5	● Utilize exponent rules to simplify exponential expressions ● Perform operations on expressions in scientific notation ● Identify exponential growth and decay in applications in terms of the context ● Interpret key features of exponential functions algebraically and graphically ● Construct and compare linear and exponential models ● Build an exponential function that models a relationship between two quantities	

		● Analyze successive differences to create a regression equation of best fit for a data set. ● Evaluate exponential and linear regression lines of real-world situations ● Evaluate and create arithmetic and geometric sequences	

Subject: Fundamentals of High School Math	**Grade: 9**	**Unit: 1**	**1st Marking Period**

Content Standards	**Suggested Standards for Mathematical Practice**	**Critical Knowledge & Skills**
● A.SSE.A.1. Interpret expressions that represent a quantity in terms of its context. A.SSE.A.1a. Interpret parts of an expression, such as terms, factors, and coefficients	MP.1 Make sense of problems and persevere in solving them. MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.7 Look for and make use of structure.	Concept(s): ● No new concept(s) introduced Students are able to: ● identify different parts of an expression, including terms, factors and constants. ● explain the meaning of parts of an expression in context. Learning Goal 1: Interpret terms, factors, coefficients, and other parts of expressions in terms of a context .
● A.REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. ● A.REI.A.1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the	MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning. of others. MP.6 Attend to precision. MP.7 Look for and make use of	Concept(s): ● Literal equations can be rearranged using the properties of equality. Students are able to: ● solve linear equations with coefficients represented by letters in one variable. ● use the properties of equality to justify steps in solving linear equations.

previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. ● A.CED.A.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.	structure.	● solve linear inequalities in one variable. ● rearrange linear formulas and literal equations, isolating a specific variable. Learning Goal 2: Solve linear equations and inequalities in one variable (including literal equations); justify each step in the process.
● A.CED.A.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear functions and quadratic functions, and simple rational and exponential functions. ● A.REI.A.1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable a viable	MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.7 Look for and make use of structure.	Concept(s): ● Equations and inequalities describe relationships. ● Equations can represent real-world and mathematical problems Students are able to: ● identify and describe relationships between quantities in word problems. ● create linear equations in one variable. ● create linear inequalities in one variable. ● use equations and inequalities to solve real world problems. ● explain each step in the solution process

argument to justify a solution method.		Learning Goal 3: Create linear equations and inequalities in one variable and use them in contextual situations to solve problems. Justify each step in the process and the solution.
● N.Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; Choose and interpret units consistently in formulas; Choose and interpret the scale and the origin in graphs and data displays. ● N.Q.A.2. Define appropriate quantities for the purpose of descriptive modeling	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.6 Attend to precision.	Concept(s): ● Units are associated with variables in expressions and equations in context. ● Quantities may be used to model attributes of real world situations. ● Measurement tools have an inherent amount of uncertainty in measurement. Students are able to: ● use units to understand real world problems. ● use units to guide the solution of multi-step real world problems (e.g. dimensional analysis). ● choose and interpret units while using formulas to solve problems. ● identify and define appropriate quantities for descriptive modeling. ● choose a level of accuracy when reporting measurement quantities. Learning Goal 4: Solve multi-step problems, using units to guide the solution, interpreting units consistently in formulas and choosing an appropriate level of accuracy on measurement quantities. Develop descriptive models by defining appropriate quantities.

Formative Assessments	**Summative Assessments**

• Independent, guided, and group practice/activities • Teacher observation • Marzano 9 strategies (think-pair share, graphic organizers, ques and questions, etc.) • Technology result data (desmos, quizlet, quizizz, kahoot, IXL, etc.)	• Mid-chapter and chapter standard aligned assessments (tests and quizzes) • MAP Fall
Suggested Primary Resources	**Suggested Supplemental Resources**
• Glencoe Algebra 1 2012 (https://connected.mcgraw-hill.com/connected/login.do) • TI 84 Graphing Calculator (https://parcctrng.testnav.com/client/index.html#login?username=17MTA1PTOE01010200&password=PCPRACTICE) • Desmos Graphing Calculator (www.desmos.com)	• Desmos Classroom Activities • Quizlet, Quizizz, Kahoot, etc. • Edpuzzle • IXL Math • Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
• Science, Technology, Engineering, and Mathematics (STEM) Literacy • Global Awareness • Creativity and Innovation • Critical Thinking and Problem Solving • Communication and Collaboration • Life and Career Skills	
Essential Questions	**Enduring Understanding**
• How do mathematical models/representations shape our understanding of mathematics? • What are the similarities and differences in the procedures for solving and expressing the solutions of equations and inequalities? • What makes a strategy to problem solving effective and efficient in solving linear equations or inequalities in one variable?	• Rules of arithmetic and algebra can be used together with notions of equivalence to transform equations and inequalities so solutions can be found. • Being able to compute fluently means making smart choices about which tools to use and when to use them to accurately solve real-world applications of equations and inequalities.

● How can a variable transform itself?	

Subject: Fundamentals of High School Math	Grade: 9	Unit: 2	2nd Marking Period

Content Standards	Suggested Standards for Mathematical Practice	Critical Knowledge & Skills

● F.IF.A.1. 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. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x). ● F.IF.A.2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. ● F.BF.A.1. Write a function that describes a relationship between two quantities.	MP 2 Reason abstractly and quantitatively. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): ● F(x) is an element in the range and x is an element in the domain. Students are able to: ● use the definition of a function to determine whether a relationship is a function. ● use function notation once a relation is determined to be a function. ● evaluate functions for given inputs in the domain. ● explain statements involving function notation in the context of the problem. ● write a function from given information. Learning Goal 1: Explain the definition of a function, including the relationship between the domain and range. Use function notation, write functions, evaluate functions and interpret statements in context.
● F.IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified	MP.1 Make sense of problems and persevere in solving them. MP.3 Construct viable arguments and critique the reasoning of others. MP.5 Use appropriate tools	Concept(s): ● Rate of change of non-linear functions varies Students are able to: ● compare key features of two linear functions represented in different ways.

interval. Estimate the rate of change from a graph.	strategically. MP.6 Attend to precision. MP.8 Look for and express regularity in repeated reasoning.	● calculate the rate of change from a table of values or from a function presented symbolically. ● estimate the rate of change from a graph. Learning Goal 2: Calculate and interpret the average rate of change of a function presented symbolically or as a table; estimate the rate of change from a graph.
● A.CED.A.2. Create equations in two or more variables to represent relationships between quantities; Graph equations on coordinate axes with labels and scales. ● N.Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; Choose and interpret units consistently in formulas; Choose and interpret the scale and the origin in graphs and data displays. ● A.REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision MP.7 Look for and make use of structure.	Concept(s): ● Equations and inequalities represent quantitative relationships Students are able to: ● create linear equations and inequalities in two variables, including those from a context. ● select appropriate scales for constructing a graph. ● interpret the origin in graphs. ● graph equations on coordinate axes, including labels and scales. ● model real world situations by creating a linear equations or inequality given a context. ● identify and describe the solutions in the graph of an equation or range of solutions for an inequality. Learning Goal 3: Create linear equations and inequalities in two variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Learning Goal 4: Solve and graph linear inequalities and

● A.REI.D.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). [Focus on linear equations.] ● A.REI.D.12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-plane		explain that the solution in context.
● F.IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the	MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.6 Attend to precision.	Concept(s): ● Graphs of linear equations and functions obtain key features that can be compared (ie. intercepts, slopes, etc.) ● Terms describing a linear graph such as positive or negative, end behavior, etc. Students are able to: ● given a verbal description of a relationship, sketch linear functions.

function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *[Focus on linear functions] ● F.LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context. ● F.IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. ● F.IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. F.IF.C.7a Graph linear and		● identify intercepts and intervals where the function is positive/negative. ● interpret parameters in context. ● determine the practical domain of a function. Learning Goal 5: Sketch graphs of linear functions expressed symbolically or from a verbal description. Show key features and interpret parameters in context.

quadratic functions and show intercepts, maxima, and minima. *[Focus on linear functions.]		
● F.BF.B.4 Find inverse functions. F.BF.B.4a Solve an equation of the form f(x)=c for a simple function f that has an inverse and write an expression for the inverse. F.BF.B.4c Read values of an inverse function from a graph or table, given that the function has an inverse. ● A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; Graph equations on coordinate axes with labels and scales.	MP.1 Make sense of problems and persevere in solving them. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): ● Linear relations and functions have inverse relations and functions. ● Inverse relations are sets obtained by exchanging the x-coordinate with the y-coordinate. ● Inverse functions of linear functions can be found by interchanging the x variable with the y variable. ● Inverses can be represented as relations, tables, graphs, or equations. Students are able to: ● find the inverse of a relation represented in set notation or in a table. ● graph inverse relations. ● find the inverse of a linear function. ● graph inverse linear functions. ● use a linear function and its inverse to represent a real-world situation. ● determine the meaning or significance of a inverse function in context of a problem. Learning Goal 6: Explain the relationship between a function and its inverse. Find inverses of a given representation assuming there is an inverse. Use inverse relationships to analyze

		real-word problems.

Formative Assessments	Summative Assessments
● Independent, guided, and group practice/activities ● Teacher observation ● Marzano 9 strategies (think-pair share, graphic organizers, ques and questions, etc.) ● Technology result data (desmos, quizlet, quizizz, kahoot, IXL, etc.)	● Mid-chapter and chapter standard aligned assessments (tests and quizzes) ● MAP Winter
Suggested Primary Resources	**Suggested Supplemental Resources**
● Glencoe Algebra 1 2012 (https://connected.mcgraw-hill.com/connected/login.do) ● TI 84 Graphing Calculator (https://parcctrng.testnav.com/client/index.html#login?username=17MTA1PTOE01010200&password=PCPRACTICE) ● Desmos Graphing Calculator (www.desmos.com)	● Desmos Classroom Activities ● Quizlet, Quizizz, Kahoot, etc. ● Edpuzzle ● IXL Math ● Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
● Science, Technology, Engineering, and Mathematics (STEM) Literacy ● Global Awareness ● Creativity and Innovation ● Critical Thinking and Problem Solving ● Communication and Collaboration ● Life and Career Skills	
Essential Questions	**Enduring Understanding**

● Why are tables, graphs, and equations useful for representing relationships? ● Why are linear functions useful in real-world settings? ● Why would you use multiple representations of linear equations and inequalities?	● Real world situations can be represented symbolically and graphically to influence patterns of prediction or highlight past, present, or future occurrences of linear situations.

Subject: Fundamentals of High School Math	**Grade: 9**	**Unit: 3**	**3rd Marking Period**

Content Standards	**Suggested Standards for Mathematical Practice**	**Critical Knowledge & Skills**
● A.REI.D.11. Explain why the x coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases	MP.1 Make sense of problems and persevere in solving them. MP.3 Construct viable arguments and critique the reasoning of others. MP.5 Use appropriate tools strategically	Concept(s): ● y = f(x), y = g(x) represent a system of equations. ● Systems of equations can be solved graphically. Students are able to: ● explain the relationship between the x-coordinate of a point of intersection and the solution to the equation f(x) = g(x) for linear equations y = f(x) and y = g(x).

where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* [Focus on linear equations.]		● find approximate solutions to the system by making a table of values, graphing, and finding successive approximations. Learning Goal 1: Explain why the solutions of the equation f(x) = g(x) are the x-coordinates of the points where the graphs of the linear equations y=f(x) and y=g(x) intersect. ** function notation is not introduced here Learning Goal 2: Find approximate solutions of f(x) = g(x), where f(x) and g(x) are linear functions, by making a table of values, using technology to graph and finding successive approximations.
● A.REI.C.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. ● A.CED.A.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.3 Construct viable arguments & critique the reasoning. of others. MP.4 Model with mathematics.	Concept(s): ● Systems of equations can be solved exactly (algebraically) and approximately (graphically). Students are able to: ● identify and define variables representing essential features for the model. ● model real world situations by creating a system of linear equations. ● solve systems of linear equations using the elimination or substitution method. ● solve systems of linear equations by graphing. ● interpret the solution(s) in context. Learning Goal 3: Solve multistep contextual problems by identifying variables, writing equations, and solving systems

constraints on combinations of different foods. ● A.REI.C.5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.		of linear equations in two variables algebraically and graphically.
● A.REI.D.12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. ● A.CED.A.3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a	MP.1 Make sense of problems and persevere in solving them. MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.6 Attend to precision.	Concept(s): ● No new concept(s) introduced Students are able to: ● model real world situations by creating a system of linear inequalities given a context. ● interpret the solution(s) in context Learning Goal 4: Graph linear inequalities and systems of linear inequalities in two variables and explain that the solution to the system.

modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.		

Formative Assessments	Summative Assessments
• Independent, guided, and group practice/activities • Teacher observation • Marzano 9 strategies (think-pair share, graphic organizers, ques and questions, etc.) • Technology result data (desmos, quizlet, quizizz, kahoot, IXL, etc.)	• Mid-chapter and chapter standard aligned assessments (tests and quizzes) • MAP Spring
Suggested Primary Resources	**Suggested Supplemental Resources**
• Glencoe Algebra 1 2012 (https://connected.mcgraw-hill.com/connected/login.do) • TI 84 Graphing Calculator (https://parcctrng.testnav.com/client/index.html#login?username=17MTA1PTOE01010200&password=PCPRACTICE) • Desmos Graphing Calculator (www.desmos.com)	• Desmos Classroom Activities • Quizlet, Quizizz, Kahoot, etc. • Edpuzzle • IXL Math • Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
• Science, Technology, Engineering, and Mathematics (STEM) Literacy • Global Awareness • Creativity and Innovation • Critical Thinking and Problem Solving • Communication and Collaboration • Life and Career Skills	

Essential Questions	Enduring Understanding
● What does the number of solutions (one, none, or infinite) of a system of linear equations or inequalities represent? ● What are the advantages and disadvantages of solving a system of linear equations graphically versus algebraically? ● How can systems of equations or inequalities be used to represent situations and solve real world problems?	● There are situations that require two or more equations or inequalities to be satisfied simultaneously. ● There are several methods for solving systems of equations (graphing, substitution, and elimination). ● Solutions to systems can be interpreted algebraically, geometrically, and in terms of problem contexts. ● The number of solutions to a system of equations and/or inequalities can vary from no solution to an infinite number of solutions.

Subject: Fundamentals of High School Math	Grade: 9	Unit: 4	4th Marking Period

Content Standards	Suggested Standards for Mathematical Practice	Critical Knowledge & Skills
● A.SSE.B.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A.SSE.B.3c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as (1.151/12) 12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. *[Algebra 1: limit to exponential	MP.1 Make sense of problems and persevere in solving them. MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.7 Look for and make use of structure	Concept(s): ● Solve equations involving rational exponents by the use of exponent properties ● Use technology to solve harder exponential equations Students are able to: ● use the properties of exponents to simplify or expand exponential expressions, recognizing these are equivalent forms. ● use the properties of exponents to create equivalent forms of expressions to determine the solution of exponential equations ● utilize technology to determine the solutions of complex exponential equations (equations without common bases)

expressions with integer exponents]		Learning Goal 1: Use properties of exponents to produce equivalent forms of exponential expressions in one variable. Learning Goal 2: Use properties of exponents to produce equivalent expressions to solve an exponential equations, utilize technology for exponential equations without common bases.
● F.IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *[Focus on exponential functions] ● F.LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.	MP 2 Reason abstractly and quantitatively. MP.3 Construct viable arguments and critique the reasoning of others. MP.4 Model with mathematics. MP.6 Attend to precision.	Concept(s): ● Linear functions grow by equal differences over equal intervals. ● Exponential functions grow by equal factors over equal intervals. Students are able to: ● identify and describe situations in which one quantity changes at a constant rate. ● identify and describe situations in which a quantity grows or decays by a constant percent. ● show that linear functions grow by equal differences over equal intervals. ● show that exponential functions grow by equal factors over equal intervals ● given a verbal description of a relationship, sketch linear and exponential functions. ● identify intercepts and intervals where the function is positive/negative. ● interpret parameters in context. ● determine the practical domain of a function.

F.LE.A.1a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. F.LE.A.1b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. F.LE.A.1c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another ● F.LE.B.5. Interpret the parameters in a linear or exponential function in terms of a context. ● F.IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive		Learning Goal 3: Distinguish between and explain situations modeled with linear functions and with exponential functions. Learning Goal 4: Sketch graphs of linear and exponential functions expressed symbolically or from a verbal description. Show key features and interpret parameters in context.

integers would be an appropriate domain for the function		
● F.LE.A.2. Construct linear and exponential functions - including arithmetic and geometric sequences - given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *[Algebra 1 limitation: exponential expressions with integer exponents] ● F.IF.A.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.	MP.1 Make sense of problems and persevere in solving them. MP.2 Reason abstractly and quantitatively. MP.4 Model with mathematics. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.7 Look for and make use of structure.	Concept(s): ● Sequences are functions, sometimes defined and represented recursively. ● Sequences are functions whose domain is a subset of integers. Students are able to: ● create arithmetic and geometric sequences from verbal descriptions. ● create arithmetic sequences from linear functions. ● create geometric sequences from exponential functions. ● identify recursively defined sequences as functions. ● create linear, exponential, and quadratic regression functions given − a graph; − a description of a relationship; − a table of values Learning Goal 5: Write linear and exponential functions given a graph, table of values, or written description; construct arithmetic and geometric sequences.

● F.BF.A.1. Write a function that describes a relationship between two quantities. 1a. Determine an explicit expression, a recursive process, or steps for calculation from a context. ● A.SSE.A.1. Interpret expressions that represent a quantity in terms of its context A.SSE.A.1a: Interpret parts of an expression, such as terms, factors, and coefficients. A.SSE.A.1b: Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P. *[Algebra 1 limitation: exponential expressions with integer exponents]	MP 2 Reason abstractly and quantitatively. MP.4 Model with mathematics	Concept(s): ● Creating linear and exponential equations/functions through the regression feature of a graphing calculator (technology) Students are able to: ● given a data set, analyze successive differences, write an explicit regression function of best fit for linear or exponential models ● interpret parts of linear and/or exponential functions in context ● use technology to evaluate or predict outcomes of real-world problems Learning Goal 6: Create a regression function of best fit (linear and exponential) by analyzing successive differences and use the regression function to solve or predict outcomes of real-world problems.

● F.IF.C.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. *[Limit to linear and exponential] ● F.IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	MP.1 Make sense of problems and persevere in solving them. MP.3 Construct viable arguments and critique the reasoning of others. MP.5 Use appropriate tools strategically. MP.6 Attend to precision. MP.8 Look for and express regularity in repeated reasoning.	Concept(s): ● Rate of change of non-linear functions varies. Students are able to: ● compare key features of two linear functions represented in different ways. ● compare key features of two exponential functions represented in different ways. ● calculate the rate of change from a table of values or from a function presented symbolically. ● estimate the rate of change from a graph. Learning Goal 7: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Formative Assessments	Summative Assessments
● Independent, guided, and group practice/activities ● Teacher observation	● Mid-chapter and chapter standard aligned assessments (tests and quizzes)

• Marzano 9 strategies (think-pair share, graphic organizers, ques and questions, etc.) • Technology result data (desmos, quizlet, quizizz, kahoot, IXL, etc.)	
Suggested Primary Resources	**Suggested Supplemental Resources**
• Glencoe Algebra 1 2012 (https://connected.mcgraw-hill.com/connected/login.do) • TI 84 Graphing Calculator (https://parcctrng.testnav.com/client/index.html#login?username=17MTA1PTOE01010200&password=PCPRACTICE) • Desmos Graphing Calculator (www.desmos.com)	• Desmos Classroom Activities • Quizlet, Quizizz, Kahoot, etc. • Edpuzzle • IXL Math • Kuta Software LLC, TeachersPayTeachers, Khan Academy
Cross-Curricular Connections & 21st Century Skills	
• Science, Technology, Engineering, and Mathematics (STEM) Literacy • Global Awareness • Creativity and Innovation • Critical Thinking and Problem Solving • Communication and Collaboration • Life and Career Skills	
Essential Questions	**Enduring Understanding**
• How can exponential functions be used to model real-world problems and solutions? • How do multiplicative patterns model the physical world? • How do we create, test and validate a mathematical model?	• Exponential models carefully define the percent rate of change in real-world applications. • In a geometric sequence, the ratio of any term to its preceding term is a constant value. • Exponential functions are important because they can be used to describe real-world situation involving population growth, decay of radioactive materials (half-life), compound interest.

Appendix A

Written By: Patricia Martel, Adam Cramer
Reapproved June 2017

Course Title: Pre-Algebra Unit Name: Operations on Numbers and Expressions
Grade Level: 9

Content Statements Successful students will be able to perform operations with real numbers and algebraic expressions, including expressions involving exponents, scientific notation, and square roots, using estimation and an appropriate level of precision. Reasoning skills will be emphasized, including justification of results.	**NJSLS:** **N-RN.3** **N-Q.1** **N-Q.2** **N-Q.3** **A-CED.4**
Overarching Essential Questions What are some ways to represent, describe, and analyze patterns (that occur in our world)? When is one representation of a function more useful than another? How can we use algebraic representation to analyze patterns? Why are number and algebraic patterns as important as rules? How are arithmetic operations related to functions? How can numeric operations be extended to algebraic objects? Why is it useful to represent real-life situations algebraically? What makes an algebraic algorithm both effective and efficient?	**Overarching Enduring Understandings** Logical patterns exist and are a regular occurrence in mathematics and the world around us. Algebraic representation can be used to generalize patterns and relationships. The same pattern can be found in many different forms. Relationships can be described and generalizations made for mathematical situations that have numbers or objects that repeat in predictable ways. Functions are a special type of relationship or rule that uniquely associates members of one set with members of another set. Algebraic and numeric procedures are interconnected and build on one another to produce a coherent whole. Rules of arithmetic and algebra can be used together with (the concept of) equivalence to transform equations and inequalities so solutions can be found to solve problems. Variables are symbols that take the place of numbers or ranges of numbers; they have different meanings depending on how they are being used.

	Proportionality involves a relationship in which the ratio of two quantities remains constant as the corresponding values of the quantities change.
Unit Essential Questions How can a problem be translated into an equation? How can you apply the rules of multiplication and division? How is the distributive property used in an algebraic equation or expression? What are number operations and algebraic expressions? How can rates, ratios, percents, and proportions be applied to problem solving? What are the steps to solving an equation that involves one or more transformations? How can equations involving the addition and subtraction of polynomials be simplified and solved? How can equations be solved for different variables? How can numbers be represented using scientific notation? How can fractions be multiplied and divided? Why do you need a common denominator to work with some algebraic fractions and rational expressions? Why is it useful to know equivalent forms for rational expressions? Why is simplifying an algebraic fraction like simplifying a numeric fraction? How can the Pythagorean theorem be used to find the length of a side of a right triangle?	**Unit Enduring Understandings** Use properties of number systems within the set of real numbers to verify or refute conjectures or justify reasoning. Use rates, ratios and proportions to solve problems, including measurement problems. Describe and distinguish among the various uses of variables, including: Symbols for varying quantities (such as $3x$) Symbols for fixed unknown values (such as $3x - 2 = 7$) Symbols for all numbers in properties (such as $x + 0 = x$) Symbols for formulas (such as $A = l * w$) Symbols for parameters (such as m and b for slope in $y = mx + b$) Apply the laws of exponents to numerical and algebraic expressions with integral exponents to rewrite them in different but equivalent forms or to solve problems. Use the properties of radicals to convert numerical or algebraic expressions containing square roots in different but equivalent forms or to solve problems. Add, subtract and multiply polynomial expressions. Factor simple polynomial expressions.

How can we determine the difference between rational and irrational numbers? How can general quadratic trinomials be factored? How can factoring help us to solve equations? How can problems be solved by factoring quadratic equations? What is prime factorization? What does GCF mean?	
Unit Rationale Core content for Pre-Algebra includes a number of discrete skills and concepts, each related to broader mathematical principles. In teaching and learning Algebra I, it is important for teachers and students to comprehend the following big ideas and to connect the individual skills and concepts of Algebra I to these broad principles. **PATTERNS AND FUNCTIONS** Algebra provides language through which we describe and communicate mathematical patterns that arise in both mathematical and non-mathematical situations, and in particular, when one quantity is a function of a second quantity or where the quantities change in predictable ways. Ways of representing patterns and functions include tables, graphs, symbolic and verbal expressions, sequences, and formulas. **EQUIVALENCE:** There are many different – but equivalent – forms of a number, expression, function, or equation, and these forms differ in their efficacy and efficiency in interpreting or solving a problem, depending on the context. Algebra extends the properties of numbers to rules involving symbols; when applied properly, these rules allow us to transform an expression, function, or equation into an equivalent form and substitute equivalent forms for each other. Solving problems	**Unit Overview** Number Sense and Operations Reasoning with real numbers Using ratios, rates, and proportions Using variables in different ways Using numerical exponential expressions Using algebraic exponential expressions Using numerical radical expressions Using algebraic radical expressions Algebraic Expressions Operating with polynomial expressions Factoring polynomial expressions

algebraically typically involves transforming one equation to another equivalent equation until the solution becomes clear.	

Resources

New Jersey Algebra I Content Document
Scientific Calculator
TI Smart software
Kuta worksheets - http://www.kutasoftware.com/free.html
Tutorials on www.brightstorm.com
A New Algebra: Tools, Themes, Concepts (1993) Henri Picciotto, Anita Wah
http://www.mathedpage.org/new-algebra/new-algebra.html
Alexandria City Schools Algebra I Curriculum http://www.acps.k12.va.us/curriculum/design/sample-algebra-course.pdf

Key Terms

Binomial - polynomial with exactly two terms
constant - number
consecutive integers - whole numbers that are all in a row
equation - contains numbers and/or variables and must contain an equal sign
integer - positive or negative whole number
Monomial - variable or number or both separated only by multiplication
numerical expression - numbers separated by mathematical operations
Order of operations - order that must be followed when there is more than 1 mathematical operation present; PEMDAS - Parenthesis, Exponents, Multiplication/Division, Addition/Subtraction
percent - something out of 100
percent increase - comparison of how much a value has increased compared to the original
percent decrease - comparison of how much a value has decreased compared to the original
Polynomial - one or more monomials separated by addition or subtraction
proportion - two fractions set equal to each other
ratio - comparison between two values

rational number - can be written as a fraction scientific notation - easier way to write really big or really small numbers simple interest - percentage of every dollar the bank pays as a reward for allowing them to hold your money tax - percentage added on to every dollar for the government Term - a piece of a polynomial Trinomial - polynomial with exactly three terms tip - percentage added on to every dollar for a service performed variable - letter or symbol that stands for a number variable expression -variable or number or both separated by mathematical operations

Audubon Public Schools
Engaging Students ~ Fostering Achievement ~ Cultivating 21st Century Global Skills
Written By: Patricia Martel, Adam Cramer
Reapproved June 2017

Course Title: Pre-Algebra Unit Name: Linear Relationships
Grade Level: 9

Content Statements	**NJSLS:**
Successful students will be able to solve and graph the solution sets of linear equations, inequalities to use words, tables, graphs, and symbols to represent, analyze, and model with linear functions. In contextual problems students graph and interpret their solutions in terms of the context. They apply such problem solving heuristics as: identifying missing or irrelevant information; testing ideas; considering analogous or special cases; making appropriate estimates; using inductive or deductive reasoning; analyzing situations using symbols, tables, graphs, or diagrams; evaluating progress regularly; checking for reasonableness of results; using technology appropriately; deriving	**A-CED.2** **A-CED.4** **A-REI.3** **A-REI.10** **S-ID.7**

independent methods to verify results; and using the symbols and terms of mathematics correctly and precisely. Function notation should be introduced and used regularly but not exclusively.	
Overarching Essential Questions How can change be best represented mathematically? How can we use mathematical language to describe change? How can we use mathematical models to describe change or change over time? How can patterns, relations, and functions be used as tools to best describe and help explain real-life situations? How are patterns of change related to the behavior of functions? How are functions and their graphs related? How can technology be used to investigate properties of linear functions and their graphs? How can systems of equations be used to solve real-life situations?	**Overarching Enduring Understandings** Graphs and equations are alternative (and often equivalent) ways for depicting and analyzing patterns of change. Functional relationships can be expressed in real contexts, graphs, algebraic equations, tables, and words; each representation of a given function is simply a different way of expressing the same idea. The value of a particular representation depends on its purpose. A variety of families of functions can be used to model and solve real world situations. Understanding patterns and predicting the next term in a sequence. Determining the algebraic formula for a sequence and using it to predict a future term in the sequence.
Unit Essential Questions What does it mean if two lines intersect? What is the slope of the line? How can variables be used to solve problems dealing with consecutive integers? (Writing equations) How are verbal and algebraic models used to represent real life situations? Why does dividing by zero create an undefined result?	**Unit Enduring Understandings** Recognize, describe and represent linear relationships using words, tables, numerical patterns, graphs and equations. Describe, analyze and use key characteristics of linear functions and their graphs. Key characteristics include constant slope and *x*- and *y*-intercepts. Graph the absolute value of a linear function and determine and analyze its key characteristics. Key characteristics include e vertex, slope of each branch, intercepts, domain and range, maximum, minimum, transformations, and opening direction. Recognize, express and solve problems that can be modeled using linear functions. Interpret solutions in terms of the context of the problem.

Unit Rationale	**Unit Overview**
Relationships between quantities can be represented in compact form using expressions, equations, and inequalities. Representing quantities by variables gives us the power to recognize and describe patterns, make generalizations, prove or explain conclusions, and solve problems by converting verbal conditions and constraints into equations that can be solved. Representing quantities with variables also enables us to model situations in all areas of human endeavor and to represent them abstractly. **LINEARITY** In many situations, the relationship between two quantities is linear so the graphical representation of the relationship is a geometric line. Linear functions can be used to show a relationship between two variables that has a constant rate of change and to represent the relationship between two quantities which vary proportionately. Linear functions can also be used to model, describe, analyze, and compare sets of data.	Linear Functions Representing linear functions in multiple ways Analyzing linear function Using linear models Graphing linear equations Identifying slope and y-intercept
Resources New Jersey Algebra I Content Document Scientific Calculator TI Smart software Kuta worksheets - http://www.kutasoftware.com/free.html Tutorials on www.brightstorm.com A New Algebra: Tools, Themes, Concepts (1993) Henri Picciotto, Anita Wah http://www.mathedpage.org/new-algebra/new-algebra.html Alexandria City Schools Algebra I Curriculum http://www.acps.k12.va.us/curriculum/design/sample-algebra-course.pdf	
Key Terms linear equation - two variable equation whose graph is a straight line parallel lines - have same slope; are everywhere equidistant and never intersect perpendicular lines- have slopes that make right angles: Slopes are opposite reciprocal.	

reciprocal – product of reciprocal and itself is one. Multiplicative inverse. slope - rise over run; steepness of a line solution of a system of equations - x and y value that makes all equations in the system true system of linear equations - two or more linear equations unit rate - ratio that contains the number one

Audubon Public Schools
Engaging Students ~ Fostering Achievement ~ Cultivating 21st Century Global Skills
Written By: Patricia Martel, Adam Cramer
Course Title: Pre-Algebra Unit Name: Systems of Equations and Inequalities
Grade Level: 9

Content Statements Students will be able to consistently graph lines with parallel, perpendicular slopes. Use graphing skills to graph multiple lines at the same time and identify solutions based on their intersection. Repetition is necessary. Stress the importance of checking the answers by plugging in the solution. Three methods of solving systems will be used; graphing, substitution, and elimination. Students will also understand all systems do not have a solution and some systems have infinitely many solutions. Function notation should be introduced and used regularly but not exclusively.	**NJSLS:** **A-CED.1** **A-CED.3** **A-REI.5** **A-REI.6**
Overarching Essential Questions How can systems of equations be used to solve real-life situations? What is the solution to a system of equations and what the solution means? How can we interpret the solution to a system when there is no solution or infinitely many solutions?	**Overarching Enduring Understandings** Solve word problems which involve finances, intersecting paths, optimal situations, business models, and other everyday system applications. Identify the intersection of two graphs is the solution to a system of equations. These means any solution to a system is an ordered pair (x, y) Solve systems and identify when systems have no solutions or cases where we get an infinite number of solutions.

Unit Essential Questions	**Unit Enduring Understandings**
What method would be most appropriate to solve the system of equations? Is the solution to a system of equations reasonable? Does the system have one, none, or infinitely many solutions? What is a system of linear equations and how do you solve it? What does it mean when the system does not have a single solution? What is slope and how is it related to solutions of a system of linear equations?	Solve single-variable linear equations and inequalities with rational coefficients. Linear equations may have no solution (empty set), an infinite number of solutions (identity) or a unique solution. Graph and analyze the graph of the solution set of a two-variable linear inequality. Solve systems of linear equations in two variables using algebraic and graphic procedures. Recognize, express and solve problems that can be modeled using single-variable linear equations; one- or two-variable inequalities; or two-variable systems of linear equations.
Unit Rationale Systems of equations are located in real-world situations everywhere. Students must develop proper problem solving skills in order to solve for certain situations that require one solution to work in multiple areas. Longer problems solving skills are used in order to solve more tedious problems then typical mathematics problems.	**Unit Overview** Linear Equations and Inequalities Solving linear equations and inequalities Graphing linear inequalities Solving systems of linear equations Modeling with single variable linear equations, one-or two-variable inequalities or systems of equations
Resources New Jersey Algebra I Content Document Scientific Calculator TI Smart software Kuta worksheets - http://www.kutasoftware.com/free.html Tutorials on www.brightstorm.com A New Algebra: Tools, Themes, Concepts (1993) Henri Picciotto, Anita Wah http://www.mathedpage.org/new-algebra/new-algebra.html Alexandria City Schools Algebra I Curriculum http://www.acps.k12.va.us/curriculum/design/sample-algebra-course.pdf	
Key Terms solution of a system of equations - x and y value that makes all equations in the system true system of linear equations - two or more linear equations	

inequality - contains numbers and/or variables and uses four inequality symbols no solution- case where two lines are parallel infinitely many solutions – Case where two lines are the same

Audubon Public Schools
Engaging Students ~ Fostering Achievement ~ Cultivating 21st Century Global Skills
Written By: Patricia Martel, Adam Cramer
Course Title: Pre-Algebra Unit Name: Basic Statistics/Probability/ Data Analysis
Grade Level: 9

Content Statements Students will be able to study basic probability, and statistics. Students will work on problems with probability that cover ratios, odds, and chances, ect. In covering statistics students will work on basic data analysis with central tendency. They will use real-world data in order to solve for mean, median, mode, and range. Students will learn the application of outliers on central tendency as well as being able to create box and whisker plots.	**NJSLS:** **S-ID.7** **S-IC.1** **S-IC.2** **S-IC.3**
Overarching Essential Questions Students will be able to extract mean, median, mode and understand how to use it? How can probability be used to solve real-world problems? How can probability help us make the best decisions? How do people use data to support their own agenda?	**Overarching Enduring Understandings** Students must be able to understand how to analyze data. They will do this by understanding mean, median, mode, range, and other statistic and probability concepts. Data analysis and probability skills will allow students to make better or correct decisions about real world problems. How do sales, politicians and other pop-culture environments use and skew data in order to support their own agenda.

Unit Essential Questions	**Unit Enduring Understandings**
What is probability? What is statistics? What are the three forms of central tendencies? How can we determine what is the best measure of central tendency? What is an outlier? What is range and how does it differ with each set of data? What is a box and whisker plot?	Understanding probability is number of desired outcomes divided by total number of all possible outcomes. Determine all three central tendencies given specific data and based on the data determine what the best measure of central tendency is. Understand an outlier can change data and should be taken into consideration or removed when finding central tendency. Using 5 pieces of data in order to create a stem and whisker plot. (Median, Min , Max, Q1, Q3)
Unit Rationale This unit will cover all materials that students will see in everyday life that includes data and probability. The unit enhances problem solving skills and more importantly decision making skills. It is necessary to be able to extract information from any real life situation as well as organize data in a way that anyone can recognize.	**Unit Overview** Students not only will be able to analyze and determine data from plots, graphs and tables, but will also be able to do the opposite and construct a plot given specific data.
Resources New Jersey Algebra I Content Document Scientific Calculator TI Smart software Kuta worksheets - http://www.kutasoftware.com/free.html Tutorials on www.brightstorm.com A New Algebra: Tools, Themes, Concepts (1993) Henri Picciotto, Anita Wah http://www.mathedpage.org/new-algebra/new-algebra.html Alexandria City Schools Algebra I Curriculum http://www.acps.k12.va.us/curriculum/design/sample-algebra-course.pdf	
Suggested Student Activities M&M Activity – Students will measure the occurrence of a specific color of M&M. Any Statistical data can be used to analyze or construct a graph of, or determine whether information is honest. Students will be able to provide their own data that they find online, or in a magazine	
Key Terms	

Central tendency – Way of identify the “average” or “middle” of a piece of data
Mean – This is the average of data.
Median – This is the middle term when data is organized from largest to smallest.
Mode – This is the most frequent occurring term in data.
Range – This is the difference between the maximum data point and the minimum data point.
Outlier – Piece of data very far away from the rest of the data.
Skewed – Outliers cause data to be skewed or appear differently then what it actual represents.