ACALANES UNION HIGH SCHOOL DISTRICT
COURSE OF STUDY: CURRICULAR AREA – MATH

COURSE TITLE:	ALGEBRA A
GRADE LEVEL:	9-12
COURSE LENGTH:	One Year
PREFERRED PREVIOUS COURSE OF STUDY:	Common Core Math 8
CREDIT:	10 Credits
UC/CSU CREDIT:	Meets UC/CSU credit for mathematics requirement; subject area (“c”)
GRADUATION REQUIREMENT:	Fulfills 10 units of Algebra 1 credit required for graduation
STANDARDS AND BENCHMARKS:	California Common Core State Standards in Mathematics
ADOPTED:	May 20, 2015
INSTRUCTIONAL MATERIALS:	Big Ideas Algebra 1, Big Ideas Learning, 2015

COURSE DESCRIPTION: Algebra A reviews, formalizes, and extends the mathematics that students learned in Common Core math 6 through 8. This course includes content standards from the conceptual categories of Number and Quantity, Algebra, Functions, and Statistics and Probability. Through the application of the Standards for Mathematical Practice, students will increasingly engage with the subject matter and grow in mathematical maturity and expertise.

COURSE OBJECTIVES:

Content Objectives

During the course students will:

1. Develop and extend an understanding of linear and exponential relationships including contrasting these models
2. Solve linear and quadratic equations
3. Engage in methods for analyzing quadratic functions
4. Explore, manipulate, and compare different types of function
5. Analyze real world data using statistics

Skill Objectives:

During the course students will work toward:

1. Active learning through investigation and conjecture
2. Consistent study habits, organization, and personal responsibility for learning
3. Proficiency in writing about mathematics and fluency in using mathematical vocabulary
4. Strategic implementation of instructional technologies
5. Effective communication and collaboration

ASSESSMENT: Assessments are designed to promote and evaluate mathematical thinking. Teachers use engaging activities that involve students in investigating, conjecturing, verifying, applying, evaluating, and communicating in various assessment modalities.

Formal and informal assessments can be made on the basis of both individual and group work. Assessments should be from a variety of means and could include performance tasks, quizzes, tests, projects, investigations, and daily assignments.

Assessments should be measuring the following claims:
Claim #1 – Concepts & Procedures
Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.
Claim #2 – Problem Solving
Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies.
Claim #3 – Communicating Reasoning
Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Claim #4 – Modeling and Data Analysis
Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

Performance Tasks
Performance tasks are used to better measure capacities such as depth of understanding, research skills, and complex analysis, which cannot be adequately assessed with selected- or constructed-response items. These tasks may require students to evaluate, optimize, design, plan, model, transform, generalize, justify, interpret, represent, estimate, and calculate solutions. Performance Tasks can be used for a variety of purposes such as topic engagement, formative and evaluative assessment. They may be performed individually or in small groups, depending on the purpose of assessment.

Performance tasks should:

- Integrate knowledge and skills across multiple claims
- Require student-initiated planning and management of information and ideas
- Reflect a real-world task and/or scenario-based problem
- Allow for multiple approaches
- Represent content that is relevant and meaningful to students
- Be assessed using an understandable rubric that provides meaningful feedback for students and the teacher

GRADING GUIDELINES: See AUHSD Grading Guidelines: Final Mark Rubric and Final Course mark Determination Components

COURSE CONTENT:

Mathematical Practices

The Standards for Mathematical Practice are “habits of the mind of mathematically proficient students”. They describe the attributes that mathematics educators at all levels are striving to develop in their students, as these practices are based on key mathematical processes and proficiencies. The goal of implementing these practices is to develop students who can use their knowledge of mathematics in flexible, sophisticated, and relevant ways across multiple disciplines.

#1 Make sense of problems and persevere in solving them (Hypothesize & Strategize)

- Students are:
  - Making conjectures about what the problem is asking and how they can begin to solve it
  - Checking for the reasonableness of the strategy as the work progresses and making adjustments as needed
- Teachers develop this skill by having students:
  - Explain the meaning of the problem and/or restate the problem
  - Analyze the given information and develop entry points into the problem and develop strategies for solving the problem
  - Execute and evaluate multiple strategies

#2 Reason abstractly and quantitatively (De/Contextualize)

- Students are:
  - Determining what numbers and symbols represent through the use of diagrams, graphs or equations
- Teachers develop this skill by having students:
  - Move between multiple representations to determine the meaning behind quantities
  - Express purely mathematical expressions with real world context and taking quantities out of context and representing them as abstract mathematical ideas or expressions

#3 Construct viable arguments; critique others’ reasoning

- Students are:
  - Justifying their thinking by providing evidence based on mathematical properties and using that evidence to evaluate the reasoning of others
- Teachers develop this skill by having students:

- Make conjectures, compare and contrast methods, and identify flawed logic by providing counter-example

#4 Model with Mathematics

- Students are:
  - Interpreting and constructing graphs, tables, number lines, diagrams or equations to model real-world situational data
- Teachers develop this skill by having students:
  - Use models to make interpolative and extrapolative inferences
  - Examine the effectiveness and appropriateness of a model

#5 Use appropriate tools strategically

- Students are:
  - Selecting appropriate math tools and technology to help solve problems including manipulatives, graphing utilities, tables, matrices, computer applications, compasses, etc.
- Teachers develop this skill by having students:
  - Identify the strengths and weaknesses of different tools in relation to solving a given problem and also use tools to explore, confirm or deepen understanding

#6 Attend to Precision

- Students are:
  - Calculating quantities accurately through proper rounding (based on context), labeling of units of measure, and checking their work
  - Selecting a problem solving method that allows for appropriate precision
- Teachers develop this skill by having students:
  - Formulate precise explanations of their work using vocabulary and justify their rounding process
  - Re-examine their work or thinking process, and then demonstrate the method by which they check their answers

#7 Look For and Make Use of Structure

- Students are:
  - Looking for patterns or relationships and using that structure to simplify complex ideas
- Teachers develop this skill by having students:

- Extend prior knowledge of similar situations to novel ones or break down complex problems in smaller parts which resemble simpler, more familiar ideas

#8 Look for and express regularity in repeated reasoning (Generalize)

- Students are:
  - Developing general methods, rules, or short cuts and determining when they are appropriate
- Teachers develop this skill by:
  - Facilitating activities which allow for students' "aha!" moments and then helping them use it to develop "rules" based on repeated trials with a process

The Number System (A)	
Common Core State Standard (CCSS)	**Learning Objective**
7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged. b. Understand p + q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. c. Understand subtraction of rational numbers as adding the additive inverse, p – q = p + (–q). Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. d. Apply properties of operations as strategies to add and subtract rational numbers.	• Review addition and subtraction of real numbers
7.NS.2 Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers	• Review operations of real numbers • Review of negative and positive integers • Review distributive property

(with non-zero divisor) is a rational number. If p and q are integers, then –(p/q) = (–p)/q = p/(–q). Interpret quotients of rational numbers by describing real-world contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers. d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.	
7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.	• Apply operations of real numbers to real life situations
7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.	• Review of adding and subtracting like terms
8.NS.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.	• Categorize numbers as rational or irrational
Modeling with Functions (A)	
Common Core State Standard (CCSS)	**Learning Objective**
8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.	• Introduction to domain and range • Create and interpret mapping diagrams and how they relate to graphs
N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	• Apply appropriate units given a specific context • Determine rates from a graph or equation to solve a problem • Interpret and create distance time graphs
N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.	• Perform unit conversions • Create and solve proportions

N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	• Select an appropriate level of precision within the context of a problem
F.IF.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)	• Differentiate between independent and dependent quantities • Understand and identify the key features of the Cartesian plane • Define and understand domain and range • Determine the domain and range for a relation • Differentiate between relations and functions by using tables, graphs, equations, mapping diagrams and set • Use the vertical line test to determine if a graph is a function
F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	• Evaluate expressions • Evaluate and interpret function notation • Create linear functions from patterns
F.IF.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.	• Represent an arithmetic sequence as a linear function; as a table, list or a graph • Represent a geometric sequence as an exponential function; as a table, list or a graph • Experiment with types of sequences other than arithmetic or geometric
8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	• Explain patterns represented in a graph • Sketch graphs
F.IF.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.	• Use patterns, graphs and tables to create functions • Use function notation • Distance Time Graphs including Increasing, Decreasing interpretation • Discrete vs Continuous Graphs • Interpreting Linear, Quadratic and Exponential Graphs, maximums/minimums, Symmetries, and End Behavior

F.IF.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.	• Interpreting linear, quadratic and exponential graphs • Relating the domain to its graph
8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.	• Develop understanding of how slope relates to rate of change
F.IF.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.	• Compare key characteristics of two different representations of functions, e.g. slope, y-intercepts, maximum, minimum, transformations
8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.	• Use the rate of change to determine the linear model

F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	• Use the rate of change to determine the mathematical model: linear or exponential • Associate a common difference with a linear model • Associate a common ratio with an exponential model • Distinguish between growth and decay models
F.LE.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.	• Compare and identify linear, quadratic and exponential functions • Compare and contrast the growth of linear, quadratic and exponential functions
F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.	• Contextualize models with appropriate constraints or parameters
Linear Functions (A)	
Common Core State Standard (CCSS)	**Learning Objective**
F.IF.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.	• Choose and write functions to model data • Compare functions using average rates of change • Solve real world scenarios involving linear functions • Calculate the slope of a line from a table, list of points or graph
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima.	• Compare functions using average rates of change • Solve real world scenarios involving linear functions • Construct a graph from a linear equation • Analyze a graph to identify key characteristics
F.BF.1 Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context.	• Write equations in slope-intercept, point-slope and standard form • Use linear equations to solve real world scenarios • Write an equation of a line given its slope and a point on the line • Write an equation of a line given two points on the line • Use lines of fit to model data

F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	• Write the terms of arithmetic sequences given the rule or inductive reasoning to extend the pattern • Graph arithmetic sequences • Write arithmetic sequences as functions • Write terms of recursively defined sequences • Write recursive rules for sequence. • Translate between recursive rules and explicit rules
F.BF.4 Find inverse functions. a. 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. For example, f(x) = 2 x3 or f(x) = (x+1)/(x-1) for x ≠ 1.	• Find the inverse of a relation • Explore the relationship between a function and its inverse: algebraically and graphically
F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.	• Associate a common difference with a linear model • Associate a common ratio with an exponential model • Justify that a model is linear or exponential using rate of change
Linear Equations & Inequalities in One Variable (A)	
Common Core State Standard (CCSS)	**Learning Objective**
8.EE.7a Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).	• Solve and understand the range of solutions to one variable equations
A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	• Solve simple equations, multi-step equations, equations with variables on both sides, and linear absolute value equations • Use unit analysis to model real world scenarios • Identify special solutions (no solutions, all real numbers, etc.) • Justify steps to solve equations using properties of equality

8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.	• Solve multi-step one variable equations
A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	• Solve linear equations and inequalities including multi-step, variables on both sides, and absolute value
A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.	• Decontextualize real world scenarios to create equation and inequalities to find the solution in the context of the problem
A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.	• Identify restrictions in the context of the problem: domain and range
A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.	• Isolate specified variables in formulas and/or equations
Linear Equations & Inequalities in Two Variables (A)	
Common Core State Standard (CCSS)	**Learning Objective**
8.EE.8a Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.	• Understanding the graphical representation of a system of equations

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	• Identify and graph linear equations and inequalities • Using function notation to evaluate and graph functions • Create linear equations from a given data set (graph, table, etc.) • Graph special cases e.g. vertical or horizontal lines and absolute value • Slope and writing equations using slope-intercept and point-slope form • Recognize and rearrange equations into standard form • Recognize and write equations for parallel and perpendicular lines • Compare linear functions to other types • Solve systems by graphing, substitution and elimination
A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.	• Use linear equations, inequalities and systems to model real world scenarios • Consider the context of the problem when verifying solutions (constraints) • Understand special case solutions to systems e.g. no solution and infinitely many solutions
A.REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	• Solve a system using elimination
8.EE.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.	• Inspect a system without solving to determine the nature of the solutions
A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	• Solve a system using graphing, substitution or elimination • Select and differentiate between appropriate methods: graphing, substitution or elimination
A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	• Create a graphic representation of the infinite set of all solutions points for linear equations • Verify that the points on the line are solutions to the linear equation

A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.	• Verify that the intersection point is a solution to the given linear system • Solve the linear system by graphing • Use technology to model a linear system
A.REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	• Graph linear inequalities and systems of linear inequalities • Understand that the shaded region is the set of all solutions for the linear inequality • Recognize that the intersection of shaded regions represents the solution set for a system of linear inequalities
Statistics (A)	
CCSSM Common Core State Standard (CCSS)	**Learning Objective**
S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).	• Construct and analyze histograms and box and whisker plots which represent data
S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.	• Compare and contrast representations of data to make observations about distribution and measures of central tendencies
S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	• Analyze the effects of changes within the given data set • Determine how data points can affect the central tendencies and measures of distribution
S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.	• Read and interpret a two-way frequency table

7.SP.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.	• Introduction to statistics • Use real world examples and data
8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	• Introduction to scatter plots • Introduction to negative and positive correlation
S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.	• Create a scatter plot from a given data set • Identify and describe correlations between data sets • Draw and estimate a line of best fit • Use two points to write an equation that estimates the line of best fit • Use residuals to determine how well the function fits the data • Critique graphs for skewed representation (i.e. scale) • Model a real world scenario
8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.	• Application of slope to data
S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	• Analyze characteristics of the graph and to relate to the context of the real world scenario

S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.	• Compute and interpret the correlation coefficient of linear fit using technology • Connect a given correlation coefficient to the characteristics of the graph
8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?	• Introduction to correlation and causation
S.ID.9 Distinguish between correlation and causation.	• Determine whether data is in a cause-and-effect relationship or merely related