**La Cañada High School**

***Proposed Course Outline – CC Math 8 Advanced***

# **Course Title – CC Math 8 Advanced**

1. **Grade Level(s) – 8th Grade**

# **Length/Credit – 1 Year - 10.0 units Satisfies Second Year of Required 7/8 Math**

# **Preparations – Completion of CC Math 7 Advanced with a grade of B or higher or CC Math 7 with a grade of A and teacher recommendation.**

1. **Course Description**

This is the second course in an advanced common core middle school math sequence. This course builds on, and deepens, the conceptual understanding of working with expressions and linear equations from CC Math 7. As the second course in an accelerated two-year progression, it will include standards traditionally taught in Algebra 1, Geometry, and Algebra II. Successful completion of CC Math 8 Advanced positions students to enter accelerated math pathways upon matriculation into high school. The main purpose of CC Math 8 Advanced is to develop students’ fluency of the number system, expressions and equations, and the attributes of functions. The critical areas of instruction involve deepening and extending students’ understanding of formulating and reasoning about expressions and equations, grasping the concept of a function and using functions to describe quantitative relationships, analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem. Since the Standards for Mathematical Practice will be woven throughout each unit of the course, students will analyze each other’s work, make and prove conjectures, use tools to experiment and validate conclusions, and problem solve.

# **Standards/ESLRs Addressed**

**1. Standards for Mathematical Practices**

* Make sense of problems and persevere in solving them.
* Reason abstractly and quantitatively.
* Construct viable arguments and critique the reasoning of others.
* Model with mathematics.
* Use appropriate tools strategically.
* Attend to precision.
* Look for and make use of structure.
* Look for and express regularity in repeated reasoning.

**2. The Number System**

**Rational and Irrational Numbers Standards Abbreviation: 8.NS**

* Know that there are numbers that are not rational, and approximate them by rational numbers.
  + 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.
  + Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g.,π2). For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.

**The Real Number System Standards Abbreviation: N-RN**

* Extend the Properties of Exponents to Rational Exponents
  + Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5
  + Rewrite expressions involving radicals and rational exponents using the properties of exponents
* Use Properties of Rational and Irrational Numbers
  + Explain why the sum or product of two 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.

**3. Expressions and Equations**

* **Work with Radicals and Integer Exponents Standards Abbreviation: 8.EE**
  + Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3–5 = 3–3 = 1/33 = 1/27.
  + Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
  + Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 × 108 and the population of the world as 7 × 109, and determine that the world population is more than 20 times larger.
  + Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
* **Understand the Connections Between Proportional Relationships, Lines, and Linear Equations.** 
  + Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
  + Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.
* **Analyze and Solve Linear Equations and Pairs of Simultaneous Linear Equations**
  + Solve linear equations in one variable.
    - a. 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).
    - b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

* **Analyze and Solve Pairs of Simultaneous Linear Equations**
  + Analyze and solve pairs of simultaneous linear equations.a. 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.b. 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.c. Solve real-world and mathematical problems leading to linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

**Creating Equations Standards Abbreviation: A-CED**

* **Create equations that Describe Numbers or Relationships**
  + Create equations and inequalities in one variable including ones with absolute value and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

**Reasoning with Equations and Inequalities Standards Abbreviation: A-REI**

* **Understand Solving Equations as a Process of Reasoning and Explain the Reasoning.**
  + 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 Equations and Inequalities in One Variable**
  + Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
  + Solve one-variable equations and inequalities involving absolute value, graphing the solutions and interpreting them in context.

**4. Functions Standards Abbreviation: 8.F**

* **Define, Evaluate, and Compare Functions** 
  + 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.
  + 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.
  + Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.
* **Use Functions to Model Relationships Between Quantities**
  + 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.
  + 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.
* **Construct and Compare Linear, Quadratic, and Exponential Models and Solve Problems**
  + 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).
  + Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
* **Interpret Expressions for Functions in Terms of the Situation They Model**
  + Interpret the parameters in a linear or exponential function in terms of a context. [Linear and exponential of form f(x) = bx + k]

**5. Geometry Standards Abbreviation: 8.G**

* **Understand Congruence and Similarity Using Physical Models, Transparencies, or Geometry Software.**
  + Verify experimentally the properties of rotations, reflections, and translations:
    - a. Lines are taken to lines, and line segments to line segments of the same length.
    - b. Angles are taken to angles of the same measure.
    - c. Parallel lines are taken to parallel lines.
  + Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
  + Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates
  + Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
  + Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.
* **Understand and Apply the Pythagorean Theorem**
  + Explain a proof of the Pythagorean Theorem and its converse.
  + Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
  + Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
* **Solve Real-World and Mathematical Problems Involving Volume of Cylinders, Cones, and Spheres.**
  + Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

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* **Congruence Standard Abbreviation: G-CO**
  + Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
  + Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
  + Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
  + Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

**6. Statistics and Probability Standards Abbreviation: 8.G**

* **Investigate Patterns of Association in Bivariate Data**
  + 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.
  + Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
  + 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.
  + 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?

**Statistics and Probability Standards Abbreviation: S-ID**

* **Summarize, Represent, and Interpret Data on Two Categorical and Quantitative Variables**
  + 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.
  + 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, quadratic, 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.
* **Interpret Linear Models**
  + Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
  + Compute (using technology) and interpret the correlation coefficient of a linear fit.
  + Distinguish between correlation and causation.

# **Brief Course Outline**

**Essential Course Concepts: Quarter 1: Expanding Knowledge of the Number System and Formulating and Reasoning About Expressions and Equations**

* Introduction to Irrational Numbers
* Approximation of Irrational Numbers with Rational Numbers
* Work with Radicals and Integer Exponents
* Understand the Connection between Proportional Relationships, Lines, and Linear Equations.
* Create Equations that Describe Numbers or Relationships
* Analyze and Solve Linear Equations and Pairs of Simultaneous Linear Equations
* Extend the properties of Exponents to Rational Exponents
* Use Properties of Rational and Irrational Numbers.

**Common Core State Standards Addressed**: 8.NS.1, 8.NS.2, 8EE.1, 8EE.2, 8EE.3, 8EE.4, 8EE.5, 8EE.6, 8EE.7, 8EE.8, N-RN.1, N-RN.2, N-RN3, A-CED 1, A-REI 3

**Course Concepts Description**: Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions (y/x = m or y = mx) as special linear equations (y = mx + b), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount m . Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

**Essential Course Concepts: Quarter 2: Functions**

* Define, Evaluate, and Compare Functions
* Use of Functions to Model Relationships Between Quantities
* Solve One-Variable Equations and Inequalities Involving Absolute Value
* Construct and Compare Linear, Quadratic, and Exponential Models and Solve Problems
* Construct Linear and Exponential Functions
* Interpret the Parameters in a Linear or Exponential Function

**Common Core State Standards Addressed**: 8F.1, 8F.2, 8.F.3, 8F.4, 8F.5, 8F.6, A-REI.1, REI.3, REI.3.1, F-LE.1, F-LE.2, F-LE.3, F-LE.4, F-LE.5

**Course Concepts Description**: Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

**Essential Course Concepts: Quarter 3: Geometry**

* Understand Congruence and Similarity Using Physical Models, Transparencies, or Geometry Software
* Understand and Apply the Pythagorean Theorem
* Solve Real-World and Mathematical Problems Involving Volume of Cylinders, Cones, and Spheres.
* Experiment with Transformations in the Plane

**Common Core Concepts Addressed**: 8.G1, 8G.2, 8G.3, 8G.4, 8G.5, 8G.6, 8G.7, 8G.8, G-CO.2, G-CO.3, G-CO.4, G-CO.5

**Course Concepts Description**: Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students

show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

**Essential Course Concepts: Quarter 4: Statistics**

* Investigate Patterns of Association with Bivariate Data
* Construct and Interpret Scatter Plots
* Use the Equation of Linear Model to Solve Problems in the Context of Bivariate Measurement Data, Interpreting the Slope and Intercept
* Understand that patterns of association can also be seen in Bivariate Categorical Data by Displaying Frequencies and Relative Frequencies in a Two-Way Table
* Represent Data for Two Categories in Two-Way Frequency Tables
* Represent Data on Two Quantitative Variables on a Scatter Plot

**Common Core Concepts Addressed**: 8>SP.1, 8.SP.2, 8SP.3, 8SP.4, S-I.5, S-ID.6, S-ID.7, S-ID.8, S-ID.9

**Course Concepts Description**: Students construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Students will describe patterns such as clustering, positive or negative association, linear association, and nonlinear association. Students will know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest linear associations, students will informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. When using the equation of a linear model to solve problems in the context of bivariate measurement data, students will also interpret slope and intercept. For example, in a linear model for a biology experiment, students will interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight is associated with an additional 1.5 cm in mature plant height. Students will construct and interpret a two-way table summarizing data on two categorical variables collected from the same subject. For example, students will collect data from students in their class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. They will identify patterns of association, determining whether those who have a curfew also tend to have chores.

# **Methods of Assessment**

**Evaluation:**

1. **Examinations**: Examinations are a critical component in monitoring comprehension and in preparing students in the development of key critical thinking, operational and computational skills, data analysis, and reading skills. The examinations in this course will follow the district examination policies. Exams will take the form of tests and quizzes given at appropriate instructional periods.
2. **Projects**: Students will be asked to complete both individual and group projects related to key concepts of this course. .
3. **Homework**: Students will be assigned homework daily to provide independent practice opportunities to practice and deepen key concepts. **Homework Intensity for this course expects that students will complete homework that will require approximately 30 minutes daily.**
4. **Final Exam**: A final exam will be given at the conclusion of both first and second semester. It will be a comprehensive exam based upon the course of study completed during the year.

**Grades:**

All work will be assigned a point value, although not all work will receive a letter grade. Grades are based on total points accumulated during each grading period. I have structured the class in such a way to approximate your grade breaking down into the following percentages:

**Examinations: 55% A-= 90-100%**

**Classwork/Homework: 30% B - 80-89.9%**

**Final Exam: 15% C = 70- 79.9%**

**D = 60 – 69.9%**

**F = 59.9% and below**

1. **Materials/Textbook(s)** *California Algebra I*, Allan E. Bellman, et al., Prentice Hall, Boston, 2009. Ready Common Core Math - Grade 8, Student Practice and Problem Solving Book, 2016.

# **Seeking “a-f” Approval –** Yes/No – No - As a 7/8 class, this course does not seek UC A-F approval.

# **Seeking AP Class Approval –** Yes/No – This course does NOT seek AP approval.

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