

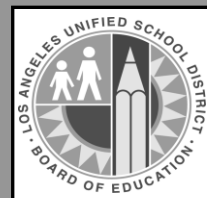
LOS ANGELES UNIFIED SCHOOL DISTRICT

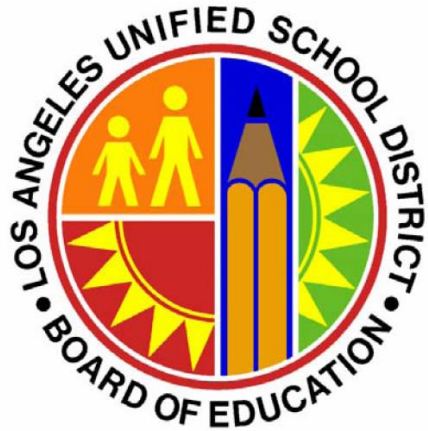
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Guidelines for Standards-Based Instruction

Secondary
Mathematics
Grades 6 - 12

Secondary Instructional Support Services
Secondary Mathematics Branch
Publication No. **SC-863.14** (Revised **March 2015**)





Los Angeles Unified School District
Instructional Support Services, Secondary
Secondary Mathematics Branch

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Foreword

The *Guidelines for Standards-Based Instruction in Secondary Mathematics, 2014 Edition*, provides a directory of courses adopted by the Los Angeles Unified School District for students in grades 6-12. It is designed to communicate to stakeholders—students, parents, school personnel and community representatives—the Mathematics content and skills students should master by the end of each grade level and course. It includes standards, descriptions, prerequisites, academic outcomes, course codes, syllabi, required assessments, and recommended instructional resources that meet the needs of diverse learners. As such, it is a comprehensive resource for implementation of and access to a rigorous standards-based secondary Mathematics curriculum that meets the District’s A through G graduation requirements and provides a gateway to multiple post-secondary options.

On November 6, 2013, the California Department of Education adopted the Common Core State Standards aligned *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve*, established a curricular platform for instruction and assessment, state-wide. The adoption of the Common Core State Standards (CCSS) content and practice standards for Mathematics by Board supported state and national efforts to improve student achievement. In 2001 the federal government reauthorized the *No Child Left Behind Act* and AB 484, signed by Governor Brown on October 1, 2013, decreases the number of tests under the Standardized Testing and Reporting system (STAR) and established California's new student assessment system, now known as the California Assessment of Student Performance and Progress (CAASPP). Consequently, the District’s secondary Mathematics program—the curricula, teaching and learning methodology, instructional resources, textbooks, assessments, and related resources—align to the CCSS as well as current accountabilities including the Smarter Balanced Assessment and to the academic demands of the 21st century.

The *Mathematics Guidelines for Standards-Based Instruction, revised in 2015* reflects a philosophy of teaching and learning that is consistent with current research, best practices and national and state accountabilities. It also reflects the changing needs of students and society and supports what students need to know and be able to do to be college and career ready as well as meet the challenges of the evolving global community of the 21st century.

Ramon C. Cortines
Superintendent

Gerardo Loera
Chief Academic Officer, OCIS

Acknowledgements, 2015 Edition

The grade level scope and sequence of the courses in this 2015 edition of the *Guidelines for Standards-Based Instruction in Mathematics* are the result of the collective expertise of both the present and past LAUSD Secondary Mathematics Team.

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**MATHEMATICS
LIST OF COURSES
MIDDLE SCHOOL
GRADES 6-8**

Course Number	Title	Abbreviation	Grade Level	Page(s)
CORE COURSES				
310111	Common Core Mathematics 6A	CC MATH 6A	6	8
310112	Common Core Mathematics 6B	CC MATH 6B	6	
310115	Common Core Mathematics 7A	CC MATH 7A	7	16
310116	Common Core Mathematics 7B	CC MATH 7B	7	
310117	Accelerated Common Core Math 7A	ACC CC MATH 7A	7	23
310118	Accelerated Common Core Math 7B	ACC CC MATH 7B	7	
310337	Common Core Mathematics 8A	CC MATH 8A	8	31
310338	Common Core Mathematics 8B	CC MATH 8B	8	
310339	Accelerated Common Core Algebra 1	ACC CC ALG 1A	8-9	37
310340	Accelerated Common Core Algebra 1	ACC CC ALG 1B**	8-9	
OTHER COURSES				
310113	Alternative Accelerated CC Math 6/7A ^{&}	ALT ACC CC MATH 6/7	6-7	48
310114	Alternative Accelerated CC Math 6/7B ^{&}	ALT ACC CC MATH 6/7	6-7	
310119	Alternative Accelerated CC Math 8/Algebra ^{&} 1A	ALT ACC CC MATH 8/AL	8	
310120	Alternative Accelerated CC Math 8/ Algebra ^{&} 1B	ALT ACC CC MATH 8/AL	8	
&Contact your ESC Math Coordinator and CCSS Director if your school is planning to offer any of the Alternative Accelerated courses				
INTERVENTION ELECTIVE COURSES				
312607	CC Math 6 Tutorial Lab A	CC MATH TUT LAB A	6-7	48
312608	CC Math 6 Tutorial Lab B	CC MATH TUT LAB B	6-7	
312619	CC Math 7 Tutorial Lab B	CC MATH TUT LAB A	7	53
312620	CC Math 7 Tutorial Lab B	CC MATH TUT LAB B	7	
312611	CC Math 8 Tutorial Lab A	CC MATH TUT LAB A	7-8	57
312612	CC Math 8 Tutorial Lab B	CC MATH TUT LAB B	7-8	

** Must be enrolled concurrently with 310339.

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MATHEMATICS

LIST OF COURSES SENIOR HIGH SCHOOL GRADES 9-12

Course Number	Title	Abbreviation	Grade Level	Page(s)
CORE C REQUIREMENT COURSES				
310341	Common Core Algebra 1A	ALGEBRA 1A*	8-12	64
310342	Common Core Algebra 1B	ALGEBRA 1B*	8-12	
310423	Common Core Geometry A	CC GEOM A	9-12	78
310424	Common Core Geometry B	CC GEOM B	9-12	
310343	Common Core Algebra 2A	CC ALG2 A	10-12	71
310344	Common Core Algebra 2B	CC ALG2 B	10-12	
310509	Advanced Mathematics	ADV MATH A	10-12	
310510	Advanced Mathematics	ADV MATH A	10-12	
310509	Honors Advanced Mathematics	H ADV MATH A	10-12	82
310510	Honors Advanced Mathematics	H ADV MATH A	10-12	
310601	Math Analysis A	MATH ANALY A [@]	10-12	96
310602	Math Analysis B	MATH ANALY B [@]	10-12	
310711	Precalculus A	PRECALC A	10-12	
310712	Precalculus B	PRECALC B	10-12	
310503	Discrete Mathematics A	DISCR MATH A	10-12	107
310504	Discrete Mathematics B	DISCR MATH B	10-12	
310607	Probability & Statistics A	STAT & PROB A	10-12	108
310608	Probability & Statistics B	STAT & PROB B	10-12	
Advanced Placement Year-Long Courses				
310701	AP Calculus A	AP CALCULUS A	11-12	111
310702	AP Calculus B	AP CALCULUS B	11-12	
or				
310705	AP Calculus B	AP CALCULUS B		115
310706	AP Calculus C	AP CALCULUS C	11-12	
310609	AP Statistics A	AP STATISTICS A	11-12	120
310610	AP Statistics B	AP STATISTICS B	11-12	
*Must be enrolled concurrently with 310342. This is a year-long course				
INTERVENTION ELECTIVE COURSES				
173101	ESL Mathematics A	ESL MATH A	9-12	61
173102	ESL Mathematics B	ESL MATH B	9-12	
310209	Essential Standards in Mathematics	ESS STAND MATH	10-12	143
312613	CC Algebra 1 Tutorial Lab A	CC ALG1 TUT LAB A	9-12	126

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312614	CC Algebra 1 Tutorial Lab B	CC ALG1 TUT LAB B	9-12	
312615	CC Geometry Tutorial Lab A	CC GEOM TUT LAB A	9-12	133
312616	CC Geometry Tutorial Lab B	CC GEOM TUT LAB B	9-12	
312617	CC Algebra 2A Tutorial Lab A	CC ALG2 TUT LAB A	10-12	137
312618	CC Algebra 2A Tutorial Lab B	CC ALG2 TUT LAB B	10-12	

@Note: Math Analysis will meet LAUSD graduation requirements as part of two years of high school mathematics for students graduating through 2015 only.

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Sequence of Secondary Mathematics Courses 6-12
Possible Pathways

	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
Regular Pathway	CC Math 6	CC Math 7	CC Math 8	CC Algebra 1	CC Geometry	CC Algebra 2 11th Grade	Precalculus
Accelerated Pathway Option 1	CC Math 6	Accelerated CC Math 7	Accelerated CC Algebra 1	CC Geometry	CC Algebra 2	Precalculus S B A	AP Calculus or Discrete Math or Probability & Statistics or AP Statistics
Accelerated Pathway Option 2	CC Math 6	Accelerated CC Math 7	Accelerated CC Algebra 1	CC Geometry	Honors Advanced Math	AP Calculus or Discrete Math or Probability & Statistics or AP Statistics C	AP Calculus or Discrete Math or Probability & Statistics or AP Statistics

← Meets the “C” requirement of A-G →

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Regular Pathway Stat Option	CC Math 6	CC Math 7	CC Math 8	CC Algebra 1	CC Geometry	11 th Grade Introduction to Data Science	AP Statistics
Accelerated Pathway Stat Option	CC Math 6	Accelerated CC Math 7	Accelerated CC Algebra 1	CC Geometry	Introduction to Data Science	AP Statistics	AP Calculus or Discrete Math
HS Accelerated Pathway Option	CC Math 6	CC Math 7	CC Math 8	CC Algebra 1 & CC Geometry	CC Algebra 2	Precalculus	AP Calculus or Discrete Math or Probability & Statistics or AP Statistics

This is not an exhaustive list of options

**MIDDLE SCHOOL
Mathematics
COURSES
Grades 6-8**

Middle School Core Mathematics Courses

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Common Core Mathematics 6AB
(Annual Course – Grade 6)
Prerequisite: Mathematics 5AB

310111 CC Mathematics 6A
310112 CC Mathematics 6B

Course Description

The major purpose of this course is to serve as a vehicle by which students will master the four Critical Areas of Instruction. In grade six, instructional time should focus on four critical areas: (1) connecting ratio, rate, and percentage to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; and (4) developing understanding of statistical thinking (CCSSO 2010, Grade 6 Introduction). Students also work toward fluency with multi-digit division and multi-digit decimal operations.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

MATHEMATICAL PRACTICES

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

Unit 1

Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

CLUSTERS	COMMON CORE STATE STANDARDS
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<p>(m)¹ Understand ratio concepts and use ratio reasoning to solve problems.</p>	<p>6.RP.1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. <i>For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”</i></p> <p>6.RP.2. Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. <i>For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”</i>¹</p> <p>6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</p> <ul style="list-style-type: none"> a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. b. Solve unit rate problems including those involving unit pricing and constant speed. <i>For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?</i> c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
<p>(s/a)² Solve real-world and mathematical problems involving area, surface area, and volume.</p>	<p>6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.</p> <p>6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.</p> <p>6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.</p>

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Unit 2

In this course, students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

CLUSTER	COMMON CORE STATE STANDARDS
<p>(m)¹ Apply and extend previous understandings of multiplication and division to divide fractions by fractions.</p>	<p>Number System</p> <p>6.NS.1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. <i>For example, create a story context for $(2/3) \div (3/4)$ and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $(2/3) \div (3/4) = 8/9$ because $3/4$ of $8/9$ is $2/3$. (In general, $(a/b) \div (c/d) = ad/bc$.) How much chocolate will each person get if 3 people share $1/2$ lb of chocolate equally? How many $3/4$-cup servings are in $2/3$ of a cup of yogurt? How wide is a rectangular strip of land with length $3/4$ mi and area $1/2$ square mi?</i></p> <p>6.NS.2. Fluently divide multi-digit numbers using the standard algorithm.</p> <p>6.NS.3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.</p> <p>6.NS.4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. <i>For example, express $36 + 8$ as $4(9 + 2)$.</i></p> <p>6.NS.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p> <p>6.NS.6. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., $-(-3) = 3$, and that 0 is its own opposite.</p>
<p>(m)¹ Compute fluently with multi-digit numbers and find common factors and multiples.</p>	
<p>(m)¹ Apply and extend previous understandings of numbers to the system of rational numbers.</p>	

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	<p>b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.</p> <p>c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.</p> <p>6.NS.7. Understand ordering and absolute value of rational numbers.</p> <p>a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. <i>For example, interpret $-3 > -7$ as a statement that -3 is located to the right of -7 on a number line oriented from left to right.</i></p> <p>b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. <i>For example, write $-3^{\circ}\text{C} > -7^{\circ}\text{C}$ to express the fact that -3°C is warmer than -7°C.</i></p> <p>c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. <i>For example, for an account balance of -30 dollars, write $-30 = 30$ to describe the size of the debt in dollars.</i></p> <p>d. Distinguish comparisons of absolute value from statements about order. <i>For example, recognize that an account balance less than -30 dollars represents a debt greater than 30 dollars.</i></p> <p>6.NS.8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.</p>
<p>(s/a)² Solve real-world and mathematical problems involving area, surface area, and volume.</p>	<p>Geometry</p> <p>6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.</p> <p>6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.</p>

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Unit 3

Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

	COMMON CORE STATE STANDARDS
m¹ Apply and extend previous understandings of arithmetic to algebraic expressions	<p>Expressions and Equations</p> <p>6.EE.1. Write and evaluate numerical expressions involving whole-number exponents.</p> <p>6.EE.2. Write, read, and evaluate expressions in which letters stand for numbers.</p> <ul style="list-style-type: none"> a. Write expressions that record operations with numbers and with letters standing for numbers. <i>For example, express the calculation “Subtract y from 5” as $5 - y$.</i> b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. <i>For example, describe the expression $2(8 + 7)$ as a product of two factors; view $(8 + 7)$ as both a single entity and a sum of two terms.</i> c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). <i>For example, use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = \frac{1}{2}$.</i> <p>6.EE.3. Apply the properties of operations to generate equivalent expressions. <i>For example, apply the distributive property to the expression $3(2 + x)$ to produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6(4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$.</i></p> <p>6.EE.4. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). <i>For example, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number y stands for.</i></p>
Reason about and solve one-variable equations and inequalities.	6.EE.5. Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine

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	<p>whether a given number in a specified set makes an equation or inequality true.</p> <p>6.EE.6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>6.EE.7. Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.</p> <p>6.EE.8. Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams.</p>
Represent and analyze quantitative relationships between dependent and independent variables.	<p>6.EE.9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</p>
(s/a)² Solve real-world and mathematical problems involving area, surface area, and volume.	<p>Geometry</p> <p>6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.</p> <p>6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = lwh$ and $V = bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.</p> <p>6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.</p>

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Unit 4

Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability.

Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected. Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

CLUSTER	COMMON CORE STATE STANDARDS
Develop understanding of statistical variability.	<ul style="list-style-type: none"> • Statistics and Probability • 6.SP.1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. <i>For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.</i> • 6.SP.2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. • 6.SP.3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
Summarize and describe distributions.	<p>6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.</p> <p>6.SP.5. Summarize numerical data sets in relation to their context, such as by:</p> <ul style="list-style-type: none"> • Reporting the number of observations. • Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.

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	<ul style="list-style-type: none"> • Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. • Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.
Summarize and describe distributions.	<p>6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.</p> <p>6.SP.5. Summarize numerical data sets in relation to their context, such as by:</p> <ul style="list-style-type: none"> • Reporting the number of observations. • Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. • Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. • Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Representative Performance Outcomes and Skills

In this course, students will know and be able to master the four critical areas:

- 1) connecting ratio, rate, and percentage to whole number multiplication and division and using concepts of ratio and rate to solve problems;
- 2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers;
- 3) writing, interpreting, and using expressions and equations; and
- 4) developing understanding of statistical thinking

Assessments will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Interim Assessments

Texts/Materials

- LAUSD *Secondary Mathematics Curriculum Map*
- Textbook: District approved materials
- Supplemental materials and resources

Los Angeles Unified School District
Secondary Mathematics Branch

Common Core Mathematics 7AB

(Annual Course – Grade 7)

Prerequisite: Common Core Mathematics 6AB

310115 CC Mathematics 7A

310116 CC Mathematics 7B

COURSE DESCRIPTION

In grade seven instructional time should focus on four critical areas: (1) developing understanding of and applying proportional relationships, including percentages; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and (4) drawing inferences about populations based on samples. Students also work towards fluently solving equations of the form $px + q = r$ and $p(x + q) = r$.

COURSE SYLLABUS

Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

UNIT 1

CLUSTER	COMMON CORE STATE STANDARDS
m¹ Analyze proportional relationships and use them to solve real-world and mathematical problems.	<p>7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. <i>For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $\frac{1/2}{1/4}$ miles per hour, equivalently 2 miles per hour.</i></p> <p>7.RP.2 Recognize and represent proportional relationships between quantities.</p> <p>a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</p> <p>c. Represent proportional relationships by equations. <i>For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number</i></p>

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	<p><i>of items can be expressed as $t = pn$.</i></p> <p>d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.</p> <p>7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. <i>Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.</i></p>
m¹ Draw, construct, and describe geometrical figures and describe the relationships between them.	<p>7.G.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</p>

UNIT 2

Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

CLUSTER	COMMON CORE STATE STANDARDS
m¹ Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	<p>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.</p> <ol style="list-style-type: none"> Describe situations in which opposite quantities combine to make 0. <i>For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.</i> 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. 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. Apply properties of operations as strategies to add and subtract rational numbers. <p>7.NS.2 Apply and extend previous understanding of multiplication and division and of fractions to multiply and divide rational numbers.</p> <ol style="list-style-type: none"> Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue

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	<p>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.</p> <p>b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (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.</p> <p>c. Apply properties of operations as strategies to multiply and divide rational numbers.</p> <p>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.</p> <p>7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.</p>
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UNIT 3

Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers division including expanding linear expressions with rational coefficient, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

CLUSTER	COMMON CORE STATE STANDARDS
m¹ Use properties of operations to generate equivalent expressions	<p>7.EE.1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients</p> <p>7.EE.2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, $a + 0.05a = 1.05a$ means that “increase by 5%” is the same as “multiply by 1.05.”</p>
m¹ Solve real-life and mathematical problems using numerical and algebraic expressions and equations	<p>7.EE.3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. <i>For example: If a woman making \$25 an hour gets a 10% raise, she will</i></p>

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	<p><i>make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.</i></p> <p>7.EE.4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently.</p> <p>Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i></p> <p>b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. <i>For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.</i></p>
m¹ Solve real-life and mathematical problems involving angle measure, area, surface area, and volume	<p>7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure</p>

UNIT 4

Students continue their work with area from Grade 6, solving problems Involving the area and circumference of a circle and surface area of three-dimensional objects. Students reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with relationships between angles formed by Intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. Students build on their work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

CLUSTERS	COMMON CORE STATE STANDARDS
Geometry (s/a)² Draw, construct, and describe geometrical figures	7.G.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale

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<p>and describe the relationships between them.</p>	<p>drawing and reproducing a scale drawing at a different scale. 7.G.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. 7.G.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. 7.G.3.1 <i>Describe how two or more objects are related in space (e.g., skew lines, the possible ways three planes might intersect).</i>CA</p>
<p>(s/a)² Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.</p>	<p>7.G.4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. 7.G.5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. 7.G.6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>
<p>Statistics and Probability (s/a)² Use random sampling to draw inferences about a population.</p>	<p>7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. 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. <i>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.</i></p>
<p>(s/a)² Draw informal comparative inferences about two populations.</p>	<p>7.SP.3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. <i>For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.</i> 7.SP.4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. <i>For example, decide whether the words in a chapter of a seventh-grade science book are generally</i></p>

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	<i>longer than the words in a chapter of a fourth-grade science book.</i>
(s/a)² Investigate chance processes and develop, use, and evaluate probability models.	<p>7.SP.5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.</p> <p>7.SP.6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. <i>For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.</i></p> <p>7.SP.7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.</p> <p>a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. <i>For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.</i></p> <p>b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. <i>For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?</i></p> <p>7.SP.8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.</p> <p>a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.</p> <p>b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event.</p> <p>c. Design and use a simulation to generate frequencies for compound events. <i>For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?</i></p>

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Proportional reasoning is essential in problem solving
- Understanding mathematical relationships allows us to make predictions, calculate and model unknown quantities.

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- Proportional relationships express how quantities change in relationship to each other.
- Computation with positive and negative numbers is often necessary to determine relationships between quantities.
- Models, diagrams, manipulatives, number lines, and patterns are useful in developing and remembering algorithms for computing with positive and negative numbers.
- Properties of real numbers hold for all rational numbers.
- Positive and negative numbers are often used to solve problems in everyday life.
- Demonstrate that a number and its opposite have a sum of 0.
- A positive quantity and negative quantity of the same absolute value add to make 0.
- Generating equivalent, linear expressions with rational coefficients using the properties of operations will lead to solving linear equation.
- Discovering that rewriting expressions in different forms in a problem context leads to understanding that the values are equivalent.
- Ability to solve and explain real life and mathematical problems involving rational numbers using numerical and algebraic expressions is important for preparation for HS Algebra.
- Constructing simple equations and inequalities to solve real life word problems is a necessary concept.
- Write and solve real- life and mathematical problems involving simple equations for an unknown angle in a figure would help students as the engage in higher Geometry concepts.
- Solve problems involving the area and circumference of a circle and surface area of three-dimensional objects.
- Reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, which will lead to gaining familiarity with the relationships between angles formed by intersecting lines. Work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections.
- Solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms
- Compare two data distributions and address questions about differences between populations.
- Begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences

Assessments will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Interim Assessments

Texts/Materials

LAUSD *Secondary Mathematics Curriculum Map*

- Textbook: District approved materials
- Supplemental materials and resources

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Accelerated Common Core Mathematics 7AB

(Annual Course – Grade 7)

Prerequisite: Common Core Mathematics 6AB

310117 Accelerated CC Mathematics 7A

310118 Accelerated CC Mathematics 7B

COURSE DESCRIPTION

Accelerated CC Math 7 contains all the CC Math 7 standards and half of the CC Math 8 standards. Standards are not cut or skipped but compacted requiring students to learn at a faster pace. “Mathematics is by nature hierarchical. Every step is a preparation for the next one. Learning it properly requires thorough grounding at each step and skimming over any topics will only weaken one’s ability to tackle more complex material down the road” (Wu 2012). Serious efforts must be made to consider solid evidence of a student’s conceptual understanding, knowledge of procedural skills, fluency, and ability to apply mathematics before moving a student into an accelerated pathway.” (The California Mathematics Framework - Appendix A, November 6, 2013.). The Accelerated Pathway is only for students who show advanced readiness or for students currently enrolled in an accelerated pathway. Students should not skip any math concepts as they accelerate to higher courses, otherwise, they will not have the depth of understanding needed to be successful in those courses.

In grade seven instructional time should focus on four critical areas: (1) developing understanding of and applying proportional relationships, including percentages; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and (4) drawing inferences about populations based on samples. Students also work towards fluently solving equations of the form $px + q = r$ and $p(x + q) = r$.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

UNIT 1

Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems. They extend their mastery of the properties of operations to develop an understanding of integer exponents, and to work with numbers written in scientific notation

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CLUSTERS	COMMON CORE STATE STANDARDS
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	<p>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.</p> <p>a. Describe situations in which opposite quantities combine to make 0. <i>For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.</i></p> <p>b. Understand $p+q$ as the number located a distance 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.</p> <p>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.</p> <p>d. Apply properties of operations as strategies to add and subtract rational numbers.</p> <p>7.NS.2 Apply and extend previous understanding of multiplication and division and of fractions to multiply and divide rational numbers.</p> <p>e. 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.</p> <p>f. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (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.</p> <p>g. Apply properties of operations as strategies to multiply and divide rational numbers.</p> <p>h. 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.</p> <p>7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.</p>
Know that there are numbers that are not rational, and approximate them by rational numbers.	<p>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.</p> <p>8.NS.2. 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., $\sqrt{2}$). <i>For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.</i></p>
Work with radicals and integer exponents.	<p>8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. <i>For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.</i></p> <p>8.EE.2 Use square root and cube root symbols to represent solutions to</p>

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	<p>equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.</p> <p>8.EE.3 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. <i>For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.</i></p> <p>8.EE.4 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.</p>
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UNIT 2

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 $m \times A$. 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.

CLUSTERS	COMMON CORE STATE STANDARDS
Analyze proportional relationships and use them to solve real-world and mathematical problems.	<p>7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. <i>For example, if a person walks $1/2$ mile in each $1/4$ hour, compute the unit rate as the complex fraction $1/2 / 1/4$ miles per hour, equivalently 2 miles per hour.</i></p> <p>7.RP.2 Recognize and represent proportional relationships between quantities.</p> <ol style="list-style-type: none"> Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. Represent proportional relationships by equations. <i>For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.</i> Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate. <p>7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. <i>Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent</i></p>

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	<i>error.</i>
Use properties of operations to generate equivalent expressions	<p>7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients</p> <p>7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. For example, $a + 0.05a = 1.05a$ means that “increase by 5%” is the same as “multiply by 1.05.”</p>
Solve real-life and mathematical problems using numerical and algebraic expressions and equations	<p>7.EE.3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. <i>For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.</i></p> <p>7.EE.4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <ol style="list-style-type: none"> Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i> Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. <i>For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.</i>
Understand the connections between proportional relationships, lines and linear equations.	<p>8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <i>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</i></p> <p>8.EE.6 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.</p>
Analyze and solve linear equations and pairs of simultaneous linear equations.	<p>8.EE.7 Solve linear equations in one variable.</p> <ol style="list-style-type: none"> 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 linear equations with rational number coefficients, including equations whose solutions require expanding expressions

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	using the distributive property and collecting like terms.
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UNIT 3

Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

CLUSTERS	COMMON CORE STATE STANDARDS
Statistics and Probability (s/a)2 Use random sampling to draw inferences about a population.	7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. 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. <i>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.</i>
(s/a)2 Draw informal comparative inferences about two populations.	7.SP.3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. <i>For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.</i> 7.SP.4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. <i>For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.</i>
(s/a)2 Investigate chance processes and develop, use, and evaluate probability models.	7.SP.5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. 7.SP.6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. <i>For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.</i> 7.SP.7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. <i>For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.</i>

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	<p>b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. <i>For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?</i></p> <p>7.SP.8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.</p> <p>a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.</p> <p>b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify the outcomes in the sample space which compose the event.</p> <p>c. Design and use a simulation to generate frequencies for compound events. <i>For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?</i></p>
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UNIT 4

Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity, they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms. 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 complete their work on volume by solving problems involving cones, cylinders, and spheres.

CLUSTERS	COMMON CORE STATE STANDARDS
Geometry Draw, construct, and describe geometrical figures and describe the relationships between them.	<p>7.G.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</p> <p>7.G.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.</p> <p>7.G.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.</p> <p>7.G.3.1 <i>Describe how two or more objects are related in space (e.g., skew lines, the possible ways three planes might intersect).</i></p>
Solve real-life and mathematical	7.G.4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship

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problems involving angle measure, area, surface area, and volume.	<p>between the circumference and area of a circle.</p> <p>7.G.5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.</p> <p>7.G.6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.</p>
Understand congruence and similarity using physical models, transparencies, or geometry software.	<p>8.G.1 Verify experimentally the properties of rotations, reflections, and translations:</p> <p>a. Lines are taken to lines, and line segments to line segments of the same length.</p> <p>b. Angles are taken to angles of the same measure.</p> <p>c. Parallel lines are taken to parallel lines.</p> <p>8.G.2 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.</p> <p>8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.</p> <p>8.G.4 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.</p> <p>8.G.5 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. <i>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.</i></p>
Solve real-world and mathematical problem involving volume of cylinders, cones, and spheres.	<p>8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.</p>

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Proportional reasoning is essential in problem solving
- Understanding mathematical relationships allows us to make predictions, calculate and model unknown quantities.
- Proportional relationships express how quantities change in relationship to each other.
- Computation with positive and negative numbers is often necessary to determine relationships between quantities.
- Models, diagrams, manipulatives, number lines, and patterns are useful in developing and remembering algorithms for computing with positive and negative numbers.
- Properties of real numbers hold for all rational numbers.
- Positive and negative numbers are often used to solve problems in everyday life.
- Demonstrate that a number and its opposite have a sum of 0.
- A positive quantity and negative quantity of the same absolute value add to make 0.

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- Generating equivalent, linear expressions with rational coefficients using the properties of operations will lead to solving linear equation.
- Discovering that rewriting expressions in different forms in a problem context leads to understanding that the values are equivalent.
- Ability to solve and explain real life and mathematical problems involving rational numbers using numerical and algebraic expressions is important for preparation for HS Algebra.
- Constructing simple equations and inequalities to solve real life word problems is a necessary concept.
- Write and solve real- life and mathematical problems involving simple equations for an unknown angle in a figure would help students as the engage in higher Geometry concepts.
- Solve problems involving the area and circumference of a circle and surface area of three-dimensional objects.
- Reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, which will lead to gaining familiarity with the relationships between angles formed by intersecting lines. Work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections.
- Solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms
- Compare two data distributions and address questions about differences between populations.
- Begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences

Assessments will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Interim Assessments

Texts/Materials

LAUSD Secondary Mathematics Curriculum Map

- Textbook: District approved materials
- Supplemental materials and resources

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Common Core Mathematics 8AB

(Annual Course – Grade 8)

Prerequisite: Common Core Mathematics 7AB

310339 CC Mathematics 8 A

310340 CC Mathematics 8 B

COURSE DESCRIPTION

In grade eight, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence and understanding and applying the Pythagorean Theorem. Students also work towards fluency with solving simple sets of two equations with two unknowns by inspection.

Students will understand informally the rational and irrational numbers and use rational numbers approximation of irrational numbers. Students will use rational numbers to determine an unknown side in triangles. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students use radicals and integers when they apply the Pythagorean Theorem in real word. Students understand the connections between proportional relationships and linear equations involving bivariate data. Students will analyze and solve linear equations and pairs of simultaneous linear equations. Students use similar triangles to explain why the slope is the same between two distinct points on a non-vertical line in the coordinate plane as well as derive the equation of a line.

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. 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. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

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COURSE SYLLABUS

Mathematical Practices

Unit 1

Students will understand informally the rational and irrational numbers and use rational numbers approximation of irrational numbers. Students will use rational numbers to determine an unknown side in triangles. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students use radicals and integers when they apply the Pythagorean Theorem in real word.

CLUSTER	COMMON CORE STATE STANDARDS
Understand and apply the Pythagorean Theorem.	<p>8.G.6 Explain a proof of the Pythagorean Theorem and its converse.</p> <p>8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real world and mathematical problems in two and three dimensions.</p> <p>8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.</p>
Know that there are numbers that are not rational, and approximate them by rational numbers.	<p>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.</p> <p>8.NS.2. 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., π^2). <i>For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.</i></p>
Work with radicals and integer exponents.	<p>8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. <i>For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$</i></p> <p>8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.</p> <p>8.EE.3 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. <i>For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.</i></p>

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	8.EE.4 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.
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Unit 2

Students understand the connections between proportional relationships and linear equations involving bivariate data. Students will analyze and solve linear equations and pairs of simultaneous linear equations. Students use similar triangles to explain why the slope is the same between two distinct points on a non-vertical line in the coordinate plane as well as derive the equation of a line.

CLUSTER	COMMON CORE STATE STANDARDS
Understand the connections between proportional relationships, lines and linear equations.	<p>8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <i>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</i></p> <p>8.EE.6 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.</p>
Investigate patterns of association in bivariate data.	<p>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. <i>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.</i></p>
Analyze and solve linear equations and pairs of simultaneous linear equations.	<p>8.EE.7 Solve linear equations in one variable.</p> <p>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).</p> <p>b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</p> <p>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.</p> <p>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. <i>For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.</i></p> <p>c. Solve real-world and mathematical problems leading to two linear</p>

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	equations in two variables. <i>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.</i>
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Unit 3

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.

CLUSTER	COMMON CORE STATE STANDARDS
Define, evaluate and compare functions. MP 2,4, and 7	<p>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.</p> <p>8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>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.</i></p> <p>8.F.3 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. <i>For example, the function $A = s^2$ 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.</i></p>
Use functions to model relationships between quantities. MP 1, 2, and, 4	<p>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.</p> <p>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.</p>
Investigate patterns of association in bivariate data. MP 1, 4, 5, 6, and 7	<p>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.</p> <p>8.SP.2 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.</p> <p>8.SP.3 Use the equation of a linear model to solve problems in the</p>

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	<p>context of bivariate measurement data, interpreting the slope and intercept. <i>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.</i></p> <p>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.</p> <p>Use relative frequencies calculated for rows or columns to describe possible association between the two variables. <i>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?</i></p>
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Unit 4

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. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

CLUSTER	COMMON CORE STATE STANDARDS
Understand congruence and similarity using physical models, transparencies, or geometry software.	<p>8.G.1 Verify experimentally the properties of rotations, reflections, and translations:</p> <ul style="list-style-type: none"> 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. <p>8.G.2 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.</p> <p>8.G.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.</p> <p>8.G.4 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.</p> <p>8.G.5 Use informal arguments to establish facts about the angle sum and</p>

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Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.	<p>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. <i>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.</i></p> <p>8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.</p>
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REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Apply real world problem using Pythagorean Theorem.
- Approximate irrational numbers using their understanding of square and cube roots.
- Extend their understanding of the number system by investigating the relationship between the sides of a right triangle. Create equivalent expressions using integer exponents.
- Apply their understanding of exponents to express and compare numbers.
- Demonstrate the understanding of irrational numbers and when to use them in solving problems.
- Compare proportional relationships using a variety of representations of these relationships (graph, table, symbols).
- Understand and represent slope as a unit rate, and apply their knowledge of right triangles to represent slope. Students relate the slope with its concept as a rate and its visual representation as a set of right triangle that are similar for each line.
- Interpret slope and intercept using real world applications (e.g. bivariate data).
- Employ graphical, tabular and symbolic representations to express linearity and determine the number of solutions. Interpret a linear equation in a real world application by deriving the equation.
- Understand that a function is a relationship with a unique output for each input.
- Develop their ability to make connections between multiple representations of functions and interpret the features of functions in terms of real world contexts.
- Identify (from a graph, table, $y = mx + b$, etc.) and interpret the rate of change and initial value of a linear function in terms of the situation. Construct a function to model a linear relationship.
- Apply the understanding of the effect of geometric transformation(s) on a figure or shape.
- Describe how two figures or shapes are congruent or similar.
- Create or identify a sequence of transformations that lead to congruent or similar figures.
- Analyze the relationship between angles measures (triangle sum; parallel lines cut by a transversal; impact of a geometric transformation).
- Prove the Pythagorean Theorem, use to determine the distance between two coordinate points, and apply to real world situations.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Interim Assessments

TEXTS/MATERIALS

- LAUSD *Secondary Mathematics Curriculum Map*
- Textbook: District approved materials

Supplemental materials and resources

Los Angeles Unified School District
Secondary Mathematics Branch

Accelerated Common Core Algebra 1 AB

(Annual Course – Grade 8)

Prerequisite: Accelerated CC Mathematics 7AB

310339 ACC CC Algebra 1 Year-Long

310340 ACC CC Algebra 1 Year-Long

COURSE DESCRIPTION

The purpose of this course is to serve as the vehicle by which students make the transition from arithmetic to symbolic mathematical reasoning. It is an opportunity for students to extend and practice logical reasoning in the context of understanding, writing, solving, and graphing problems involving linear and quadratic equations (including systems of two linear equations in two unknowns).

In this course, students are expected to demonstrate their ability to extend specific problems and conditions to general assertions about mathematical situations. Additionally, they are expected to justify steps in an algebraic procedure and check algebraic arguments for validity.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

The following are recurring standards in the course:

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

Unit 1

By the end of eighth grade students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. This unit builds on these earlier experiences by asking students to analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations. All of this work is grounded on understanding quantities and on relationships between them.

CLUSTERS	COMMON CORE STATE STANDARDS
(m) Interpret the structure of expressions. <i>Limit to linear</i>	A.SSE.1 Interpret expressions that represent a quantity in terms of its context. ★ a. Interpret parts of an expression, such as terms, factors, and coefficients.

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<p><i>expressions and to exponential expressions with integer exponents.</i></p> <p>(m) Understand solving equations as a process of reasoning and explain the reasoning. <i>Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses.</i></p> <p>(m) Solve equations and inequalities in one variable. <i>Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents, such as $5x = 125$ or $2x = \frac{1}{16}$.</i></p>	<p>b. Interpret complicated expressions by viewing one or more of their parts as single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i></p> <p>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.</p> <p>A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>A.REI.3.1 Solve one-variable equations and inequalities involving absolute value, graphing the solutions and interpreting them in context. CA addition</p>
<p>(s/a) Reason quantitatively and use units to solve problems. <i>Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.</i></p> <p>(s/a) Create equations that describe numbers or relationships. <i>Limit A.CED.1 and A.CED.2 to linear and exponential equations, and, in the case of</i></p>	<p>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.</p> <p>N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>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.</p> <p>A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as</p>

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<i>exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. Limit A.CED.3 to linear equations and inequalities. Limit A.CED.4 to formulas which are linear in the variable of interest.</i>	viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R .
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Unit 2

Students will learn function notation and develop the concepts of domain and range. They move beyond viewing functions as processes that take inputs and yield outputs and start viewing functions as objects in their own right. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that, depending upon the context, these representations are likely to be approximate and incomplete. Their work includes functions that can be described or approximated by formulas as well as those that cannot. When functions describe relationships between quantities arising from a context, students reason with the units in which those quantities are measured. Students explore systems of equations and inequalities, and they find and interpret their solutions. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

CLUSTERS	COMMON CORE STATE STANDARDS
Extend the properties of exponents to rational exponents.	<p>N.RN.1. 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 $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.</p> <p>N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.</p>
Define evaluate and compare functions	<p>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.</p> <p>8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>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.</i></p> <p>8.F.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not</p>

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<p>Understand the concept of a function and use function notation.</p>	<p>linear. <i>For example, the function $A = s^2$ 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.</i></p> <p>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 $y = f(x)$.</p> <p>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.</p> <p>F-IF 3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. <i>For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ for $n \geq 1$.</i></p>
<p>Build a function that models a relationship between two quantities.</p> <p><i>Limit to F.BF.1a, 1b, and 2 to linear and exponential functions. In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions.</i></p>	<p>F.BF.1. Write a function that describes a relationship between two quantities. ★</p> <p>a. Determine an explicit expression, a recursive process, or steps for calculation from a context.</p> <p>b. Combine standard function types using arithmetic operations. <i>For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.</i></p> <p>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. ★</p>
<p>Build new functions from existing functions.</p> <p><i>Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in</i></p>	<p>F.BF.3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. <i>Include recognizing even and odd functions from their graphs and algebraic expressions for them.</i></p>

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<i>this standard.</i>	
Construct and compare linear, quadratic, and exponential models	<p>F.LE.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. ★</p> <p>b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ★</p> <p>c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. ★</p> <p>F.LE.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). ★</p>
Use functions to model relationships between quantities	<p>8F.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.</p> <p>8F.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.</p>
<p>Interpret functions that arise in applications in terms of a context.</p> <p><i>Focus linear and exponential functions</i></p>	<p>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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> ★</p> <p>F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function h 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.</i> □ □</p> <p>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. □ □</p>
Analyze functions using different representations. <i>Linear, exponential, quadratic, absolute value, step, piecewise-defined.</i>	<p>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.</p> <p>a. Graph linear and quadratic functions and show intercepts, maxima, and minima.</p>

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	<p>b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. ★</p> <p>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.</p>
<p>Analyze and solve linear equations and pairs of simultaneous linear equations</p>	<p>8.EE.8 Analyze and solve pairs of simultaneous linear equations</p> <p>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.</p> <p>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. <i>For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.</i></p> <p>c. Solve real-world and mathematical problems leading to linear equations in two variables. <i>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.</i></p>
<p>Solve systems of equations. <i>Linear-linear and linear-quadratic.</i></p>	<p>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</p> <p>A.REI.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</p>
<p>Represent and solve equations and inequalities Graphically. <i>Linear and exponential; learn as general principle.</i></p>	<p>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).</p> <p>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. ★</p> <p>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.</p>

Unit 3

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Experience with descriptive statistics began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatterplots and recognizing linear trends in data. This unit builds upon that prior experience, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

CLUSTERS	COMMON CORE STATE STANDARDS
<p>Summarize, represent, and interpret data on a single count or measurement variable.</p> <p><i>In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.</i></p>	<p>S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>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.</p> <p>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).</p>
<p>Summarize, represent, and interpret data on two categorical and quantitative variables.</p> <p><i>Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals.</i></p> <p><i>S.ID.6b should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course.</i></p>	<p>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.</p> <p>S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.</p> <ul style="list-style-type: none"> a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. <i>Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.</i> 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.
<p>Investigate patterns of association in bivariate</p>	<p>8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.</p>

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<p>data.</p> <p><i>While this content is likely subsumed by S.I.D. 6-9, it could be used for scaffolding instruction to the more sophisticated content found there.</i></p>	<p>Describe patterns such as clustering, outliers, positive or negative association, linear association and nonlinear association.</p> <p>8.SP.2 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.</p> <p>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.</p> <p>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?</p>
<p>Interpret linear models.</p> <p><i>Build on students' work with linear relationships in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.</i></p>	<p>S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p>S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.</p> <p>S.ID.9 Distinguish between correlation and causation.</p>

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Unit 4

CLUSTER	COMMON CORE STATE STANDARDS
Interpret the structure of expressions.	<p>A.SSE.1 Interpret expressions that represent a quantity in terms of its context. ★</p> <p>a. Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i></p> <p>A.SSE.2 Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i></p>
Write expressions in equivalent forms to solve problems.	<p>A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★</p> <p>a. Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>c. Use the properties of exponents to transform expressions for exponential functions. <i>For example the expression $1.15t$ can be rewritten as $(1.151/12)^{12t} \approx 1.01^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</i></p>
Perform arithmetic operations on polynomials.	<p>A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</p>
Create equations that describe numbers or relationships.	<p>A.CED.1 Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i></p> <p>A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. <i>For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i></p>
Solve equations and inequalities in one variable.	<p>A.REI.4 Solve quadratic equations in one variable.</p> <p>a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.</p> <p>b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.</p>

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	Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .
Solve systems of equations.	A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. <i>For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.</i>

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Interpret the structure of expressions.
- Understand solving equations as a process of reasoning and explain the reasoning.
- Solve equations and inequalities in one variable.
- Reason quantitatively and use units to solve problems.
- Create equations that describe numbers or relationships.
- Extend the properties of exponents to rational exponents.
- Build a function that models a relationship between two quantities.
- Build new functions from existing functions.
- Construct and compare linear, quadratic, and exponential models and solve problems.
- Interpret functions that arise in applications in terms of a context.
- Analyze functions using different representations.
- Solve systems of equations.
- Represent and solve equations and inequalities Graphically.
- Summarize, represent, and interpret data on a single count or measurement variable.
- Summarize, represent, and interpret data on two categorical and quantitative variables.
- Interpret linear models.
- Write expressions in equivalent forms to solve problems.
- Perform arithmetic operations on polynomials.
- Use properties of rational and irrational numbers.
- Analyze functions using different representations.
- Compare linear and exponential growth to quadratic growth.
- Interpret expressions for functions in terms of the situation they model.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- Interim Assessments

TEXTS/MATERIALS

- LAUSD Secondary Mathematics Curriculum Map
- Textbook: District approved materials
- Supplemental materials and resources

Middle School Elective Mathematics Courses

Los Angeles Unified School District
Secondary Mathematics Branch

Common Core Math 6 Tutorial Lab AB
(Intervention Course for Grade 6)

312607 **CC Math 6 Tutorial Lab A**
312608 **CC Math 6 Tutorial Lab B**

COURSE DESCRIPTION

Common Core Math 6 Tutorial Lab is designed to provide foundational knowledge and intervention for students enrolled in or preparing to enroll in Common Core Math 6. This course serves not only as intervention, but also as support for students experiencing difficulty in mastering the core standards and academic language constraints of the Common Core Math 6 course. Common Core Math 6 Tutorial Lab is an elective mathematics course provided to students as a supplemental course to enhance the student's knowledge of prerequisite skills and academic language that is required in order to successfully access the standards-based Common Core Math 6 course.

COURSE SYLLABUS

The structure of this course is divided into four separate, but coherent, units mirroring the Common Core Math 6 course. Additionally, an immense element of this intervention course is an emphasis on student engagement with the Standards for Mathematical Practice on a daily basis. Students enrolled in this intervention course need to be assessed on an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to adapt their instruction through ongoing formative assessments to provide genuine, differentiated instruction. The outcome of the initial and ongoing assessments are to analyze and identify key skills and concepts required for students to access the Common Core State Standards, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

The goal of this intervention course is to support Common Core Math 6 and to provide explicit, systematic, and intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards' expectations, they must be able to accurately identify areas of student deficit and match students to an appropriate academic intervention plan. An expectation from the Common Core Math 6 Tutorial Lab is to create evidence-based intervention plans that are customized to individual students, and that are also tied to specific Common Core Standards.

Unit 1

Using Concepts of Rate and Ratio to Solve Problems

Concepts/Clusters	Prerequisite Standards to Support CC Math 6
Understand ratio concepts and use ratio reasoning to solve problems.	4.OA.2: Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. 4.MD.1: Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system

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Concepts/Clusters	Prerequisite Standards to Support CC Math 6
	<p>of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. <i>For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...</i></p> <p>5.NF.5: Interpret multiplication as scaling (resizing), by:</p> <ol style="list-style-type: none"> Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. Explaining multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1. <p>5.NF.3: Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. <i>For example, interpret $3/4$ as the result of dividing 3 by 4, noting that $3/4$ multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size $3/4$. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?</i></p> <p>5.NF.7: Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.</p>

Unit 2

Extending the Understanding of the Number System

Concepts/Clusters	Prerequisite Standards to Support CC Math 6
Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	<p>5.NF.4: Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.</p> <ol style="list-style-type: none"> Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. <i>For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5)$</i>

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	$= 8/15$. (In general, $(a/b) \times (c/d) = ac/bd$.) b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.
Compute fluently with multi-digit numbers and find common factors and multiples.	5.NBT.5: Fluently multiply multi-digit whole numbers using the standard algorithm. 5.NBT.6: Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 5.NBT.7: Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Apply and extend previous understandings of numbers to the system of rational numbers.	5.G.1: Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x -axis and x -coordinate, y -axis and y -coordinate).

Unit 3

Understanding Expressions and Equations

Concepts/Clusters	Standards to Support CC Math 6
Apply and extend previous understandings of arithmetic to algebraic expressions.	4.OA.4: Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite. 5.OA.2: Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. <i>For example, express the calculation “add 8 and 7, then multiply by 2” as $2 \times (8 + 7)$. Recognize that $3 \times (18932 + 921)$ is three times as large as $18932 + 921$, without having to</i>

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	<p><i>calculate the indicated sum or product.</i></p> <p>5.OA.2.1: Express a whole number in the range 2–50 as a product of its prime factors. For example, find the prime factors of 24 and express 24 as $2 \times 2 \times 2 \times 3$. CA</p> <p>5.OA.3: Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. <i>For example, given the rule “Add 3” and the starting number 0, and given the rule “Add 6” and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.</i></p> <p>5.NBT.2: Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.</p>
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Unit 4

Geometry and Statistical Thinking

Concepts/Clusters	Standards to Support CC Math 6
Develop understanding of statistical variability and summarize and describe distributions.	<p>5.MD.2: Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Use operations on fractions for this grade to solve problems involving information presented in line plots. <i>For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.</i></p>
Solve real-world and mathematical problems involving area, surface area, and volume.	<p>4.MD.3: Apply the area and perimeter formulas for rectangles in real world and mathematical problems. <i>For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.</i></p> <p>5.MD.5: Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.</p> <ol style="list-style-type: none"> Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. Apply the formulas $V = l \times w \times h$ and $V = B \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge

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	<p>lengths in the context of solving real world and mathematical problems.</p> <p>c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.</p> <p>5.G.2: Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.</p>
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Common Core Math 7 Tutorial Lab AB
(Intervention Course for Grade 7)

312619 **CC Math 7 Tutorial Lab A**
312620 **CC Math 7 Tutorial Lab B**

COURSE DESCRIPTION

Common Core Math 7 Tutorial Lab is designed to provide foundational knowledge and intervention for students enrolled in or preparing to enroll in Common Core Math 7. This course serves not only as intervention, but also as support for students experiencing difficulty in mastering the core standards and academic language constraints of the Common Core Math 7 course. Common Core Math 7 Tutorial Lab is an elective mathematics course provided to students as a supplemental course to enhance the student's knowledge of prerequisite skills and academic language that is required in order to successfully access the standards-based Common Core Math 7 course.

COURSE SYLLABUS

The structure of this course is divided into four separate, but coherent, units mirroring the Common Core Math 7 course. Additionally, an immense element of this intervention course is an emphasis on student engagement with the Standards for Mathematical Practice on a daily basis. Students enrolled in this intervention course need to be assessed on an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to adapt their instruction through ongoing formative assessments to provide genuine, differentiated instruction. The outcome of the initial and ongoing assessments are to analyze and identify key skills and concepts required for students to access the Common Core State Standards, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

The goal of this intervention course is to support Common Core Math 7 and to provide explicit, systematic, and intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards' expectations, they must be able to accurately identify areas of student deficit and match students to an appropriate academic intervention plan. An expectation from the Common Core Math 7 Tutorial Lab is to create evidence-based intervention plans that are customized to individual students, and that are also tied to specific Common Core Standards.

Unit 1

Using Concepts of Rate and Ratio to Solve Problems

Concepts/Clusters	Prerequisite Standards to Support CC Math 7
Analyze proportional relationships and use them to solve real-world and mathematical problems.	<p>6.RP.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. <i>For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”</i></p> <p>6.RP.2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. <i>For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate</i></p>

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	<p><i>of \$5 per hamburger.”</i></p> <p>6.RP.3:</p> <p>Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</p> <ul style="list-style-type: none">a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.b. Solve unit rate problems including those involving unit pricing and constant speed. <i>For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?</i>c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
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Unit 2

Understanding Operations with Rational Numbers

Concepts/Clusters	Prerequisite Standards to Support CC Math 7
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers	<p>5.NF.4: Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.</p> <p>b. Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. <i>For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5) = 8/15$. (In general, $(a/b) \times (c/d) = ac/bd$.)</i></p> <p>b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.</p> <p>6.NS.1: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. <i>For example, create a story context for $(2/3) \div (3/4)$ and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that $(2/3) \div (3/4) = 8/9$ because $3/4$ of $8/9$ is $2/3$. (In general, $(a/b) \div (c/d) = ad/bc$.) How much chocolate will each person get if 3 people share $1/2$ lb of chocolate equally? How many $3/4$-cup servings are in $2/3$ of a cup of yogurt? How wide is a rectangular strip of land with length $3/4$ mi and area $1/2$ square mi?</i></p> <p>6.NS.3: Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.</p> <p>6.NS.5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p> <p>6.NS.6: Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.</p> <p>a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., $-(-3) = 3$, and that 0 is its own opposite.</p> <p>b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.</p> <p>c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.</p> <p>6.NS.7: Understand ordering and absolute value of rational numbers.</p> <p>a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. <i>For example, interpret $-3 > -7$ as a statement that -3 is located to the right of -7 on a number line oriented from left to right.</i></p> <p>b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. <i>For example, write $-3^{\circ}\text{C} > -7^{\circ}\text{C}$ to express the fact that -3°C is warmer than</i></p>

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	<p>-7°C.</p> <p>c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. <i>For example, for an account balance of -30 dollars, write $-30 = 30$ to describe the size of the debt in dollars.</i></p> <p>d. Distinguish comparisons of absolute value from statements about order. <i>For example, recognize that an account balance less than -30 dollars represents a debt greater than 30 dollars.</i></p>
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Unit 3

Understanding Expressions and Linear Equations

Concepts/Clusters	Prerequisite Standards to Support CC Math 7
Use properties of equations to generate equivalent expressions	<p>6.EE.3: Apply the properties of operations to generate equivalent expressions. <i>For example, apply the distributive property to the expression $3(2 + x)$ to produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6(4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$.</i></p> <p>6.EE.4: Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). <i>For example, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number y stands for.</i></p>

Unit 4

Understanding Geometry and Statistical Probability

Concepts/Clusters	Prerequisite Standards to Support CC Math 7
<p>Draw, construct, and describe geometrical figures and describe the relationships between them</p> <p>Solve real-life and mathematical problems involving angle measure, area, surface area, and volume</p>	<p>6.G.1: Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.</p>

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Common Core Math 8 Tutorial Lab AB
(Intervention Course for Grade 8)

312611 **CC Math 8 Tutorial Lab A**
312612 **CC Math 8 Tutorial Lab B**

COURSE DESCRIPTION

Common Core Math 8 Tutorial Lab is designed to provide foundational knowledge and intervention for students taking CC Math 8 and for students who are preparing to be enrolled in Math 8. The course is also used to provide intervention for the students who are enrolled in CC Math 8 but are experiencing difficulty in mastering the core standards and academic language of CC Math 8. Common Core Math 8 Tutorial Lab is an elective mathematics course provided to students as a second course to support the core CC Math 8 course. The course is designed to enhance the student's knowledge of prerequisite skills and academic language that are needed to access the standards-based CC Math 8 course.

COURSE SYLLABUS

Students enrolled in this intervention course need to be assessed in an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to tailor instruction through ongoing assessment to provide true differentiated instruction. The outcome of the initial and ongoing assessments are analyze to identify skill and concept requirements necessary for any Common Core State Standard, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

The aim of the intervention in CC Math 8 is to provide explicit, systematic, intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards expectations, they must be able to accurately identify areas of student deficit and to match any student to an appropriate academic intervention plan. The idea of the CC Math 8 intervention is to create evidence-based intervention plans that customized to individual students and that are tied to specific Common Core Standards.

Unit 1

Concepts/Clusters	Prerequisite Standards to Support CC Math 8
Understand and apply the Pythagorean Theorem.	6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. 7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
Know that there are numbers that are not rational, and approximate them by rational numbers.	7.NS.2d Convert a rational number to a decimal using long division; know that the decimal from of a rational number terminates in 0s or eventually repeats.
Work with radicals and integer exponents.	4.OA.2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the

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	<p>unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.</p> <p>5.NBT.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.</p> <p>6.EE.1 Write and evaluate numerical expressions involving whole-number exponents.</p> <p>6.EE.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.</p> <p>7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. <i>For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.</i></p> <p>7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.</p>
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Unit 2

Concepts/Clusters	Prerequisite Standards to Support CC Math 8
Understand the connections between proportional relationships, lines and linear equations.	<p>7.RP.2 Recognize and represent proportional relationships between quantities.</p> <p>a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</p> <p>c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.</p> <p>d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.</p> <p>7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and</p>

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	reproducing a scale drawing at a different scale.
Analyze and solve linear equations and pairs of simultaneous linear equations.	<p>6.EE.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.</p> <p>7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients</p> <p>7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</p>

Unit 3

Concepts/Clusters	Prerequisite Standards to Support CC Math 8
Apply and extend previous understandings of numbers to the system of rational numbers.	<p>7.RP.2 Recognize and represent proportional relationships between quantities.</p> <p>a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</p> <p>c. Represent proportional relationships by equations. <i>For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.</i></p> <p>d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.</p>
Apply and extend previous understandings of numbers to the system of rational numbers.	<p>6.NS.8 Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.</p> <p>$+ y^2$).</p>

Unit 4

Concepts/Clusters	Prerequisite Standards to Support CC Math 8
Understand congruence and similarity using	<p>6.G.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of</p>

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physical models, transparencies, or geometry software.	<p>solving real-world and mathematical problems.</p> <p>7.G.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.</p> <p>7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure</p>
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(Grade 6, 7 or 8)

173101 **ESL Mathematics A**
173102 **ESL Mathematics B**

COURSE DESCRIPTION

ESL Mathematics is a one-year enabling course for newcomers enrolled in the Structured English Immersion Program. The course is designed to provide an introduction to key language and concepts in mathematics and to build a foundation for standards-based mathematics instruction taught in English. It may be offered under the following conditions:

- As a prerequisite for standards-based sheltered math courses taught using specially designed academic instruction in English (SDAIE).
- As an intervention for English Learners in need of basic language and conceptual development in mathematics, to be offered during summer or intersession.

COURSE SYLLABUS

The standards should be taken from the *Mathematics Standards for the Mathematics Intervention Program* on page 340/341 of the Mathematics Framework for California Public Schools to be appropriate for each student's needs.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

HIGH SCHOOL Mathematics COURSES Grades 9-12

High School Core Mathematics Courses

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COMMON CORE ALGEBRA 1 AB

(Annual Course – Grade 9 or 10)

Prerequisite: Common Core Mathematics 8AB

310341 CC Algebra 1A

310342 CC Algebra 1B

COURSE DESCRIPTION

The purpose of Algebra I is for students to use reasoning about structure to define and make sense of rational exponents and explore the algebraic structure of the rational and real number systems. They understand that numbers in real world applications often have units attached to them, that is, they are considered *quantities*. Students explore the structure of algebraic expressions and polynomials. They see that certain properties must persist when working with expressions that are meant to represent numbers, now written in an abstract form involving variables. When two expressions with overlapping domains are set equal to each other, resulting in an equation, there is an implied solution set (be it empty or non-empty), and students not only refine their techniques for solving equations and finding the solution set, but they can clearly explain the algebraic steps they used to do so.

In Algebra I, students extend this knowledge to working with absolute value equations, linear inequalities, and systems of linear equations. After learning a more precise definition of function in this course, students examine this new idea in the familiar context of linear equations (for example, by seeing the solution of a linear equation as solving $f(x) = g(x)$ for two linear functions f and g). Students continue building their understanding of functions beyond linear ones by investigating tables, graphs, and equations that build on previous understandings of numbers and expressions. They make connections between different representations of the same function. They learn to build functions in a modeling context, and solve problems related to the resulting functions. Note that the focus in Algebra I is on linear, simple exponential, and quadratic equations.

This course is offered to students who demonstrate a thorough understanding of Pre- algebra concepts. The intent of the course is to develop skill and understanding of the language of algebra, functions, number operations, solving and graphing equations and inequalities involving real-world concepts, ratios, quadratic functions, factoring terms, completing the square, using the quadratic formula, monomial and polynomial expressions, exponents and rational expressions, and problem solving. Through the study and use of Algebra, the learner develops an understanding of the symbolic language of mathematics and the sciences. Algebra 1 develops the skills and concepts to help solve a wide variety of problems. Goals:

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A) To help students own and command the language of Algebra; B) To prepare students for the study of higher mathematics and for those who are college bound, to provide a basic understanding of the symbolic nature of algebra; C) To focus on the big ideas of Algebra1.

Finally, students extend their prior experiences with data, using more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

Algebra I Overview

Number and Quantity

The Real Number System

- Extend the properties of exponents to rational exponents.
- Use properties of rational and irrational numbers.

Quantities.

- Reason quantitatively and use units to solve problems.

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions.
- Write expressions in equivalent forms to solve problems.

Arithmetic with Polynomials and Rational Expressions

- Perform arithmetic operations on polynomials.

Creating Equations

- Create equations that describe numbers or relationships.

Reasoning with Equations and Inequalities

- Understand solving equations as a process of reasoning and explain the reasoning.
- Solve equations and inequalities in one variable.
- Solve systems of equations.
- Represent and solve equations and inequalities graphically.

Functions

Interpreting Functions

- Understand the concept of a function and use function notation.
- Interpret functions that arise in applications in terms of the context.
- Analyze functions using different representations.

Building Functions

- Build a function that models a relationship between two quantities.

Mathematical Practices

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

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- Build new functions from existing functions.

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems.
- Interpret expressions for functions in terms of the situation they model.

Statistics and Probability

Interpreting Categorical and Quantitative Data

- Summarize, represent, and interpret data on a single count or measurement variable.
- Summarize, represent, and interpret data on two categorical and quantitative variables.
- Interpret linear models.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

Unit 1: Relationships between Quantities and Reasoning with Equations

- **Interpret the structure of expressions.**
Limit to linear expressions and to exponential expressions with integer exponents.
- **Understand solving equations as a process of reasoning and explain the reasoning.**
Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses.
- **Solve equations and inequalities in one variable.**
Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents, such as $5x = 125$ or $2x = \frac{1}{16}$

Unit 2: Linear and Exponential Relationships

- Build a function that models a relationship between two quantities.
Limit to F.BF.1a, 1b, and 2 to linear and exponential functions. In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions.
- Build new functions from existing functions.
Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in this standard.
- Construct and compare linear, quadratic, and exponential models and solve problems.
For F.LE.3, limit to comparisons between linear and exponential models. In constructing linear functions in F.LE.2, draw on and consolidate previous work in Grade 8 on finding equations for lines and linear functions (8.EE.6, 8.F.4).
- Interpret expressions for functions in terms of the situation they model.
Limit exponential functions to those of the form $f(x) = bx + k$.

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Unit 3: Descriptive Statistics

- Summarize, represent, and interpret data on a single count or measurement variable.
In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.
- Summarize, represent, and interpret data on two categorical and quantitative variables.
Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals.

S.ID.6b should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course.

- Interpret linear models.
Build on students' work with linear relationships in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.

Unit 4: Expressions and Equations

- Interpret the structure of expressions.
- Write expressions in equivalent forms to solve problems.
- Perform arithmetic operations on polynomials.
- Create equations that describe numbers or relationships.
- Solve equations and inequalities in one variable.
- Solve systems of equations.

Unit 5: Quadratic Functions and Modeling

- **Use properties of rational and irrational numbers.**
- **Interpret functions that arise in applications in terms of a context.**
Focus on quadratic functions; compare with linear and exponential functions studied in Unit 2.
- **Analyze functions using different representations.**
For F.IF.7b, compare and contrast absolute value, step and piecewise defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise defined functions. Note that this unit, and in particular in F.IF.8b, extends the work begun in Unit 2 on exponential functions with integer exponents. For F.IF.9, focus on expanding the types of functions considered to include, linear, exponential, and quadratic.

Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are known, a quadratic equation can be factored.
- **Build a function that models a relationship between two quantities.**
Focus on situations that exhibit a quadratic relationship.
- **Build new functions from existing functions.**
For F.BF.3, focus on quadratic functions, and consider including absolute value functions. For F.BF.4a, focus on linear functions but consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x > 0$.
- **Construct and compare linear, quadratic, and exponential models and solve problems.**
Compare linear and exponential growth to quadratic growth.

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

Scope and Sequence

Concept Lessons, Performance Tasks, Projects, Technology enhanced projects,

The Algebra 1 course consists of 5 instructional units: Relationships between Quantities and Reasoning with Equations, Linear and Exponential Relationships, Descriptive Statistics, Expressions and Equations, and Quadratic Functions and Modeling. Each instructional unit will include concept lessons, performance tasks, technology enhanced projects, homework, class presentations, collaborative assignments and warm-

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ups. Concept Tasks are extended problem-solving scenarios in a real world context. In Concept Tasks, students model with mathematics, attend to precision, construct viable arguments, look for and make use of structure, and use appropriate tools strategically. In performance tasks students will make sense of problems, persevere in solving them, model mathematics, use appropriate tools strategically, and look for and express regularity in repeated reasoning. For all assignments students will be expected to make sense of problems and persevere in solving them as well as attend to precision. During collaborative assignments and presentations, students are expected to construct viable arguments, critique the reasoning of others and reason abstractly.

Unit 1 Relationships between Quantities and Reasoning with Equations

Comparing Investments— Students interpret linear and exponential equations that model simple and compound interest investments. Students will be able to explain the difference between simple interest and compound interest. They will also be able to understand multiple representations of the same model, including descriptive, algebraic and tabular data, and graphical representations of the equations.

A Stack of Cups – Students use hands on techniques to investigate the meaning of linear equations. Students will write the equation of line that models the height of the cups and they will interpret the meaning of the slope and y-intercept in relation to the number and size of the cups.

Solving Linear Equations in One Variable – Students will solve linear equations in one variable. Given a linear equation in one variable, students will determine if it has one, none, or infinitely many solutions. Students will collaboratively create posters displaying their justifications and they will critique each others' reasoning.

Calling Plans – Students will explore a real world problem to determine which is the best deal on a cell phone plan. Students will create a table, draw a graph, and write an equation to model the situation and to assist them in finding the best deal.

Reasoning with Linear Inequalities – Students will critique a student's solution to a linear inequality and find the mathematical errors the student made. Students will explain why some of the steps in the solution are mathematically incorrect.

Two Storage Tanks – Students interpret information given in graphical form and use analytical techniques to solve problems. Students will use the concept of a constant rate of change over time to solve problems and relate it to the slope of a line to create linear equations.

Tommy's T-Shirts – Students work with linear equations to find out how much they should charge T-shirts. Students will develop an understanding and interpret the meaning of algebraic expressions in one variable that model real life situations.

Unit 2: Linear and Exponential Relationships

Summer jobs – Students use linear functions to analyze and compare the weekly income for the allowances and summer jobs for two high schools students. They determine under which circumstances each student will make the most income and explain what happens to the functions when hourly rates or allowances are changed.

Comparing Investments – Students interpret exponential and linear functions given a real world context including modeling simple and compound interest investments. Students determine how and why a quantity changes per unit interval, discovering that linear functions grow by equal distances and exponential functions grow by equal factors over equal intervals. They understand multiple representations of the same model, including descriptive, algebraic and tabular data, and graphical representations of the equations.

Arithmetic and Geometric Sequences – Students investigate arithmetic and geometric sequences by creating functions for the two types of sequences. Students link arithmetic sequences to linear functions and geometric sequences to exponential functions.

The Penny Problem – Students will evaluate a context where one quantity is growing exponentially and the other is

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linear. Students will determine that a quantity that is increasing exponentially will eventually exceed a quantity that is increasing linearly.

Unit 3: Descriptive Statistics

Line of Best Fit-Students experiment with line of best fit using technology or an applet. Students will use a scatter graph to investigate a possible connection between length and width of bird's eggs. They will create a **scatter plot** to compare team salary with team wins and analyze data in this timely activity. Students can use this data to see if there is a statistically significant correlation between team salary and wins.

Representing Data: Using Frequency Graphs- students use frequency graphs to identify a range of measures and make sense of data in a real world context, and approximate a frequency graph by a continuous distribution.

Using Box Plots- Students interpret data using frequency graphs and box plots.
Interpreting Statistics: Students interpret data and evaluate statistical summaries and critique each others' interpretation.

Devising a Measure for Correlation-Students understand the notion of correlation.

Super Bowl Scores-students study historical Super Bowl data to reflect on average (mean, median, and mode) losing scores, winning scores, and range of scores. They are asked to judge which of these central measurements seem the most meaningful and explain their reasoning.

Unit 4: Expressions and Equations

Sorting Equations and Identities- Students in this assignment will recognize the differences between equations and identities, substitute numbers in to algebraic statements in order to test their validity in special cases and carry out correct algebraic manipulation while learning about common errors

Identify and interpret structure - Students in this assignment will identify the structure in the two algebraic expressions by interpreting them in terms of a geometric context, the principal source of challenge in this task is to encourage a multitude and variety of approaches, both in terms of the geometric argument and in terms of the algebraic manipulation.

Representing Polynomials- Students in this assignment will translate between graphs and algebraic representation of polynomials. The focus of the students learning in this assignment is recognizing the connection between the zeros of polynomials when suitable factorizations are available, and graphs of the functions defined by polynomials and recognizing the connection between transformations of the graphs and transformations of the functions

Unit 5: Quadratic Functions and Modeling Operations with Rational and Irrational Numbers

Students perform operations with rational and irrational numbers. They explore the sums and products of two rational numbers and compare them the sum or products of rational and irrational numbers. Students conclude that the product of a nonzero rational number and an irrational number is always irrational.

Throwing Baseballs - Students compare properties of two functions represented in different ways -

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algebraically, graphically, or in numerical tables. Using tables and graphs, students determine which function has the greatest maximum and the greatest non-negative root.

Functions and Everyday Situations - Students are able to describe the relationships between variables arising in everyday situations and sketch graphs of those relationships. They interpret the functions in terms of the contexts in which they arise, analyze the domains of those functions, and classify the functions as discrete or continuous.

Which Function? - Students compare several functions derived by factoring or completing the square. They analyze the functions in terms of the roots, the vertex, and the sign of the leading coefficient. Then, students connect this information to the important features of the graph. Students are able to determine the sign of the leading coefficient without actually writing the quadratic expressions in ax^2+bx+c form.

Temperature Conversions - Students write a function that describes a relationship between two quantities. They explore unit conversion as composition of two functions (when several successive conversions are required) and the inverses of those functions (units can always be converted in either of two directions).

Building a quadratic function from $f(x)=x^2$ - Students sketch the graphs of parabolas with transformations by hand or using graphing calculators. They interpret and recognize the impact of the different transformations on the graphs.

Building a General Quadratic Function - Students manipulate the quadratic expressions in ax^2+bx+c form with numerical coefficients. Students derive the quadratic formula by completing the square and rewriting the trinomial as $a(x+d)^2+k$ and separating x .

Population and Food Supply – Students construct linear/ exponential functions from verbal descriptions and explore the idea of the dominance of exponential over linear functions. They construct/ compare linear and exponential functions and find the intersections of their graphs. Using graphs and tables students observe that an exponential increase eventually exceeds a linear or quadratic increase in quantities.

TEXTS/MATERIALS

- LAUSD *Secondary Mathematics Curriculum Map*
- Textbook: District approved materials
- Supplemental materials and resources

Algebra 1 will utilize each of the following forms of assessment to monitor student progress.

The following assessments and tools will measure student progress to drive instructional delivery:

- Formative Assessments will Examples include
- Frequent teacher progress monitoring and quizzes
- Performance Tasks, Quizzes, projects, and Concept Tasks
- Criteria Charts

The following assessments and tools to evaluate incremental student learning on key concepts of the intended standards:

- Summative Assessments
- Performance Assessments
- Criteria Charts, Rubric, and Projects
- Smarter Balanced Interim Assessments
- Smarter Balanced End of Course Assessment

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COMMON CORE ALGEBRA 2AB

(Grade 9, 10 or 11)

Prerequisite: Common Core Algebra 1AB or Common Core Geometry AB

310343 CC Algebra 2A

310344 CC Algebra 2B

COURSE DESCRIPTION

In this course, students expand understanding of expressions including rewriting, interpreting and examining rational, radical, polynomial expressions and deriving the formula of the sums of finite geometric series. Students continue expanding their knowledge of rational, polynomial, radical, exponential and logarithmic functions; they learn to represent functions algebraically, graphically, in numerical tables and by verbal descriptions. Students expand their knowledge of the real numbers to model/ solve a variety of equations/ inequalities and the systems of equations with two or more variables. Students practice creating equations for the real world situations, learn how to solve them, interpret the solutions and explain the reasoning. Students learn about complex numbers and explore real /complex roots of polynomial functions using the Fundamental Theorem of Algebra. Students explore/ apply the Remainder Theorem and the Binomial Theorem with the polynomial expressions and equations. Students explore the relationship between the exponential functions and their inverses, the logarithmic functions.

Students explore all conic sections and learn how to express geometric properties with equations. Students extend their trigonometry knowledge: they learn how to interpret the radian measure of angles in the unit circle, graph all six trigonometric functions, model the periodic phenomena of the graphs, and prove/apply trigonometric identities.

Finally, students continue expanding their knowledge of statistics by summarizing, representing, and interpreting data using the normal distribution. Moreover, students make inferences and justify conclusions based on sampling, experiments and observational studies.

The standards in this Algebra II course cover the following conceptual categories: Modeling, Functions, Number and Quantity, Algebra, and Statistics and Probability. The standards are developed to help educators implement mathematical practices of reasoning abstractly/ quantitatively, constructing viable arguments, modeling with mathematics, analyzing the structure of algebraic problems and persevering in solving them. This course content provides the rich instructional experiences for students and helps them to succeed beyond the high school and compete in the 21st century job market.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

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8. Look for and express regularity in repeated reasoning

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

Unit 1: Model and Reason with Equations and Inequalities

Students use reasoning to analyze equations/ inequalities and develop strategies for solving them. Through reasoning students develop fluency writing, interpreting, analyzing and translating between various forms of linear equations and inequalities. By exploring a question about the world around them (mathematical modeling) and attempting to answer the question students expand the scope of algebraic operations to solve a wide variety of linear and quadratic real world problems. Students explain why the x-coordinates of the points where the graphs $y = f(x)$ and $y = g(x)$ intersect and explore cases involving polynomial, rational, absolute value, exponential, and logarithmic functions.

Unit 2: Structure in Expressions and Arithmetic with Polynomials.

Students connect the polynomial operations with the background knowledge of the algorithms found in multi-digit integer operations. Students realize that the operations on rational expressions (the arithmetic of rational expressions) are governed by the same rules as the arithmetic of rational numbers. Students analyze the structure in expressions and write them in equivalent forms. By modeling students expand the scope of algebraic operations to solve a wide variety of polynomial equations and real world problems. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. The role of factoring, as both an aid to the algebra and to the graphing of polynomials, is explored.

Unit 3: Functions

Instructional time should focus on relating arithmetic of rational expressions to arithmetic of rational numbers. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. Students will expand understandings of functions and graphing to include trigonometric functions. Building on their previous work with functions and on their work with trigonometric ratios and circles in the Geometry course, students now use the coordinate plane to extend trigonometry to model periodic phenomena. Students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function.

Unit 4: Geometry and Trigonometry

Students use algebraic manipulation, including completing the square, as a tool for geometric understanding to determine if the equation represents a circle or a parabola. They graph shapes and relate the graphs to the behavior of the functions with the transformation on the variable (e.g. the graph of $y = f(x+2)$). Students expand on their understanding of the trigonometric functions first developed in Geometry to explore the graphs of trigonometric functions with attention to the connection between the unit circle representation of

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the trigonometric functions and their properties, use trigonometric functions to model periodic phenomena. Students use Pythagorean identity to find the trig function outputs given the angle and understand that interpretation of sine and cosine yield the Pythagorean Identity. Finally, students model and apply Trigonometric Functions.

Unit 5: Statistics and Probability

Students analyze data to make sound statistical decisions based on probability models. By investigating examples of simulations of experiments and observing outcomes of the data, students gain an understanding of what it means for a model to fit a particular data set. Students develop a statistical question in the form of a hypothesis (supposition) about a population parameter, choose a probability model for collecting data relevant to that parameter, collect data, and compare the results seen in the data with what is expected under the hypothesis. Students build on their understanding of data distributions to help see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). In addition, they can learn through examples the empirical rule, that for a normally distributed data set, 68% of the data lies within one standard deviation of the mean, and that 95% are within two standard deviations of the mean.

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

Number and Quantity

Students complete their extension of the concept of number to include complex numbers and apply their understanding of properties of operations (the commutative, associative, and distributive properties) and exponents and radicals to solve equations (e.g. $(x-2)^2 = -25$)

Key Assignment	Description
Exploring Complex Numbers	Given scenarios that can be modeled by a polynomial functions, students will do arithmetic, rationalize and simplify, graph, find absolute value, and distinguish between real and imaginary zeros of the polynomial functions. Students will explain their reasoning and justify their conclusions (MP 3, 4, 5, 6, 7).

Algebra

Students extend their equation solving skills to those that involve rational expressions and radical equation; they make sense of extraneous solutions when they arise. In addition, students continue to develop their understanding of solving equations as solving for values of x such that $f(x) = g(x)$, now including combinations of linear, polynomial, rational, radical, absolute value, and exponential functions, and understand that some equations can only be solved approximately with the tools they possess.

Students create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales; and represent constraints in modeling context by equations or inequalities. Students work with linear, exponential, or quadratic functions to create equations.

Students connect multiplication of polynomials with multiplication of multi-digit integers and division of polynomials with long division of integers. Students continue developing their understanding of the set of polynomials as a system analogous to the set of integers that exhibits certain properties, and they explore the relationship between the factorization of polynomials and the roots of a polynomial. Students use the zeroes of a polynomial to create a rough sketch of its graph and connect the results to their understanding of polynomials as function. Students rewrite $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and

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$r(x)$ are polynomials with degree of $r(x)$ less than that of $b(x)$, to highlight end behavior of such rational functions.

Students pay attention to the meaning of expressions in context and interpret the parts of an expression by viewing parts of an expression as a single entity. Students use the structure of an expression to identify ways to rewrite it in equivalent forms that help in solving problems.

Key Assignment	Description
Interpreting Expressions	Given general expressions (e.g. $P(1 + r)^n$, $ax^2 + bx + c$) students will interpret different parts such as: terms, factors and coefficients (MP 3, 4, 7).
Finding Solutions	Given equations involving radicals, rational expressions and inequalities, students will: <ul style="list-style-type: none"> • Solve equations and inequalities, state the domain and excluded values, and explain why the values are excluded. (MP 1, 3, 5) • Justify and determine extraneous solutions. (MP 1,3) • For systems of equations and inequalities, they will explain the solution in the context of the problem. (MP 1,3)
Linear Programming	Given linear programming problems, students will <ul style="list-style-type: none"> • Write the constraints using equations or inequalities (MP 1, 2, 4) • Graph the systems of equation and inequalities. (MP 5, 6) • Interpret solutions as viable or non-viable. (MP 3)
Sum of Geometric Series	Students investigate several concrete examples of finite geometric series (e.g. mortgage payments, retirement accounts). Students use technology to investigate growth in the sums and patterns that arise (MP 1, 4, 5, 8).
Performing Arithmetic with Polynomials and Rational Expressions	Given polynomial expressions and rational expressions, students will: <ul style="list-style-type: none"> • Use numerical substitutions for the variables to show that expressions represent numbers.(MP 7) • Rewrite rational expressions in different forms and use the new form to solve problems. (MP 7) • Explain how the remainder part of the reduced form could be used to approximate the value of a rational function for large value of the independent variable. (MP 1, 2, 3, 4, 7)
Interpreting Parts of Mathematical Expressions	Given equations with the same structure but increasing complexity, student will <ul style="list-style-type: none"> • Identify the basic structure and use substitution to solve problems of higher complexity. (MP 1, 4, 7) • Graph the equations by determining which forms of the equations provide important information (i.e. x-

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	intercepts, zeros, minimums or maximums) and how to use this information to sketch the graph. (1, 4, 5, 7)
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Functions

Students will develop ways of thinking that are general and allow them to approach any function, work with it, and understand how it behaves, rather than see each function as a completely different animal in the bestiary. Students will explore the relationship between exponential functions and their inverses. For instance, in Algebra II students see quadratic, polynomial, and rational functions as belonging to the same system. Students begin to work with complex numbers and apply their understanding of properties of operations (the commutative, associative, and distributive properties) and exponents and radicals to solve equations including square roots of negative numbers.

Key Assignment	Description
Analyzing Functions	Given graphs, tables and equations, students will: Match linear, quadratic, polynomial, absolute value, rational, and exponential (MP 1, 2, 8). Explain their reasoning and justify their conclusions (MP 3).
Exploring Inverses	Given graphs of a functions, students will: Make a table, graph, and derive the equation of the inverse function (MP 2, 5, 8). Use graphing tools to confirm the relationship between a function and their inverses (MP 5). Explain their reasoning and justify their conclusions (MP 3).

Geometry and Trigonometry

Students use algebraic manipulation, including completing the square, as a tool for geometric understanding to determine if the equation represents a circle or a parabola. They graph the shapes and relate the graph to the equation. Students apply trigonometric functions to angles in right triangles; $\sin\theta$, $\cos\theta$, and $\tan\theta$ for $0 \leq \theta \leq 2\pi$. They represent right triangles with hypotenuse equal to 1 in the first quadrant on a coordinate plane and see that $(\cos\theta, \sin\theta)$ represents a point on the unit circle.

Students use trigonometric functions to model periodic phenomena and understand the relationship between the parameters appearing in the general sine and cosine function graph and behavior of the function. Students will derive the Pythagorean Identity $\cos^2\theta + \sin^2\theta = 1$ and use algebraic manipulation to find values of other trigonometric functions for a given θ if one of them is known.

Key Assignment	Description
Relationships Between Circles and Parabolas	Given equations of planar curves, students will: <ul style="list-style-type: none"> Convert the equations to standard form ($ax^2 + by^2 + cx + dy + e = 0$) by completing the square. (MP 1,7) Justify and determine if the equations represents a circle of a parabola. (MP 3,7) Graph the equations. (MP 4, 5)
Trigonometry and the Unit Circle	Applying special right triangles with hypotenuse equal to 1 on the coordinate plane students will: <ul style="list-style-type: none"> Find values of $\sin\theta$, $\cos\theta$, and $\tan\theta$, for $0 \leq \theta \leq 2\pi$. (MP 1, 5, 6)

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	<ul style="list-style-type: none"> See that $(\cos\theta, \sin\theta)$ represents a point on the unit circle. (MP 3, 4, 8)
Modeling Trigonometric Functions	<p>Given real-world situations with periodic phenomena, students will :</p> <ul style="list-style-type: none"> Model the situations using trigonometric functions. (MP 4) Graph the trigonometric function. (MP 5) Explain the relationship between the parameters appearing in the general cosine function, $f(x)=A\cdot\cos(Bx-C)+D$ (and sine function) and behavior of the function (e.g., amplitude, phase-shift, period, frequency, line of symmetry). (MP 3, 7)
Applying Trigonometric Identities	<p>Taking $\cos\theta$ to be the x-coordinate of a point corresponding to a rotation in a unit circle, and $\sin\theta$ the y-coordinate, students will:</p> <ul style="list-style-type: none"> Derive the Pythagorean Identity $\cos^2\theta+\sin^2\theta=1$. (MP 1, 7) Use algebraic manipulation to find values of other trigonometric functions for a given θ if one of them is known. (MP 1, 3, 7)

Statistics and Probability

Students analyze data to make sound statistical decisions based on probability models. By investigating examples of simulations of experiments and observing outcomes of the data, students gain an understanding of what it means for a model to fit a particular data set. Students build on their understanding of data distribution to see how the normal distribution uses area to make estimates of frequencies, which can be expressed as probabilities.

Key Assignment	Description
Normal Distribution in the Real World	<p>Students will research standardized test data that is normally distributed with a mean and standard deviation, students will:</p> <ul style="list-style-type: none"> Use spreadsheet software to summarize the data (MP 4, 5). Determine the probability of a randomly selected value and explain its meaning (MP 1, 3). Understand that the normal distribution is only an approximation to the true distribution of data values (MP 1).
Estimating a Population Proportion	<p>Students investigate whether a certain percentage of the student population will favor a change (MP 4). If x students in the school are sampled and y agree, then the sample proportion of students agreeing to the change is y/x. Students will:</p> <ul style="list-style-type: none"> Explain the accuracy of the proportions of students in favor of the change (MP 3). Determine if the sample size taken accurately depicts the situation (MP 2).

ASSESSMENTS

Multiple assessment types including diagnostic, formative, and summative measures will be used to monitor students' progress towards the established learning goals.

Diagnostic

These assessments inform teachers of students existing knowledge in order to plan and modify instruction that targets identified deficits and reinforces strengths.

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Formative

These assessment include district periodic benchmarks, teacher generated measures, and performance tasks drawn from common core resources such as MARS, SBAC, PARCC, LAUSD Concept lessons, and Illustrative Mathematics.

MARS Functions Example

Novice: Short items focused on specific content or skills.

Novice tasks are short items, each focused on a specific concept or skill, as set out in the Common Core State Standards. They involve only two of the CCSS mathematical practices (MP2 – reason abstractly and quantitatively; MP6 – attend to precision), and do so only at the comparatively low level that short items allow.

Example: <http://map.mathshell.org/materials/download.php?fileid=844>

Apprentice: Substantial tasks, structured to ensure that all students have access to the problem.

Apprentice tasks are substantial, often involving several aspect of mathematics, and structured so as to ensure that all students have access to the problem. Students are guided through a “ramp” of increasing challenge to enable them to show the levels of performance they have achieved. While any of the CCSS mathematical practices may be required, these tasks especially feature MP2, MP6 and two others (MP3 – construct viable arguments and critique the reasoning of others; MP7 – look for and make use of structure). Because the structure guides the students, the mathematical practices involved are at a comparatively modest level.

Expert: Rich, less structured tasks requiring strategic problem-solving skills as well as content knowledge.

Example: <http://map.mathshell.org/materials/download.php?fileid=780>

Expert: Rich tasks, each presented in a form in which it might naturally arise in applications.

They require the effective use of problem solving strategies, as well as concepts and skills. Performance on these tasks indicates how well a person will be able to do and to use mathematics beyond the mathematics classroom. They demand the full range of mathematical practices, as described in the Common Core State Standards, including: MP1 – make sense of problems and persist in solving them; MP4 – model with mathematics; MP5 – use appropriate tools strategically; MP8 – look for and express regularity in repeated reasoning.

Example: <http://map.mathshell.org/materials/download.php?fileid=810>

Two Smarter Balanced periodic assessments will be given.

Summative

The Smarter Balanced summative assessment measures students’ learning and progress towards four claims:

1. Concepts and Procedures
2. Problem solving
3. Communicating Reasoning
4. Modeling and Data Analysis

TEXTS/MATERIALS

- LAUSD *Secondary Mathematics Curriculum Map*
- Textbook: District approved materials
- Supplemental materials and resources

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COMMON CORE GEOMETRY AB

(Annual Course – Grade 9 or 10)

Prerequisite: Common Core Algebra 1 AB

310423 CC Geometry A

310424 CC Geometry B

BRIEF COURSE DESCRIPTION

The essential purpose of this Geometry course is to introduce students to formal geometric proofs and the study of plane figures, with an emphasis on plane Euclidean geometry—both synthetically and analytically. Furthermore, transformations of rigid motion are the foundations of proof for congruency and similarity. Concepts included in this course are geometric transformations, proving geometric theorems, congruence and similarity, analytic geometry, right triangle trigonometry, and probability and statistics. Students are expected to model real world situations and make decisions using these ideas.

Course Purpose:

The purpose of this course is to formalize and deepen a students' understanding of how transformational geometry, trigonometry, probability and statistics can be used to model and interpret the real world. Students will be able to grasp abstract Euclidean proofs, transformational proofs, and apply them to understand real world, geometric relationships—including relationships between two and three dimensional objects. Students will continue to develop mathematical ways of thinking through the Mathematical Practice Standards and content standards. Students will be expected to make sense of real world situations and apply mathematics to develop solutions.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

Unit 1: Congruence

In this unit, students will make geometric constructions; experiment with transformations in the plane; understand congruence in terms of rigid motion; and, prove geometric theorems using rigid motion. Students understand that a geometric construction is a visual representation of geometric principles that allows them to develop a deeper understanding of the spatial relationship between pairs of figures. Conceptually, students will understand that the properties of transformations are rigid motions that can be used to identify and prove congruence of figures in a plane.

Unit 2: Similarity

In this unit, students will understand similarity in terms of dilations in transformations; and, prove theorems involving similarity. Students will define two objects as similar if there is a sequence of transformations that maps one figure exactly onto another. Students prove similarity of two objects using their given ratio by a scale factor; prove similar triangles have corresponding pairs of angles and proportional pairs of sides; prove theorems about triangles (e.g. the line parallel to one side of a triangle divides the other two proportionately and conversely; using triangle similarity to prove the Pythagorean Theorem).

Unit 3: Expressing Geometric Properties with Equations; Circles

In this unit, students will use coordinates to prove simple geometric theorems algebraically; understand

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and prove theorems about circles; find arc lengths and areas of sectors of circles; and, translate between the geometric description and the equation for a conic section. Students derive the equation of a circle using the distance formula; derive the equation of a parabola in terms of the focus and directrix. Students prove and justify algebraically the relationships between slopes of parallel and perpendicular lines; use the algebraic representation of a geometric problem to prove theorems in the coordinate plane; extend the concept of similarity to circles with proofs; investigate relationships between angles, radii and chords; and, apply similarity to derive arc length and sector area.

Unit 4: Similarity, Right Triangles, and Trigonometry; Geometric Measurement and Dimensions; Conditional Probability and the Rules of Probability

In this unit, students will define trigonometric ratios and solve problems involving right triangles; explain volume formulas and use them to solve problems; visualize relationships between 2-D and 3-D objects; understand independence and conditional probability and use them to interpret data; use rules of probability to compute probabilities of compound events in a uniform probability model; and, use probability to evaluate outcomes of decisions. Based on similarity, students will connect the concept of side ratios as angle properties to define the three trigonometric ratios. Students will define trigonometric ratios; understand that trigonometric ratios are relationships between sides and angles in right triangles; derive the three trigonometric ratios for special right triangles (30° , 60° , 90° and 45° , 45° , 90°). Students will solve real world problems using right triangles, trigonometric ratios and the Pythagorean Theorem. Students develop formulas for circumference of a circle, area of a circle, volume of a cylinder, pyramid, and a cone, using informal reasoning. Students recognize and explain the concepts of conditional probability and independence in everyday language and situations. Students will also use probabilities to make fair decisions and analyze decisions and strategies using probability concepts.

Key Assignments:

Transforming 2D Figures – Students explore transformations in the plane using patty paper and/or geometric software. Students will be able to describe transformations in the plane and note this change symbolically.

Sequence of Transformations Activity – Students use transparencies or geometric software to justify a sequence of transformations to map one shape onto another. Students illustrate their reasoning in writing and diagrams to show that the corresponding parts of a triangle are congruent; triangle ABC \rightarrow triangle A'B'C'.

Transformations in Commercial and Fine Arts – Students identify and analyze the use of transformations in commercial and fine arts.

Experimenting with Dilations – Students are given opportunities to experiment with dilations and determine how they affect planar objects. Students engage in an activity to discover that the lengths of corresponding sides of triangles have the same ratio as dictated by the scale factor. For example, students conduct a simple investigation to observe how the distance at which a projector is placed from a screen affects the size of the image on the screen.

Analyzing Congruency Proofs – Students are given sets of properties about triangles. They illustrate examples from the written descriptions and decide whether or not the triangles would be congruent. Students write convincing proof or explain why they are not congruent. Students evaluate other students' work and critique the reasoning of others.

Bermuda Triangle Task – Students make connections between algebraic results and geometric ideas in a real world context, such as navigation. Students prove conjectures and provide geometric

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justification using coordinate geometry to make connections between different points on the earth's surface.

Longitude and Latitude – Students use modeling to find the distance traveled on Earth's surface between two locations, such as from Moscow to Tokyo, using arc length. Student write their results in degrees and in radians.

Awesome Amanda – Students explore the validity of a claim about the angle between two lines intersecting inside a circle and the measures of the arcs they intercept.

Amazing Amanda – Students explore the sum of the interior angles of various polygons and discover the formula for the sum of the interior angles of an n-gon.

The Chocolate Factory – Students explore the volumes of chocolate bars with different shapes, but with the same size lateral area. Students identify the relationships between scale factor and volume.

Is this game fair? – Students investigate theoretical and experimental probability using a colored spinner and use experimental probability to determine whether a game is fair. Students apply the concepts of probability and solve real-world probability problems.

Working-Group Leaders – Students model the probability of randomly choosing 2 out of 5 people in a group. For example, suppose a 5-person working group consisting of three girls and two boys wants to randomly choose two people to lead the group, because they are group leaders, order is important in the selection.

Instructional Methods and/or Strategies:

Cooperative Learning Groups – Students work together in mixed-ability groups or partners to solve problems. Together, they construct viable arguments, communicate their reasoning, and critique the reasoning of others.

Problem-Based Learning – Students work individually or as a team to solve challenging problems with real-world applications. Students use this strategy to make sense of problems and persevere in solving them; reason abstractly and quantitatively.

Project-Based Learning – Students explore an extended process of inquiry in response to a complex question, problem, or challenge. Students create rigorous projects that are carefully planned, managed, and assessed to help students learn key academic content.

Inquiry – Students observe, analyze patterns, and make conjectures. Students engage in collecting data and testing hypotheses, then use this data to draw conclusions.

Concept Attainment Model – Teachers provide examples and non-examples, and then asks students to 1) develop and test hypotheses about the exemplars, and 2) analyze the thinking processes that were utilized. For example, students may be asked to categorize informal arguments for the formula for circumference and area of a circle.

Concrete Model – Students make use of visual tools for representing geometry, such as simple patty paper or transparencies, graph paper, calculators, reflective devices, dynamic geometry software, or other manipulatives.

Geometry Construction – Students use a variety of tools and methods to make formal geometric constructions, such as copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

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Discourse – Students develop and deepen their understanding of mathematical concepts through discussions and writing. They make sense of problems, construct viable arguments, and model with mathematics by communicating their understanding of mathematical concepts, receiving feedback, and progressing to a deeper understanding.

Five Practices for Orchestrating Productive Mathematics Discussions – Facilitate instruction that advances the mathematical understanding involving 1) Anticipating; 2) Monitoring; 3) Selecting; 4) Sequencing; 5) Connecting.

Common Assessments – Teachers design and administer common assessments at the school site level and at the district level.

Interim, Benchmark, and Diagnostic Assessment – These assessments will be used to monitor and make instructional decisions.

Students will provide evidence of learning through a variety of assessments, such as constructed response items; projects; selected response items that resemble Smarter Balanced assessment items, performance tasks, self-evaluative assessments; student reflections; projects and presentations; informal assessment; discussion.

Students will be assessed during classroom and group discussions by evidence of viable arguments, thinking and building on the reasoning of others, and the precise use of academic vocabulary.

Formative Assessments – include checking for understanding using dry-erase boards, exit tickets. Students and teachers use evidence to adapt teaching and learning to meet immediate learning needs minute-to-minute and day-by-day. The formative assessment would involve the five strategies recommended by Marnie Thompson and Dylan Williams including:

1. Clarifying and sharing learning intentions and criteria for success
2. Engineering effective discussion, questions, activities, and tasks that elicit evidence of learning
3. Providing feedback that moves students forward
4. Activating students as instructional resources for one another
5. Activating students as owners of their own learning.

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Honors Advanced Mathematics AB

(Annual Course – Grade 9 or 10)

Prerequisite: Common Core Algebra 1 AB and Common Core Geometry AB

310509 Advanced Mathematics A

310509 Advanced Mathematics B

310509H Honors Advanced Mathematics A

310509H Honors Advanced Mathematics B

BRIEF COURSE DESCRIPTION

Honors Advanced Mathematics is accelerated, covering all topics in the regular Precalculus course, and advancing through introductory concepts of Limit, instantaneous rate of change including differentiation, and definite integral. Students will develop the ability to apply the knowledge gained to real-world application of these ideas. In this course also, students are provided more thorough practice with basic sequences, series such as Taylor's series and McLaurin series, and summation notation. To receive Honors designation and credit, Students will be asked to design a project that would help to solve problems in the district or in the city such as water conservation project or a system to minimize electric consumption at their school sites as well as participate as peer tutors on campus. This course is intended for students who wish to advance directly to AP Calculus BC the following academic year, or for any student who wishes to undertake a higher level course than the regular Precalculus.

In the Honors Advanced Mathematics course, students connect the addition of complex numbers to addition of vectors. Students learn complex numbers and explore real and complex roots of polynomial functions using the Fundamental Theorem of Algebra. They also investigate the geometric interpretation of multiplying polar coordinates using polar representation. They perform operations on matrices and use matrices in applications. In this course also, students expand their understanding of interpretation and examination of complex rational, radical, and polynomial expressions as well as derive the sums of finite geometric series formula. They continue to expand their knowledge of rational, polynomial, radical, exponential and logarithmic functions; and explore the relationship between the exponential functions and their inverses. They also explore and apply the Remainder Theorem and the Binomial Theorem with the polynomial expressions and equations.

Students explore all conic sections and learn how to express geometric properties with equations. They extend their trigonometry knowledge: they learn how to interpret the radian measure of angles in the unit circle, graph all six trigonometric functions, model the periodic phenomena of the graphs, and prove and apply trigonometric identities. The Standards for Mathematical Practice would be embedded throughout the course. The Mathematical Practices describe varieties of expertise that teachers of this course should seek to develop in their students by the end of the course. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. Therefore, students will reason abstractly/ quantitatively, construct viable arguments and critique the reasoning of others, model with mathematics, analyze the structure of algebraic problems and persevering in solving them. They also solve problems with mathematical precision, look for and make use of structures, look for and express regularity in repeated reasoning, and use appropriate tools strategically. (Common Core State Standards, Mathematics (2010). This course content provides the rich instructional experiences for students and helps them to succeed beyond the high school and compete in the 21st century job market.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

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Course Purpose

This course is designed to advance students' knowledge of mathematics, in order for them to become adept at problem solving - allowing them to model real-world situations, explore complex ideas in depth, and develop good problem-solving skills required in various applications. Higher-level thinking strategies are reinforced, and idea-rich mathematical discourse involving students constructing viable argument and critiquing the idea of others provide them the opportunity to practice these higher-level thinking strategies, and to understand mathematics as a formal language that describes the world around them.

Honors Advanced Mathematics course provides students with the tools they will need for college mathematics courses, particularly calculus. Students will deepen their Algebra 2 learning and build on learning from geometry to construct a deeper understanding of functions. As students study mathematics analysis, pre-calculus and trigonometry, they will be investigating functions in new ways and working with more abstract forms, including trigonometric functions. Trigonometric functions are extended to all real numbers, and their graphs and properties are studied. They deepen their understanding of the concept of function, including system of polynomial functions, analogous to the integers, is extended to the field of rational functions, which is analogous to the rational numbers. Students explore the relationship between exponential functions and their inverses, and the logarithmic functions. They will develop a deeper understanding of the concepts of limits, area under a curve, and rate of change including gradient that are essential in the development of calculus. The outcomes achieved will be fluency and accuracy in Algebra and Trigonometry at an advanced level and also to introduce students to the elementary foundations of Calculus in preparation for Advanced Placement courses.

Students connect the addition of complex numbers to addition of vectors. They also investigate the geometric interpretation of multiplying polar coordinates using polar representation. Students use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network and write a comprehensive report regarding the approached used in manipulating the data. Based on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students now use the coordinate plane to extend trigonometry to model periodic phenomena. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function. They identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. The concepts of summation notation would be introduced through students exploring and applying the Remainder Theorem and the Binomial Theorem expansion with the polynomial expressions and equations.

Unit 1: Introduction and Preliminaries to Honors Advanced Mathematics

Students will review the vital topics drawn from previous courses that are used to develop higher ideas, including:

Model and Reason with Equations and Inequalities: Students use reasoning to analyze equations/ inequalities and develop strategies for solving them. Through reasoning students develop fluency writing, interpreting, analyzing and translating between various forms of linear equations and inequalities. By exploring a question about the world around them (mathematical modeling) and attempting to answer the

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question students expand the scope of algebraic operations to solve a wide variety of linear and quadratic real world problems. Students explain why the x-coordinates of the points where the graphs $y = f(x)$ and $y = g(x)$ intersect and explore cases involving polynomial, rational, absolute value, exponential, and logarithmic functions. They hone and sharpen their understanding of representing mathematical ideas numerically, algebraically, and graphically.

Structure in Expressions and Arithmetic with Polynomials. Students connect the polynomial operations with the background knowledge of the algorithms found in multi-digit integer operations. Students realize that the operations on rational expressions (the arithmetic of rational expressions) are governed by the same rules as the arithmetic of rational numbers. Students analyze the structure in expressions and write them in equivalent forms. By modeling students expand the scope of algebraic operations to solve a wide variety of polynomial equations and real world problems. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. The role of factoring, as both an aid to the algebra and to the graphing of polynomials, is explored.

Advanced Algebra

In this part of the unit, students investigate algebraic techniques designed to make them better problem solvers in more complex situations. Students begin by understanding how functions behave and learn the terms and academic vocabulary used to describe the properties of functions, including; increasing and decreasing functions, concavity, even and odd functions. Students practice setting up more complex word problems and practice simplifying, factoring, using substitution, completing the Square, polynomial and synthetic division, and using Pascal's Triangle to write Binomial expressions. Students rediscover the arithmetic and geometric series in preparation for the more complex study of series to come. Throughout the unit students further their study in analyzing the process of reading a college level textbook, noting the structure and characteristics of a college text.

Unit 2: Functions and Trigonometry

Functions

Students will develop ways of thinking that are general and allow them to approach any function, work with it, and understand how it behaves, rather than see each function as a completely different animal in the bestiary. They explore the relationship between exponential functions and their inverses. Students expand understandings of functions and graphing to include trigonometric functions. Building on their previous work with functions and on their work with trigonometric ratios and circles in the Geometry course, students now use the coordinate plane to extend trigonometry to model periodic phenomena. Students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function. They graph shapes and relate the graphs to the behavior of the functions with the transformation on the variable (e.g. the graph of $y = f(x + 2)$).

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The Conic Sections

Students derive the equations of ellipses and hyperbolas given foci. Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, they use the method of completing the square to put the equation in standard form; identify whether the graph of the equation is a circle, parabola, ellipse, or hyperbola as well as graph the equation. Students apply themselves solving problems involving conic sections, and understand and use eccentricity. Students use algebraic manipulation, including completing the square, as a tool for geometric understanding to determine if the equation represents a circle or a parabola. They graph the shapes and relate the graph to the equation.

The Unit Circle and Trigonometric Functions

Students apply trigonometric functions to angles in right triangles; $\sin\theta$, $\cos\theta$, and $\tan\theta$ for $0 \leq \theta \leq 2\pi$. They represent right triangles with hypotenuse equal to 1 in the first quadrant on a coordinate plane and see that $(\cos\theta, \sin\theta)$ represents a point on the unit circle. Students use Pythagorean identity to find the trigonometric function outputs given the angle and understand that interpretation of sine and cosine yield the Pythagorean Identity. By applying the fundamental identity students build other identities and engage in verifying identities of various kinds. Students discover the reciprocal functions, and model activities using the periodic functions. Other specific studies include graphical addition, angular frequency and period, and simplifying complex fractions. Students expand their understanding of the trigonometric functions first developed in Geometry to explore the graphs of trigonometric functions with attention to the connection between the unit circle representation of the trigonometric functions and their properties, use trigonometric functions to model periodic phenomena.

Unit 3: Polar Equations and The Complex Plane

In Unit 3, students investigate conversions between polar and rectangular coordinates, with an emphasis on common forms and rotations in polar coordinates. Students build polar forms of complex numbers, and practice simplifying and managing powers and roots of complex numbers. Students prove DeMoivre's Theorem, and use it to find the result of raising a complex number to a power. They also investigate the geometric interpretation of multiplying polar coordinates using polar representation.

Modeling with Periodic Functions

Students begin by solving trigonometric Equations and practice graphing trigonometric functions of the form $y = a\sin(b(x - h)) + k$ to model sinusoidal functions in the real world. After investigating the ambiguous case for the Law of Sines, students develop the angle sum and difference formulas, and the double and half angle formulas. Students engage in solving more complex trigonometric equations, utilizing the inverse trigonometric functions, with applications in surveying and navigation.

Unit 4: Vector and Matrix Quantities

- Students will represent and model with vector quantities.
- Students will perform operations on vectors.
- Students will perform operations on matrices and use matrices in applications

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Vectors and Parametric Equations

Students connect the addition of complex numbers to addition of vectors. Students investigate vectors as geometric objects in the plane that can be represented by ordered pairs, and matrices as objects that act on vectors. Students discover that vector addition and subtraction behave according to certain properties, while matrices and matrix operations observe their own set of rules. Beginning with simple vector addition, students learn the mechanical aspects of working with vectors, developing the component form of a vector and sketching vectors specifying magnitude and standard Angle. Students apply the dot product, and vector equations in a variety of applications. Parametric equations and their inverses are investigated, and students work with parametric functions by making sense of the equations $x = 2t, y = 3t + 1, 0 \leq t \leq 10$. They use a parametric equation to trace the motion of an object. Applications of both vectors and parametrics are conducted using graphing calculators or other technologies, such as ipads and computer softwares.

Matrices

Students use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network and write a comprehensive report regarding the approached used in manipulating the data. Students discover with matrices a new set of mathematical objects and operations among them that has a multiplication that is not commutative. Matrices are initially used to solve advanced systems of equations and 3-space, then students' progress to linear transformation, rotation, composition of matrices, and applications to vectors. Students discover the Identity matrix, Matrix operations (adding, multiplying), and Eigenvalues.

Unit 5: Introduction to Calculus

Area Under the Curve

The emphasis will include the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function. Students numerically analyze curves by first drawing rectangles, then trapezoids to approximate the area under the curve. The importance of unit analysis is emphasized as students discover the physical meanings of the area they have computed. They are also introduced to Simpson's rule as another approach to approximating the area under a curve. In the discussion of curves, students investigate vertical and horizontal shifts of piecewise- defined functions, and gain an intuitive notion of Continuity. Sigma Notation is introduced as a clever way to represent the sums of the areas of figures under the curve.

Instantaneous Rates of Change

Slope of a curve at a point is investigated. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents. Slopes and rates of change are also investigated graphically using Secant lines between two points on the graph of a function. Students practice graphic, numeric and algebraic methods to calculate the average rate of change of a function and discover that the instantaneous rate of change as the limit of average rate of change as well as approximate rate of change from graphs and tables of values. They learn the definition of the derivative and apply it to analyze velocity and position functions, noting the physical meanings of their results in a variety of contexts.

Limits and the Infinite Geometric Series

Students are provided an intuitive understanding of limiting process while studying direct and inverse

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variation and investigating asymptotic behavior. They calculate limits using algebra. By simplifying algebraic fractions and noting the domain of rational functions, the concepts of continuity and limit become clearer. Students would estimate limits from graphs or tables of data. Provided with the correct notation, students practice and apply the definition of limit with various kinds of functions, including piece-wise defined functions with a step-discontinuity. One-sided limits are utilized to discuss the criteria for continuity of a function at a point.

Students understand asymptotes in terms of graphical behavior. They will describe asymptotic behavior in terms of limits involving infinity. Students investigate how the dominant terms of an expression affect its graph, and become more comfortable with the holes and asymptotes in their graphs. Students compare relative magnitude of functions and their rates of change. For example: contrasting exponential growth, polynomial growth, and logarithmic growth. Looking carefully toward the number e , students model growth and decay in a variety of contexts, and investigate the Infinite Geometric Series, Harmonic Series, and Fibonacci Series.

Unit 6: Statistics and Probability

Students analyze data to make sound statistical decisions based on probability models. By investigating examples of simulations of experiments and observing outcomes of the data, students gain an understanding of what it means for a model to fit a particular data set. Students develop a statistical question in the form of a hypothesis (supposition) about a population parameter, choose a probability model for collecting data relevant to that parameter, collect data, and compare the results seen in the data with what is expected under the hypothesis. Students build on their understanding of data distributions to help see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). In addition, they can learn through examples the empirical rule, that for a normally distributed data set, 68% of the data lies within one standard deviation of the mean, and that 95% are within two standard deviations of the mean.

Key Assignments

In Honors Advanced Mathematics course, students would involve in projects that would require them to model real-world phenomena and solve them using appropriate mathematics schemes. These projects and assignments would ask students questions about the world around them, and mathematics is then constructed in the process of attempting to answer the question. A variety of assignments drawn from several sources will be used to strengthen, deepen, and reinforce students' conceptual understanding of mathematics. These activities will be delivered in the form of combination of cooperative group and individual discovery learning. Daily homework and classwork from different resources including online resources, textbooks, apps, and software would be assigned in order to assess students' knowledge of the information covered during class period. These assignments would be enhanced by integrating the specific assignments outlined below:

Unit 1: Introduction and Preliminaries to Honors Advanced Mathematics

Model and Reason with Equations and Inequalities and Structure in Expressions and Arithmetic with Polynomials:

- Given various expressions, students will write these expressions in different forms and identify, interpret, and explain the structure of the expression such as the compound interest.

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- Given various rational expressions, students will perform long division if rational expression is improper and use the remainder to explain the end value behavior; and understand that rational expressions are analogous to rational numbers and use this understanding to further explore rational expressions.
- Given a real-life situation in a factory where main objective is to maximize profit and reduce costs, students will write the equation for the objective function, find the constraints for resources and capacity and determine viable and nonviable options.
- Given a soccer field of length x and width y , and a perimeter of n meters, students will write expression for the width in terms of the length, the expression for the area and estimate the dimension that will yield **maximum** area.
- Students investigate algebraic techniques designed to make them better problem solvers in more complex situations.
- Students practice setting up more complex word problems and practice simplifying, factoring, using substitution, Completing the Square, Polynomial and Synthetic division, and using Pascal's Triangle to write Binomial Expressions.
- Students rediscover the Arithmetic and Geometric Series in preparation for the more complex study of series to come and analyze the process of reading a college level textbook, noting the structure and characteristics of a college text.
- **Nutritional Analysis Project:** Students would conduct a research on the amount students spend at their school on snacks and determine how healthy the snacks they buy. Students use participatory sensing system to collect data. From the data collected, they create charts and graphs of the function to represent whether students are making healthy nutritional choices based on the amount they spend on snacks. They would use the properties of the equation and linear inequality to explain and defend their views regarding whether it is reasonable to spend certain amount on certain nutritional snacks.

Unit 2: Functions and Trigonometry

Functions

- **Investment Decisions:** A modeling problem involving the most efficient way to solve an investment dilemma for stock broker will be posed to the students. They model the problem by finding a solution pathway that would optimize the profit of the brokerage firm when they invest in different stock options. Given the stock pricing which would involve volume-based discount, students will model and graph the revenue, cost, and profit functions. They would interpret the vertices, intercepts, and intersection points as well as solve systems of equations to discover the exact number of customers that would help them maximize revenue and profit.
- Students apply, interpret, and build functions in the cases of polynomial functions of degree greater than two, including more complicated rational functions, the reciprocal trigonometric functions, and inverse trigonometric functions.
- Students examine end behavior of polynomial and rational functions and find asymptotes.
- Students explore the relationship between two functions that are inverses of each other, i.e. that f and g are inverses if $(f \circ g)(x) = x$ and $(g \circ f)(x) = x$. They construct inverse functions by appropriately restricting the domain of the given function and use inverses in context.

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- Students investigate parametric function; work with polar coordinates, and graph polar curves. This assignment would enable them to make connections between polar coordinates and polar representation of complex numbers.
- Students investigate new concepts in modeling situations, such as by recording points on the curve of a tossed ball as it travels along, graphing the points as vectors, and deriving the equation for $x(t)$ and $y(t)$.
- Given a polynomial function, students will give verbal description of the relationship and interpret key features of the graph and table by doing the following:
 - Sketch the graph and determine where the function is increasing and where it is decreasing
 - Determine the relative maxima and minima
 - Determine the interval over which the value of the function is positive and where it is negative
 - Describe the end behavior of the function
 - Determine whether or not the function is symmetric about the y-axis.
 - Relate the domain of the function to its graph and where applicable the quantitative relationship it describes
- Student will be given various functions to graph by hand and show key features, and where the function is complicated, they use technology to analyze the key features of the function.
- Students will graph rational functions and identify the following:
 - The zeros, and their multiplicities
 - Identify the asymptotes
 - And describe the end behavior
- Student graph exponential and logarithmic functions and show intercepts and end behavior; and trigonometric functions showing period, midline and amplitude.
- Students perform transformation and explore the effect of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, $f(x + k)$ for all the parent functions. They will identify which transformation result in vertical shift, horizontal shift, vertical compression and vertical stretch, horizontal compression and horizontal stretch, reflection in the y-axis and reflection in the x-axis
- Students will also be able to write the new functions that result from a combination of the above transformations and use technology to confirm and give explanation. Students will also be able to tell whether a function is even or odd by determining if $f(x) = f(-x)$, and $f(-x) = -f(x)$, respectively.
- Students will understand the process of determining whether or not a function is invertible, and if it is how to find the inverse and know how to produce an invertible function from a non-invertible function by restricting the domain.
- **Investigation of Piecewise Functions:** Students practice both graphing given functions on closed intervals such as popping a balloon, and developing their own functions and graphs by symbolically modeling situations. They compare each other's work and describe in writing as well as prepare a PowerPoint presentation the physical parameters that create "breaks" in the graphs of their models.

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The Conic Sections

- **Conic Section Exploration:** Students will explore the conic sections and describe how to cut a cone to create the various conic sections. Separate the class into 6 groups (or a multiple of 6 for large class). Assign two conic sections to each group. There are 6 different ways to do this: circle/ellipse, circle/hyperbola, circle/parabola, ellipse/hyperbola, ellipse/parabola, and hyperbola/parabola. Each group should create a poster summarizing what they've learned about their two conic sections and comparing and contrasting them.
- Students translate between the geometric description and the equation for a conic section.
- Students derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
- Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, use the method for completing the square to put the equation in standard form; identify whether the graph of the equation is a circle, parabola, ellipse, or hyperbola, and graph the equation.

The Unit Circle and Trigonometric Functions

- Students investigate new concepts in modeling situations, such as by recording points on the curve of a tossed ball as it travels along, graphing the points as vectors, and deriving the equation for $x(t)$ and $y(t)$. They also investigate the relationship between the graphs of the sine and cosine as a function of θ on one hand and the graph of the curve defined by $x(\theta) = \cos(\theta)$, $y(\theta) = \sin(\theta)$ on the other hand, drawing connections between the two.
- Given a point $P = (x, y)$ on a unit circle that corresponds to the angle θ , and a point Q on a unit circle that corresponds to the angle $-\theta$ with coordinates $(x, -y)$; students will use the definition of trigonometric functions to show that

$$\sin(\theta) = y, \sin(-\theta) = -y, \cos(\theta) = x, \cos(-\theta) = x$$

$$\text{So, } \sin(-\theta) = -\sin(\theta), \text{ and } \cos(\theta) = \cos(-\theta).$$

Using these results and some of the fundamental identities students will show that:

$$\tan(-\theta) = -\tan(\theta), \cot(-\theta) = -\cot(\theta), \sec(-\theta) = -\sec(\theta), \csc(-\theta) = -\csc(\theta).$$

- **Phases of the Moon Project:** Students will demonstrate their understanding of functions and equations defined parametrically by designing a project involving collecting the phases of moon data for x number of days (e.g. 30 days). They will graph polar coordinates of the data collected. Students will need to recall that the period for this model is 30, as the graph begins on day 1. This assignment requires students to recall how to enter data points, plot them, and have the correct window for viewing.
- Student use the inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
- **Space Shuttle Project:** Students would work in groups to create word problems involving inverse functions. For instance: Around 1:30 p.m., people heard that the space shuttle will fly around Los Angeles area. People were outside waiting. Finally, the space shuttle was sighted. At one point, it

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looked as if the shuttle was really low. How could you estimate the distance from the shuttle to where you are standing (diagonal distance) with an angle of elevation of 30° ? The students will estimate how high the shuttle could be from the ground.

- Students prove the addition and subtraction formulas for sine, cosine, and tangent, and use them to solve problems.
- Students prove the half angle and double angle identities for sine and cosine and use them to solve problems.

Unit 3: Polar Equations and The Complex Plane

- Students investigate the geometry of complex numbers more fully and connect it to operations with complex numbers. In addition, students develop the notion of a vector and connect operations with vectors and matrices to transformations of the plane.
- Given a complex number, students will explain the conjugate and the modulus
Example: Write the trigonometric form of the complex number $5/(2+3i)$
- Students will represent complex numbers in polar and rectangular forms and show that they are the same. *Example:* Write and graph $z = -2 - 2(3i)^{1/2}$ in polar form.
- Students prove DeMoivre's Theorem, and use it to find the result of raising a complex number to a power. Given a complex number to a power, students can use DeMoivre's Theorem to find the modulus and argument, and the value. *Example:* Use DeMoivre's Theorem to find $(-1 + (3i)^{1/2})^{12}$. Students prove DeMoivre's Theorem, and use it to find the result of raising a complex number to a power.
- Students calculate the distance between numbers in the complex plane as the modulus of the distance of the midpoint. Example: <http://www.illustrativemathematics.org/illustrations/1094>
- Students will investigate the geometric interpretation of multiplying polar coordinates using polar representation.

Modeling with Periodic Functions

- Students solve trigonometric equations and graph trigonometric functions of the form $y = a \sin(b(x - h)) + k$ to model sinusoidal functions in the real world.
- Students investigating the Ambiguous Case for The Law of Sines, and develop the Angle Sum and Difference Formulas, and the Double and Half angle Formulas.
- Students solve more complex trigonometric equations, utilizing the inverse trigonometric functions, with applications in surveying and navigation.

Unit 4: Vector and Matrix Quantities

- Students will represent and model with vector quantities. Students would be given assignments involving connecting the addition of complex numbers to addition of vectors.

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- Students recognize that vectors have both magnitude and direction, and use appropriate symbols for vectors and magnitudes.
Example: Let u be represented by the directed segment from $P = (0, 0)$ to $Q = (3, 2)$, and let v be represented by the directed line segment from $R = (1, 2)$ to $S = (4, 4)$. Show that $u = v$.
- Students can find components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
Example: Find the component and magnitude of the vector v with the initial point $(4, -7)$ and terminal point $(-1, 5)$.
- Students solve problems involving velocity and other quantities represented by vectors:
Example: A car has driven 125 km due west, then 60 km due south. Represent the displacement of the car with a vector. Find the magnitude of the vector to find the displacement of the car.
- Students add vectors end-to-end, component wise, and by the parallelogram rule. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
- Students represent vector subtraction graphically by connecting the tips in appropriate order, and perform vector subtraction component-wise.
- Students represent scalar multiplication graphically by scaling vectors, and possibly reversing their direction; perform scalar multiplication component-wise. *Example:* $c(v_x, v_y) = (cv_x, cv_y)$
- Students compute the magnitude of a scalar multiple cv using $\|cv\| = |c|\|v\|$.
- Students compute the direction of cv knowing that when $c \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$).
- **Vector Project:** Given the speed of an aircraft and its bearing (coordinates) students would find the resultant speed and direction of the aircraft by simulating the velocity of wind effects on all four nautical directions.
- **Financial Analysis Project:** Have students consider a variety of businesses, such as small software company, online trading investment, and shoe manufacturing company. They would model the investment cost of the business based on startup cost borrowed at different percentages, capital expenditure, profit, and earnings. They would use a system of equation to determine how much was borrowed at each rate based on an annual interest. Then students will solve the resulting system by matrices. They would verify their solutions by graphing the system and interpreting their results.
- Given a system of linear equations, students will prove that replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions and write the equation in matrix form. They solve system of linear equations by matrices.
- Students model situations involving payoffs in games, economic, or geometric situations. Students discover with matrices a new set of mathematical objects and operations among them that has a multiplication that is not commutative.
- **Cryptograph Project:** Cryptograph is the study of writing in secret code that goes back to ancient times. In modern time, cryptography are used in mathematics, computational science, and engineering. Cryptography has applications in banking, credit cards, computer passwords, and internet. One of the earliest and easiest methods of coding message is the substitution cipher which date back to 1900 BC, in which each letter in the alphabet is substituted for another letter/number/symbol. Each student will make up a message and encode it using the coding chart. Also, each student should come up with their own matrix C . Each student will present their encoded message and the inverse of matrix C to the class to decode the message. Students can use technology to solve matrices beyond 3×3 . Include matrix solution scheme involving Cramer's rule, Row echelon method, or Gauss-Jordan elimination method.

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Unit 5: Introduction to Calculus

Area Under the Curve

- Students will understand the interplay between the geometric and analytic information and use calculus to predict and to explain the observed local and global behavior of a function.
- Students numerically analyze curves by first drawing rectangles, then trapezoids to approximate the area under the curve to discover the physical meanings of the area they have computed. They would use Simpson's rule as another approach to approximate the area under a curve and compare the magnitude of the values from both methods.
- Students investigate vertical and horizontal shifts of piecewise- defined functions, and gain an intuitive notion of continuity. Sigma Notation is introduced as a way to represent the sums of the areas of figures under the curve.
- **Exploration of Area under a Curve with Geometer's Sketchpad or Desmos.** In this assignment, students explore how and why area on a time-velocity graph represents distance, and they examine change of position by estimating area under the graph (curve) using trapezoidal and Simpson's methods. They would construct viable argument regarding the efficiency of both numerical methods and with respect to attending to precision.
- **Desmos and Geometer's Sketchpad Activity:** Exploration involving finding distance from acceleration: Students design an experiment to collect acceleration of object and collect acceleration data. Students investigate and calculate rates of change and area from given graphs. This exploration would enable students to investigate area and limits, building area, and connect area and integrals.

Instantaneous Rates of Change

- **Investigations of Average Rates:** Using tables of data students would investigate average rate of change. In this assignment students focus on the numeric analysis of change over very short intervals of time, leading to discussion of limit, and instantaneous rate of change.
- **Exploration of Calculus with Geometer's Sketchpad:** Students will use the Sketchpads on their ipads and devices to explore cooperatively to practice plotting numerical rates of change and compare the numerical values to the slope of tangent line graphs.
- Students investigate slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
- Students explore graphic, numeric and algebraic methods to calculate the average rate of change of a function and discover that the instantaneous rate of change as the limit of average rate of change as well as approximate rate of change from graphs and tables of values.
- Students compare relative magnitude of functions and their rates of change. For example: contrasting exponential growth, polynomial growth, and logarithmic growth. Looking carefully toward the number e , students model growth and decay in a variety of contexts, and investigate the infinite geometric series, harmonic series, and Fibonacci sequence.

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Limits and the Infinite Geometric Series

- Students engage in intuitive understanding of limiting process involving direct and inverse variation and investigate asymptotic behavior. They calculate limits using algebra.
- Given graphs or tables of data, students estimate limits from.
- Given the correct notation, students practice and apply the definition of limit with various kinds of functions, including piece-wise defined functions with a step-discontinuity.
- **Calculus Activities for Tablets and Devices:** Students would utilize Desmos app or TI Calculator to explore and develop an intuitive understanding of various function limit by repeatedly evaluating function zoomed in different views. The purpose of this assignment is to provide the students a numerical and graphical investigation of limits.
- **Investigation of definition of Limit:** Students would formally define limit, and practice existence proofs of limits as x approaches a fixed number. This investigation would help students practice to strengthen the meaning of a limit and get them ready to work symbolically.
- **Exploring Non-routine Problems:** Students will justify answers analytically, graphically, numerically, and verbally and construct viable argument regarding the non-routine problems posed.
- Students explore by graphing functions to discover asymptotes in terms of graphical behavior. In this assignment they will describe asymptotic behavior in terms of limits involving infinity.
- Students investigate how the dominant terms of an expression affect its graph, and become more comfortable with the holes and asymptotes in their graphs. Series.

Unit 6: Statistics and Probability

- Students would design an experiment and/ or design a survey to collect and analyze data to make sound statistical decisions based on probability models. The expectation is that by investigating examples of simulations of experiments and observing outcomes of the data, students gain an understanding of what it means for a model to fit a particular data set.
- Students develop a statistical question in the form of a hypothesis (supposition) about a population parameter, choose a probability model for collecting data relevant to that parameter and compare the results seen in the data with what is expected under the hypothesis.

Students explore data distributions to investigate how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). In this exploration, they can learn through examples the empirical rule, that for a normally distributed data set, 68% of the data lies within one standard deviation of the mean, and that 95% are within two standard deviations of the mean.

Assessment

Multiple assessment types including diagnostic, formative, and summative measures will be used to monitor students' progress towards the established learning goals.

Diagnostic

These assessments inform teachers of students existing knowledge in order to plan and modify instruction that targets identified deficits and reinforces strengths.

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Formative

These assessment include district periodic benchmarks, teacher generated measures, and performance tasks drawn from common core resources such as MARS, SBAC, PARCC, LAUSD Concept lessons, and Illustrative Mathematics.

MARS Functions Example

Novice: Short items focused on specific content or skills: Novice tasks are short items, each focused on a specific concept or skill, as set out in the Common Core State Standards. They involve only two of the CCSS mathematical practices (MP2 – reason abstractly and quantitatively; MP6 – attend to precision), and do so only at the comparatively low level that short items allow.

Example: <http://map.mathshell.org/materials/download.php?fileid=844>

Apprentice: Substantial tasks, structured to ensure that all students have access to the problem.

Apprentice tasks are substantial, often involving several aspect of mathematics, and structured so as to ensure that all students have access to the problem. Students are guided through a “ramp” of increasing challenge to enable them to show the levels of performance they have achieved. While any of the CCSS mathematical practices may be required, these tasks especially feature MP2, MP6 and two others (MP3 – construct viable arguments and critique the reasoning of others; MP7 – look for and make use of structure). Because the structure guides the students, the mathematical practices involved are at a comparatively modest level.

Example: <http://map.mathshell.org/materials/download.php?fileid=780>

Expert: Rich tasks, each presented in a form in which it might naturally arise in applications.

They require the effective use of problem solving strategies, as well as concepts and skills. Performance on these tasks indicates how well a person will be able to do and to use mathematics beyond the mathematics classroom. They demand the full range of mathematical practices, as described in the Common Core State Standards, including: MP1 – make sense of problems and persist in solving them; MP4 – model with mathematics; MP5 – use appropriate tools strategically; MP8 – look for and express regularity in repeated reasoning.

Two Smarter Balanced periodic assessments will be given.

Summative

The Smarter Balanced summative assessment measures students’ learning and progress towards four claims:

1. Concepts and Procedures
2. Problem solving
3. Communicating Reasoning
4. Modeling and Data Analysis

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Precalculus AB

(Grade 10, 11 or 12)

Prerequisite: CC Algebra 2AB

310711

Precalculus A

310712

Precalculus B

COURSE DESCRIPTION

The focus of the course will be on problem solving using mathematical models to represent real world situations. Students enrolled in Honors Precalculus will gain the confidence and skills necessary to be successful in Advanced Placement Calculus and math related curriculum in college. Students will build upon and further explore expressions, equations and functions learned in earlier math courses to develop patterns, make or test conjectures and try multiple representations. Students will also learn about inverse functions and how restricting the domain of a function that is not always increasing or decreasing allows its inverse to be constructed. Students are introduced to vectors in the complex plane and gain fluency transferring between rectangular and polar forms. Students will explore the properties of matrices as they apply matrix operations to solve systems of equations and gain the understanding of how matrices help solve real world problems quickly and algorithmically. Students will apply their knowledge of trigonometry as they explore the unit circle and model periodic phenomena with trigonometric functions. Students will solve the real world problems involving the Laws of Sines and Cosines. Students will derive equations for conic sections from the definition of foci and by completing the square.

The standards in this Honors Precalculus course cover the following conceptual categories: Functions, Number and Quantity, Algebra and Geometry. The standards assure the implementation of the eight mathematical practices including reasoning abstractly/ quantitatively, constructing viable arguments, modeling with mathematics, analyzing the structure of algebraic problems, and persevering in solving them. This course content provides rich instructional experiences for students and helps them to succeed beyond high school and compete in the 21st century job market.

[The Curriculum Map for planning, teaching, and assessing this course is available on the math website](#)

COURSE SYLLABUS

Unit 1: Complex Number System with Vector and Algebra

Students extend their work in Algebra II to work with higher degree polynomials and complicated rational functions. Students see that complex numbers can be represented in the Cartesian plane and that operations with complex numbers have a geometric interpretation. They connect their understanding of trigonometry and geometry of the plane to express complex numbers in polar form. Students also work with vectors, representing them geometrically and performing operations with them. They connect the notion of vectors to the complex numbers. Students also work with matrices and their operations, experiencing for the first time an algebraic system in which multiplication is not commutative. Finally, they see the connection between matrices and transformations of the plane, namely: that a vector in the plane can be multiplied by a 2x2 matrix to produce another vector, and they work with matrices from the point of view of transformations. They also find inverse matrices and use matrices to represent and solve linear systems.

- Interpret the structure of expressions.
- Rewrite rational expressions.
- Create equations that describe numbers or relationships.
- Perform arithmetic operations with complex numbers.
- Represent complex numbers and their operations on the complex plane

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- Represent and model with vector quantities.
- Perform operations on vectors.
- Perform operations on matrices and use matrices in applications
- Solve systems of equations by matrix.

Unit 2: Function and Modeling

Students develop conceptual knowledge of functions that set the stage for the learning of other standards in Honors Precalculus. Students apply the standards in Interpreting Functions and Building Functions in the cases of polynomial functions of degree greater than two, more complicated rational functions, the reciprocal trigonometric functions, and inverse trigonometric functions. Students will examine end behavior of functions and learn how to find asymptotes. Students further their understanding of inverse functions and construct inverse functions by appropriately restricting domains. They also investigate the relationship between the graphs of sine and cosine as a function of theta and also use the parametric form of the functions where $x(\theta) = \cos(\theta)$ and $y(\theta) = \sin(\theta)$.

Students will be presented with opportunities to model in mathematics. The mathematical modeling in this course will begin with students asking a question about the world around them, and mathematics is then constructed in the process of attempting to answer the question. When students are presented with a real-world situation and challenged to ask a question, all sorts of new issues arise: which of the quantities present in this situation are known and unknown? Students need to decide on a solution path, which may need to be revised. They make use of tools such as calculators, dynamic geometry software, or spreadsheets. They may use previously derived models (e.g. linear functions) but may find that a new equation or function will apply. They may see that solving an equation arises as a necessity when trying to answer their question, and that oftentimes the equation arises as the specific instance of the knowing the output value of a function at an unknown input value. In the modeling taught in this course, mathematics is used as a tool to answer questions that students really want answered. Specifically, students will:

- Interpret functions that arise in applications in terms of the context.
- Model and interpret key features of functions including graphs and tables in terms of quantities.
- Relate the domain of a function to its graph and to the quantitative relationship it describes.
- Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available.
- Graph exponential and logarithmic functions, showing its key features.
- Demonstrate an understanding of functions and equations defined parametrically and graph them.
- Graph polar coordinates and curves. Convert between polar and rectangular coordinate systems.
- Analyze functions using different representations.
- Find inverse functions.
- Build new functions from existing functions.
- Mathematical Modeling

Unit 3: Trigonometry

Students expand their understanding of the trigonometric functions by connecting properties of the functions to the unit circle, e.g., understanding that since traveling 2π radians around the unit circle returns one to the same point on the circle, this must be reflected in the graphs of sine and cosine. Students extend their knowledge of finding inverses to doing so for trigonometric functions, and use them in a wide range of application problems. Students derive the addition and subtraction formulas for sine, cosine and tangent, as well as the half angle and double angle identities for sine and cosine, and make connections between among these. The relationships of general triangles using appropriate auxiliary lines result in the Laws of Sines and Cosines in general cases, and they connect the relationships described to the geometry of vectors. Students investigate the geometry of the complex numbers more fully and connect it to operations with complex numbers. In addition, students develop the notion of

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a vector and connect operations with vectors and matrices to transformations of the plane. By the end of this Unit, students will be able to:

- Expand the domain of trigonometric functions using a unit circle.
- Model periodic phenomena with trigonometric functions.
- Use inverse functions to solve trigonometric equations that arise in modeling contexts.
- Prove the sine, cosine, and tangent formulas and use them to solve problems.
- Prove and apply trigonometric identities.
- Similarity, Right Triangles, and Trigonometry.
- Prove the Laws of Sines and Cosines and use them to solve problems.
- Expressing Geometric Properties with Equations.
- Apply trigonometry to general triangles.
- Represent and model with vector quantities.
- Perform operations on vectors.
- Represent complex numbers on the complex plane in rectangular and polar form.
- Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane.

Unit 4: Conics, Systems and Matrices

Students derive the equations of ellipses and hyperbolas given foci. Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, they use the method of completing the square to put the equation in standard form; identify whether the graph of the equation is a circle, parabola, ellipse, or hyperbola as well as graph the equation. Students model situations, involving payoffs in games, economic, or geometric situations to systems of linear equations and connect the newfound knowledge of matrices to solving problems. Students investigate vectors as geometric objects in the plane that can be represented by ordered pairs, and matrices as objects that act on vectors. Students discover that vector addition and subtraction behave according to certain properties, while matrices and matrix operations observe their own set of rules. Students discover with matrices a new set of mathematical objects and operations among them that has a multiplication that is not commutative. They expand the skills involved in working with equations into several areas: trigonometric functions, by setting up and solving equations such as $\sin 2\theta = \frac{1}{2}$; parametric functions by making sense of the equations $x = 2t$, $y = 3t + 1$, $0 \leq t \leq 10$. Specifically in this Unit, students will:

- Translate between the geometric description and the equation for a conic section.
- Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant. Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, use the method for completing the square to put the equation in standard form; identify whether the graph of the equation is a circle, parabola, ellipse, or hyperbola, and graph the equation.
- Represent systems of linear equations as a single matrix equation in a vector form.
- Deepen their understanding of complex numbers on the complex plane in rectangular and polar form.
- Use matrices to represent and manipulate data.
- Find the inverse of matrix if it exists and use to solve system of linear equations
- Perform operations on matrices and use matrices in applications

Key Assignments

Throughout the course, students would be involved in projects that would require them to model real-world phenomena and solve them using appropriate mathematics schemes. These projects and assignments would ask students questions about the world around them, and mathematics is then constructed in the process of attempting to

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answer the question. Daily homework and classwork from different resources including online resources, textbooks, and software would be assigned in order to assess students' knowledge of the information covered during class period. These assignments would be enhanced by integrating the specific assignments outlined below:

Unit 1:

The Complex Number System with Vector and Algebra

Students investigate the geometry of complex numbers more fully and connect it to operations with complex numbers. In addition, students develop the notion of a vector and connect operations with vectors and matrices to transformations of the plane. Specifically, students would explore the following:

Perform arithmetic operations with complex numbers and represent complex numbers and their operations in the complex plane.	<p>Given a complex number, students will explain :</p> <ul style="list-style-type: none"> • the conjugate • the modulus <p><i>Example: Write the trigonometric form of the complex number $5/(2+3i)$</i></p> <p>Students will represent complex numbers in polar and rectangular forms and show that they are the same. <i>Example: Write and graph $z=-2-2(3i)^{1/2}$ in polar form.</i></p> <p>Given a complex number to a power, students can use DeMoivre's Theorem to find the modulus and argument, and the value. <i>Example: Use DeMoivre's Theorem to find $(-1+(3i)^{1/2})^{12}$</i></p> <p>Students can calculate the distance between numbers in the complex plane as the modulus of the distance of the midpoint. <i>Example: http://www.illustrativemathematics.org/illustrations/1094</i></p>
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Vector and Matrix Quantities

In this Unit, students would be given assignments involving connecting the addition of complex numbers to addition of vectors. They also investigate the geometric interpretation of multiplying polar coordinates using polar representation. Assignments would include the following:

Represent and model with vector quantities.	<p>Vector Project: Given the speed of an aircraft and its bearing (coordinates) students would find the resultant speed and direction of the aircraft by simulating the velocity of wind effects on all four nautical directions.</p> <p>Students recognize that vectors have both magnitude and direction, and use appropriate symbols for vectors and magnitudes. <i>Example: Let u be represented by the directed segment from $P=(0,0)$ to $Q=(3,2)$, and let v be represented by the directed line segment from $R=(1,2)$ to $S=(4,4)$. Show that $u=v$.</i></p> <p>Students can find components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. <i>Example: Find the component and magnitude of the vector v with the initial point $(4,-7)$ and terminal point $(-1,5)$.</i></p> <p>Students can solve problems involving velocity and other quantities represented by vectors: <i>Example: A car has driven 125 km due west, then 60 km due south. Represent the</i></p>
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Perform operations on vectors	<p>displacement of the car with a vector. Find the magnitude of the vector to find the displacement of the car.</p> <p>Add and subtract vectors.</p> <p>a) Add vectors end-to-end, component wise, and by the parallelogram rule. Understand that the magnitude of two vectors is typically not the sum of the magnitudes.</p> <p>b) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.</p> <p>c) Understand vector subtraction $v-w$ as $v + (-w)$, where $-w$ is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in appropriate order, and perform vector subtraction component-wise.</p>
Perform operations on matrices and use matrices in applications.	<p>Multiply a vector by a scalar</p> <p>a) Represent scalar multiplication graphically by scaling vectors, and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$</p> <p>b) Compute the magnitude of a scalar multiple $c\mathbf{v}$ using $\ c\mathbf{v}\ = c \ \mathbf{v}\$. Compute the direction of $c\mathbf{v}$ knowing that when $c \ \mathbf{v}\ \neq 0$, the direction of $c\mathbf{v}$ is either along \mathbf{v} (for $c > 0$) or against \mathbf{v} (for $c < 0$).</p> <p>Financial Analysis Project: Have students consider a variety of businesses, such as small software company, online trading investment, and shoe manufacturing company. They would model the investment cost of the business based on startup cost borrowed at different percentages, capital expenditure, profit, and earnings. They would use a system of equation to determine how much was borrowed at each rate based on an annual interest. Then students will solve the resulting system by matrices. They would verify their solutions by graphing the system and interpreting their results.</p>

Algebra

Precalculus students work with higher degree polynomials and more complicated rational functions. The assignment is designed so students would show a well-developed understanding of functions to make work with rational expressions more meaningful. Some assignments would give students the opportunities to connect rational expressions to real functions. For example, in a traditional exercise with adding two rational expressions with the intention of finding a common denominator, they view the two expressions as output of two functions. Students are asked to consider the domain of the two functions, the domain on which the sum of the two functions makes sense and what the sum denote. Furthermore, students can calculate tables of outputs for the two functions using spreadsheet, and then graph the resulting outputs, only to discover that the data fits the graph of the equation represented by the sum of the two expressions with a common denominator. Finally, if these expressions arise in a modeling context, students can interpret the results of studying these functions and their sum in the real world context. They connect their newfound knowledge of matrices to representing systems of linear equations by matrix multiplication.

Key Assignment	Description
Interpreting the structure of expressions	Given various expressions, students will write these expressions in different forms and identify, interpret, and explain the structure of the expression such as the compound interest

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Rewrite rational expressions.	<p>Given various rational expressions, students will:</p> <ul style="list-style-type: none"> • Determine whether or not it is proper. • Determine the excluded values in the domain of the expression. • Do long division if rational expression is improper and use the remainder to explain the end value behavior. • Understand that rational expressions are analogous to rational numbers and use this understanding to further explore rational expressions.
Creating Equations	<p>Given a real-life situation an in a factory where main objective is to maximize profit and reduce costs, students will:</p> <ul style="list-style-type: none"> • Write the equation for the objective function • Constraints for resources and capacity • Viable and nonviable options. <p>Given a soccer field of length x and width y, and a perimeter of 360 meters, students will:</p> <ul style="list-style-type: none"> • Write expression for the width in terms of the length • An expression for the area • Estimate the dimension that will yield maximum area.
Reasoning with Equations and Inequalities	<p>Given a system of linear equations in two variables, students will:</p> <ul style="list-style-type: none"> • Prove that replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions and write the equation in matrix form. • Solve system of linear equations by matrix
Represent and solve equations and inequalities graphically.	<p>Nutritional Analysis Project: Students would conduct a research on the amount students spend at their school on snacks and determine how healthy the snacks they buy. From the survey administered, they would create a chart and graph the function to represent whether students are making healthy nutritional choices based on the amount they spend on snacks. They would use the properties of the equation and linear inequality to explain and defend their views regarding whether it is reasonable to spend certain amount on certain nutritional snacks.</p>

Unit 2:

Functions and Modeling

Investment Dilemma: A modeling problem involving the most efficient way to solve an investment dilemma for stock broker will be posed to the students. They model the problem by finding a solution pathway that would optimize the profit of the brokerage firm when they invest in different stock options. Given the stock pricing which would involve volume-based discount, students will model and graph the revenue, cost, and profit functions. They would interpret the vertices, intercepts, and intersection points as well as solve systems of equations to discover the exact number of customers that would help them maximize revenue and profit.

Building Design: Students would model the design of a building by factoring in location, dimensions, materials, costs, environmental impact, and city code in deciding where to site the building. Students would interpret the cost implications, based on location to site the building.

Students apply the standards in Interpreting Functions and Building Functions in the cases of polynomial functions of degree greater than two, more complicated rational functions, the reciprocal trigonometric functions, and inverse trigonometric functions. Students examine end behavior of polynomial and rational functions and learn how to find

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asymptotes. Students further their understanding of inverse functions by exploring the relationship between two functions that are inverses of each other, i.e. that f and g are inverses if $(f \circ g)(x) = x$ and $(g \circ f)(x) = x$. They construct inverse functions by appropriately restricting the domain of the given function and use inverses in context. They also study parametric functions and work with polar coordinates and graph polar curves. This assignment would enable them to make connections between polar coordinates and polar representation of complex numbers. Students investigate new concepts in modeling situations, such as by recording points on the curve of a tossed ball as it travels along, graphing the points as vectors, and deriving the equation for $x(t)$ and $y(t)$.

Key Assignment	Description
Interpret functions that arise in applications in terms of the context	<p>Given a polynomial function, students will give verbal description of the relationship and interpret key features of the graph and table by doing the following:</p> <ul style="list-style-type: none"> • Sketch the graph • Determine where the function is increasing and where it is decreasing • Determine the relative maxima and minima • Determine the interval over which the value of the function is positive and where it is negative • Determine the x-intercepts and y-intercept • Describe the end behavior of the function • Determine whether or not the function is symmetric about the y-axis. • Relate the domain of the function to its graph and where applicable the quantitative relationship it describes
Analyze Functions using different representations	<p>Student will be given various functions to graph by hand and show key features, and where the function is complicated, they use technology to analyze the key features of the function.</p> <p>Students will graph rational functions and identify the following:</p> <ul style="list-style-type: none"> • The zeros, and their multiplicities • Where the graph is touching the x-axis and where it is crossing the x-axis • Identify the asymptotes • And describe the end behavior <p>Student will also graph exponential and logarithmic functions and show intercepts and end behavior; and trigonometric functions showing period, midline and amplitude.</p>
Build new functions from existing ones	<p>Students will use transformation to explore the effect of replacing $f(x)$ by $f(x)+k$, $kf(x)$, $f(kx)$, $f(x+k)$ for all the parent functions. They will identify which transformation result in:</p> <ul style="list-style-type: none"> • Vertical shift • Horizontal shift • Vertical compression and vertical stretch • Horizontal compression and horizontal stretch • Reflection in the y-axis and reflection in the x-axis <p>Students will also be able to write the new functions that result from a combination of the above transformations and use technology to confirm and give explanation. Students will also be able to tell whether a function is even or odd by determining if $f(x) = f(-x)$, and $f(-x) = -f(x)$, respectively.</p> <p>Students will understand the process of determining whether or not a function is invertible, and if it is, how to find the inverse and know how to produce an invertible function from a non-invertible function by restricting the domain.</p>

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Unit 3:

Trigonometry

Students work with parametric functions and with polar coordinates and graph polar curves. The assignment would help students to make connections between polar coordinates and polar representation of complex numbers. Students investigate new concepts in modeling situations, such as by recording points on the curve of a tossed ball as it travels along, graphing the points as vectors, and deriving the equation for $x(t)$ and $y(t)$. They also investigate the relationship between the graphs of the sine and cosine as a function of θ on one hand and the graph of the curve defined by $x(\theta) = \cos(\theta)$, $y(\theta) = \sin(\theta)$ on the other hand, drawing connections between the two.

Phases of Moon Project: Students will demonstrate their understanding of functions and equations defined parametrically by designing a project involving collecting the phases of moon data for x number of days (e.g. 30 days). They will graph polar coordinates and curves, and convert between polar and rectangular coordinate system of the data collected. Students will need to recall that the period for this model is 30, as the graph begins on day 1. This assignment requires students to recall how to enter data points, plot them, and have the correct window for viewing.

Other assignments in this unit would address the following:

Expand the domain of trigonometric functions using a unit circle.	<p>Given a point $P=(x,y)$ on a unit circle that corresponds to the angle θ, and a point Q on a unit circle that corresponds to the angle $-\theta$ with coordinates $(x,-y)$; students will use the definition of trigonometric functions to show that $\sin(\theta) = y$, $\sin(-\theta) = -y$, $\cos(\theta) = x$, $\cos(-\theta) = x$ so, $\sin(-\theta) = -\sin(\theta)$, and $\cos(\theta) = \cos(-\theta)$.</p> <p>Using these results and some of the fundamental identities students will show that: $\tan(-\theta) = -\tan(\theta)$, $\cot(-\theta) = -\cot(\theta)$, $\sec(-\theta) = -\sec(\theta)$, $\csc(-\theta) = -\csc(\theta)$</p>
Model periodic phenomena with trigonometric functions.	<p>Students know that periodic functions are not one-to-one and thus do not have inverses, but when trigonometric functions are restricted to a domain on which it is always increasing or always decreasing, the inverse function could be constructed.</p> <p>Student use the inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.</p> <p>Group Project: Students would work in groups to create word problems involving inverse functions. For instance: Around 1:30 p.m., people heard that the space shuttle will fly around Los Angeles area. People were outside waiting. Finally, the space shuttle was sighted. At one point, it looked as if the shuttle was really low. How could you estimate the distance from the shuttle to where you are standing (diagonal distance) with an angle of elevation of 30°? The students will estimate how high the shuttle could be from the ground.</p>
Prove and apply trigonometric identities.	<p>Students prove the addition and subtraction formulas for sine, cosine, and tangent, and use them to solve problems.</p> <p>Students prove the half angle and double angle identities for sine and cosine and use them to solve problems.</p>

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Geometry

Students would be given assignments that would help them extend further their understanding of conic sections they started earlier on. They are given opportunities to view conic sections as parametric functions, and this provides a rich ground for studying such functions. A project would be given to the students to discover that trigonometric functions can be introduced into general triangles using appropriate auxiliary lines. The relationships they give rise to then result in the Laws of Sines and Cosines in general cases. Students can derive these laws and use them to solve problems, and they connect the relationships they describe to the geometry of vectors.

Conic Section Exploration: Students will explore the conic sections and describe how to cut a cone to create the various conic sections. Separate the class into 6 groups (or a multiple of 6 for large class). Assign two conic sections to each group. There are 6 different ways to do this: circle/ellipse, circle/hyperbola, circle/parabola, ellipse/hyperbola, ellipse/parabola, and hyperbola/parabola. Each group should create a poster summarizing what they've learned about their two conic sections and comparing and contrasting them.

Key Assignment	Description
Apply trigonometry to general triangle.	<p>Given a SAS Triangle, with sides a and b and an included angle C, students will draw an auxiliary line from a vertex perpendicular to the opposite side, find the height of the triangle and use the area formula of a triangle to prove the formula, $A = (1/2)ab\sin(C)$</p> <p>Students prove the Laws of Sines and Cosines and use them to solve problems.</p> <p>Students understand and apply the Laws of Sines and Cosines to find unknown measurements in right triangles and non-right triangles (e.g., surveying problems, and resultant forces).</p>
Translate between the geometric description and the equation for a conic section.	<p>Students will derive the equations of ellipses and hyperbolas using the definitions of an ellipse and a hyperbola; the fact that sum or difference of distances from the foci is constant.</p> <p>Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, students will use the method for completing the square to put the equation in standard form; identify whether the graph of the equation is a circle, parabola, or hyperbola, and graph the equation.</p>

Unit 4:

Conics, Systems and Matrices

Students would model situations involving payoffs in games, economic, or geometric situations. They also expand on their understanding of conic sections to view them as parametric functions. Students investigate vectors as geometric objects in the plane that can be represented by ordered pairs, and matrices as objects that act on vectors. Students discover that vector addition and subtraction behave according to certain properties, while matrices and matrix operations observe their own set of rules. Students discover with matrices a new set of mathematical objects and operations among them that has a multiplication that is not commutative. They can do this in modeling situations, involving payoffs in games, economic quantities and geometric situations.

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Key Assignment	Description
<p>Represent systems of linear equations as a single matrix equation in a vector form.</p> <p>Deepen their understanding of complex numbers on the complex plane in rectangular and polar form.</p>	<p><i>Culminating Project:</i> Students will complete larger assignment involving matrices with deeper thought and a fuller understanding of course material. This assignment will force students to challenge and expand their understanding of the concepts learned in the previous unit. They would write a paper and short presentation to their peers.</p>
<p>Use matrices to represent and manipulate data.</p> <p>Find the inverse of matrix if it exists and use to solve system of linear equations</p>	<p><i>Cryptograph Project:</i> Cryptograph is the study of writing in secret code that goes back to ancient times. In modern time, cryptography are used in mathematics, computational science, and engineering. Cryptography has applications in banking, credit cards, computer passwords, and internet. One of the earliest and easiest methods of coding message is the substitution cipher which date back to 1900 BC, in which each letter in the alphabet is substituted for another letter/number/symbol. Each student will make up a message and encode it using the coding chart. Also, each student should come up with their own matrix C. Each student will present their encoded message and the inverse of matrix C to the class to decode the message. Students can use technology to solve matrices beyond 3x3. Include matrix solution scheme involving Cramer's rule, Row echelon method, or Gauss-Jordan elimination method.</p>
<p>Perform operations on matrices and use matrices in applications.</p>	<p><i>Search Area Project:</i> A large region of a desert has been identified as the possible crash site of a small airplane. The region is triangular. From the northernmost vertex of the region, the distance to the other vertices are 75 miles south and 35 miles east, and 47 miles south and 56 miles east. Students will use a graphing utility to find the approximate number of square miles in the region. They would explain how they arrived at their solution. They would develop a powerpoint to present their project to the class. They would include in their presentation, the following:</p> <ul style="list-style-type: none"> • Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. • Multiply matrices by scalars to produce new matrices, e.g., as when all the payoffs in a game are doubled. • Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. • Work with 3x3 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

Assessment

The assessments for advanced students will demand the ability to apply learned concepts to solving abstract or real world problems or summarize the patterns/ concepts learned using the following variety of assessments:

Common Assessments – Teachers design and administer common assessments at the school site level and at the district level.

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Interim, Benchmark, and Diagnostic Assessment – These assessments will be used to monitor and make instructional decisions.

Students will provide evidence of learning through a variety of assessments, such as constructed response items; projects; selected response items that resemble Smarter Balanced assessment items, performance tasks, self-evaluative assessments; student reflections; projects and presentations; informal assessment; discussion.

Students will be assessed during classroom and group discussions by evidence of viable arguments, thinking and building on the reasoning of others, and the precise use of academic vocabulary.

Diagnostic Assessment

These assessments inform teachers of students existing knowledge in order to plan and modify instruction that targets identified deficits and reinforces strengths.

Formative Assessments – include checking for understanding using dry-erase boards, exit tickets. Students and teachers use evidence to adapt teaching and learning to meet immediate learning needs minute-to-minute and day-by-day. The formative assessment would involve the five strategies recommended by Marnie Thompson and Dylan Williams including:

1. Clarifying and sharing learning intentions and criteria for success
2. Engineering effective discussion, questions, activities, and tasks that elicit evidence of learning
3. Providing feedback that moves students forward
4. Activating students as instructional resources for one another
5. Activating students as owners of their own learning.

These assessment include district periodic benchmarks, teacher generated measures, and performance tasks drawn from common core resources such as MARS, SBAC, PARCC, LAUSD Concept lessons, and Illustrative Mathematics.

Los Angeles Unified School District
Secondary Mathematics Branch

Discrete Mathematics AB

(Grade 11 or 12)

Prerequisite: Math Analysis AB

310503

Discrete Mathematics A

310504

Discrete Mathematics B

COURSE DESCRIPTION

Discrete mathematics is centered around elementary logic, methods of proof, set theory, basic counting, mathematical induction, recursion, matrices, optimization techniques and their applications in computer science.

INTENDED LEARNING OUTCOMES

- Utilize elementary truth tables, operations, and logical equivalences to prove compound and conditional statements.
- Understand and exploit the contrapositive, converse, and inverse forms of a conditional statement.
- Utilize the universal and existential quantifiers to construct valid propositional statements.
- Form valid arguments with compound and quantified statements using the modus ponens and modus tollens principles.
- Understand the difference between and requirements of Necessary and Sufficient conditions.
- Correctly parse and understand multiply quantified statements
- Utilize the method of direct proof, proof by contradiction, and proof by contraposition.
- Understand the technique of counter-examples and how it relates to mathematical ideas.
- Properly set up and carry out mathematical induction arguments.
- Use proper notation for set theory.
- Find the union, intersection, difference, complement, and product of two sets.
- Prove basic set identities.
- Use matrices to solve systems of linear equations.
- Understand and use permutations and combinations to solve problems in counting and probability.
- Apply the inclusion-exclusion principle to count the number of elements in a union of sets.
- Understand recursion and recursively defined sequences.
- Solve basic recurrence relations by iteration.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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Secondary Mathematics Branch

Probability & Statistics AB
(Grade 10, 11 or 12)
Prerequisite: Algebra 2AB

310607 **Probability & Statistics A**
310608 **Probability & Statistics B**

COURSE DESCRIPTION

This discipline is an introduction to the study of probability, interpretation of data, and fundamental statistical problem solving. Mastery of this academic content will provide students with a solid foundation in probability and facility in processing statistical information.

COURSE SYLLABUS

Some of the topics addressed in this course review material found in the standards for the earlier grades and reflect that this content should not disappear from the curriculum. These topics include the material with respect to the common concepts of mean, median, and mode and to the various display methods in common use, as stated in these standards:

- P&S 6.0:** Students know the definitions of the *mean*, *median*, and *mode* of a distribution of data and can compute each in particular situations.
- P&S 8.0:** Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.

In the early grades students also receive an introduction to probability at a basic level. The next topic will expand on this base so that students can find probabilities for multiple discrete events in various combinations and sequences. The standards in Algebra II related to permutations and combinations and the fundamental counting principles are also reflective of the content in these standards:

- P&S 1.0:** Students know the definition of the notion of *independent events* and can use the rules for addition, multiplication, and complementation to solve for probabilities of particular events in finite sample spaces.
- P&S 2.0:** Students know the definition of *conditional probability* and use it to solve for probabilities in finite sample spaces.
- P&S 3.0:** Students demonstrate an understanding of the notion of *discrete random variables* by using them to solve for the probabilities of outcomes, such as the probability of the occurrence of five heads in 14 coin tosses.

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The most substantial new material in this discipline is found in Standard 4.0:

P&S 4.0: Students are familiar with the standard distributions (normal, binomial, and exponential) and can use them to solve for events in problems in which the distribution belongs to those families.

Instruction typically flows from the counting principles for discrete binomial variables to the rules for elaborating probabilities in binomial distributions. The fact that these probabilities are simply the terms in a binomial expansion provides a strong link to Algebra II and the binomial theorem. From this base, basic probability topics can be expanded into the treatment of these standard distributions. In the binomial case students should now be able to define the probability for a range of possible outcomes for a set of events based on a single-event probability and thus to develop better understanding of probability and density functions.

The normal distribution, which is the limiting form of a binomial distribution, is typically introduced next. Students are not to be expected to integrate this distribution, but they can answer probability questions based on it by referring to tabled values. Students need to know that the mean and the standard deviation are parameters for this distribution. Therefore, it is important to understand variance, based on averaged squared deviation, as an index of variability and its importance in normal distributions, as stated in these standards:

P&S 5.0: Students determine the mean and the standard deviation of a normally distributed random variable.

P&S 7.0: Students compute the variance and the standard deviation of a distribution of data.

Standard 4.0 also includes exponential distributions with applications, for example, in lifetime of service and radioactive decay problems. Including this distribution acquaints students with probability calculations for other types of processes. Here, students learn that the distribution is defined by a scale parameter, and they learn simple probability computations based on this parameter.

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REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will:

- Know the definition of the notion of *independent events* and can use the rules for addition, multiplication, and complementation to solve for probabilities of particular events in finite sample spaces
- Know the definition of *conditional probability* and use it to solve for probabilities in finite sample spaces
- Demonstrate an understanding of the notion of *discrete random variables* by using them to solve for the probabilities of outcomes, such as the probability of five heads in 14 coin tosses
- Be familiar with the standard distributions (normal, binomial, and exponential) and can use them to solve for events in problems in which the distribution belongs to those families
- Determine the mean and standard deviation of a normally distributed random variable
- Know the definitions of the *mean*, *median* and *mode* of a distribution of data and can compute each in particular situations
- Students compute the variance and the standard deviation of a distribution of data
- Organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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Secondary Mathematics Branch

AP Calculus AB

(Grade 11 or 12)

Prerequisite: Math Analysis AB

Before studying calculus, all students should complete four years of secondary mathematics designed for college-bound students: courses in which they study algebra, geometry, trigonometry, analytic geometry, and elementary functions. These functions include linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric and piecewise-defined functions. In particular, before studying calculus, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on) and know the values of the trigonometric functions at the numbers $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$, and their multiples.

310701 AP Calculus A

310702 or AP Calculus B

310705

COURSE DESCRIPTION

Calculus AB is primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The courses emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations also are important.

COURSE SYLLABUS

I. Functions, Graphs, and Limits

Analysis of graphs With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.

Limits of functions (including one-sided limits)

- An intuitive understanding of the limiting process
- Calculating limits using algebra
- Estimating limits from graphs or tables of data

Asymptotic and unbounded behavior

- Understanding asymptotes in terms of graphical behavior
- Describing asymptotic behavior in terms of limits involving infinity
- Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)

Continuity as a property of functions

- An intuitive understanding of continuity (The function values can be made as close as desired by taking

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sufficiently close values of the domain).

- Understanding continuity in terms of limits
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)

II. Derivatives

Concept of the derivative

- Derivative presented graphically, numerically, and analytically
- Derivative interpreted as an instantaneous rate of change
- Derivative defined as the limit of the difference quotient
- Relationship between differentiability and continuity

Derivative at a point

- Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
- Tangent line to a curve at a point and local linear approximation
- Instantaneous rate of change as the limit of average rate of change
- Approximate rate of change from graphs and tables of values

Derivative as a function

- Corresponding characteristics of graphs of f and f'
- Relationship between the increasing and decreasing behavior of f and the sign of f'
- The Mean Value Theorem and its geometric interpretation
- Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.

Second derivatives

- Corresponding characteristics of the graphs of f , f' , and f''
- Relationship between the concavity of f and the sign of f''
- Points of inflection as places where concavity changes

Applications of derivatives

- Analysis of curves, including the notions of monotonicity and concavity
- Optimization, both absolute (global) and relative (local) extrema
- Modeling rates of change, including related rates problems
- Use of implicit differentiation to find the derivative of an inverse function
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations

Computation of derivatives

- Knowledge of derivatives of basic functions, including power, exponential,

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logarithmic, trigonometric, and inverse trigonometric functions

- Derivative rules for sums, products, and quotients of functions
- Chain rule and implicit differentiation

III. Integrals

Interpretations and properties of definite integrals

- Definite integral as a limit of Riemann sums
- Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:

$$\int_a^b f'(x) dx = f(b) - f(a)$$

- Basic properties of definite integrals (examples include additivity and linearity).

Applications of integrals Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region, the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, and accumulated change from a rate of change.

Fundamental Theorem of Calculus

- Use of the Fundamental Theorem to evaluate definite integrals
- Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined

Techniques of antidifferentiation

- Antiderivatives following directly from derivatives of basic functions
- Antiderivatives by substitution of variables (including change of limits for definite integrals)

Applications of antidifferentiation

- Finding specific antiderivatives using initial conditions, including applications to motion along a line
- Solving separable differential equations and using them in modeling (including the study of the equation $y' = ky$ and exponential growth)

Numerical approximations to definite integrals Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values

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REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and should be able to use derivatives to solve a variety of problems
- Understand the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change and should be able to use integrals to solve a variety of problems
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus
- Communicate mathematics and explain solutions to problems both verbally and in written sentences
- Model a written description of a physical situation with a function, a differential equation, or an integral
- Use technology to help solve problems, experiment, interpret results, and support conclusions
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- College Board AP Calculus AB Examination

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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AP Calculus BC

(Grade 11 or 12)

Prerequisite: Math Analysis AB

Before studying calculus, all students should complete four years of secondary mathematics designed for college-bound students: courses in which they study algebra, geometry, trigonometry, analytic geometry, and elementary functions. These functions include linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric and piecewise-defined functions. In particular, before studying calculus, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on) and know the values of the trigonometric functions at the numbers $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$, and their multiples.

310702 or AP Calculus B

310705

310706 AP Calculus C

COURSE DESCRIPTION

Calculus BC is primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The courses emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations also are important. Calculus BC is an extension rather than an enhancement of Calculus AB; common topics require a similar depth of understanding.

COURSE SYLLABUS

Note: The course syllabus for Calculus BC includes all Calculus AB topics. Entirely new topics are marked with an asterisk (*), whereas new bullets within existing topics are marked with a plus sign (+).

I. Functions, Graphs, and Limits

Analysis of graphs With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.

Limits of functions (including one-sided limits)

- An intuitive understanding of the limiting process
- Calculating limits using algebra
- Estimating limits from graphs or tables of data

Asymptotic and unbounded behavior

- Understanding asymptotes in terms of graphical behavior
- Describing asymptotic behavior in terms of limits involving infinity

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- Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)

Continuity as a property of functions

- An intuitive understanding of continuity (The function values can be made as close as desired by taking sufficiently close values of the domain).
- Understanding continuity in terms of limits
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)

***Parametric, polar, and vector functions** The analysis of planar curves includes those given in parametric form, polar form, and vector form.

II. Derivatives

Concept of the derivative

- Derivative presented graphically, numerically, and analytically
- Derivative interpreted as an instantaneous rate of change
- Derivative defined as the limit of the difference quotient
- Relationship between differentiability and continuity

Derivative at a point

- Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
- Tangent line to a curve at a point and local linear approximation
- Instantaneous rate of change as the limit of average rate of change
- Approximate rate of change from graphs and tables of values

Derivative as a function

- Corresponding characteristics of graphs of f and f'
- Relationship between the increasing and decreasing behavior of f and the sign of f'
- The Mean Value Theorem and its geometric interpretation
- Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa.

Second derivatives

- Corresponding characteristics of the graphs of f , f' , and f''
- Relationship between the concavity of f and the sign of f''
- Points of inflection as places where concavity changes

Applications of derivatives

- Analysis of curves, including the notions of monotonicity and concavity
- +Analysis of planar curves given in parametric form, polar form, vector form, including velocity and acceleration

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- Optimization, both absolute (global) and relative (local) extrema
- Modeling rates of change, including related rates problems
- Use of implicit differentiation to find the derivative of an inverse function
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
- +Numerical solution of differential equations using Euler's method
- +L'Hopital's Rule, including its use in determining limits and convergence of improper integrals and series.

Computation of derivatives

- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions
- Derivative rules for sums, products, and quotients of functions
- Chain rule and implicit differentiation
- +Derivatives of parametric, polar and vector functions

III. Integrals

Interpretations and properties of definite integrals

- Definite integral as a limit of Riemann sums
- Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:

$$\int_a^b f'(x) dx = f(b) - f(a)$$

- Basic properties of definite integrals (examples include additivity and linearity)

***Applications of integrals** Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include using the integral of a rate of change to give accumulated change, finding the area of a region (including a region bounded by polar curves), the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, and the length of a curve (including a curve given in parametric form).

Fundamental Theorem of Calculus

- Use of the Fundamental Theorem to evaluate definite integrals
- Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined

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Techniques of antidifferentiation

- Antiderivatives following directly from derivatives of basic functions
- +Antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions (non-repeating linear factors only)
- +Improper integrals (as limits of definite integrals)

Applications of antidifferentiation

- Finding specific antiderivatives using initial conditions, including applications to motion along a line
- Solving separable differential equations and using them in modeling (including the study of the equation $y' = ky$ and exponential growth)
- +Solving logistic differential equations and using them in modeling

Numerical approximations to definite integrals Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values

***IV. Polynomial Approximations and Series**

***Concept of series** A series is defined as a sequence of partial sums, and convergence is defined in terms of the limit of the sequence of partial sums. Technology can be used to explore convergence or divergence.

***Series of constants**

- +Motivating examples, including decimal expansion
- +Geometric series with applications
- +The harmonic series
- +Alternating series with error bound
- +Terms of series as areas of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of p -series
- +The ratio test for convergence and divergence
- +Comparing series to test for convergence or divergence

***Taylor series**

- +Taylor polynomial approximation with graphical demonstration of convergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve)
- +Maclaurin series and the general Taylor series centered at $x = a$
- +Maclaurin series for the functions e^x , $\sin x$, $\cos x$, and $\frac{1}{1-x}$
- +Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series
- +Functions defined by power series
- +Radius and interval of convergence of power series
- +Lagrange error bound for Taylor polynomials

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REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will know and be able to:

- Work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and should be able to use derivatives to solve a variety of problems
- Understand the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change and should be able to use integrals to solve a variety of problems
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus
- Communicate mathematics and explain solutions to problems both verbally and in written sentences
- Model a written description of a physical situation with a function, a differential equation, or an integral
- Use technology to help solve problems, experiment, interpret results, and support conclusions.
- Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- Develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- College Board AP Calculus BC Examination

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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Secondary Mathematics Branch

AP Statistics AB

(Grade 11 or 12)

Prerequisite: Algebra 2AB

310609 AP Statistics A

310610 AP Statistics B

COURSE DESCRIPTION

The purpose of the AP course in statistics is to introduce students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Students are exposed to four broad conceptual themes:

1. Exploring Data: Describing patterns and departures from patterns
2. Sampling and Experimentation: Planning and conducting a study
3. Anticipating Patterns: Exploring random phenomena using probability and simulation
4. Statistical Inference: Estimating population parameters and testing hypotheses

COURSE SYLLABUS

I. Exploring Data: Describing patterns and departures from patterns

Exploratory analysis of data makes use of graphical and numerical techniques to study patterns and departures from patterns. Emphasis should be placed on interpreting information from graphical and numerical displays and summaries.

A. Constructing and interpreting graphical displays of distributions of univariate data (dotplot, stemplot, histogram, cumulative frequency plot)

1. Center and spread
2. Clusters and gaps
3. Outliers and other unusual features
4. Shape

B. Summarizing distributions of univariate data

1. Measuring center: median, mean
2. Measuring spread: range, interquartile range, standard deviation
3. Measuring position: quartiles, percentiles, standardized scores (z-scores)
4. Using boxplots
5. The effect of changing units on summary measures

C. Comparing distributions of univariate data (dotplots, back-to-back stemplots, parallel boxplots)

1. Comparing center and spread: within group, between group variation
2. Comparing clusters and gaps
3. Comparing outliers and other unusual features
4. Comparing shapes

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D. Exploring bivariate data

1. Analyzing patterns in scatterplots
2. Correlation and linearity
3. Least-squares regression line
4. Residual plots, outliers, and influential points
5. Transformations to achieve linearity: logarithmic and power transformations

E. Exploring categorical data

1. Frequency tables and bar charts
2. Marginal and joint frequencies for two-way tables
3. Conditional relative frequencies and association
4. Comparing distributions using bar charts

II. Sampling and Experimentation: Planning and conducting a study

Data must be collected according to a well-developed plan if valid information on a conjecture is to be obtained. This plan includes clarifying the question and deciding upon a method of data collection and analysis.

A. Overview of methods of data collection

1. Census
2. Sample survey
3. Experiment
4. Observational study

B. Planning and conducting surveys

1. Characteristics of a well-designed and well-conducted survey
2. Populations, samples, and random selection
3. Sources of bias in sampling and surveys
4. Sampling methods, including simple random sampling, stratified random sampling, and cluster sampling

C. Planning and conducting experiments

1. Characteristics of a well-designed and well-conducted experiment
2. Treatments, control groups, experimental units, random assignments, and replication
3. Sources of bias and confounding, including placebo effect and blinding
4. Completely randomized design
5. Randomized block design, including matched pairs design

D. Generalizability of results and types of conclusions that can be drawn from observational studies, experiments, and surveys

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III. Anticipating Patterns: Exploring random phenomena using probability and simulation

Probability is the tool used for anticipating what the distribution of data should look like under a given model.

A. Probability

1. Interpreting probability, including long-run relative frequency interpretation
2. “Law of Large Numbers” concept
3. Addition rule, multiplication rule, conditional probability, and independence
4. Discrete random variables and their probability distributions, including binomial and geometric
5. Simulation of random behavior and probability distributions
6. Mean (expected value) and standard deviation of a random variable, and linear transformation of a random variable

B. Combining independent random variables

1. Notion of independence versus dependence
2. Mean and standard deviation for sums and differences of independent random variables

C. The normal distribution

1. Properties of the normal distribution
2. Using tables of the normal distribution
3. The normal distribution as a model for measurements

D. Sampling distributions

1. Sampling distribution of a sample proportion
2. Sampling distribution of a sample mean
3. Central Limit Theorem
4. Sampling distribution of a difference between two independent sample proportions
5. Sampling distribution of a difference between two independent sample means
6. Simulation of sampling distributions
7. t-distribution
8. Chi-square distribution

IV. Statistical Inference: Estimating population parameters and testing hypotheses

Statistical inference guides the selection of appropriate models.

A. Estimation (point estimators and confidence intervals)

1. Estimating population parameters and margins of error
2. Properties of point estimators, including unbiasedness and variability
3. Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence intervals
4. Large sample confidence interval for a proportion
5. Large sample confidence interval for a difference between two proportions
6. Confidence interval for a mean
7. Confidence interval for a difference between two means (unpaired and paired)

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8. Confidence interval for the slope of a least-squares regression line

B. Tests of significance

1. Logic of significance testing, null and alternative hypotheses; p-values; one- and two-sided tests; concepts of Type I and Type II errors; concept of power
2. Large sample test for a proportion
3. Large sample test for a difference between two proportions
4. Test for a mean
5. Test for a difference between two means (unpaired and paired)
6. Chi-square test for goodness of fit, homogeneity of proportions, and independence (one- and two-way tables)
7. Test for the slope of a least-squares regression line

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

In this course, students will:

- Solve probability problems with finite sample spaces by using the rules for addition, multiplication, and complementation for probability distributions and understand the simplifications that arise with independent events
- Know the definition of *conditional probability* and use it to solve for probabilities in finite sample spaces
- Demonstrate an understanding of the notion of *discrete random variables* by using this concept to solve for the probabilities of outcomes, such as the probability of five heads in 14 coin tosses
- Understand the notion of a *continuous random variable* and can interpret the probability of an outcome as the area of a region under the graph of the probability density function associated with the random variable
- Know the definition of the *mean of a discrete random variable* and can determine the mean for a particular discrete random variable
- Know the definition of the *variance of a discrete random variable* and can determine the variance for a particular discrete random variable
- Be familiar with the standard distributions (normal, binomial, and exponential) and can use the distributions to solve for events in problems in which the distribution belongs to those families
- Determine the mean and standard deviation of a normally distributed random variable
- Know the central limit theorem and can use it to obtain approximations for probabilities in problems of finite sample spaces in which the probabilities are distributed binomially
- Know the definitions of the *mean*, *median* and *mode* of a distribution of data and can compute each of them in particular situations
- Compute the variance and the standard deviation of a distribution of data
- Find the line of best fit to a given distribution of data by using least squares regression

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- Know what the *correlation coefficient of two variables* means and are familiar with the coefficient's properties
- Organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line graphs and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots
- Be familiar with the notions of a statistic of a distribution of values, of the sampling distribution of a statistic, and of the variability of a statistic
- Know basic facts concerning the relation between the mean and the standard deviation of a sampling distribution and the mean and the standard deviation of the population distribution
- Determine confidence intervals for a simple random sample from a normal distribution of data and determine the sample size required for a desired margin of error
- Determine the P -value for a statistic for a simple random sample from a normal distribution
- Be familiar with the *chi*-square distribution and *chi*-square test and understand their uses

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments
- College Board AP Statistics Examination

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

High School Elective Mathematics Courses

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**CC Algebra 1 Tutorial Lab
(Intervention Course Grade 9-10)**

312613 **Common Core Algebra 1 Tutorial Lab A**

312614 **Common Core Algebra 1 Tutorial Lab B**

COURSE DESCRIPTION

Common Core Algebra 1 Tutorial Lab is designed to provide foundational knowledge and intervention for students taking CC Algebra 1 and for students who are preparing to be enrolled in CC Algebra 1. The course is also used to provide intervention for the students who are enrolled in CC Algebra 1 but are experiencing difficulty in mastering the core standards and academic language of CC Algebra 1. CC Algebra 1 Tutorial Lab is an elective mathematics course provided to students as a second course to support the core CC Algebra 1 course. The course is designed to enhance the student's knowledge of prerequisite skills and academic language that are needed to access the standards-based CC Algebra 1 course.

COURSE SYLLABUS

Students enrolled in this *intervention course* need **to be assessed** in an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to tailor instruction through ongoing assessment to provide true differentiated instruction. The outcome of the initial and ongoing assessments are analyze to identify skill and concept requirements necessary for any Common Core State Standard, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

The aim of the intervention in CC Algebra 1 is to provide explicit, systematic, intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards expectations, they must be able to accurately identify areas of student deficit and to match any student to an appropriate academic intervention plan. The idea of the CC Algebra 1 intervention is to create evidence-based intervention plans that customized to individual students and that are tied to specific Common Core Standards.

According to the California CCSS Mathematics Framework (November, 2013), "Universal Access in education is a concept which utilizes strategies for planning for the widest variety of learners from the beginning of the lesson design and not "added on" as an afterthought. Universal Access is not a set of curriculum materials or specific time set aside for additional assistance but rather a schema. For students to benefit from universal access, teachers may need assistance in planning instruction, differentiating curriculum, infusing Specially Designed Academic Instruction in English (SDAIE) techniques, using the California English Language Development Standards (CA ELD standards), and using grouping strategies effectively. " Therefore, through careful planning for modifying curriculum, instruction, grouping, and assessment techniques, teachers can be well prepared to adapt instruction to meet the needs of divers learners in their classrooms.

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Unit 1

Units	Concepts/Clusters	Standards
Unit 1	<p>Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.</p>	<p>Number System</p> <p>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.</p> <ol style="list-style-type: none"> Describe situations in which opposite quantities combine to make 0. <i>For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.</i> 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. 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. Apply properties of operations as strategies to add and subtract rational numbers. <p>7.NS.2 Apply and extend previous understanding of multiplication and division and of fractions to multiply and divide rational numbers.</p> <ol style="list-style-type: none"> 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. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (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. Apply properties of operations as strategies to multiply and divide rational numbers. 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. <p>7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.</p>
	<p>Understand ratio concepts and use ratio reasoning to solve problems</p> <p><i>Ratio reasoning and applying proportional</i></p>	<p>6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</p> <ol style="list-style-type: none"> Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. Solve unit rate problems including those involving unit pricing and

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Units	Concepts/Clusters	Standards
	<i>relationships</i>	<p>constant speed. <i>For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?</i></p> <p>c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.</p> <p>d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.</p>
	Analyze proportional relationships and use them to solve real-world and mathematical problems.	<p>7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. <i>For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $\frac{1/2}{1/4}$ miles per hour, equivalently 2 miles per hour.</i></p> <p>7.RP.2 Recognize and represent proportional relationships between quantities.</p> <p>a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.</p> <p>b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</p> <p>c. Represent proportional relationships by equations. <i>For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.</i></p> <p>d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.</p> <p>7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. <i>Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.</i></p>
	Apply and extend previous understandings of arithmetic to algebraic expressions <i>Generate equivalent express</i>	<p>Expressions and Equations</p> <p>6.EE.2 Write, read, and evaluate expressions in which letters stand for numbers.</p> <p>d. Write expressions that record operations with numbers and with letters standing for numbers. <i>For example, express the calculation “Subtract y from 5” as $5 - y$.</i></p> <p>e. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. <i>For example, describe the expression $2(8 + 7)$ as a product of two factors; view $(8 + 7)$ as both a single entity and a sum of two terms.</i></p> <p>f. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). <i>For example, use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = \frac{1}{2}$.</i></p> <p>6.EE.3 Apply the properties of operations to generate equivalent expressions. <i>For example, apply the distributive property to the expression $3(2 + x)$ to</i></p>

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Units	Concepts/Clusters	Standards
		<p><i>produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6(4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$.</i></p> <p>6.EE.4 Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). <i>For example, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number y stands for.</i></p>
Unit 2	<p>Understand the connections between proportional relationships, lines, and linear equations</p> <p><i>Analyze proportional relationship and use to solve real-world problems</i></p>	<p>Expressions and equations</p> <p>8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <i>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</i></p> <p>8.EE.6 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.</p>
	<p>Define, evaluate, and compare functions</p>	<p>Functions</p> <p>8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>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.</i></p> <p>8.F.3 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. <i>For example, the function $A = s^2$ 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.</i></p>
	<p>Use functions to model relationships between quantities</p>	<p>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.</p> <p>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.</p>
	<p>Apply and extend previous understandings of arithmetic to</p>	<p>Expressions and Equations</p> <p>6.EE.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given</p>

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Units	Concepts/Clusters	Standards
	algebraic expressions <i>Generate equivalent express</i>	<p>number in a specified set makes an equation or inequality true.</p> <p>6.EE.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.</p> <p>7.EE.4: Use variables to represent quantities in real-world and mathematical problems and construct simple equations and inequalities to solve problems about the quantities.</p> <p>7.EE.1: Apply properties of operations as strategies to add, subtract, factor and expand linear expressions with rational coefficients.</p>
	Analyze and solve linear equations and pairs of simultaneous linear equations	<p>Expressions and Equations</p> <p>8.EE.7 Solve linear equations in one variable.</p> <p>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).</p> <p>b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</p> <p>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.</p> <p>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. <i>For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.</i></p> <p>c. Solve real-world and mathematical problems leading to two linear equations in two variables. <i>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.</i></p>
Unit 3	Investigate patterns of association in bivariate data.	<p>Statistics and Probability</p> <p>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.</p> <p>8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear</p>

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Units	Concepts/Clusters	Standards
		<p>association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.</p> <p>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. <i>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.</i></p> <p>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.</p> <p>Use relative frequencies calculated for rows or columns to describe possible association between the two variables. <i>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?</i></p>
Unit 4	<p>Solve real-life and mathematical problems using numerical and algebraic expressions and equations</p>	<p>Expressions and Equations</p> <p>7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. <i>For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?</i></p> <p>b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. <i>For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.</i></p>
	<p>Interpret functions that arise in applications in terms of a context</p> <p><i>Use functions to model relationship between quantities</i></p>	<p>Functions - Interpreting Functions</p> <p>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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> ★</p>
Unit 5	<p>Work with radicals and integer exponents</p>	<p>Expressions and Equations</p> <p>8.EE.1 Know and apply the properties of integer exponents to generate</p>

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Units	Concepts/Clusters	Standards
		<p>equivalent numerical expressions. <i>For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$</i></p> <p>8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.</p> <p>8.EE.3 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. <i>For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.</i></p> <p>8.EE.4 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.</p>

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CC Geometry Tutorial Lab AB
(Intervention Course for Geometry, Grades 9-12)

312615 **Common Core Geometry Tutorial Lab A**

312616 **Common Core Geometry Tutorial Lab B**

COURSE DESCRIPTION

Common Core Geometry Tutorial Lab is designed to provide foundational knowledge and intervention for students enrolled in or preparing to enroll in Common Core Geometry. This course serves not only as intervention, but also as support for students experiencing difficulty in mastering the core standards and academic language constraints of the Common Core Geometry course. Common Core Geometry Tutorial Lab is an elective mathematics course provided to students as a supplemental course to enhance the student's knowledge of prerequisite skills and academic language that is required in order to successfully access the standards-based Common Core Geometry course.

COURSE SYLLABUS

The standards for this intervention course are taken primarily from the *Common Core Grade 7* and *Common Core Grade 8* math standards and support the major clusters defined in the LAUSD Curricular Maps for *Common Core Geometry*. Additionally, **an immense element of this intervention course is an emphasis on student engagement with the Standards for Mathematical Practice on a daily basis.** The structure of this course is divided into four separate, but coherent, units mirroring the *Common Core Geometry* course. The aim of this intervention course is to support *Common Core Geometry* and to provide explicit, systematic, and intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards' expectations, they must be able to accurately identify areas of student deficit and match students to an appropriate academic intervention plan. An expectation from the *Common Core Geometry Tutorial Lab* is to create evidence-based intervention plans that are customized to individual students, and that are also tied to specific Common Core Standards.

Students enrolled in this intervention course **need to be assessed** on an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to adapt their instruction through ongoing formative assessments to provide genuine, differentiated instruction. The outcome of the initial and ongoing assessments are to analyze and identify key skills and concepts required for students to access the Common Core State Standards, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

According to the California CCSS Mathematics Framework (November, 2013),

“Universal Access in education is a concept which utilizes strategies for planning for the widest variety of learners from the beginning of the lesson design and not ‘added on’ as an afterthought. Universal Access is not a set of curriculum materials or specific time set aside for additional assistance but rather a schema. For students to benefit from universal access, teachers may need assistance in planning instruction, differentiating curriculum, infusing Specially Designed Academic Instruction in English (SDAIE) techniques, using the California English Language Development Standards (CA ELD standards), and using grouping strategies effectively.”

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Therefore, through careful planning for modifying curriculum, instruction, grouping, and assessment techniques, teachers are well prepared to adapt instruction to meet the needs of diverse learners in their classrooms

Unit 1

Concepts/Clusters	Standards to Support CC Geometry
Make geometric constructions	7.G.2: Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
Experiment with transformations in the plane	8.G.1: Verify experimentally the properties of rotations, reflections, and translations: <ul style="list-style-type: none"> 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 congruence in terms of rigid motions	8.G.2: 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.
Prove geometric theorems	8.G.3: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Unit 2

Concepts/Clusters	Standards to Support CC Geometry
Understand similarity in terms of similarity transformations	8.G.4: 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. 7.G.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

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Concepts/Clusters	Standards to Support CC Geometry
Prove theorems involving similarity	<p>8.G.5: 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. <i>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.</i></p>

Unit 3

Concepts/Clusters	Standards to Support CC Geometry
Expressing Geometric Properties with Equations	<p>8.EE.5: 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 the two moving objects has greater speed.</p> <p>8.EE.6: 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 equations $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b.</p>

Unit 4

Concepts/Clusters	Standards to Support CC Geometry
Similarity, Right Triangles and Trigonometry	<p>8.G.7: Apply the Pythagorean Theorem to determine side lengths in right triangle in real-world and mathematical problems in two and three dimensions.</p> <p>7.G.5: Use facts about supplementary, complementary, vertical and adjacent angles in multi-step problems to write and solve simple equations for an unknown angle in a figure.</p>
Geometric Measurement and Dimension	<p>6.G.4: Represent three-dimensional figures using nets made up of rectangles and triangles and use the nets to find the surface area of these figures applying this techniques in the context of solving real world mathematical problems</p> <p>7.G.4: Know the formulas for the area and circumference of a circle and use them to solve problems; given an informal derivation of the relationship between the circumference and area of a circle.</p> <p>8.G.9: Know the formulas for the volumes of cones and cylinder, and spheres and use</p>

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Concepts/Clusters	Standards to Support CC Geometry
	them to solve real world and mathematical problems
Conditional Probability and Rules of Probability	<p>7.SP.5: Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the even occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely even, a probability around $\frac{1}{2}$ indicates an even that is neither unlikely nor likely and a probability near 1 indicates a likely event.</p>
Using Probability to Make Decisions	<p>7.SP.8: Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.</p> <ol style="list-style-type: none"> Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., “rolling double sixes”), identify he outcomes in the sample space which compose the event. Design and use a simulation to generate frequencies for compound events. For example, use random digits as a simulation tool to approximate the answer to the question: if 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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CC Algebra 2 Tutorial Lab
(Intervention Course Grade 9-10)

312617 Common Core Algebra 2 Tutorial Lab A

312618 Common Core Algebra 2 Tutorial Lab B

Common Core Algebra 2 Tutorial Lab is designed to provide foundational knowledge and intervention for students taking CC Algebra 2 and for students who are preparing to be enrolled in CC Algebra 2. The course is also used to provide intervention for the students who are enrolled in CC Algebra 2 but are experiencing difficulty in mastering the core standards and academic language of CC Algebra 2. CC Algebra 2 Tutorial Lab is an elective mathematics course provided to students as a second course to support the core CC Algebra 2 course. The course is designed to enhance the student's knowledge of prerequisite skills and academic language that are needed to access the standards-based CC Algebra 2 course.

COURSE SYLLABUS

Students enrolled in this intervention course need to be assessed in an ongoing basis to determine their needs for support and intervention. Teachers are encouraged to tailor instruction through ongoing assessment to provide true differentiated instruction. The outcome of the initial and ongoing assessments are analyze to identify skill and concept requirements necessary for any Common Core State Standard, compare those requirements to the student's existing skill set, and analyze any potential student deficits.

The aim of the intervention in CC Algebra 2 is to provide explicit, systematic, intensive instruction for at-risk populations. As teachers strive to assist struggling students to reach the Common Core State Standards expectations, they must be able to accurately identify areas of student deficit and to match any student to an appropriate academic intervention plan. The idea of the CC Algebra 2 intervention is to create evidence-based intervention plans that customized to individual students and that are tied to specific Common Core Standards.

Unit 1

Concepts/Clusters CC Algebra 2	Standards to Support CC Algebra 2
Analyze and solve linear equations and pairs of simultaneous linear equations.	<p>8.EE.7 Solve linear equations in one variable.</p> <p>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).</p> <p>b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</p> <p>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</p> <p>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.</p> <p>b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by</p>

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	<p>inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.</p> <p>c. Solve real-world and mathematical problems leading to two 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.</p>
Represent and solve equations and inequalities graphically.	<p>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.</p>

Unit 2

Concepts/Clusters	Standards to Support CC Algebra 2
Use polynomial identities to solve problems.	<p>A.SSE.1 Interpret expressions that represent a quantity in terms of its context. ★</p> <p>a. Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>b. Interpret complicated expressions by viewing one or more of their parts as single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i></p> <p>A.SSE.2 Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i></p>

Unit 3

Concepts/Clusters	Standards to Support CC Algebra 2
Define, evaluate, and compare functions	<p>Functions</p> <p>8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).</p> <p>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.</p> <p>8.F.3 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 $A = s^2$ 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.</p>
Use functions to model relationships between quantities	<p>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,</p>

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	<p>and in terms of its graph or a table of values.</p> <p>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.</p>
Analyze Functions Using Different Representations.	<p>F.IF.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. ★</p> <p>b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. ★</p> <p>c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. ★</p>

Unit 4

Concepts/Clusters	Standards to Support CC Algebra 2
<p>Extend the domain of the trigonometric functions using the unit circle.</p> <p>Prove and apply trigonometric identities.</p>	<p>F-TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</p> <p>F-TF.2.1. Graph all 6 basic trigonometric functions.</p>
Model periodic phenomena with trigonometric functions.	<p>6.RP.2. Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. <i>For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar." "We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger."</i>¹</p> <p>6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.</p> <p>d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.</p> <p>F.BF.3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. <i>Include recognizing even and odd functions from their graphs and algebraic expressions for them.</i></p> <p>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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> ★</p>

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	<p>F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>F-TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</p> <p>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.</p>
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Unit 5

Concepts/Clusters	Standards to Support CC Algebra 2
Summarize, represent, and interpret data on a single count or measurement data.	<p>6.SP.1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. <i>For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.</i></p> <p>6.SP.2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.</p> <p>6.SP.3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.</p> <p>6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.</p> <p>S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>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.</p>

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<p>Understand and evaluate random processes underlying statistical experiments.</p> <p>Make inferences and justify conclusions from sample surveys experiments, and observational studies.</p>	<p>6.SP.1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. <i>For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.</i></p> <p>7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.</p> <p>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. <i>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.</i></p>
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ESL Mathematics
(Grade 9 - 12)

173101 **ESL Mathematics A**
173102 **ESL Mathematics B**

COURSE DESCRIPTION

ESL Mathematics is a one-year enabling course for newcomers enrolled in the Structured English Immersion Program. The course is designed to provide an introduction to key language and concepts in mathematics and to build a foundation for standards-based mathematics instruction taught in English. It may be offered under the following conditions:

- As a prerequisite for standards-based sheltered math courses taught using specially designed academic instruction in English (SDAIE).
- As an intervention for English Learners in need of basic language and conceptual development in mathematics, to be offered during summer or intersession.

COURSE SYLLABUS

The standards should be taken from the *Mathematics Standards for the Mathematics Intervention Program* of the Mathematics Framework for California Public Schools so as to be appropriate for the student's needs.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

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**Essential Standards in Mathematics
(Grade 10, 11 or 12)**

310209 Essential Standards in Mathematics

COURSE DESCRIPTION

This one semester course is designed as a preparation for the CAHSEE with instruction (review) in pre-algebraic and introductory algebra concepts and skills that are not yet understood well enough by the student to earn a passing score. It is intended for either 11th or 12th grade students who did not pass the CAHSEE or 10th grade students whose past performance in mathematics places them in jeopardy of not passing. The course will focus on meeting the California content standards in mathematics in some selected standards from Algebra 1 and strands from Grades 6 and 7 including Number Sense; Algebra and Function; Measurement and Geometry; Statistics, Data Analysis and Probability; and Mathematical Reasoning.

COURSE SYLLABUS

The course covers essential standards from middle school mathematics and a selection of Algebra 1 standards. Algebra topics include much of the concepts in the first part of Algebra 1A course: understanding, writing, solving, and graphing linear equations and inequalities, including systems of linear equations in two unknowns, and the solving of problems utilizing algebraic techniques.

REPRESENTATIVE PERFORMANCE OUTCOMES AND SKILLS

Below is the set of CAHSEE standards with strikethroughs to indicate portions of standards that are not covered:

- 6 SDAP 1.0** Students compute and analyze statistical measurements for data sets:
- 1.1** Compute the ~~range~~, mean, median, and mode of data sets.
- 6SDAP 2.0** Students use data samples of a population and describe the characteristics and limitations of the samples:
- 2.5** Identify claims based on statistical data and, in simple cases, evaluate the validity of the claims
- 6 SDAP 3.0** Students determine theoretical and experimental probabilities and use these to make predictions about events
- 3.1** Represent all possible outcomes for compound events in an organized way (e.g., tables, grids, tree diagrams) and express the theoretical probability of each outcome.
 - 3.3** Represent probabilities as ratios, proportions, decimals between 0 and 1, and percentages between 0 and 100 and verify that the probabilities computed are reasonable; know that if P is the probability of an event, $1-P$ is the probability of an event not occurring.
 - 3.5** Understand the difference between independent and dependent events.

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- 7 NS 1.0** Students know the properties of, and compute with, rational numbers expressed in a variety of forms:
- 1.1** Read, write, and compare rational numbers in scientific notation (positive and negative powers of 10) with approximate numbers using scientific notation.
 - 1.2** Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.
 - 1.3** Convert fractions to decimals and percents and use these representations in estimations, computations, and applications.
 - 1.4** Differentiate between rational and irrational numbers.
 - 1.5** Know that every rational number is either a terminating or repeating decimal and be able to convert terminating decimals into reduced fractions.
 - 1.6** Calculate the percentage of increases and decreases of a quantity.
 - 1.7** Solve problems that involve discounts, markups, commissions, and profit and compute simple and compound interest.
- 7 NS 2.0** Students use exponents, powers, and roots and use exponents in working with fractions:
- 2.1** Understand negative whole-number exponents. Multiply and divide expressions involving exponents with a common base.
 - 2.2** Add and subtract fractions by using factoring to find common denominators.
 - 2.3** Multiply, divide, and simplify rational numbers by using exponent rules.
 - 2.4** Use the inverse relationship between raising to a power and extracting the root of a perfect square integer; for an integer that is not square, determine without a calculator the two integers between which its square root lies and explain why.
 - 2.5** Understand the meaning of the absolute value of a number; interpret the absolute value as the distance of the number from zero on a number line; and determine the absolute value of real numbers.
- 7AF 1.0** Students express quantitative relationships by using algebraic terminology, expressions, equations, inequalities, and graphs:
- 1.1** Use variables and appropriate operations to write an expression, an equation, an inequality, or a system of equations or inequalities that represents a verbal description (e.g., three less than a number, half as large as area A).
 - 1.2** Use the correct order of operations to evaluate algebraic expressions such as $3(2x + 5)^2$.
 - 1.5** Represent quantitative relationships graphically and interpret the meaning of a specific part of a graph in the situation represented by the graph.
- 7AF 2.0** Students interpret and evaluate expressions involving integer powers and simple roots:
- 2.1** Interpret positive whole-number powers as repeated multiplication and negative whole-number powers as repeated division or multiplication by the multiplicative inverse. Simplify and evaluate expressions that include exponents.
 - 2.2** Multiply and divide monomials; extend the process of taking powers and extracting roots to monomials when the latter results in a monomial with an integer exponent.

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- 7 AF 3.0** Students graph and interpret linear and some nonlinear functions:
- 3.1** Graph functions of the form $y = nx^2$ and $y = nx^3$ and use in solving problems.
 - 3.3** Graph linear functions, noting that the vertical change (change in y - value) per unit of horizontal change (change in x - value) is always the same and know that the ratio ("rise over run") is called the slope of a graph.
 - 3.4** Plot the values of quantities whose ratios are always the same (e.g., cost to the number of an item, feet to inches, circumference to diameter of a circle). Fit a line to the plot and understand that the slope of the line equals the quantities.
- 7 AF 4.0** Students solve simple linear equations and inequalities over the rational numbers:
- 4.1** Solve two-step linear equations and inequalities in one variable over the rational numbers, interpret the solution or solutions in the context from which they arose, and verify the reasonableness of the results.
 - 4.2** Solve multi step problems involving rate, average speed, distance, and time or a direct variation.
- 7 MG 1.0** Students choose appropriate units of measure and use ratios to convert within and between measurement systems to solve problems:
- 1.1** Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).
 - 1.2** Construct and read drawings and models made to scale.
 - 1.3** Use measures expressed as rates (e.g., speed, density) and measures expressed as products (e.g., person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.
- 7 MG 2.0** Students compute the perimeter, area, and volume of common geometric objects and use the results to find measures of less common objects. They know how perimeter, area, and volume are affected by changes of scale:
- 2.1** Use formulas routinely for finding the perimeter and area of basic two-dimensional figures and the surface area and volume of basic three-dimensional figures, including rectangles, parallelograms, trapezoids, squares, triangles, circles, prisms, and cylinders.
 - 2.2** Estimate and compute the area of more complex or irregular two-and three-dimensional figures by breaking the figures down into more basic geometric objects.
 - 2.3** Compute the length of the perimeter, the surface area of the faces, and the volume of a three-dimensional object built from rectangular solids. Understand that when the lengths of all dimensions are multiplied by a scale factor, the surface area is multiplied by the square of the scale factor and the volume is multiplied by the cube of the scale factor.
 - 2.4** Relate the changes in measurement with a change of scale to the units used (e.g., square inches, cubic feet) and to conversions between units ($1 \text{ square foot} = 144 \text{ square inches}$ or $[1 \text{ ft}^2] = [144 \text{ in}^2]$, 1 cubic inch is approximately $16.38 \text{ cubic centimeters}$ or $[1 \text{ in}^3] = [16.38 \text{ cm}^3]$).

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- 7 MG 3.0** Students know the Pythagorean theorem and deepen their understanding of plane and solid geometric shapes by constructing figures that meet given conditions and by identifying attributes of figures:
- 3.2** Understand and use coordinate graphs to plot simple figures, determine lengths and areas related to them, and determine their image under translations and reflections.
 - 3.3** Know and understand the Pythagorean theorem and its converse and use it to find the length of the missing side of a right triangle and the lengths of other line segments and, in some situations, empirically verify the Pythagorean theorem by direct measurement.
 - 3.4** Demonstrate an understanding of conditions that indicate two geometrical figures are congruent and what congruence means about the relationships between the sides and angles of the two figures.
- 7 SDAP 1.0** Students collect, organize, and represent data sets that have one or more variables and identify relationships among variables within a data set by hand and through the use of an electronic spreadsheet software program:
- 1.1** Know various forms of display for data sets, including a stem-and-leaf plot or box-and-whisker plot; use the forms to display a single set of data or to compare two sets of data.
 - 1.2** Represent two numerical variables on a scatter plot and informally describe how the data points are distributed and any apparent relationship that exists between the two variables (e.g., between time spent on homework and grade level).
- 7 MR 1.0** Students make decisions about how to approach problems:
- 1.1** Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.
 - 1.2** Formulate and justify mathematical conjectures based on a general description of the mathematical question or problem posed.
- 7 MR 2.0** Students use strategies, skills, and concepts in finding solutions:
- 2.1** Use estimation to verify the reasonableness of calculated results.
 - 2.3** Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.
 - 2.4** Make and test conjectures by using both inductive and deductive reasoning.
- 7 MR 3.0** Students determine a solution is complete and move beyond a particular problem by generalizing to other situations:
- 3.3** Develop generalizations of the results obtained and the strategies used and apply them to new problem situations.
- Algebra 1, 2.0** Students understand and use such operations as taking the opposite, finding the reciprocal, taking a root, ~~and raising to a fractional power~~. They understand and use the rules of exponents.
- Algebra 1, 3.0** Students solve equations and inequalities involving absolute values.
- Algebra 1, 4.0** Students simplify expressions before solving linear equations and inequalities in one variable, such as $3(2x-5) + 4(x-2) = 12$.

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- Algebra 1, 5.0** Students solve multi-step problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.
- Algebra 1, 6.0** Students graph a linear equation and compute the x - and y - intercepts (e.g., graph $2x + 6y = 4$). ~~They are also able to sketch the region defined by linear inequality (e.g., they sketch the region defined by $2x + 6y < 4$).~~
- Algebra 1, 7.0** Students verify that a point lies on a line, given an equation of the line. Students are able to derive linear equations ~~by using the point-slope formula.~~
- Algebra 1, 8.0** Students understand the concepts of parallel lines ~~and perpendicular lines~~ and how those slopes are related. ~~Students are able to find the equation of a line perpendicular to a given line that passes through a given point.~~
- Algebra 1, 9.0** Students solve a system of two linear equations in two variables algebraically and are able to interpret the answer graphically. Students are able to solve a system of two linear inequalities in two variables and to sketch the solution sets.
- Algebra 1, 10.0** Students add, subtract, multiply, and divide monomials and polynomials. Students solve multi-step problems, including word problems, by using these techniques.
- Algebra 1, 15.0** Students apply algebraic techniques to solve rate problems, work problems, and percent mixture problems.

ASSESSMENTS will include:

- Teacher designed standards-based quizzes and tests
- Projects and group tasks
- Teacher designed formative assessments

TEXTS/MATERIALS

- Textbook: District approved materials
- Supplemental materials and resources

Appendix

The A-G Curriculum and Mathematics

California's optional A-G curriculum, aligned with the state's public university entrance requirements for the California State University (CSU) and University of California (UC) systems, is not just for college-bound students. According to a report from Education Trust-West (2004), completing the A-G requirements "makes for a more meaningful high school experience by providing the challenges that encourage high schoolers to learn more and to live up to high expectations." The A-G curriculum is not just preparation for college and work, the report contends; it is preparation for life.

On June 14, 2005, the Board of Education approved a Resolution to create educational equity through the implementation of the A-G course sequence as a part of the high school graduation requirement for the class of 2012. The required A-G courses comprise about 65 percent of LAUSD graduation unit total of 230. If a student enrolls in the more rigorous recommended sequence of A-G courses, he/she will have completed approximately 78 percent of LAUSD graduation requirements.

A-G SEQUENCE OF COURSES		
A	History/Social Studies	2 years required
B	English	4 years required
C	Mathematics	3 years required 4 years recommended
D	Laboratory Science	2 years required 3 years recommended
E	Languages other than English - All years of same language	2 years required 3 years recommended
F	Visual and Performing Arts	1 year required of year-long course
G	Electives - Interdisciplinary	2 semesters required

References

Education Trust-West. (2004). "The A-G Curriculum: College-Prep? Work-Prep? Life Prep. Understanding and Implementing a Rigorous Core Curriculum for All." <http://www.edtrustwest.org>.

Designing Advanced and Honors Courses

Students need opportunities to take advanced and enriched mathematics courses in middle and high school when they demonstrate higher levels of proficiency, effort, and achievement. Research shows that coursework in advanced and honors-level classes should be differentiated, or specially designed for students whose achievement is significantly above that of their peers. In the *Mathematics Framework for California Public Schools*, adopted by the State Board of Education on November 6, 2013, these courses provide students with opportunities necessary to reach their fullest potential. **Differentiation** in a core mathematics class includes curriculum, instruction, and assessment that are enriched along four dimensions: acceleration/pacing, depth, complexity, and novelty (CDE, 1994 and Appendix A: Course Placement and Sequences, SBE Mathematics Framework, November 6, 2013.). Differentiation in advanced and honors-level courses implies that students will be working on concepts that are more cognitively demanding than those addressed in core courses, and students will be engaged in both collaborative and independent study that exceeds grade-level standards and builds students' independence with difficult reading, writing, listening, and speaking tasks.

- **Acceleration/Pacing** provides arrangements for students to move more rapidly through a curricular sequence. An accelerated curriculum would include challenging and appropriate opportunities above and beyond the usual grade-level content: special projects, seminars, independent study, alternate assessments, and flexible grouping.
- **Depth** allows students who demonstrate an extraordinary knowledge, skills, or interest in a topic or task to pursue it in greater detail and to a greater level of understanding. Depth refers to approaching or studying something from the concrete to the abstract, from the familiar to the unfamiliar, and from the known to the unknown. An in-depth study would often include a significant amount of outside, independent research guided by essential questions that lead to advanced insight and comprehension.
- **Complexity** involves making relationships between and among ideas, connecting other concepts, and layering—a why/how interdisciplinary approach that connects and bridges to other disciplines, always enhancing the meanings of ideas. Students working individually or together on relatively complex ideas and relationships should be particularly encouraged to examine their own thinking.
- **Novelty** differs primarily from the other forms of differentiation because it is primarily student-initiated. Differentiating the curriculum through increasing depth and complexity should always begin with the students' response to the topics, issues, ideas, and tasks presented. Providing advanced learning opportunities through *novelty* depends entirely on the students' perceptions and responses, their inquiry and exploration using personalized and nontraditional approaches to finding the irony, paradoxes, metaphors, and other sophisticated symbolic processes within and across content areas. Teachers should encourage students to develop original interpretations, reinterpretations, or new implications among or within disciplines.

The University of California grants special “honors” designation and extra credit in students' grade point average computation only to those level courses that meet specific criteria. (See High School Honors Level Mathematics Courses)

References

- California Department of Education. (November, 2013) *Mathematics Framework for California Public Schools: Kindergarten Through Grade 12*.
- California Department of Education and California Association for the Gifted. (1994). *Differentiating the Core Curriculum and Instruction to Provide Advanced Learning Opportunities: A Position Paper*.

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National Governors Association Center for Best Practices, Council of Chief State School Officers (2010).
Common Core States Standards Mathematics. NGABP, CCSSO, Washington, DC.

High School Honors Level Mathematics Courses

The University of California grants special "honors" designation and extra credit in students' grade point average computation only to those high school honors level courses that meet the following criteria. The University strongly encourages that such courses be available to all sectors of the school population.

- **AP Courses.** Advanced Placement (AP) courses in the "a-g" subjects which are designed to prepare students for an Advanced Placement Examination of the College Board are automatically granted honors status, even if they are offered at the 10th grade level (e.g., newly developed courses/exams in Human Geography and World History). For more information about AP, go to the College Board's web site at www.collegeboard.org/ap/.
- **International Baccalaureate.** Designated International Baccalaureate (IB) courses offered by schools participating in the IB program are automatically granted honors status. For a list of IB courses that are granted honors status, search for the "International Baccalaureate" program list on the Doorways course list web site at <http://www.ucop.edu/agguide/>. For more information about IB programs, go to www.ibo.org.
- **College Courses.** College courses in the "a-g" subjects that are transferable to the University of California. To determine whether a course is transferable, go to www.assist.org.
- **Other Honors Courses.** Other honors courses (that are not AP, IB, or college courses) specifically designed by the high school are acceptable *if they are in the disciplines of history, English, advanced mathematics, laboratory science, languages other than English, and advanced visual and performing arts* and have distinctive features which set them apart from regular high school courses in the same discipline areas. These courses should be seen as comparable in terms of workload and emphasis to AP, IB, or introductory college courses in the subject. Acceptable honors level courses are specialized, advanced, collegiate-level courses offered at the 11th and 12th grade levels. Please refer to the notes below for special requirements for the certification of these honors courses.

NOTE

The only non-AP, UC-approved Honors mathematics courses are Honors Mathematical Analysis AB and Honors Trigonometry/Math Analysis AB

Reference

University of California Office of the President, *2008 Guide to "a-g" Requirements and Instructions for Updating Your School's "a-g" Course List*.

LAUSD Reference Guide, REF-1469.3, January 23, 2008

GUIDELINES FOR STANDARDS-BASED INSTRUCTION

References:

Mathematics Framework for California Public Schools,
Kindergarten through Grade twelve.

Adopted by the California State Board of Education, November, 2013
Published by the California Department of Education Sacramento, 2004

Secondary Mathematics Instructional Guide
2014-2015

Los Angeles Unified School District

Calculus, Calculus AB, Calculus BC Course Description
May 2006, May 2007

AP College Board

Statistics Course Description
May 2007, May 2008

AP College Board

Prepared by the Mathematics Unit, OCIS, March 2015