SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
BOARD OF EDUCATION

Agenda Item 8.1f

Meeting Date: August 4th, 2016

Subject: Approve Courses of Study for Integrated Math 1, MIS101, MIS102, ZIS131, ZIS132; Integrated Math 2, MIS201, MIS202, ZIS231, ZIS232; Integrated Math 2 Plus, MIS203, MIS204

- ☐ Information Item Only
- ☒ Approval on Consent Agenda
- ☐ Conference (for discussion only)
- ☐ Conference/First Reading (Action Anticipated: _____)
- ☐ Conference/Action
- ☐ Action
- ☐ Public Hearing

Division: Curriculum and Instruction

Recommendation: Approve the courses of study for "Integrated Math 1", "Integrated Math 2", and "Integrated Math 2 Plus"

Background/Rationale: SCUSD has elected the integrated pathway of mathematics to implement the CCSS-M at the high school level, which has been phased in over a three-year period: Math 1 in 2014-15; Math 2 and Math 2 Plus in 2015-16; and Math 3 and Math 3 Plus in 2016-17.

The integrated pathway (Math 1, Math 2, and Math 3) is a sequence of courses that build upon the foundation established in elementary and middle school mathematics. These courses develop mathematics across multiple categories, including a blend of Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability concepts throughout all three courses.

The "plus" (+) standards are additional standards written in the CCSS-M that prepare students for advanced math courses, like AP Calculus and college-level math courses. High schools will generally offer two options for mathematics courses. In Option 1, students take Math 1, Math 2, and Math 3, followed by Pre- Calculus (or other 4th course options, e.g. Statistics or College Ready Math). In Option 2, students take Math 1, Math 2 Plus, and Math 3 Plus, followed by AP Calculus AB. Math 2 Plus and Math 3 Plus have the Pre-Calculus standards embedded within them, which prepares students to go directly to AP Calculus AB upon completion of those 2 courses. Both options meet the University of California A – G requirements, and will prepare students for college and career opportunities upon graduation. The plus courses are specifically designed for students who can move through the mathematics content at a faster pace, and who may be interested in further higher-level mathematics courses in college.

These courses meet the University of California A – G requirements, and will prepare students for college and career opportunities upon graduation.

Financial Considerations: None

LCAP Goal(s): College, Career and Life Ready Graduates

Documents Attached:
1. Courses of Study for “Integrated Math 1”, “Integrated Math 2” and “Integrated Math 2 Plus”

Estimated Time of Presentation: N/A	
Submitted by:	Matt Turkie, Interim Assistant Superintendent of Curriculum and Instruction
Approved by:	José L Banda, Superintendent

Sacramento City Unified School District

COURSE OF STUDY

FOR

Integrated Math 1

INTEGRATED MATH 1 1P / MIS101
INTEGRATED MATH 1 2P / MIS102
INTEGRATED MATH 1 / ZIS131
INTEGRATED MATH 1 / ZIS132

Segment	High School
Length of Course	One Year
Developed by	Math Training Specialists (lead: Jennifer Graziano)
First Edition	Spring 2016

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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INTEGRATED MATHEMATICS 1

SECTION ONE — GENERAL INFORMATION

COURSE DESCRIPTION

The standards in the Integrated Mathematics I course come from the following conceptual categories: Modeling, Functions, Number and Quantity, Algebra, Geometry, and Statistics and Probability.The fundamental purpose of the Mathematics I course is to formalize and extend students' understanding of linear functions and their applications. The critical topics of study deepen and extend understanding of linear relationships—in part, by contrasting them with exponential phenomena and, in part, by applying linear models to data that exhibit a linear trend. Mathematics I uses properties and theorems involving congruent figures to deepen and extend geometric knowledge gained in prior grade levels *(From CA Framework for Mathematics I .)*

RATIONALE

SCUSD has elected the integrated pathway of mathematics to implement the CCSS-M at the high school level, which will be phased in over a three-year period: Math 1 in 2014-15; Math 2 in 2015-16; and Math 3 in 2016-17.
The integrated pathway (Math 1, Math 2, and Math 3) is a sequence of courses that build upon the foundation established in elementary and middle school mathematics. These courses develop mathematics across multiple categories, including a blend of Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability concepts throughout all three courses. SCUSD currently has a graduation requirement of 2 years of math in high school, with completion of Integrated Math 2 (or equivalent course, for students who transfer from out-of-district). This course meets the University of California A – G requirements, and will prepare students for college and career opportunities upon graduation.

COURSE GOALS

Upon completion of this course, students will be able to:

- Extend understanding of numerical manipulation to algebraic manipulation.
- Synthesize understanding of function.
- Deepen and extend understanding of linear relationships.
- Apply linear models to data that exhibit a linear trend.
- Wstablish criteria for congruence based on rigid motions.

- Apply the Pythagorean Theorem to the coordinate plane.

COURSE STANDARDS

CCSS-M Standards for Mathematical Practice (K-12):

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

3.1 (CA) Students build proofs by induction and proofs by contradiction

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

CA CCSS-M High School Content Standards for Integrated Math 2:

Number and Quantity

The Real Number System

- Reason quantitatively and use units to solve problems. (N-Q.1–3)

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions (A-SSE.1)

Creating Equations

- Create equations that describe numbers of relationships (A-CED.1 - 4)

Reasoning with Equations and Inequalities

- Understand solving equations as a process of reasoning and explain the reasoning. (A-REI.1)
- Solve equations and inequalities in one variable. (A-REI.3, 3.1 (CA))
- Solve systems of equations. (A-REI.5 - 6)
- Represent and solve equations and inequalities graphically. (A.REI.10 - 12)

Functions

Interpreting Functions

- Understand the concept of a function and use function notation. (F-IF. 1- 3)
- Interpret functions that arise in applications in terms of the context. (F-IF.4,5,6)
- Analyze functions using different representations. (F-IF.7a,7e, 9)

Building Functions

- Build a function that models a relationship between two quantities. (F-BF.1a,1b, 2)
- Build new functions from existing functions. (F-BF.3)

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems (F-LE.1-3)
- Interpret expressions for functions in terms of the situation they model. (F-LE.5)

Geometry

Congruence

- Experiment with transformations in the plane. (G-CO.1 - 5)
- Understand congruence in terms of rigid motions. (G-CO.6 - 8)
- Make geometric constructions. (G-CO.12 - 13)

Expressing Geometric Properties with Equations

- Use coordinates to prove simple geometric theormes algebraically. (G-GPE.4, 5, 7)

Statistics and Probability

Interpreting Categorical and Quantitative Data

- Summarize, represent, and interpret data on a single count or measurement variable. (S-ID.1–3)
- Summarize, represent, and interpret data on two categorical and quantitative variables. (S-ID.5 - 6)
- Interpret linear models. (S-ID.7 - 9)

To read the descriptions of the Standards for Mathematical Practice and to read the specific Math 2 Content Standards, see the CA Framework for Mathematics I .

INSTRUCTIONAL MATERIALS

Textbook: CCSS IP Mathematics I by Walch Education (Publisher) 2014 www.walch.com

SUPPLEMENTARY MATERIALS:

SCUSD Math 2 Curriculum Map, found at www.scusd-math.wikispaces.com/Math1

SUGGESTED AVERAGE TIME FOR COVERING MAJOR UNITS

Units	Content Standards
Unit 1: Relationships between Quantities ≈30 days	A.SSE.1a,b N-Q.1,2,3 A-CED.1,2,3,4
Unit 2: Linear and Exponential Relationsjips ≈40 days	A-REI.10 - 12 F-IF.1 – 6, 7a, 7e, 9 F-LE.1, 2, 3, 5 F-BF.1, 2, 3
Unit 3: Reasoning with Equations ≈25 days	A-REI.1, 3, 5, 6
Unit 4: Descriptive Statistics ≈35 days	S-ID.1, 2, 3, 5, 6, 7, 8, 9
Unit 5: Congruence, Proof, and Constructions ≈30 days	G-CO.1, 2, 3, 4, 5, 6, 7, 8, 12, 13
Unit 6: Connecting Algebra and Geometry Through Coordinates ≈20 days	G-GPE.4, 5, 7

TEACHER RESOURCES

- http://www.corestandards.org/
- www.walchconnect.com
- www.scusd-math.wikispaces.com/Math1
- www.learnzillion.com
- www.illustrativemathematics.org
- www.map.mathshell.org
- https://www.engageny.org/

RECOMMENDED STUDENT RESOURCES

- www.walchconnect.com
- See “Recommended Resources” in the Walch textbook (Teacher Resource books) for each lesson. *This is a list of websites that can be used as additional resources. Some websites are games; others provide additional examples and/or explanations. The links for these resources are live in the PDF version of the Teacher Resource.*

SECTION TWO — COURSE UNITS

See our SCUSD Curriculum Map for Math 1 to access links to documents, tasks, and resources related to the lessons within each unit. Our curriculum map is available here.

UNIT 1: Relationships between Quantities

In this unit, students will understand and explain what the terms of an expression or equation mean in the context of a situation that it models, as well as *write* linear equations, linear inequalities, and exponential equations based on a given scenario (word problem). Students will also graph linear and exponential equations and understand the constraints of an equation based on the situation it models.

Standards Addressed
CCSS-M Standards in Unit 1:
A.SSE.1a,b; N-Q.1,2,3; A-CED.1,2,3,4

Instructional Objectives
Students will be able to:

- Write an expression given a context and identify parts of the expression, such as its terms, factors, coefficients, and constants.
- Interpret the meaning of each of the parts (terms, factors, coefficients, and constants) in terms of the context that they represent.
- Analyze a linear expression from a given context to determine how the output (independent variable) changes based on the input (dependent variable), in terms of the situation it models.
- Analyze an exponential expression from a given context to determine how the output (independent variable) changes based on the input (dependent variable), in terms of the situation it models.
- Describe the appropriate units needed for a given situation/context.
- Model a real-world context by writing a linear equation in one variable, and solve the equation for a quantity using appropriate units.
- Model a real-world context by writing a linear inequality in one variable, and solve the inequality for a quantity using appropriate units.
- Interpret the solution of an inequality in terms of the context of the problem.

- Understand the definition of absolute value and use it to solve one-variable absolute value equations and inequalities.
- Create a one-variable absolute value equation from a given context, solve it and graph the solution on a number line, and interpret the solution in terms of the context.
- Use a given table of values that represents exponential growth/decay to write an exponential equation for the given table in the form .
- Given a real-world context, write an exponential equation in the form and solve it for a quantity using appropriate units.
- Interpret the solution of an exponential equation in terms of the context of the problem.
- Graph a linear equation in two variables (from the form) on a coordinate plane.
- Create and graph a linear equation in two variables from a given context.
- Graph an exponential equation in two variables on a coordinate plane.
- Create and graph an exponential equation in two variables from a given context.
- Identify constraints of a linear equation or inequality, within the context of a given situation.
- Decide if solution(s) make sense within the context of a given situation.
- Rearrange a given formula in order to solve for a specific variable or quantity of interest.

Suggested Activities

- Provide students with a context and also some expressions related to the context, and ask them to identify and interpret what the parts of the expression mean in the context. *For example:*

Context (given): A company uses two different sized trucks to deliver sand. The first truck can transport *x* cubic yards, and the second *y* cubic yards. The first truck makes *S* trips to a job site, while the second makes *T* trips. What do the following expressions represent in practical terms?	
Expression (given)	**Interpretation of the expression *(sample student response)***
$S + T$	equals the total number of trips each truck made to a job site.
$x + y$	equals the total number of sand (in cubic yards) that both trucks can transport together in one trip.
$xS + yT$	equals the total amount of sand (in cubic yards) being delivered to a job site by both trucks.

$\frac{xS+yT}{S+T}$	equals the average amount of sand being transported per trip.

- Build on students' understanding of absolute value and their working definition as the "distance from 0" to help them understand the notation

$$|x| = \begin{cases} -x, & x < 0 \\ x, & x \geq 0 \end{cases}$$

Students should be able to *write* and *explain* this notation in words; i.e. "The absolute value of is equal to whenever is 0 or positive, but the absolute value of is the *opposite* of whenever is negative".

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 1 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 1 Unit 1 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 1 standards from https://scusd.illuminateed.com

UNIT 2: Linear and Exponential Relationships

Students develop understanding of the concept of function. They use function notation, represent functions with graphs and identify key features of[JG1] graphs. Students interpret, analyze and compare functions using different representations. Students build functions that model relationships between two quantities. They combine functions using arithmetic operations and use transformations to build new functions from existing functions. Students understand sequences as functions and write arithmetic and geometric sequences. Students also solve and graph solutions of linear inequalities in two variables and systems of linear inequalities in two variables.

Standards Addressed
CCSS-M Standards in Unit 2:
A-REI.10 - 12; F-IF.1 – 6, 7a, 7e, 9; F-LE.1, 2, 3, 5; F-BF.1, 2, 3

Instructional Objectives
Students will be able to:

- Create a table of values and graph points given an equation in context.
- Create an equation from context through use of tables and graphs.
- Find and explain a solution from a graph.
- Create a table and graph for a system of linear equations, from mathematical and real-world contexts.
- From a table of values or a graph, estimate a solution to a system of linear equations by locating the point of intersection.
- Find the domain and range from a given context.
- Given a table or graph, determine whether or not it is a function.
- Given a table of values or a graph of a function, identify the domain and range.
- Evaluate a function over a given domain in order to determine the range (from an equation, graph, or context).
- Given the equation of a linear or exponential function from a context, evaluate the function for a specific input value and interpret the results in terms of the context.
- Graph the solution set of a linear inequality in two variables.
- From a given context, write a linear inequality in two variables and graph the solution set (considering constraints, when applicable).
- Graph the solution set to a system of linear inequalities in two variables.

- From a given context, write a system of linear inequalities, graph the solution, and interpret the solution set in terms of the situation.
- Find a specific term(s) or a missing term(s) in a given sequence.
- Use a recursive formula in order to create a table of values and a graph.
- Write and use a recursive formula from a given context.
- Interpret key features from a graph (including intercepts, positive/ negative, increasing/ decreasing, maximum/ minimum values, and domain). *Include linear and exponential functions.*
- Create a graph that represents a given context and determine its key features. *Include linear and exponential functions.*
- Calculate the rate of change for a linear or exponential function over an interval (from an equation or from a table of values), and explain what it means in terms of the context.
- Determine the approximate rate of change given a graph and interval(s) for exponential and linear functions.
- Predict a rate of change for future intervals.
- Graph a linear function and identify the slope and intercepts.
- Write and graph a linear function from a context, and explain what the intercepts of the graph mean in terms of the situation.
- Graph an exponential function from a table of values, identify the asymptote and y-intercept, and describe end behavior of the graph.
- Compare properties of two linear functions represented in different ways. Compare properties of two exponential functions represented in different ways.
- Understand that a quantity increasing exponentially eventually exceeds a quantity increasing linearly.
- Compare the rate of change of a linear function to the rate of change of an exponential function to determine which increases or decreases faster.
- Write an explicit *linear* function to represent a given pattern from a context.
- Write an explicit *exponential* function to represent a given pattern from a context.
- Create an exponential function, including geometric sequences, from a graph or from a table of values.
- Create a linear function, including arithmetic sequences, from a graph or from a table of values.
- Perform the four basic operations on functions.
- Compare two different functions that represent *similar* contexts and describe how the function rules are different.
- Determine a function rule given a graph of a translated function.
- Determine the value of *k* when given *f(x)*, *g(x),* and *g(x) = f(x) + k.*
- Write an explicit formula for an arithmetic sequence to find the n^{th} term.
- Find the first 5 terms of an arithmetic sequence given a recursive formula.
- Write an explicit formula for a geometric sequence to find the n^{th} term.
- Find the first 5 terms of a geometric sequence given a recursive formula.

- Identify the parameters in a given linear or exponential equation.
- Interpret what the parameters of a linear or exponential function mean in terms of a situation that it models.

Suggested Activities

- Continue to use both tables and graphs to represent equations, so students can see and understand connections between various representations.
- Ask students: Why is the point of intersection of two graphs the solution to the system of equations?
- Provide opportunities for students to compare and contrast domain and range to build understanding of the two.
- Have students interpret their results in terms of the situation it models, when evaluating a function in a real-world context. *For example:*

Situation: A shipping company charges $5.00 to ship a package plus an additional $1.20 per ounce that the package weighs.		
Function	Evaluate *f(20)*	What does *f(20)* mean in terms of this situation?
f(x) = 1.2x + 5	*f(20) = 29*	It costs $29 to ship a 20-ounce package. (*Show graph, if applicable*)

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 2 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 1 Unit 2 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 2 standards from https://scusd.illuminateed.com

UNIT 3: Reasoning with Equations

Students make use of properties of equality to solve linear equations and inequalities in one variable including ones with absolute values (**CA added**) as well as simple exponential equations of the form $b^x = c$. Students explain and justify solution methods. Students also prove equivalencies and solve systems of linear equations exactly and approximately (e.g., with graphs).

Standards Addressed
CCSS-M Standards in Unit 3:
A-REI.1, 3, 5, 6

Instructional Objectives
Students will be able to:

- Use properties to justify a solution method to a simple linear equation (informal proof).
- Solve linear equations in one variable, including literal equations with coefficients represented by letters.
- Solve linear inequalities in one variable and check that the solution set is reasonable.
- Solve equations and inequalities in one variable involving absolute value.
- Graph the solutions to an absolute value equation or inequality on a number line and interpret the solutions in terms of a situation it models.
- Solve simple exponential equations in one variable by inspection, for example $2^x = 8$, and verify solutions through substitution.
- Explain why the sum or difference of two linear equations results in an equation that produces a line that passes through the point of intersection of the original system of equations.
- Use the “elimination method” to solve a system of linear equations in two variables, resulting from real-world and mathematical contexts.
- Use the “substitution method” to solve a system of linear equations in two variables, resulting from real-world and mathematical contexts.
- Solve systems of linear equations approximately or exactly by using a graph and identifying the point of intersection.
- From the graph, determine whether a system of linear equations has one solution, no solution, or infinitely many solutions.

Suggested Activities

- Have students make connections between solving systems using the elimination method and solving systems using the substitution method.
  For example:

Solve: $\begin{cases} y = 3x + 7 \\ x - 4y = -6 \end{cases}$		Solve: $\begin{cases} 2x + 3y = 4 \\ x - y = -4 \end{cases}$	
Solve by substituon	Solve by elimination	Solve by substitution	Solve by elimination

- Provide opportunities for students to *choose* the method that works best for them, when solving a system of linear equations in two variables.
  Ask the questions:
  - When might it be easier to use the “elimination method?” Why?
  - When might it be easier to use the “substitution method?” Why?
- Provide opportunities for students to solve a system in different ways (including graphs and tables) and have them compare their strategies with other students (graphing calculators could be used).

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 3 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 1 Unit 3 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 3 standards from https://scusd.illuminateed.com

UNIT 4: Descriptive Statistics

Students build on previous understanding of key ideas for describing distributions. They summarize, represent, compare, and interpret data sets beginning with situations involving a single measurement variable. Students also take a deeper look at bivariate data (two categorical and quantitative variables). They use their knowledge of functions to fit mathematical models to data and explain what these models communicate about the relationship between the variables. Students interpret linear models and distinguish between correlation and causation.

Standards Addressed
CCSS-M Standards in Unit 4:
S-ID.1, 2, 3, 5, 6, 7, 8, 9

Instructional Objectives
Students will be able to:

- Represent data (from a table) as a dot plot, box plot, or histogram.
- Identify the median, maximum and minimum values, and quartiles of a set of data.
- Determine the *best* representation (i.e. a dot plot, box plot, or histogram) for a set of data.
- Determine the appropriate measure of center (median or mean) and spread (interquartile range or standard deviation) of two data sets, and use them to describe similarities and differences between the data sets.
- Identify outliers in a given data set and explain how they influence the shape and spread of the data.
- Calculate joint, marginal, and conditional relative frequencies from data presented in a two-way frequency table, and interpret them in terms of the context of the data.
- Create a two-way frequency table to represent data and identify any trends in the data.
- Create a scatter plot given data that represents two quantitative variables.
- Determine whether a given equation (linear or exponential) is a *best fit* data on a scatter plot.
- Use functions fitted to data to solve problems about the data.

- Calculate the residuals of a linear graph (i.e. the distance between an observed data point and an estimated data value on a line of best fit), and plot them on a residual plot.
- Use a residual plot to determine whether a line of best fit is a good approximation for the data or not.
- Create a scatter plot to represent given data, and determine if the data can be represented by a linear function.
- For scatter plots that suggest a linear association, draw a line of best fit and write its equation.
- Interpret the slope (rate of change) and the intercept (constant) for a *line of best fit* in the context of the data.
- Compute the correlation coefficient of a linear fit (using technology) and use it to describe the strength of the relationship between the data.
- Analyze data (from a table and/or scatter plot) and determine if it is likely that there is a causal relationship between the data.

Suggested Activities

- Provide opportunities for students to compare/contrast the different representations (dot plot, box plot, and histogram) and *reason* about which representation is appropriate for a given situation. Students can analyze the strengths and weaknesses of each type of representation by comparing different plots of the same data.
- Provide opportunities for students to gather their *own* set of data and organize it in a table *first*, then continue to use that set of data to show how to represent it on a box plot, dot plot, and histogram.
- Provide opportunities for students to explain *why* a given data set may (or may not) have outliers, and *how* that might affect the measure of center (mean or median) and how it might affect the spread (interquartile range or standard deviation).

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 4 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 1 Unit 4 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 4 standards from https://scusd.illuminateed.com

UNIT 5: Congruence, Proofs, and Constructions

Students experiment with transformations in the plane and develop precise definitions for the rigid motions, rotation, reflection, and translation. Students develop an understanding of congruence in terms of rigid motions specifically including criteria for triangle congruence. Students utilize a variety of tools and methods to make formal geometric constructions.

Standards Addressed

CCSS-M Standards in Unit 5:
G-CO.1, 2, 3, 4, 5, 6, 7, 8, 12, 13

Instructional Objectives

Students will be able to:

- Use the notions of point, line, distance along a line, and distance around a circular arc in order to *understand* and *explain* the definitions of angle, circle, perpendicular line, parallel line, and line segment.
- Represent transformations in the plane using transparencies and geometry software.
- Describe transformations as functions that take points in the plane as inputs and give other points as outputs
- Compare transformations that preserve distance and angle to those that do not.
- Draw lines of symmetry for rectangles, parallelograms, trapezoids, and regular polygons.
- Given a rectangle, parallelogram, trapezoid, or regular polygon, use lines of symmetry to describe the rotations and reflections that carry it onto itself.
- Understand and *explain* the definitions of rotations, reflections, and translations in terms of angles, points, and lines.
- Given a geometric figure and a transformation (rotation, reflection, or translation), draw the transformed figure on a coordinate plane.

- Given a pre-image and an image, determine a transformation that occurred.
- Copy a segment using only a compass and a straightedge.
- Copy an angle using only a compass and a straightedge.
- Bisect a segment (i.e. find the midpoint) using a compass and straightedge.
- Bisect an angle using a compass and straightedge.
- Construct a perpendicular bisector of a given line segment, using a compass and straightedge.
- Construct a perpendicular line through a point *on* a given line, and *not* on the given line.
- Given a line, construct a parallel line to it through a given point.
- Construct an equilateral triangle inscribed in a circle, using a compass and straightedge.
- Construct a square inscribed in a circle, using a compass and straightedge.
- Construct a regular hexagon inscribed in a circle, using a compass and straightedge.
- Describe a transformation that has taken place.
- Use a given rigid motion to predict the effects it will have on a given figure.
- Determine if two figures are congruent by identifying the transformation(s) that occurred (and determine whether the transformation is rigid or non-rigid).
- Name corresponding parts of triangles to identify congruent triangles.
- Determine if two triangles are congruent by identifying whether their corresponding pairs of sides and corresponding pairs of angles are congruent or not.
- Determine if triangles are congruent by using the criteria for triangle congruence (ASA, SAS, or SSS).

Suggested Activities

- Provide opportunities for students to use transparencies (e.g. “patty paper”) and/or geometry software (e.g. Geogebra) to experiment with transformations in the plane.
- Provide opportunities for students to describe a given transformation *orally* and in *writing*, before requiring a symbolic representation. Have them make connections between their written description and the symbolic description.

- Allow students to compare and contrast various methods for constructions, and decide which makes the most sense for them and for the problem. Ultimately, students should be making constructions with a compass and straightedge, but then should be able to compare their results with a construction done on patty paper or through geometry software.

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 5 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 1 Unit 5 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 5 standards from https://scusd.illuminateed.com

UNIT 6: Connecting Algebra and Geometry through Coordinates

Students explore the intersection between algebra and geometry. They will use coordinate geometry to prove simple geometric theorems algebraically, including slope criteria for parallel and perpendicular lines. Students will also use coordinates to calculate perimeter of polygons and area of rectangles and triangles.

Standards Addressed
CCSS-M Standards in Unit 6:
G-GPE.4, 5, 7

Instructional Objectives
Students will be able to:

- Discover that the slopes of parallel lines are equal and that the slopes of perpendicular lines have a product of –1, through an investigative approach.
- Calculate the distance between points.
- Use slope and distance to prove (or disprove) geometric theorems and definitions.
- Write an equation for a line that passes through a given point and is either parallel or perpendicular to the graph of another line, both in a real-world and mathematical context.
- Use the distance formula and coordinate points to compute perimeters of polygons and areas of triangles and rectangles.

Suggested Activities

- Provide opportunities for students to make connections between a graphical approach and an algebraic approach to solving problems. For example:

Write an equation for a line that passes through $(3,1)$ and is parallel to $y = -2x + 5$	
Graphical Approach Graph $y = -2x + 5$ and plot point $(3,1)$. Use the slope of the line (-2) to plot more points starting at $(3,1)$, until you can determine the features of the line and write the equation. *(See right)*	
Algebraic Approach Notice the slope of $y = -2x + 5$ and use it to rewrite an equation in the form $y = mx + b$, substituting $m = 2$ and $(3,1)$ as (x, y). Solve for b and rewrite equation with the m and b values. *(See right)*	$y = -2x + 5$ Slope is -2 $y = mx + b$ $m = -2$ and point $(3,1)$ $1 = -2(3) + b$ $b = 7$ $y = -2x + 7$

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 6 Assessment from Walch Textbook; **or**
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- Customized online assessment on Unit 6 standards from https://scusd.illuminateed.com

Sacramento City Unified School District

COURSE OF STUDY

FOR

Integrated Math 2

Course Codes:
INTEGRATED MATH 2 1P / MIS201
INTEGRATED MATH 2 2P / MIS202
INTEGRATED MATH 2 / ZIS231
INTEGRATED MATH 2 / ZIS232

Segment	High School
Length of Course	One Year
Developed by	Math Training Specialists (lead: Suzie Craig)
First Edition	Spring 2016

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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Integrated Mathematics 2

SECTION ONE — GENERAL INFORMATION

COURSE DESCRIPTION

Integrated Math 2 is comprised of standards selected from the high school conceptual categories (Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability.) The focus of Math 2 is on quadratic expressions, equations, and functions, and comparing their characteristics and behavior to those of linear and exponential relationships from Math 1. In addition, students will be introduced to complex numbers, they will explore the link between probability and data, they will understand right triangle trigonometry through Pythagorean relationships (including writing proofs in a variety of formats), and prove basic theorems about circles

RATIONALE

SCUSD has elected the integrated pathway of mathematics to implement the CCSS-M at the high school level, which will be phased in over a three-year period: Math 1 in 2014-15; Math 2 in 2015-16; and Math 3 in 2016-17.
The integrated pathway (Math 1, Math 2, and Math 3) is a sequence of courses that build upon the foundation established in elementary and middle school mathematics. These courses develop mathematics across multiple categories, including a blend of Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability concepts throughout all three courses. SCUSD currently has a graduation requirement of 2 years of math in high school, with completion of Integrated Math 2 (or equivalent course, for students who transfer from out-of-district). This course meets the University of California A – G requirements, and will prepare students for college and career opportunities upon graduation.

COURSE GOALS

Upon completion of this course, students will be able to:

- Extend the laws of exponents to rational exponents
- Compare key characteristics of quadratic functions with those of linear and exponential functions.
- Create and solve equations and inequalities involving linear, exponential, and quadratic expressions (create equations from context, graph, solve, and interpret results in terms of the context; focus on *quadratic* functions).
- Extend work with probability (e.g. compute probabilities of compound events).
- Establish criteria for similarity of triangles based on dilations and proportional reasoning, understand right triangle trigonometry, and prove theorems about similarity and congruence involving lines, angles, triangles,

and other polygons.

COURSE STANDARDS

CCSS-M Standards for Mathematical Practice (K-12):

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

3.1 (CA) Students build proofs by induction and proofs by contradiction

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

CA CCSS-M High School Content Standards for Integrated Math 2:

Number and Quantity

The Real Number System

- Extend the properties of exponents to rational exponents (N-RN.1–2)
- Use properties of rational and irrational numbers (N-RN.3)

The Complex Number System

- Perform arithmetic operations with complex numbers (N-CN.1,2)
- Use complex numbers in polynomial identifies and equations (N-CN.7,8+,9+)

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions (A-SSE.1–2)
- Write expressions in equivalent forms to solve problems (A-SSE.3)

Arithmetic with Polynomials and Rational Expressions

- Perform arithmetic operations on polynomials (A-APR.1)

Creating Equations

- Create equations that describe numbers of relationships (A-CED.1,2,4)

Reasoning with Equations and Inequalities

- Solve equations and inequalities in one variable (A-REI.4a,4b)
- Solve systems of equations (A-REI.7)

Functions

Interpreting Functions

- Interpret functions that arise in applications in terms of the context (F-IF.4,5,6)
- Analyze functions using different representations (F-IF.7a,7b,8a,8b,9)

Building Functions

- Build a function that models a relationship between two quantities (F-BF.1a,1b)

- Build new functions from existing functions (F-BF.3,4a)

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems (F-LE.3)
- Interpret expressions for functions in terms of the situations they model (F-LE.6(CA))

Trigonometric Functions

- Prove and apply trigonometric identities (F-TF.8)

Geometry

Congruence

- Prove geometric theorems (G-CO.9–11)

Similarity, Right Triangles, and Trigonometry

- Understand similarity in terms of similarity transformations (G-SRT.1–3)
- Prove theorems involving similarity (G-SRT.4–5)
- Define trigonometric ratios and solve problems involving right triangles (G-SRT.6–8, 8.1(CA))

Circles

- Understand and apply theorems about circles (G-C.1–3,4+)
- Find arc lengths and areas of sectors of circles (G-C.5)

Expressing Geometric Properties with Equations

- Translate between the geometric description and the equations for a conic section (G-GPE.1, 2)
- Use coordinates to prove simply geometric theorems algebraically (G-GPE.4, 6)

Geometric Measurement and Dimension

- Explain volume formulas and use them to solve problems (G-GMD.1, 3, 5(CA), 6(CA))

Statistics and Probability

Conditional Probability and the Rules of Probability

- Understand independene and conditional probability and use them to interpret data (S-CP.1–5)
- Use the rules of probability to compute probabilities of compound events in a uniform probability model (S-CP.6, 7, 8+, 9+)

Using Probability to Make Decisions

- Use probability to evaluate outcomes of decisions (S-MD.6+,7+)

To read the descriptions of the Standards for Mathematical Practice and to read the specific Math 2 Content Standards, see the CA Framework for Math 2.

INSTRUCTIONAL MATERIALS

Textbook: CCSS IP Mathematics II by Walch Education (Publisher) 2014 www.walch.com

SUPPLEMENTARY MATERIALS:

SCUSD Math 2 Curriculum Map, found at www.scusd-math.wikispaces.com/Math2

SUGGESTED AVERAGE TIME FOR COVERING MAJOR UNITS

Units	Content Standards
Unit 1: Extending the Number System ≈25 days	N-RN.1–3 A-APR.1 N-CN.1,2
Unit 2: Quadratic Functions and Modeling ≈40 days	F-IF.4–9 F-BF.1ab,3,4a F-LE.3,**6(CA)**
Unit 3: Expressions and Equations ≈35 days	A-SSE.1–3 A-CED.1,2,4 A-REI.4a,4b,7 N-CN.7,8+,9+
Unit 4: Applications of Probability ≈25 days	S-CP.1–7, 8+,9+ S-MD.6+,7+
Unit 5: Similarity, Right Triangle Trigonometry, and Proof ≈25 days	G-GPE.6 G-SRT.1–8, **8.1(CA)** **G-GMD.6(CA)** G-CO.9–11 F-TF.8
Unit 6: Circles With and Without Coordinates ≈20 days	G-C.1–3,4+,5 G-GMD.1,3 **G-GMD.5(CA)** G-GPE.1,2,4

TEACHER RESOURCES

- http://www.corestandards.org/
- www.walchconnect.com
- www.scusd-math.wikispaces.com/Math2
- www.learnzillion.com
- www.illustrativemathematics.org
- www.map.mathshell.org
- https://www.engageny.org/

RECOMMENDED STUDENT RESOURCES

- www.walchconnect.com
- See “Recommended Resources” in the Walch textbook (Teacher Resource books) for each lesson. *This is a list of websites that can be used as additional resources. Some websites are games; others provide additional examples and/or explanations. The links for these resources are live in the PDF version of the Teacher Resource.*

SECTION TWO — COURSE UNITS

See our SCUSD Curriculum Map for Math 2 to access links to documents, tasks, and resources related to the lessons within each unit. Our curriculum map is available here.

UNIT 1: Extending the Number System

Unit 1 focuses on 4 main topics: 1) expressions and equations with rational exponents; 2) properties of rational and irrational numbers; 3) adding, subtracting, and multiplying polynomials; and 4) adding, subtracting and multiplying complex numbers (in the form). Students will be introduced to complex numbers, in which they will discover the need for imaginary numbers and derive the definition of $□^2 = -1$.

Standards Addressed
CCSS-M Standards in Unit 1: N-RN.1,2,3; A-APR.1; N-CN.1,2

Instructional Objectives
Students will be able to:

- Understand and explain the connection between radicals with rational exponents
- Rewrite and evaluate expressions with rational exponents from mathematical and real-world contexts
- Make sense of why rational numbers form a closed system under addition and multiplication
- Use visual representations (for example "algebra tiles" or area models) to model multiplication of polynomials
- Perform operations with polynomials, including from a real-world context
- Discover the need for imaginary numbers, and derive $□^2 = -1$
- Perform operations with complex numbers, including from a real-world context

Suggested Activities:

- Provide opportunities for students to explain the connection between radicals and rational exponents. *For example:*
    - See task: Evaluating Exponential Expressions
    - *Students could complete this task with a partner or small group in class, during which they will make sense of the two methods shown to them, evaluate expressions with rational exponents, and reason*

about a general rule that will always be true for rewriting rational exponents as radicals.

Suggested Assessments:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 1 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 2 Unit 1 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 1 standards from https://scusd.illuminateed.com

UNIT 2: Quadratic Functions and Modeling

Unit 2 focuses on graphing various functions and identifying key features from the graph, including intercepts, maxim and minima, as well as comparing the properties of exponential, linear, and quadratic functions. Students are introduced to quadratic functions and will focus solely on understanding the graph and key features of a quadratic function [Note: Students will not solve quadratic equations in this unit]. Students will also be introduced to the graphs and key features of absolute value, step, and piecewise-defined functions.

Standards Addressed
CCSS-M Standards in Unit 2: F-IF.4,5,6,7a,7b,8a,8b; F-BF.1a,1b,3,4a; F-LE.3, **6(CA)**

Instructional Objectives
Students will be able to:

- Graph quadratic functions from mathematical and real-world contexts
- Interpret key features of quadratic functions, including domain and average rate of change, and interpret those key features in terms of the situation it models in a real-world context
- Build quadratic functions from a real-world context
- Graph other functions: square root, cube root, absolute value, step functions, and piecewise functions
- Compare properties of exponential, linear, and quadratic functions
- Use their understanding if the key features of the graph in order to transform and translate quadratic functions
- Discover the relationship between an original function and its' inverse; find inverse functions

Suggested Activities

- Provide opportunities for students to make sense of a situation that models a quadratic function, build a quadratic function, solve and graph it, identify key features from the graph, and interpret the solution in terms of the context.
    - *For example: Cal owns and operates a small oil field in Texas. The field has 75 oil wells, and each well produces 945 barrels of oil per day. There is enough land in the oil field for Cal to drill more wells, but every additional well will cause oil production to drop by 3 barrels per day for each well. Cal believes that it would be profitable to build more wells in the field, but he is not sure how many to build. Building too few wells won't result in the most possible profits. Help Cal create a model that allows him to predict the effect that more*

wells will have on oil production. Use this model to determine the maximum number of wells Cal should have on his land.

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 2 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 2 Unit 2 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 2 standards from https://scusd.illuminateed.com

UNIT 3: Expressions and Equations

Unit 3 focuses on creating and solving quadratic equations and inequalities in various ways (e.g. by factoring, completing the square, and applying the quadratic formula), including solving quadratic equations with complex solutions. Students will also build from their understanding of solving systems of linear equations (Math 1) to now solve quadratic-linear systems of equations (i.e. a system of 2 equations in which one is a linear equation and one is a quadratic equation).

Standards Addressed
CCSS-M Standards in Unit 3:
A-SSE.1a,1b,2,3a,3b,3c; A-CED.1,2,4; A-REI.4a,4b,7; N-CN.7,8(+),9(+)

Instructional Objectives
Students will be able to:

- Identify terms, factors, and coefficients of quadratic equations, related to a real-world context
- Create and solve quadratic equations by factoring, completing the square, and the quadratic formula, from mathematical and real-world contexts
- Solve quadratic inequalities and graph the solution(s) on a number line, and relate the graph to a situation it models
- Create quadratic equations using standard form, using the x-intercepts, and using vertex form (and decide which form to use, based on the structure of a given real-world scenario)
- Solve quadratic equations with complex solutions, understanding what imaginary solutions mean in terms of the given problem
- Create and graph rational equations and inequalities (identify asymptotes, domain, and range)
- Solve quadratic-linear systems of equations graphically and algebraically, from mathematical and real-world contexts

Suggested Activities

- Provide opportunities for students to explore why “completing the square” works in rewriting quadratic equations, and where the name comes from (e.g. use “Algebra Tiles” as a visual representation).
- Once students have become comfortable with solving quadratic equations using a variety of methods (e.g. graphing, factoring, completing the square, and use the quadratic formula), provide opportunities for students to make connections between the various methods (make decisions about when it’s best to use each method for solving, depending on the form of the given equation).

- For graphing quadratic equations (given in any form), students may need a graphic organizer to keep their work organized and to also see connections between the equations and their graphical representations. *For example:*

Equation	Key Features	Graph
	· *y*-intercept: · *vertex:* Is this a max or min? · *x-intercepts:* · *Axis of symmetry* · *Other points on the curve?*	

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 3 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 3 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 3 standards from https://scusd.illuminateed.com; **or**
- Rather than a traditional assessment, provide the opportunity for students to work with a partner or a small group to answer questions related to a given scenario tht that models a quadratic relationship. *Students are expected to write the function, graph it, identify the key features of the graph, solve the equation in order to answer the question (using any suitable method), and interpret the solution in terms of the context.* See Project: Fall of Javert, in which students use quadratic functions and information about how objects fall to determine how high Javert's bridge must have been (from the play Les Miserables).

UNIT 4: Applications of Probability

Unit 4 builds on students' previous experiences and understanding of probability and includes finding probabilities using the Addition Rule, Multiplication Rule, combinations, and permutations. Students will construct and use two-way frequency tables and make and analyze decisions using probability concepts.

Standards Addressed
CCSS-M Standards in Unit 4: S-CP.1,2,3,4,5,6,7,8(+),9(+); S-MD.6(+),7(+)

Instructional Objectives
Students will be able to:

- Describe events, identify a sample space, list outcomes (including experiments done in the classroom)
- Find probabilities of events using the addition rule and independent events, and compare theoretical probabilities to actual probabilities (for example, from classroom experiments)
- Construct and use two-way frequency tables to draw conclusions
- Use the multiplication rule, combinations, and permutations to find probabilities of compound events, and draw conclusions about the data
- Make and analyze decisions using probability concepts

Suggested Activities

- Provide opportunities for students to perform experiments in the classroom in order to collect data to work with
- Before students learn how to *solve* for probabilities of independent events, they need to understand what *kinds* of events are *independent* and what *kinds* of events are *not independent.* Provide opportunities for students to make comparisons between different situations (*without solving for probabilities*) and *just identify* whether an event is independent or not.
- A graphic organizer (or "personal dictionary") may be used by students to keep their definitions and examples organized and in kid-friendly language
- Before having students calculate probabilities to solve problems, have them make *predictions* first, for example, about whether or not a game is fair.
    - *For example:* Jake and Melanie are playing a game with 2 dice. Jake earns a point if both dice are even and Melanie earns a point if either of the dice is odd.
    - Ask guiding questions:
        - Does this game sound fair? Why or why not?
        - What experiments might you want to conduct to find out more information?

        - What probabilities should you calculate to determine for certain if the game is fair or not?

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 4 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 4 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 4 standards from https://scusd.illuminateed.com; **or**
- Students can be assessed through a culminating project on a variety of probability standards, e.g. "Three Shots", in which students compute probabilities and investigate conditions to make a decision about "to foul or not to foul" at the buzzer for any player in a basketball game.

UNIT 5: Similarity, Right Triangle Trigonometry, and Proof

In Unit 5, students will use a variety of strategies for writing proofs related to triangle similarity, the Pythagorean Theorem, vertical angles and angles in parallel lines cut by a transversal, angles and centers of triangles, and properties of quadrilaterals. Students will also define and use the 6 trigonometric ratios, and prove the Pythagorean Identity $\square\square\square^2\square + \square\square\square^2\square = 1$.

Standards Addressed

CCSS-M Standards in Unit 5:
G-GPE.6; G-SRT.1a,1b,2,3,4,5,6,7,8; G-CO.9,10,11; F-TF.8, **8.1(CA)**

Instructional Objectives

Students will be able to:

- Investigate properties of dilations (including parallelism and scale factors)
- Define similarity and apply similarity using the Angle-Angle (AA) criterion
- Prove triangle similarity using Side-Angle-Side (SAS) and Side-Side-Side (SSS) similarity
- Prove the Pythagorean Theorem using similarity, and solve real-world problems using similarity and congruence
- Prove the vertical angles theorem, and theorems about angles in parallel lines cut by a transversal
- Prove the interior angle sum theorem, theorems about isosceles triangles, the mid-segment of a tringle, and centers of triangles
- Prove properties of parallelograms and special quadrilaterals
- Define and use trigonometric ratios; Prove the Pythagorean Identity and use it to simplify expressions

Suggested Activities

- Provide opportunities for students write proofs using a variety of strategies, including: using ample pictures to demonstrate results; using patty paper, transparencies, or dynamic geometry software to explore the relationships in a proof; creating flow charts and other organizational diagrams for outlining a proof; and writing step-by-step paragraph formats for the complete proof. Above all else, the reasoning involved in connecting one step in the logical argument to the next should be emphasized.
- Provide opportunities for students to experiment and explore with triangles, and to *discover* theorems about triangles using manipulatives like transparency paper, or geometry software, or through drawing pictures. *For example, see discovery activities below:*
    - *Magical Triangle Theorem Activity*
    - *In-Class Activity – Explore Triangles*

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 5 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 5 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 5 standards from https://scusd.illuminateed.com; **or**
- See assessments from EngageNY's Geometry Units:
    - Geometry Unit: Congruence, Proof, and Constructions and
    - Geometry Unit: Similarity, Proof, and Trigonometry

UNIT 6: Circles With and Without Coordinates

Unit 6 focuses on extensive work with circles, including understanding and using properties of central angles, inscribed angles, chords, and tangents. Students will do constructions with circles, as well as find circumference and area using radian measure. In addition to work with circles, Unit 6 also focuses on volumes of certain three-dimensional solids, and deriving the equations for a circle and a parabola.

Standards Addressed
CCSS-M Standards in Unit 6:
G-C.1,2,3,4(+),5; G-GMD.1,3,**5(CA)**,**6(CA)**; G-GPE.1,2,4

Instructional Objectives
Students will be able to:

- Find arc lengths and angles using properties of central angles, inscribed angles, chords, and tangents
- Construct inscribed circles, circumscribed circles, and tangent lines
- Find circumference and area of a circle, and area of a sector (using radian measure), in mathematical and real-world contexts
- Find volumes of cylinders, pyramids, cones, and spheres, in mathematical and real-world contexts
- Derive the equations of a circle and a parabola
- Use coordinates to prove geometric theorems about circles and parabolas

Suggested Activities

- Provide opportunities for students to derive the equations for circles and parabolas, and explain the meaning of their equations. *For example:*
    - *See task:* Explaining the Equation for a Circle
    - For this assignment, students produce an explanation about why the equation for a circle works for a given center and given points, and then generalize that to write an equation for all circles with points (x, y) and radius r. Students could complete this assignment with a partner in class, as a discovery exercise for deriving the equation of a circle. Students reason abstractly and quantitatively in order to translate their geometric knowledge of what a circle is into an algebraic relationship.
- Use the Vitruvian Man Math Project as a way to engage students in understanding the angles of a quadrilateral inscribed in a circle, and a connection to art.

Suggested Assessment:
Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 6 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 6 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 6 standards from https://scusd.illuminateed.com; **or**
- See assessments from the Math Assessment Project's "Formative Assessment Lessons" on circles and triangles
    - Solving Problems with Circles and Triangles
    - Inscribing and Circumscribing Right Triangles

Sacramento City Unified School District

COURSE OF STUDY

FOR

Integrated Math 2 Plus

Course Codes:
INTEGRATED MATH 2 PLUS 1P / MIS203
INTEGRATED MATH 2 PLUS 2P / MIS204

Segment	High School
Length of Course	One Year
Developed by	Math Training Specialists (lead: Suzie Craig)
First Edition	Spring 2016

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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Integrated Mathematics 2

SECTION ONE — GENERAL INFORMATION

COURSE DESCRIPTION

Integrated Math 2 Plus is recommended for students who are interested in taking 4 years of math in high school, who have shown success in previous math courses, who are interested in a STEM career and/or college education, and who are prepared to learn higher-level math concepts from Pre-Calculus that will begin preparing them for Calculus.

The course is comprised of standards selected from the high school conceptual categories (Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability),including 14 additional “plus” (+) standards from Pre-Calculus. Students who are successful in Integrated Math 2 Plus will progress to Integrated Math 3 Plus the following year, during which they will learn the remaining Pre-Calculus standards. Students who successfully complete both “plus” courses will be prepared for AP Calculus AB.

The course focuses on quadratic expressions, equations, and functions, and comparing their characteristics and behavior to those of linear and exponential relationships from Math 1. In addition, students will be introduced to complex numbers, they will explore the link between probability and data, they will understand right triangle trigonometry through Pythagorean relationships (including writing proofs in a variety of formats), they will be introduced to vectors and will focus on representing and modeling with vector quantities, they will prove basic theorems about circles, and they will derive equations for parabolas, ellipses, and hyperbolas.

RATIONALE

SCUSD has elected the integrated pathway of mathematics to implement the CCSS-M at the high school level, which will be phased in over a three-year period: Math 1 in 2014-15; Math 2 and Math 2 Plus in 2015-16; and Math 3 and Math 3 Plus in 2016-17. The integrated pathway (Math 1, Math 2, and Math 3) is a sequence of courses that build upon the foundation established in elementary and middle school mathematics. SCUSD currently has a graduation requirement of 2 years of math in high school, with completion of Integrated Math 2 or Math 2 Plus (or equivalent course, for students who transfer from out-of-district).

The “plus” (+) standards are additional standards written in the CCSS-M that prepare students for advanced math courses, like AP Calculus and college-level math courses. High schools will generally offer two options for mathematics courses. In Option 1, students take Math 1, Math 2, and Math 3, followed by Pre-Calculus (or other 4th course options, e.g. Statistics or College Ready Math). In Option 2, students take Math 1, Math 2 Plus, and Math 3 Plus, followed by AP Calculus AB. Math 2 Plus and Math 3 Plus have the Pre-Calculus standards

embedded within them, which prepares students to go directly to AP Calculus AB upon completion of those 2 courses. Both options meet the University of California A – G requirements, and will prepare students for college and career opportunities upon graduation. This course is specifically designed for students who can move through the mathematics content at a faster pace, and who may be interested in further higher-level mathematics courses in college.

COURSE GOALS

Items that have a (+) are the additional Pre-Calculus "plus" standards that have been added to this course, to prepare students for Math 3 Plus the following year, and AP Calculus AB the year after that.

Upon completion of this course, students will be able to:

- Extend the laws of exponents to rational exponents
- Compare key characteristics of quadratic functions with those of linear and exponential functions.
- Create and solve equations and inequalities involving linear, exponential, and quadratic expressions (create equations from context, graph, solve, and interpret results in terms of the context; focus on *quadratic* functions).
- Extend work with probability (e.g. compute probabilities of compound events).
- Establish criteria for similarity of triangles based on dilations and proportional reasoning, understand right triangle trigonometry, and prove theorems about similarity and congruence involving lines, angles, triangles, and other polygons.
- (+) Extensive work with complex numbers in non-polar form.
- (+) Represent and model with vector quantities and perform operations on vectors.
- (+) Extend work with conic sections to include deriving the equation of an ellipse.
- (+) Use Cavalieri's principle as an informal argument for volume formulas

COURSE STANDARDS

CCSS-M Standards for Mathematical Practice (K-12):

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

3.1 (CA) Students build proofs by induction and proofs by contradiction

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

CA CCSS-M High School Content Standards for Integrated Math 2 Plus:

Number and Quantity

The Real Number System

- Extend the properties of exponents to rational exponents (N-RN.1–2)
- Use properties of rational and irrational numbers (N-RN.3)

The Complex Number System

- Perform arithmetic operations with complex numbers (N-CN.1,2, 3+)
- Represent complex numbers and their operations on the complex plane (N-CN.4+,5+,6+)
- Use complex numbers in polynomial identifies and equations (N-CN.7,8+,9+)

Vector Quantities and Matrices

- Represent and model with vector quantities (N-VM.1+,2+,3+)
- Perform operations on vectors (N-VM.4+,5+)

Algebra

Seeing Structure in Expressions

- Interpret the structure of expressions (A-SSE.1–2)
- Write expressions in equivalent forms to solve problems (A-SSE.3)

Arithmetic with Polynomials and Rational Expressions

- Perform arithmetic operations on polynomials (A-APR.1)

Creating Equations

- Create equations that describe numbers of relationships (A-CED.1,2,4)

Reasoning with Equations and Inequalities

- Solve equations and inequalities in one variable (A-REI.4a,4b)
- Solve systems of equations (A-REI.7)

Functions

Interpreting Functions

- Interpret functions that arise in applications in terms of the context (F-IF.4,5,6)

- Analyze functions using different representations (F-IF.7a,7b,8a,8b,9)

Building Functions

- Build a function that models a relationship between two quantities (F-BF.1a,1b)
- Build new functions from existing functions (F-BF.3,4a)

Linear, Quadratic, and Exponential Models

- Construct and compare linear, quadratic, and exponential models and solve problems (F-LE.3)
- Interpret expressions for functions in terms of the situations they model (F-LE.6(CA))

Trigonometric Functions

- Prove and apply trigonometric identities (F-TF.8)

Geometry

Congruence

- Prove geometric theorems (G-CO.9–11)

Similarity, Right Triangles, and Trigonometry

- Understand similarity in terms of similarity transformations (G-SRT.1–3)
- Prove theorems involving similarity (G-SRT.4–5)
- Define trigonometric ratios and solve problems involving right triangles (G-SRT.6–8, 8.1(CA))

Circles

- Understand and apply theorems about circles (G-C.1–3,4+)
- Find arc lengths and areas of sectors of circles (G-C.5)

Expressing Geometric Properties with Equations

- Translate between the geometric description and the equations for a conic section (G-GPE.1, 2, 3+)
- Use coordinates to prove simply geometric theorems algebraically (G-GPE.4, 6)

Geometric Measurement and Dimension

- Explain volume formulas and use them to solve problems (G-GMD.1,2+,3, 5(CA), 6(CA))

Statistics and Probability

Conditional Probability and the Rules of Probability

- Understand independene and conditional probability and use them to interpret data (S-CP.1–5)
- Use the rules of probability to compute probabilities of compound events in a uniform probability model (S-CP.6, 7, 8+, 9+)

Using Probability to Make Decisions

- Use probability to evaluate outcomes of decisions (S-MD.6+,7+)

To read the full descriptions of the Standards for Mathematical Practice and the specific Math 2 Plus Content Standards, see the CA Framework for Math 2 and the Higher Mathematics Standards by Conceptual Category (p. 119).

INSTRUCTIONAL MATERIALS

Textbook: CCSS IP Mathematics II by Walch Education (Publisher) 2014; *and*
CCSS IP Honors Supplement for SCUSD Mathematics II by Walch Education
www.walch.com

SUPPLEMENTARY MATERIALS:

SCUSD Math 2 Curriculum Map, found at www.scusd-math.wikispaces.com/Math2
SCUSD Math 2 Plus "Year at a Glance", found at www.scusd-math.wikispaces.com/Math2

SUGGESTED AVERAGE TIME FOR COVERING MAJOR UNITS

Units	Content Standards
Unit 1: Extending the Number System ≈25 days	N-RN.1–3 A-APR.1 N-CN.1,2 (+)N-CN.3,4,5,6
Unit 2: Quadratic Functions and Modeling ≈40 days	F-IF.4–9 F-BF.1ab,3,4a F-LE.3,**6(CA)**
Unit 3: Expressions and Equations ≈35 days	A-SSE.1–3 A-CED.1,2,4 A-REI.4a,4b,7 N-CN.7,8+,9+
Unit 4: Applications of Probability ≈25 days	S-CP.1–7, 8+,9+ S-MD.6+,7+
Unit 5: Similarity, Right Triangle Trigonometry, and Proof ≈25 days	G-GPE.6 G-SRT.1–8, **8.1(CA)** **G-GMD.6(CA)** G-CO.9–11 F-TF.8 (+)N-VM.1,2,3,4,5
Unit 6: Circles With and Without Coordinates ≈20 days	G-C.1–3,4+,5 G-GMD.1,3 **G-GMD.5(CA)**

	G-GPE.1,2,4 (+)G-GPE.3 (+)G-GMD.2

TEACHER RESOURCES

- http://www.corestandards.org/
- www.walchconnect.com
- www.scusd-math.wikispaces.com/Math2
- www.learnzillion.com
- www.illustrativemathematics.org
- www.map.mathshell.org
- https://www.engageny.org/

RECOMMENDED STUDENT RESOURCES

- www.walchconnect.com
- See "Recommended Resources" in the Walch textbook (Teacher Resource books) for each lesson. *This is a list of websites that can be used as additional resources. Some websites are games; others provide additional examples and/or explanations. The links for these resources are live in the PDF version of the Teacher Resource.*

SECTION TWO — COURSE UNITS

See our SCUSD Curriculum Map for Math 2 to access links to documents, tasks, and resources related to the lessons within each unit. Our curriculum map is available here.

UNIT 1: Extending the Number System

Unit 1 focuses on 4 main topics: 1) expressions and equations with rational exponents; 2) properties of rational and irrational numbers; 3) adding, subtracting, and multiplying polynomials; and 4) adding, subtracting and multiplying complex numbers (in the form). Students will be introduced to complex numbers, in which they will discover the need for imaginary numbers and derive the definition of $□^2 = -1$.

The honors lessons in this unit extend students' work with complex numbers to include finding a conjugate, and representing complex numbers and their operations on the complex plane.

Standards Addressed
CCSS-M Standards in Unit 1: N-RN.1,2,3; A-APR.1; N-CN.1,2
Pre-Calculus plus (+) standards included in Unit 1: (+)N-CN.3,4,5,6

Instructional Objectives
Students will be able to:

- Understand and explain the connection between radicals with rational exponents
- Rewrite and evaluate expressions with rational exponents from mathematical and real-world contexts
- Make sense of why rational numbers form a closed system under addition and multiplication
- Use visual representations (for example "algebra tiles" or area models) to model multiplication of polynomials
- Perform operations with polynomials, including from a real-world context
- Discover the need for imaginary numbers, and derive $□^2 = -1$
- Perform operations with complex numbers, including from a real-world context
- (+) Explain why the rectangular and polar forms of a given complex number represent the same number
- (+) Represent operations and conjugation of complex numbers geometrically on the complex plane

Suggested Activities:

- Provide opportunities for students to explain the connection between radicals and rational exponents. *For example:*
    - See task: Evaluating Exponential Expressions
    - *Students could complete this task with a partner or small group in class, during which they will make sense of the two methods shown to them, evaluate expressions with rational exponents, and reason about a general rule that will always be true for rewriting rational exponents as radicals.*

Suggested Assessments:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 1 Assessment from Walch Textbook, including progress assessment from "Honors Supplement" book; **or**
- *Online*: CCSS IP Math 2 Unit 1 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 1 standards from https://scusd.illuminateed.com

UNIT 2: Quadratic Functions and Modeling

Unit 2 focuses on graphing various functions and identifying key features from the graph, including intercepts, maxim and minima, as well as comparing the properties of exponential, linear, and quadratic functions. Students are introduced to quadratic functions and will focus solely on understanding the graph and key features of a quadratic function [Note: Students will not solve quadratic equations in this unit]. Students will also be introduced to the graphs and key features of absolute value, step, and piecewise-defined functions.

Standards Addressed
CCSS-M Standards in Unit 2: F-IF.4,5,6,7a,7b,8a,8b; F-BF.1a,1b,3,4a; F-LE.3, **6(CA)**

Instructional Objectives
Students will be able to:

- Graph quadratic functions from mathematical and real-world contexts
- Interpret key features of quadratic functions, including domain and average rate of change, and interpret those key features in terms of the situation it models in a real-world context
- Build quadratic functions from a real-world context
- Graph other functions: square root, cube root, absolute value, step functions, and piecewise functions
- Compare properties of exponential, linear, and quadratic functions
- Use their understanding if the key features of the graph in order to transform and translate quadratic functions
- Discover the relationship between an original function and its' inverse; find inverse functions

Suggested Activities

- Provide opportunities for students to make sense of a situation that models a quadratic function, build a quadratic function, solve and graph it, identify key features from the graph, and interpret the solution in terms of the context.
    - *For example: Cal owns and operates a small oil field in Texas. The field has 75 oil wells, and each well produces 945 barrels of oil per day. There is enough land in the oil field for Cal to drill more wells, but every additional well will cause oil production to drop by 3 barrels per day for each well. Cal believes that it would be profitable to build more wells in the field, but he is not sure how many to build. Building too few wells won't result in the most possible profits. Help Cal create a model that allows him to predict the effect that more*

wells will have on oil production. Use this model to determine the maximum number of wells Cal should have on his land.

Suggested Assessment

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 2 Assessment from Walch Textbook; **or**
- *Online*: CCSS IP Math 2 Unit 2 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 2 standards from https://scusd.illuminateed.com

UNIT 3: Expressions and Equations

Unit 3 focuses on creating and solving quadratic equations and inequalities in various ways (e.g. by factoring, completing the square, and applying the quadratic formula), including solving quadratic equations with complex solutions. Students will also build from their understanding of solving systems of linear equations (Math 1) to now solve quadratic-linear systems of equations (i.e. a system of 2 equations in which one is a linear equation and one is a quadratic equation).

Standards Addressed
CCSS-M Standards in Unit 3:
A-SSE.1a,1b,2,3a,3b,3c; A-CED.1,2,4; A-REI.4a,4b,7; N-CN.7,8(+),9(+)

Instructional Objectives
Students will be able to:

- Identify terms, factors, and coefficients of quadratic equations, related to a real-world context
- Create and solve quadratic equations by factoring, completing the square, and the quadratic formula, from mathematical and real-world contexts
- Solve quadratic inequalities and graph the solution(s) on a number line, and relate the graph to a situation it models
- Create quadratic equations using standard form, using the x-intercepts, and using vertex form (and decide which form to use, based on the structure of a given real-world scenario)
- Solve quadratic equations with complex solutions, understanding what imaginary solutions mean in terms of the given problem
- Create and graph rational equations and inequalities (identify asymptotes, domain, and range)
- Solve quadratic-linear systems of equations graphically and algebraically, from mathematical and real-world contexts

Suggested Activities

- Provide opportunities for students to explore why “completing the square” works in rewriting quadratic equations, and where the name comes from (e.g. use “Algebra Tiles” as a visual representation).
- Once students have become comfortable with solving quadratic equations using a variety of methods (e.g. graphing, factoring, completing the square, and use the quadratic formula), provide opportunities for students to make connections between the various methods (make decisions about when it’s best to use each method for solving, depending on the form of the given equation).

- For graphing quadratic equations (given in any form), students may need a graphic organizer to keep their work organized and to also see connections between the equations and their graphical representations. *For example:*

Equation	Key Features	Graph
	· *y*-intercept: · *vertex:* Is this a max or min? · *x-intercepts:* · *Axis of symmetry* · *Other points on the curve?*	

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 3 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 3 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 3 standards from https://scusd.illuminateed.com; **or**
- Rather than a traditional assessment, provide the opportunity for students to work with a partner or a small group to answer questions related to a given scenario tht that models a quadratic relationship. *Students are expected to write the function, graph it, identify the key features of the graph, solve the equation in order to answer the question (using any suitable method), and interpret the solution in terms of the context.* See Project: Fall of Javert, in which students use quadratic functions and information about how objects fall to determine how high Javert's bridge must have been (from the play Les Miserables).

UNIT 4: Applications of Probability

Unit 4 builds on students' previous experiences and understanding of probability and includes finding probabilities using the Addition Rule, Multiplication Rule, combinations, and permutations. Students will construct and use two-way frequency tables and make and analyze decisions using probability concepts.

Standards Addressed
CCSS-M Standards in Unit 4: S-CP.1,2,3,4,5,6,7,8(+),9(+); S-MD.6(+),7(+)

Instructional Objectives
Students will be able to:

- Describe events, identify a sample space, list outcomes (including experiments done in the classroom)
- Find probabilities of events using the addition rule and independent events, and compare theoretical probabilities to actual probabilities (for example, from classroom experiments)
- Construct and use two-way frequency tables to draw conclusions
- Use the multiplication rule, combinations, and permutations to find probabilities of compound events, and draw conclusions about the data
- Make and analyze decisions using probability concepts

Suggested Activities

- Provide opportunities for students to perform experiments in the classroom in order to collect data to work with
- Before students learn how to *solve* for probabilities of independent events, they need to understand what *kinds* of events are *independent* and what *kinds* of events are *not independent.* Provide opportunities for students to make comparisons between different situations (*without solving for probabilities*) and *just identify* whether an event is independent or not.
- A graphic organizer (or "personal dictionary") may be used by students to keep their definitions and examples organized and in kid-friendly language
- Before having students calculate probabilities to solve problems, have them make *predictions* first, for example, about whether or not a game is fair.
    - *For example:* Jake and Melanie are playing a game with 2 dice. Jake earns a point if both dice are even and Melanie earns a point if either of the dice is odd.
    - Ask guiding questions:
        - Does this game sound fair? Why or why not?
        - What experiments might you want to conduct to find out more information?

        - What probabilities should you calculate to determine for certain if the game is fair or not?

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 4 Assessment from Walch Textbook; **or**
- *Online* CCSS IP Math 2 Unit 4 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 4 standards from https://scusd.illuminateed.com; **or**
- Students can be assessed through a culminating project on a variety of probability standards, e.g. "Three Shots", in which students compute probabilities and investigate conditions to make a decision about "to foul or not to foul" at the buzzer for any player in a basketball game.

UNIT 5: Similarity, Right Triangle Trigonometry, and Proof

In Unit 5, students will use a variety of strategies for writing proofs related to triangle similarity, the Pythagorean Theorem, vertical angles and angles in parallel lines cut by a transversal, angles and centers of triangles, and properties of quadrilaterals. Students will also define and use the 6 trigonometric ratios, and prove the Pythagorean Identity $\square\square\square^2\square + \square\square\square^2\square = 1$.

The honors lessons in this unit will introduce students to vectors, and will focus on representing and modeling with vector quantities and performing operations on vectors.

Standards Addressed

CCSS-M Standards in Unit 5:
G-GPE.6; G-SRT.1a,1b,2,3,4,5,6,7,8; G-CO.9,10,11; F-TF.8, **8.1(CA)**
Pre-Calculus plus (+) standards included in Unit 5: (+)N-VM.1,2,3,4,5

Instructional Objectives

Students will be able to:

- Investigate properties of dilations (including parallelism and scale factors)
- Define similarity and apply similarity using the Angle-Angle (AA) criterion
- Prove triangle similarity using Side-Angle-Side (SAS) and Side-Side-Side (SSS) similarity
- Prove the Pythagorean Theorem using similarity, and solve real-world problems using similarity and congruence
- Prove the vertical angles theorem, and theorems about angles in parallel lines cut by a transversal
- Prove the interior angle sum theorem, theorems about isosceles triangles, the mid-segment of a tringle, and centers of triangles
- Prove properties of parallelograms and special quadrilaterals
- Define and use trigonometric ratios; Prove the Pythagorean Identity and use it to simplify expressions
- (+) Represent and model with vector quantities
- (+) Perform operations on vectors, from real world and mathematical contexts

Suggested Activities

- Provide opportunities for students write proofs using a variety of strategies, including: using ample pictures to demonstrate results; using patty paper, transparencies, or dynamic geometry software to explore the relationships in a proof; creating flow charts and other organizational diagrams for outlining a proof; and writing step-by-step paragraph formats for the complete proof. Above all else, the reasoning involved in connecting one step in the logical argument to the next should be emphasized.

- Provide opportunities for students to experiment and explore with triangles, and to *discover* theorems about triangles using manipulatives like transparency paper, or geometry software, or through drawing pictures. *For example, see discovery activities below:*
    - *Magical Triangle Theorem Activity*
    - *In-Class Activity – Explore Triangles*

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
- Use appropriate problems from the textbook lessons (including the Problem-Based Task) in class and for homework
- Use links to the online tasks and other resources from our district curriculum map to assess students during the unit

Summative Assessment Strategies

- Unit 5 Assessment from Walch Textbook, including progress assessment from "Honors Supplement" book; **or**
- *Online* CCSS IP Math 2 Unit 5 Assessment from www.walchconnect.com; **or**
- Customized online assessment on Unit 5 standards from https://scusd.illuminateed.com; **or**
- See assessments from EngageNY's Geometry Units:
    - Geometry Unit: Congruence, Proof, and Constructions and
    - Geometry Unit: Similarity, Proof, and Trigonometry

UNIT 6: Circles With and Without Coordinates

Unit 6 focuses on extensive work with circles, including understanding and using properties of central angles, inscribed angles, chords, and tangents. Students will do constructions with circles, as well as find circumference and area using radian measure. In addition to work with circles, Unit 6 also focuses on volumes of certain three-dimensional solids, and deriving the equations for a circle and a parabola.
The honors lessons in this unit build on the circle and parabola equation sin order to derive the equations of an ellipse and a hyperbola. Students will also extend their work with volume to use Cavallieri's principle as an informal argument for volume formulas.

Standards Addressed
CCSS-M Standards in Unit 6: G-C.1,2,3,4(+),5; G-GMD.1,3,**5,6(CA)**; G-GPE.1,2,4
Pre-Calculus plus (+) standards included in Unit 6: (+)G-GPE.3; (+)G-GMD.2

Instructional Objectives
Students will be able to:

- Find arc lengths and angles using properties of central angles, inscribed angles, chords, and tangents
- Construct inscribed circles, circumscribed circles, and tangent lines
- Find circumference and area of a circle, and area of a sector (using radian measure), in mathematical and real-world contexts
- Find volumes of cylinders, pyramids, cones, and spheres, in mathematical and real-world contexts
- Derive the equations of a circle and a parabola
- Use coordinates to prove geometric theorems about circles and parabolas

Suggested Activities

- Provide opportunities for students to derive the equations for circles and parabolas, and explain the meaning of their equations. *For example:*
    - *See task:* Explaining the Equation for a Circle
    - For this assignment, students produce an explanation about why the equation for a circle works for a given center and given points, and then generalize that to write an equation for all circles with points (x, y) and radius r. Students could complete this assignment with a partner in class, as a discovery exercise for deriving the equation of a circle. Students reason abstractly and quantitatively in order to translate their geometric knowledge of what a circle is into an algebraic relationship.

- Use the Vitruvian Man Math Project as a way to engage students in understanding the angles of a quadrilateral inscribed in a circle, and a connection to art.

Suggested Assessment:

Formative Assessment Strategies

- Use informal formative assessment strategies on a daily basis, for example, in the form of exit tickets, individual whiteboards, and/or student engagement in small group and whole group discussions
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- Customized online assessment on Unit 6 standards from https://scusd.illuminateed.com; **or**
- See assessments from the Math Assessment Project's "Formative Assessment Lessons" on circles and triangles
    - Solving Problems with Circles and Triangles
    - Inscribing and Circumscribing Right Triangles