Glendale Unified School District

High School

April 16, 2019

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| Department: | Mathematics |
| Course Title: | Integrated Math III |
| Course Code: | 3513DH, 3514DH |
| School(s) Course Offered: | Crescenta Valley High School, Hoover High School, Verdugo Academy |
| UC/CSU Approved (Y/N, Subject): | Y, "c" Mathematics |
| Course Credits: | Full Year (10) |
| Recommended Prerequisite: | Integrated Mathematics II |
| Recommended Textbook: | *California Integrated Mathematics 3*<br>Timothy D. Kanold, Edward B. Burger, Juli K. Dixon,<br>Matthew R. Larson, Steven J. Leinwand<br>Houghton Mifflin Harcourt<br>2015 |
| Course Overview: | Integrated Mathematics III aims to apply and extend what students have learned in previous courses by focusing on finding connections between multiple representations of functions, transformations of different function families, finding zeros of polynomials and connecting them to graphs and equations of polynomials, modeling periodic phenomena with trigonometry, and understanding the role of randomness and the normal distribution in making statistical conclusions.<br><br>On a daily basis, students in this course use problem-solving strategies, questioning, investigating, analyzing critically, gathering and constructing evidence, and communicating rigorous arguments justifying their |

thinking. Under teacher guidance, students learn in collaboration with others while sharing information, expertise, and ideas.

The course is well balanced between procedural fluency (algorithms and basic skills), deep conceptual understanding, strategic competence (problem solving), and adaptive reasoning (extension and transference). The lessons in the course meet all of the content standards, including the "plus" standards, of Appendix A of the *Common Core State Standards for Mathematics*. The course imbeds the CCSS Standards for Mathematical Practice as an integral part of the lessons in the course.

**Key concepts addressed in this course are:**

- Visualize, express, interpret and describe, and graph functions (and their inverses, in many cases). Given a graph, students will be able to represent the function with an equation, and vice-versa, and transform the graph, including the following function families: absolute value, exponential, linear, logarithmic, piecewise-defined, polynomial, quadratic, square root, trigonometric.
- Use of variables and functions to represent relationships given in tables, graphs, situations, and geometric diagrams, and recognize the connections among these multiple representations.
- Application of multiple algebraic representations to model and solve problems presented as real world situations or simulations.
- Solving linear or quadratic equations in one variable, systems of equations in two variables, and linear systems of equations in three or more variables.
- Use of algebra to rewrite complicated algebraic expressions and equations in more useful forms.
- Rewriting rational expressions and arithmetic operations on polynomials.
- The relationship between zeros and factors of polynomials.
- Operations with complex numbers, and solving quadratics with complex solutions.
- Applications of the Law of Sines and Law of Cosines.
- Modeling periodic phenomena with trigonometric functions.
- Calculating the sums of arithmetic and geometric series, including infinite geometric series.
- Concepts of randomness and bias in survey design and interpretation of the results.
- Use of a normal distribution to model outcomes and to make inferences as appropriate.
- Use of computers to simulate and determine complex probabilities.
- Use of margin of error and sample-to-sample variability to evaluate statistical decisions.
- Solving trigonometric equations and proving trigonometric identities.
- Understand logarithms and their inverse relationship with exponentials.
- Use logarithms to solve exponential equations.

Course Content:

*Semester A*

Unit 1: **Measurement and Modeling in Two and Three Dimensions** *(approximately 20 days)*

STANDARDS
G-GMD.4, G-GMD.5, G-MG.1

A. Students will learn about cross sections and solids of rotation. They will utilize formulas to calculate the surface area of prisms, cylinders, pyramids, cones, and spheres. Students will work with geometric probability and scale factor. They will explore the differences between Euclidean and spherical geometry.

*Major Topics:*
Cross sections and solids of rotation
Formulas for the surface area of a prism, cylinder, pyramid, cone and sphere
Scale factor
Calculating density
Modeling to meet constraints

B. Unit Assignment(s):
At the end of this unit, students will complete a Math in Careers task relating to a scale model of a sphere. Critical skills include finding a scale factor and applying knowledge of spherical geometry. Students will experience how a model maker uses mathematics on the job.

Mathematical Practices Used in Unit:

- MP.1 - Students will make sense of problems when they use multiple formulas to find the surface area and/or volume of composite solids.
- MP.2 - Students must reason abstractly to visualize the cross sections of solids. Students relate the properties of three-dimensional figures (faces, vertices, and intersections of planes) and their rotational symmetry to help identify cross sections of solids. Students will use their knowledge of surface area of spheres and scale to find actual distances on the globe.
- MP.4 - Students represent real-world problems with mathematical models when they find the density of real-life objects as the weight or mass per unit of volume, and extend that idea to density to population density, or the population of a region per unit area of the region.
- MP.8- Students will decompose solids into two-dimensional shapes for finding surface area and determine shortcuts (formulas) for finding surface area of prisms and cylinders. Students will apply their knowledge of two- and three- dimensional figures to describe the transformation of figures by scale factor *a.*

Unit 2: **Polynomial Functions, Expressions, and Equations** *(approximately 28 days)*

STANDARDS
F-IF.4, F-IF.4, A-APR.1, A-APR.2, A-APR.5, A-APR.6, A-SSE.2

A. Students will learn about transforming function graphs and inverses of functions. They will perform operations on polynomials. Student will expand their ability to solve equations by finding rational and complex solutions.

*Major Topics:*
Transforming function graphs and inverses of functions
Graphing cubic and polynomial functions
Operations with polynomials
Binomial theorem
Finding rational and complex solutions of polynomial equations

B. Unit Assignment(s):
After completing this unit, students will complete a performance task by evaluating and subtracting quadratic functions representing the labor force of the United States. Critical skills include evaluating polynomial functions and operations with polynomials.

Using data from the U.S. Census Bureau, the students will be provided with two functions for approximating the labor force, one for the total number of workers and one for the number of female workers. First, students will use the functions to calculate the two estimates for the number of workers. Next, students will work in pairs to write a polynomial function that models the number of male workers and will explain to another pair how they found their function. Finally, students will discuss, as a class, alternative strategies for determining the number of males without using the function they wrote.

Mathematical Practices Used in Unit:

- MP.1, MP.3 - Students will make sense of problems and persevere in solving them and construct viable arguments and critique the reasoning of others as they discuss factored form of a polynomial, describe the graphs of polynomials, and develop their understanding of polynomial division.
- MP.2, MP.7, MP.8 - Students will reason abstractly and quantitatively, look for and make use of structure, and look for and express regularity in repeated reasoning as they make connections between the transformations of quadratic functions and transformations of polynomial functions. Students will also understand the relationship between a function and its inverse.
- MP.7 - Students will also look for and make use of structure as they draw graphs of polynomials, and use polynomial division to determine factors of polynomials and how those factors relate to the zeros of the function.

Unit 3: **Rational Functions, Expressions and Equations** *(approximately 15 days)*

STANDARDS
F-IF.7d, A-APR.7, A-REI.2

A. Students will learn about graphing rational functions. They will perform operations on rational expressions. Students will graph and solve rational equations.

*Major Topics:*
Graphing simple and complex rational functions
Adding, subtracting, multiplying and dividing rational functions
Solving rational equations

B. Unit Assignment(s):
After finishing this unit, students will complete a Math in Careers task by writing, analyzing, and graphing a function representing the concentration of acid in a mixture. Critical skills include representing real-world situations using rational functions, determining domain and range, and interpreting asymptotes.

Students will write a rule for a function that represents a specific acid and water mixture. Students will determine a reasonable domain for their function and explain to a partner. They will graph the function labeling the axes with the quantities they represent and indicate the axis scales. With a partner, a student will analyze the function's rule to determine the vertical and horizontal asymptotes and determine their relevance or irrelevance.

Mathematical Practices Used in Unit:

- MP.7, MP.8 - Students will look for and make use of structure as well as look for and express regularity in repeated reasoning as they connect multiplication and division of fractions to that of rational expressions, and make connections between adding and subtracting fractions and adding and subtracting rational expressions.
- MP.7 - Look for and make use of structure as they graph rational functions with the parameters a, b, h, and k.
- MP.3 - Students will construct viable arguments as they solve rational equations graphically to find the zeros of the function, and algebraically by rewriting an equivalent polynomial equation to solve the original rational equation.

Unit 4: **Radical Functions, Expressions and Equations** *(approximately 15 days)*

STANDARDS
F-BF.4a, F-IF.7b, N.RN.1, A-REI.2

A. Students will learn about inverses of quadratic and cubic functions. They will graph square and cube root functions. Students will simplify and solve radical equations.

*Major Topics:*
Inverses of simple quadratic and cubic functions
Graphing square and cube root functions
Radical expressions and rational exponents
Simplifying radical expressions
Solving radical equations

B. Unit Assignment(s):
Upon finishing this unit, students will do a performance task in which they will take on the role of a nutritionist. Students will find a quadratic function that models BMI data. Critical skills include fitting a function to data, finding the appropriate domain and range, and finding the inverse of a function.

Given the median BMI measures for a group of boys, students will create a scatter plot for the data. They will find a quadratic regression model for the data and explain their model. Students will then work with a partner to determine the domain and its restrictions for both the data set and its inverse. Lastly, students will graph the inverse of the function and determine what it models.

Mathematical Practices Used in Unit:

- MP.1 - Students will make sense of problems and persevere in solving them as they use various strategies to solve radical equations, and to obtain extraneous solutions.
- MP.4 - Students will explore how a function and its inverse can both model a given real-world situation.
- MP.7 - Students will look for and make use of structure about how the various parameters, a, b, h, and k, affect the graph of a square-root and cubic function, in relation to a quadratic and cubic function respectively.

*Semester B*

Unit 5**: Exponential and Logarithmic Functions and Equations** *(approximately 35 days)*

STANDARDS
F-BF.2, F-BF.3, F-BF.5, A-SSE.4, F-LE.2, F-LE.4.1, F-LE.4.2, S-ID.6a

A. During this unit, students will learn about both exponential and logarithmic functions. They will expand their understanding exponential functions as they learn about growth and decay. This will be the first time students have worked with the base, e.

*Major Topics:*
Exponential growth and decay
Arithmetic and geometric sequences
Choosing among linear, quadratic, and exponential models
Defining, evaluating, and graphing logarithmic functions
Using properties to solve exponential equations

B. Unit Assignment(s):
After the completion of this unit, students will explore how a nuclear medicine technologist uses math on the job. The task involves writing and using a function that describes the decay of a radioactive substance. Critical skills include representing exponential decay, interpreting exponential functions, and finding the inverses of functions.

Students will write an exponential decay function for technetium-99m with a half-life of 6 hours as it is used to map circulatory system disorders. They will describe the domain, range, and the end behavior of the functions as time increases. Students will also write the inverse of the decay function. Finally, they will determine how long it takes until a specific amount of the technetium-99m remains in the body.

Mathematical Practices Used in Unit:

- MP.7- Students will look for and make use of structure when identifying patterns in arithmetic and geometric sequences.
- MP.3- Students will construct viable arguments as to whether a sequence is arithmetic or geometric.
- MP.4- Students will understand the relationship between graphs of exponential functions, tables, real-world applications, and formulas that model exponential functions.
- MP.7- Students will understand the difference in the structure of a logarithmic equation versus its inverse, an exponential equation.

Unit 6**: Trigonometric Functions** *(approximately 25 days)*

STANDARDS
G-STR.8, G-SRT.10, F-TF.1, F-TF.2, F-TF.5, F-TF.8, F-IF.7e

A. This unit builds on the introductory trigonometric function learning from CC Integrated Mathematics II. Students will solve real life problems using trigonometric functions and Pythagorean identities. They will also work with transformations of graphs of trigonometric functions.

*Major Topics:*
Defining trigonometric functions with the unit circle
Laws of sines and cosines
Evaluating trig functions
Angle rotation and radian measure
Transformations of the parent graphs of trigonometric functions

B. Unit Assignment(s):
At the end of this unit, students will complete a Math in Careers task by using models to represent the motion of a paddle wheel. Critical skills include graphing a trigonometric function, describing what its parameters mean for the real world situation, and using the function to make a prediction.

Students will graph a function for a riverboat paddle wheel with a given diameter and revolution rate that hangs a specific distance below the water line during an identified time interval. Students will describe the significance of the intercepts, the maximum and minimum values for the situation. They will also predict how revolutions it will take for a point on the wheel to have traveled one mile.

Mathematical Practices Used in Unit:

- MP.2 Students will be able to reason abstractly in order to understand the relationship between the unit circle and the graphs of the trigonometric functions.
- MP.5 Students will be able to determine when it is appropriate to model periodic phenomena with a sinusoidal function. Students will use their knowledge of the key features of a trigonometric function to help fit the function to the model.
- MP.8 Students will look for and express regularity in repeated reasoning when organizing their work to find the angle measures of a triangle. Students will reason whether the measures given produce one triangle, two triangles or no triangle by using the Law of Sines.

Unit 7: **Statistics and Decision Making** *(approximately 22 days)*

STANDARDS
S-IC.1, S-IC.2, S-IC.3, S-IC.4, S-IC.5, S-ID.4, S-MD.6, S-CP.4

A. In this unit students will learn about statistics and using them to make sound decisions. They will gather and display data and find specific data points.

*Major Topics:*
Gathering and displaying data
Shape, center, and spread
Data distributions

Confidence intervals and margins of error
Using probability in making and analyzing decisions

B. Unit Assignment(s):
After completing this unit, the students will perform a statistical hypothesis test. Critical skills include writing a null hypothesis, creating visual representations of data, and proving or disproving the null hypothesis.

Students will work as a pharmaceutical scientist would by testing whether a certain medication for raising glucose levels is more effective at higher doses. They will be given pre-generated test results for ten patients, five high level doses and five normal level doses. They will state their null hypothesis for the experiment. Then students will compare the results using box plots. Students will then explain why or why not they have enough evidence to reject the hypothesis.

Mathematical Practices Used in Unit:

- MP.3 Students will be able to analyze whether a study is a survey experiment or an observational study and will be able to critique the results accordingly.
- MP.2 Students will be able to calculate confidence intervals and margins of error and be able to understand that statistics can help predict outcomes.
- MP.5 Students will be able to use a graphing utility to normalize data.

Unit 8: **Equations of Circles and Parabolas** *(approximately 19 days)*

STANDARDS
G-C.2, G-C.3, G-C.5, G-GMD.1, G-GPE.1

A. In this unit, students will identify whether a quadratic equation in general form represents a circle by completing the square to get the equation in standard form.

*Major Topics:*
Changing general form of quadratic equations into standard form
Identify whether the quadratic equations produces a circle or a parabola

B. Unit Assignment(s):
After completing this unit, students will complete a Module Performance Task to determine if a helicopter with a range of 290 nautical miles is in a close enough range to rescue a sailboat off the coast of California. Critical skills includes plotting, on a coordinate plane, the location of LAX and SFO airports along with the location of the sailboat given the latitude and longitude coordinates. Students need to determine which airport should send the rescue helicopter through graphing the equation of the

circle circles. Students will justify their reasons and show the evidence in their work for how they came up with their answer.

Mathematical Practices Used in Unit:

- MP.3 Students will construct viable arguments and justify their conclusions when identifying whether a quadratic equation in general form is a circle or a parabola.
- MP.8 Students will use repeated reasoning and algebraic steps when completing the square to change a general form quadratic equation into standard form.