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## San Jacinto Unified School District New Course Proposal

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Google Forms <forms-receipts-noreply@google.com>  
To: sseward@sanjacinto.k12.ca.us

Thu, Jan 30, 2020 at 2:27 PM

Thanks for filling out San Jacinto Unified School District New Course Proposal

Here's what we got from you:

[EDIT RESPONSE](#)

## San Jacinto Unified School District New Course Proposal

For more information on how to complete this form please contact:  
Janet Covacevich  
Director, Secondary C & I  
(951)929-7700 ext. 4263  
jcovacevich@sanjacinto.k12.ca.us

Your email address (sseward@sanjacinto.k12.ca.us) was recorded when you submitted this form.



### Signature Page must be printed and wet signed

Access Signature Page at this link <https://docs.google.com/a/sanjacinto.k12.ca.us/document/d/1TO2G1fXxR6WGNhinPY-oNaxtY130cZHUOJTT3Ntv5Zg/edit?usp=sharing>

School \*

SJHS

**New Course Proposal Submitted By: \***

Seward

**Course Title \***

Math III Honors

**Transcript Title (15 characters or less) \***

Please be sure to count each character and spaces used to be no more than 15.

Math III Honors

**Course Code (assigned by Data Management, extension 4221):**

M0633

**Academic Department \***

Math

**Graduation Requirement Met \***

Math ▼

**Honors (\*note: Honors courses seeking A - G status must offer a non-Honors equivalent course) \***

Yes ▼

**Grade Level (check all that apply) \***

- ☐ 6th
- ☐ 7th
- ☐ 8th
- ☐ 9th
- ☒ 10th
- ☒ 11th
- ☒ 12th

**Pre-Requisite (list all that apply) \***

Math 2 with a grade of "C" or better (required) Math Diagnostic or equivalent Placement Test demonstrating mastery of Integrated Math 2

**Co-Requisite (list all that apply) \***

n/a

**Possible credits \***

10 - year long class ▼

**Course Learning Environment \***

☒ Classroom Based

☐ Online/Hybrid

**CALPADS Course Code (assigned by Data Mgt.)**

9243

## Career Technical Education Courses

**Will this course be part of CTE Pathways? \***

No ▼

**Is this an Integrated Course (Academics with Career Technical Education) \***

No ▼

**CTE Courses Only: Indicate the Level of the Course:**

▼

**CTE Courses Only: Indicate the Industry Sector**

▼

**CTE Courses Only: Career Pathway & Code Pathway Name**

## Submitting Courses That are Program Status, Courses Modeled After Another Institution, or Online, or AP

Course Plans for Program Status, Online, or AP must be attached to this form.

Will this course meet any of the descriptors above? \*

Yes ▼

Program Status Courses (can be auto approved) - Name the Exact Program and Course Title:

### Submitting a Course Modeled After Another Institution:

When modeling after another institution's course, you will also need to enter a course overview specific to San Jacinto Unified School District as well as course content specific to SJUSD.

Any course modeled after another institution's course will not move forward until it has been written to reflect SJUSD's unique needs.

Submitting a course modeled after another institution.

Which school and ATP code? Must state exact course title.

Scotts Valley High School (053598) Honors Math 3

Adopt an Online Publisher Course

Adopt a Program Status Course

### Advanced Placement (AP) Courses Only: Please answer the following questions:

This section only applies to AP courses.

AP Courses Only: Date Submitted to CollegeBoard for AP Audit:

Month ▼

Day ▼

2020 ▼



**Exact Course Title****CollegeBoard Authorization Code**

## Course Content

Please note: There are not specific requirements regarding the number of units each course should have. For reference: University of California A-G Guide: <http://www.ucop.edu/agguide/a-g-requirements/index.html> Copy and paste the link into your web browser for course samples.

**Course Overview: Provide a brief summary (3 - 5 sentences) of the course's content. \***

Math 3 Honors is an integrated course intended for highly motivated students intending to accelerate their academic progress. Students in this course will focus on unifying and applying the accumulation of learning that they have acquired from Math 1 and Math 2. They will build and strengthen their conceptual knowledge of functions to include polynomial, rational, and logarithmic functions; they will explore the similarities between integer and polynomial arithmetic; they will expand their right triangle trigonometry skills to extend to oblique triangles, the unit circle, and periodic functions; and they will apply methods of data collection and analysis. All of these topics will be applied to mathematical modeling of real-world phenomena. Technology, particularly in the form of graphing calculators, will feature regularly in lessons and in student work.

**For EACH UNIT of the course, please provide:**

1. A unit title
2. A concise 3 - 5 sentences describing the topics being addressed that demonstrate the critical thinking, depth, and progression of the content covered.
3. A brief 3 - 5 sentences summarizing a key assignment from this unit and covering:
  - a. how a student will complete this assignment
  - b. what a student will produce
  - c. what the student will learn

Most importantly, use the unit(s) and key assignment(s) to demonstrate that the course meets the subject specific course criteria on the A - G Guide.

**Units (outline each unit in the section provided. Indicate new units with a number and title) \*****Unit One: Modeling with Linear and Non-Linear Functions**

This unit begins with creating scatter plots on the graphing calculator of data representing real-world situations that exhibit linearity, such as the length and weight of a fish, or the number of hours of sleep versus test scores. Students will discuss the correlation between variables and establish reasonable parameters for domain and range. Then technology will be used to obtain a line of best fit. Connections will be made to prior learning regarding averages as students observe that the line of best fit passes through the mean point. They will use technology to obtain the correlation coefficient, and they will interpret it

to assess fit to the data for linear models.

Regression analysis will then be extended to non-linear relationships as students explore data representing real-world situations such as the temperature of a cup of coffee as it cools, or the price of a computer in comparison to the screen size. Students will review essential features of non-linear functions that have been studied in previous courses (exponential, power, and quadratic) and they will also be introduced to logarithmic and logistic functions. They will use their knowledge of the behavior of these functions, as well as the scope and limitations of the real-world context, to suggest a reasonable model. Technology will be used to graph data points, to find regression equations, and to obtain correlations coefficients. Models will be analyzed in context and used to make predictions. Students will distinguish between interpolation and extrapolation.

Unit one will also provide an opportunity for students to review transformations (translations, dilations, and reflections) that were applied to geometric figures in prior courses. They will extend these transformations to apply to functions and develop the understanding that transformations of a graph always have the same effect regardless of the type of underlying function. They will apply function transformations to compare and refine mathematical models. For example, they can use transformations to compare models of the populations of two bacteria colonies that have the same growth rates but different initial conditions.

#### Unit Two: Sample Task

##### Parallelograms Project

Students will use recursive patterns and explicit formulas to explore the number of parallelograms,  $p$ , formed by varying numbers of intersecting parallel lines,  $m$ , and parallel transversals,  $n$ . The ultimate goal is to develop an equation in three variables.

#### Unit Three: Probability and Statistics

Unit three begins with methods of elementary probability. Students will use the fundamental counting principles, permutations, and combinations to determine the number of elements in an event and in the sample space. When appropriate, they will represent the sample space visually in a variety of ways: a list, a grid, a tree diagram, a Venn diagram. Students will identify independent and mutually exclusive events in context. Mathematical expectation will be defined as a weighted average, and students will use probabilities to calculate the expected value of random experiments. All of these skills and concepts will be applied to problem solving in a wide variety of real-world contexts. For example, students will determine if a game of chance is fair, or if an insurance policy is actuarially sound.

The characteristics of the binomial probability distribution will be introduced, and students will apply the binomial theorem, studied in unit two, to calculate probabilities. Students will use technology to analyze binomial distributions with large sample sizes, leading to the normal distribution. Properties of the normal distribution will be generalized, and students will use the empirical rules to estimate probabilities for real-world examples of normally distributed phenomena. Dilations and translations of the standard normal curve will be applied to understand why the empirical rules hold for all normal distributions.

#### Unit Three: Sample Task

##### Sea Shell Sizes

In this activity students will work in small groups to analyze the width of cockle shells. Each group will be given a distinct set of twenty data points. They will construct a grouped frequency table and draw a histogram on graph paper, and they will calculate the mean of their data set. Then students will use technology to view a histogram for a large sample of shells, and they will observe the effect of changing the length of class intervals in the graph.

#### Unit Four: Trigonometric Functions and the Unit Circle

This unit begins with review of right triangle trigonometry: definitions of sine, cosine, and tangent as ratios of sides; inverse of sine, cosine, and tangent to find angles; similarity of right triangles; special right triangles; and the Pythagorean Theorem. Students will review and apply right triangle trigonometry in real-world situations, such as calculating the height of building or a tree. Then students will tackle The Ferris Wheel Problem, an activity in which they will use right triangles to determine height above ground at various points around the ride. They will represent the height numerically as a table of values; points in the table will be plotted to create a graph; then students will apply their knowledge of transformations to find an equation, using graphing calculators as an aide.



The Ferris Wheel Problem will provide a framework upon which students can derive and understand the unit circle. Standard form of rotational angles will be defined, and students will use dilations and reflections of special triangles to fill in coordinates of points on the unit circle. These points will then be graphed to produce the sine, cosine, and tangent functions. Students will also be introduced to radian measure of angles in this unit. Repetition and practice will be emphasized in this unit so that students gain fluency in evaluating trigonometric expressions, in both degrees and radians, quickly and accurately. The unit will conclude with a study of sinusoidal functions. Graphical features such as period, amplitude, phase displacement, and sinusoidal axis, will be introduced by making connections to prior learning about transformations of function graphs from unit one. Students will explore periodic phenomena from the real-world such as tides, sound waves, and sunrise times. They will develop and apply mathematical models for these situations both analytically and using technology. They will also use technology to solve trigonometric equations in the context of sinusoidal models, setting the stage for further exploration of trigonometric equations in unit five.

Unit five also introduces trigonometric identities and proofs. Students will derive the reciprocal identities, quotient identities, and Pythagorean identities from geometric figures. They will then develop formal proofs, typically using a two-column format, for other identities involving these properties. Sum and difference identities and double angle identities will be justified informally by using technology to view graphs of both sides. All of these identities will be applied to solving trigonometric equations of increasing complexity, including quadratic forms, equations with more than one function represented, and equations with different arguments.

Unit five concludes with an exploration of formulas that apply to oblique triangles and circles. Students will use geometric figures to prove the Law of Sines, the Law of Cosines, and the triangle area formula. An additional lesson will explore the ambiguous case of the Law of Sines, and students will make connections to prior learning about the inverse sine function versus the inverse sine relation. Formulas for arc lengths and areas of sectors will be established using similarity of circles. Students will apply all of these formulas to solve real world problems, such as calculating the area of a piece of land, of finding the distance between ships sailing in different directions.

#### Unit Five: Sample Tasks

##### Proof of Hero's Formula

Students will apply their knowledge of geometry, their algebra skills, and their understanding of formal proof in a guided activity leading to a proof of Hero's formula for the area of a triangle.

##### Maximizing Area of a Triangle

Students will write a function for the area of a triangle inscribed in a semi-circle, in which the angle is the independent variable. They will use technology to graph the function and find the angle measure which gives rise to the maximum area of the triangle. This activity provides a preview of optimization which will be studied in greater depth in a calculus course.

#### Unit Six: Vectors

Unit six opens with the introduction of vectors in the context of swimming in open water. The velocity of the swimmer and of the force of the current are both examples of vector quantities. Building on this illustration, students will denote 2D vectors on graph paper as directed line segments. They will discover how to represent vectors numerically, and how to add and subtract vectors and multiply vectors by scalars. They will also be able to calculate the length of a vector using the Pythagorean Theorem. Students will then extend the skills of 2D vector algebra to 3D vectors. The dot product of vectors will be defined, and students will use it to calculate the angle between two vectors. The unit concludes with the derivation and applications of a vector equation of a line.

#### Unit Six: Sample Task

##### Flight Paths of Toy Airplanes

Students will use vector equations of lines to represent the flight paths of two toy airplanes. They will calculate the distance between the planes at a given time, and they will calculate whether or not the two planes collide by considering the intersection point of the lines.

#### Unit Seven: Families of Functions

Unit seven begins with a review of properties of exponents, with emphasis on negative and rational exponents. The effect of exponents on the behavior of functions will be explored leading students to classify three distinct types:

exponential functions, power functions, and radical functions. Inverse functions arising from interchanging  $x$  and  $y$  values will also be explored, leading to the introduction of logarithmic functions. Graphical properties of all of these functions will be discovered with the aid of graphing calculators. Formal terminology and notation will be introduced to describe intervals of increase/decrease, concavity, asymptotes, and restrictions on domain and range. Students will apply functions from these families to model real-world phenomena, such as the amount of energy released by an earthquake modeled by a logarithmic function, or the terminal velocity of a skydiver represented by a radical function.

#### Unit Seven: Sample Task

##### Graphing Moore's Law

This activity will allow students to revisit the concepts of arithmetic and geometric progression covered in unit two. Using data on the number of transistors in an integrated circuit from 1980 to 2015, students will apply analytic methods to write an exponential growth equation. They will then draw a graph by hand with a linear scale on the  $x$ -axis and a geometric scale on the  $y$ -axis. The resulting graph will appear linear. To explain this, they will use properties of logarithms to rewrite the equation as a linear function of  $x$  and  $\log y$ .

#### Unit Eight: Polynomials and Complex Numbers

In unit eight students will develop the family of polynomial functions by multiplying linear functions. This unit begins with a review of the algebraic and graphic properties of quadratic functions. Students will use algebraic methods to convert the equation of a quadratic function between three forms: factored form, standard form, and vertex form. Connections to transformations of function graphs will be related to vertex form. The quadratic formula will be applied to introduce complex numbers, and students will add, subtract, multiply, and divide numbers of the form  $a+bi$ .

These concepts will then be extended to higher degree polynomials. Students will analyze graphs of polynomials up to degree five and explore connections between equations and graphs. The Fundamental Theorem of Algebra and the Remainder Theorem will be introduced, and students apply these facts to divide and factor polynomials and find all the zeroes over the set of complex numbers.

#### Unit Nine: Sample Task

##### Rate of Change of a Cubic Polynomial

Students are given the equation of a cubic polynomial which represents the height above ground as a function of time in the context of a two-stage rocket. They will draw a large graph of the equation, and then draw secant and tangent lines on the graph to represent average and instantaneous rates of change. They will use the slope formula and limits to find numeric values of the rates of change at different points during the rocket's ascent, and they will relate these values to the shape of the graph.

## Course Materials

Provide the COURSE MATERIALS that students use and analyze throughout the course. When appropriate, please incorporate these materials into the course's unit descriptions in the COURSE CONTENT section. Some subject areas and disciplines require courses to include specific course materials. Please refer to the subject course criteria in the link above and/or the California Department of Education (<http://www.cde.ca.gov/ci/cr/cf/imagen.asp>) for more information.

## Course Material

Please access the hyperlinked Google Slide deck for a sample of the required information for any course materials that will be used in the course.



# Google Slide Deck Link w/samples

<https://docs.google.com/a/sanjacinto.k12.ca.us/presentation/d/1LaBuMtWAqL9bMaPKGQ8ooRZ6AZOLtS2PV0HGPudpYqo/edit?usp=sharing>

## Select Course Material (select all that apply) \*

- ☒ Textbook
- ☐ Literary Text
- ☐ Manual
- ☐ Periodical
- ☐ Scholarly Article
- ☒ Website
- ☐ Primary Document
- ☐ Multimedia
- ☐ Other

## Course Material: Primary \*

MVP Math III Honors

## Course Materials: Additional (if applicable)

## A-G Courses

For courses seeking A - G status please answer the questions below

## Is this course being submitted for A-G status? \*

Yes ▾

## Subject for A - G status

- ☐ "A" History/Social Science
- ☐ "B" English
- ☒ "C" Mathematics
- ☐ "D" Lab Science
- ☐ "E" Language Other Than English
- ☐ "F" Visual and Performing Arts



**Name the Discipline (i.e. US History, LOTE, Theater, etc.)**

Math

**Is this an Integrated Course (Academics with Career Technical Education)**

☐ Yes

☒ No

**Does this course need to be retro-activated to a previous year?**

No ▼

**If yes, which year(s)?**

☐ 2017-2018

☐ 2016-2017

☐ 2015-2016

☐ 2014-2015

## Final Review

Please review your course prior to submission to ensure it meets all requirements, courses will not be moved forward until they have provided all the required information.

## End of Course Submission

Before you submit, please verify that you have completed all required components for submission.

# Honors Math 3

Scotts Valley High School (053598)

## Basic Course Information

Title:	Honors Math 3
Transcript abbreviations:	H Math 3
Length of course:	Full Year
Subject area:	Mathematics (C) / Advanced Mathematics
UC honors designation?	Yes
Non-honors equivalent course:	Math 3
Prerequisites:	Math 2 (passing class with an A or B) (Required) Math 1 (passing class with an A or B) (Required) Honors Math 8 (a middle school course, passing with an A or B) (Required)
Co-requisites:	none (Recommended)
Integrated (Academics / CTE)?	No
Grade levels:	10th, 11th, 12th
Course learning environment:	Classroom Based

## Course Description

Course overview:

Math 3 Honors is an integrated course intended for highly motivated students intending to accelerate their academic progress. Students in this course will focus on unifying and applying the accumulation of learning that they have acquired from Math 1 and Math 2. They will build and strengthen their conceptual knowledge of functions to include polynomial, rational, and logarithmic functions; they will explore the similarities between integer and polynomial arithmetic; they will expand their right triangle trigonometry skills to extend to oblique triangles, the unit circle, and periodic functions; and they will apply methods of data collection and analysis. All of these topics will be applied to mathematical modeling of real-world phenomena. Technology, particularly in the form of graphing calculators, will feature regularly in lessons and in student work.

Math 3 Honors covers all of the California Common Core standards for Math 3, and is distinguished from the standard Math 3 course in several ways:

- Optional advanced math standards for California Common Core Math 3 are covered (complex roots of polynomials; the Fundamental Theorem of Algebra; the binomial theorem; algebraic manipulation of rational expressions; derivations of the law of sines, law of cosines, and triangle area formulas; and using probability to evaluate outcomes).
- Topics from the IB Math Standard Level curriculum are added (regression analysis; vectors; limits; and introduction to derivatives).
- The pace is accelerated to accommodate the additional topics.
- Students are expected to possess a high level of fluency in calculating with fractions and decimals, and a strong foundation in algebra, geometry, and statistics from prior coursework, as measured by a formal readiness assessment as well as the recommendation of the Math 2 teacher.
- Students will produce a formal mathematical research paper on a topic of their choice.
- The year-end final exam will be cumulative, integrating procedural and conceptual questions on the curriculum from the entire year of the course.

The goal of Math 3 honors is to capitalize on the dedication of highly motivated and well-prepared students and empower them to develop a high level of procedural fluency, conceptual understanding, and critical thinking skills. Students will observe and apply at least one of the eight Standards of Mathematical Practice in each lesson.

## **Course content:**

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### **Unit One: Modeling with Linear and Non-Linear Functions**

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This unit begins with creating scatter plots on the graphing calculator of data representing real-world situations that exhibit linearity, such as the length and weight of a fish, or the number of hours of sleep versus test scores. Students will discuss the correlation between variables and establish reasonable parameters for domain and range. Then technology will be used to obtain a line of best fit. Connections will be made to prior learning regarding averages as students observe that the line of best fit passes through the mean point. They will use technology to obtain the correlation coefficient, and they will interpret it to assess fit to the data for linear models.

Regression analysis will then be extended to non-linear relationships as students explore data representing real-world situations such as the temperature of a cup of coffee as it cools, or the price of a computer in comparison to the screen size. Students will review essential features of non-linear functions that have been studied in previous courses (exponential, power, and quadratic) and they will also be introduced to logarithmic and logistic functions. They will use their knowledge of the behavior of these functions, as well as the scope and limitations of the real-world context, to suggest a reasonable model. Technology will be used to graph data points, to find regression equations, and to obtain correlations coefficients. Models will be analyzed in context and used to make predictions. Students will distinguish between interpolation and extrapolation.

Unit one will also provide an opportunity for students to review transformations (translations, dilations, and reflections) that were applied to geometric figures in prior courses. They will extend these transformations to apply to functions and develop the understanding that transformations of a graph always have the same effect regardless of the type of underlying function. They



will apply function transformations to compare and refine mathematical models. For example, they can use transformations to compare models of the populations of two bacteria colonies that have the same growth rates but different initial conditions.

#### Unit One: Sample Task

- Modeling Population of the United States from 1900-2010

Using data from the US Census Bureau, students will create several models for US population, both analytically and with technology. They will discuss the pros and cons of each model in context and select the model they believe to be most accurate. They will use their model to make predictions of population growth to 2050, and they will discuss real-world factors that affect the accuracy of their model.

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#### Unit Two: Sequences and Series

Unit two will focus on observing and generalizing patterns. Students will begin by analyzing sequences of numbers to determine recursive patterns. These patterns will then be classified as arithmetic, geometric, or neither. For arithmetic and geometric sequences, explicit formulas will be derived by making connections to prior knowledge of linear and exponential functions. For sequences that are neither arithmetic nor geometric, students will use constant differences to determine a polynomial model which they can find using technology. For all types of sequences, emphasis will be placed on the comparison and connections between recursive patterns and explicit formulas, for example, by analyzing numerical properties of the Fibonacci sequence and exploring its occurrence in the real-world.

Students will then develop formulas for partial sums of finite arithmetic and finite geometric series. Sigma notation will be introduced as a compact way to represent a series. Finite series will be applied to real-world situations such as calculating mortgage payments, or exploring the number of ancestors in a genealogy tree. The concepts of convergence and limits will be introduced through analysis of infinite geometric series. Students will represent this important concept graphically by coloring in a unit square as a representation of the sum  $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots = 1$ . They will then will apply the limit as  $n$  approaches infinity to the formula for the partial sum of a finite geometric series to develop a formula for the sum to infinity of a convergent series.

Unit two also explores patterns by presenting the binomial theorem. Students will use recursive patterns to derive Pascal's triangle. They will also apply repeated pairwise multiplication of binomials to observe the properties of binomial expansion which will be summarized in the binomial theorem. Procedural fluency will be emphasized here, as the binomial theorem will be applied in later units on binomial probability and on developing the derivative.

#### Unit Two: Sample Task

- Parallelograms Project

Students will use recursive patterns and explicit formulas to explore the number of parallelograms,  $p$ , formed by varying numbers of intersecting parallel lines,  $m$ , and parallel transversals,  $n$ . The ultimate goal is to develop an equation in three variables.

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#### Unit Three: Probability and Statistics

Unit three begins with methods of elementary probability. Students will use the fundamental counting principles, permutations, and combinations to determine the number of elements in an event and in the sample space. When appropriate, they will represent the sample space visually in a variety of ways: a list, a grid, a tree diagram, a Venn diagram. Students will identify independent and mutually exclusive events in context. Mathematical expectation will be defined as a weighted average, and

students will use probabilities to calculate the expected value of random experiments. All of these skills and concepts will be applied to problem solving in a wide variety of real-world contexts. For example, students will determine if a game of chance is fair, or if an insurance policy is actuarially sound.

The characteristics of the binomial probability distribution will be introduced, and students will apply the binomial theorem, studied in unit two, to calculate probabilities. Students will use technology to analyze binomial distributions with large sample sizes, leading to the normal distribution. Properties of the normal distribution will be generalized, and students will use the empirical rules to estimate probabilities for real-world examples of normally distributed phenomena. Dilations and translations of the standard normal curve will be applied to understand why the empirical rules hold for all normal distributions.

#### Unit Three: Sample Task

- Sea Shell Sizes

In this activity students will work in small groups to analyze the width of cockle shells. Each group will be given a distinct set of twenty data points. They will construct a grouped frequency table and draw a histogram on graph paper, and they will calculate the mean of their data set. Then students will use technology to view a histogram for a large sample of shells, and they will observe the effect of changing the length of class intervals in the graph.

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#### Unit Four: Trigonometric Functions and the Unit Circle

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This unit begins with review of right triangle trigonometry: definitions of sine, cosine, and tangent as ratios of sides; inverse of sine, cosine, and tangent to find angles; similarity of right triangles; special right triangles; and the Pythagorean Theorem. Students will review and apply right triangle trigonometry in real-world situations, such as calculating the height of building or a tree. Then students will tackle The Ferris Wheel Problem, an activity in which they will use right triangles to determine height above ground at various points around the ride. They will represent the height numerically as a table of values; points in the table will be plotted to create a graph; then students will apply their knowledge of transformations to find an equation, using graphing calculators as an aide.

The Ferris Wheel Problem will provide a framework upon which students can derive and understand the unit circle. Standard form of rotational angles will be defined, and students will use dilations and reflections of special triangles to fill in coordinates of points on the unit circle. These points will then be graphed to produce the sine, cosine, and tangent functions. Students will also be introduced to radian measure of angles in this unit. Repetition and practice will be emphasized in this unit so that students gain fluency in evaluating trigonometric expressions, in both degrees and radians, quickly and accurately.

The unit will conclude with a study of sinusoidal functions. Graphical features such as period, amplitude, phase displacement, and sinusoidal axis, will be introduced by making connections to prior learning about transformations of function graphs from unit one. Students will explore periodic phenomena from the real-world such as tides, sound waves, and sunrise times. They will develop and apply mathematical models for these situations both analytically and using technology. They will also use technology to solve trigonometric equations in the context of sinusoidal models, setting the stage for further exploration of trigonometric equations in unit five.

#### Unit Four: Sample Tasks

- The Ferris Wheel Problem

As described above, students model the height above a ground of a rider on a Ferris wheel in three ways: numerically, graphically, and algebraically.

- Modeling Daily Temperatures

Using data from the National Oceanic and Atmospheric Administration, students develop a sinusoidal model for the average daily temperature during each month of the year. They will develop a model analytically and compare their result to a model obtained with technology. They will comment on fit to the data and discuss the effectiveness of the model in predicating climate change.



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## Unit Five: Trigonometric Identities and Equations

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In this unit students are introduced to solving trigonometric equations. They will use their knowledge of special right triangles, the unit circle, and radian measure to solve equations involving special angle values without the aid of technology. They will also be able to solve equations that do not correlate to special angle values using a calculator. The principle branches of the sine, cosine, and tangent functions will be defined, and by analyzing the graphical behaviors of these functions students will expand their understanding of inverse trigonometric functions to apply to rotational angles. Students will distinguish between the inverse trigonometric functions (one value) and inverse trigonometric relations (multiple values).

Unit five also introduces trigonometric identities and proofs. Students will derive the reciprocal identities, quotient identities, and Pythagorean identities from geometric figures. They will then develop formal proofs, typically using a two-column format, for other identities involving these properties. Sum and difference identities and double angle identities will be justified informally by using technology to view graphs of both sides. All of these identities will be applied to solving trigonometric equations of increasing complexity, including quadratic forms, equations with more than one function represented, and equations with different arguments.

Unit five concludes with an exploration of formulas that apply to oblique triangles and circles. Students will use geometric figures to prove the Law of Sines, the Law of Cosines, and the triangle area formula. An additional lesson will explore the ambiguous case of the Law of Sines, and students will make connections to prior learning about the inverse sine function versus the inverse sine relation. Formulas for arc lengths and areas of sectors will be established using similarity of circles. Students will apply all of these formulas to solve real world problems, such as calculating the area of a piece of land, of finding the distance between ships sailing in different directions.

### Unit Five: Sample Tasks

- **Proof of Hero's Formula**  
Students will apply their knowledge of geometry, their algebra skills, and their understanding of formal proof in a guided activity leading to a proof of Hero's formula for the area of a triangle.
- **Maximizing Area of a Triangle**  
Students will write a function for the area of a triangle inscribed in a semi-circle, in which the angle is the independent variable. They will use technology to graph the function and find the angle measure which gives rise to the maximum area of the triangle. This activity provides a preview of optimization which will be studied in greater depth in a calculus course.

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## Unit Six: Vectors

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Unit six opens with the introduction of vectors in the context of swimming in open water. The velocity of the swimmer and of the force of the current are both examples of vector quantities. Building on this illustration, students will denote 2D vectors on graph paper as directed line segments. They will discover how to represent vectors numerically, and how to add and subtract vectors and multiply vectors by scalars. They will also be able to calculate the length of a vector using the Pythagorean Theorem. Students will then extend the skills of 2D vector algebra to 3D vectors. The dot product of vectors will be defined, and students will use it to calculate the angle between two vectors. The unit concludes with the derivation and applications of a vector equation of a line.

### Unit Six: Sample Task

- **Flight Paths of Toy Airplanes**  
Students will use vector equations of lines to represent the flight paths of two toy airplanes. They will calculate the

distance between the planes at a given time, and they will calculate whether or not the two planes collide by considering the intersection point of the lines.

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## Unit Seven: Families of Functions

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Unit seven begins with a review of properties of exponents, with emphasis on negative and rational exponents. The effect of exponents on the behavior of functions will be explored leading students to classify three distinct types: exponential functions, power functions, and radical functions. Inverse functions arising from interchanging  $x$  and  $y$  values will also be explored, leading to the introduction of logarithmic functions. Graphical properties of all of these functions will be discovered with the aid of graphing calculators. Formal terminology and notation will be introduced to describe intervals of increase/decrease, concavity, asymptotes, and restrictions on domain and range. Students will apply functions from these families to model real-world phenomena, such as the amount of energy released by an earthquake modeled by a logarithmic function, or the terminal velocity of a skydiver represented by a radical function.

In unit seven students will also be introduced to properties of logarithms and the change of base formula. They will solve logarithmic and exponential equations, including quadratic forms, with particular emphasis on expressions involving base  $e$ . They will also solve radical equations both analytically and using technology. Many of the equations in this unit will require students to attend to precision by verifying that their answers fall within the domain of the original expressions.

### Unit Seven: Sample Task

- Graphing Moore's Law

This activity will allow students to revisit the concepts of arithmetic and geometric progression covered in unit two. Using data on the number of transistors in an integrated circuit from 1980 to 2015, students will apply analytic methods to write an exponential growth equation. They will then draw a graph by hand with a linear scale on the  $x$ -axis and a geometric scale on the  $y$ -axis. The resulting graph will appear linear. To explain this, they will use properties of logarithms to rewrite the equation as a linear function of  $x$  and  $\log y$ .

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## Unit Eight: Polynomials and Complex Numbers

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In unit eight students will develop the family of polynomial functions by multiplying linear functions. This unit begins with a review of the algebraic and graphic properties of quadratic functions. Students will use algebraic methods to convert the equation of a quadratic function between three forms: factored form, standard form, and vertex form. Connections to transformations of function graphs will be related to vertex form. The quadratic formula will be applied to introduce complex numbers, and students will add, subtract, multiply, and divide numbers of the form  $a+bi$ .

These concepts will then be extended to higher degree polynomials. Students will analyze graphs of polynomials up to degree five and explore connections between equations and graphs. The Fundamental Theorem of Algebra and the Remainder Theorem will be introduced, and students apply these facts to divide and factor polynomials and find all the zeroes over the set of complex numbers.

### Unit Eight: Sample Task

- Polynomial Grab Bag

Students will be given three linear functions, one non-real number, and the coordinates of two  $y$ -intercepts. They will combine these elements algebraically to create two cubic functions, one of which must have a double zero. They will



create posters showing the equation and the graph for both of their functions, and illustrate the connections between the two representations.

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## Unit Nine: Rational Functions, Limits, and Rates of Change

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Unit nine begins with students using a table of values to draw the graph of the reciprocal function,  $y = 1/x$ . By applying transformations to this function, and by using algebraic techniques to add, subtract, and multiply rational expressions, they will develop the set of rational functions of the form

$y = (ax+b)/(cx+d)$ . The attributes of these functions will be generalized and students will find equations of the vertical and horizontal asymptotes, calculate coordinates of the axis intercepts, and draw the graphs, all without the need for a graphing calculator.

Students will then use technology to explore the characteristics of higher degree rational functions. They will explore functions with multiple vertical asymptotes and they will relate vertical asymptotes to the domain of the function. The concept of convergence, studied in unit two, will be applied to understand horizontal and slant asymptotes as the limit of the function value as  $x$  approaches infinity. Formal notation for limits will be introduced.

The unit will conclude with the exploration of discontinuities and limits. Continuity will be described informally, in graphical terms, and students will distinguish between removable, infinite, and jump discontinuities. When limits exist, they will be able to estimate them from a graph. They will also evaluate limits algebraically using three methods: substitution, factoring, and numeric approximation.

The unit concludes by applying the concept of a limit to explore instantaneous rates of change. Students will compare and contrast rate of change graphically for a variety of functions that have been studied throughout the year (linear, exponential, sinusoidal, logarithmic, and logistic). They will use the slope formula to calculate rate of change over an interval, and then apply a limit to find the instantaneous rate of change, which they will define as the derivative.

### Unit Nine: Sample Task

- Rate of Change of a Cubic Polynomial

Students are given the equation of a cubic polynomial which represents the height above ground as a function of time in the context of a two-stage rocket. They will draw a large graph of the equation, and then draw secant and tangent lines on the graph to represent average and instantaneous rates of change. They will use the slope formula and limits to find numeric values of the rates of change at different points during the rocket's ascent, and they will relate these values to the shape of the graph.

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## Honors Final Exam Details:

Honors Math 3 will be taught over 2 semesters. The first semester course of study will end with a final exam that is cumulative and covers the entirety of the 1st semester material. The exam will have students demonstrate knowledge and skill mastery in multiple formats including multiple choice questions, multi-step problem solving applications where students must show their work and process, and written response requiring students to explain conceptual understanding. The 2 semester final exam will utilize the same methodology and will cover material from the entire year of instruction, though more heavily favoring the concepts and skills taught in semester 2.

# Course Materials

## Textbooks

Title	Author	Publisher	Edition	Website	Primary
Integrated Math III, A Common Core Math Program	Bartle, Dengler, Fisher, Dilla, Fitsioris, Karambelkar, Rivera, Ross	Carnegie Learning	First	<a href="http://www.resources.carnegielearning.com">www.resources.carnegielearning.com</a>	Yes
Precalculus with Trigonometry	Foerster	Key Curriculum Press	First	<a href="http://www.keypress.com">www.keypress.com</a>	No



## New Course Signature/Approval Page

- I. Suggested Course Title: Math III Honor S
- II. Department(s): Math
- III. School: SJHS
- IV. School Committee Members:
- |                                |                               |
|--------------------------------|-------------------------------|
| a. Name: <u>Enker Gardner</u>  | Signature: <u>[Signature]</u> |
| b. Name: <u>Justin Carmine</u> | Signature: <u>[Signature]</u> |
| c. Name: <u>S. Seward</u>      | Signature: <u>[Signature]</u> |
| d. Name: <u>Lloyd Sheppard</u> | Signature: <u>[Signature]</u> |
| e. Name: _____                 | Signature: _____              |
- V. Committee Meeting Date(s): 11/5, 11/8
- VI. Department Chair Signature:
- |                            |                               |                       |
|----------------------------|-------------------------------|-----------------------|
| a. Name: <u>K. Cochran</u> | Signature: <u>[Signature]</u> | Date: <u>12/10/19</u> |
| b. Name: _____             | Signature: _____              | Date: _____           |
- VII. Principal Signature:
- |                               |                               |                       |
|-------------------------------|-------------------------------|-----------------------|
| a. Name: <u>Courtney Hall</u> | Signature: <u>[Signature]</u> | Date: <u>12/10/19</u> |
|-------------------------------|-------------------------------|-----------------------|
- VIII. Course Proposal Reviewed by Educational Services:
- |   |                               |                       |
|---|-------------------------------|-----------------------|
| a. <del>Secondary</del> Director, Educational Services: <u>Janet Covacevich</u> | Signature: <u>[Signature]</u> | Date: <u>1-6-20</u>   |
| b. Assistant Superintendent of Educational Services: _____                      | Signature: <u>[Signature]</u> | Date: <u>2/2/2020</u> |
- IX. Course Proposal Approved by the Board of Trustees:
- |   |                  |             |
|---|------------------|-------------|
| a. SJUSD Board of Trustees President: _____ | Signature: _____ | Date: _____ |
|---|------------------|-------------|



