Southington Public Schools
Curriculum Map

Subject: Pre-Calculus   **Grade: 11 & 12**

UNIT TITLE	Functions, including Exponential & Logarithmic	Trigonometry, Unit Circle, Graphing, Identities	Sequences, Series and Probability	Conic Sections
CONTENT	• **Understand, apply, and graph a variety of functions** • **Explore, compare, and apply logarithmic and exponential functions**	• **Evaluate, apply, and graph trigonometric functions using the unit circle and/or calculator** • **Verify trigonometric identities**	▪ **Determine formulas and terms of arithmetic, geometric, and other sequences** ▪ **Prove summation formulas by Induction**	• **Determine the type of conic from its equation.** • **Graph parabolas, circles, ellipses, and hyperbolas and identify major parts of the graph**
STATE STANDARDS	1.1 a. (9-12E) Model real-world situations and make generalizations about mathematical relationships using a variety of patterns and functions. *(1) Describe and compare properties and classes of functions, including exponential, polynomial, rational, logarithmic and trigonometric.* *(2) Analyze essential relations in a problem to determine possible functions that could model the situation.* *(4) Solve problems involving financial applications including compound interest, amortization of loans, and investments.* 1.2 a. (9-12E) Relate the behavior of functions and relations to specific parameters and determine functions to model real-world situations. *(2) Recognize the effect of changes in parameters on the graphs of functions or relations.*	1.1 a. (9-12E) Model real-world situations and make generalizations about mathematical relationships using a variety of patterns and functions. *(1) Describe and compare properties and classes of functions, including exponential, polynomial, rational, logarithmic and trigonometric.* *(2) Analyze essential relations in a problem to determine possible functions that could model the situation.* 1.2 a.(9-12 E) Relate the behavior of functions and relations to specific parameters and determine functions to model real-world situations. *(1)Relate the graphical representation of a function to its function family and find equations, intercepts, maximum or minimum values, asymptotes and line of symmetry for that function.* *(2) Recognize the effect of changes in parameters on the graphs of functions or relations.*	1.1 a. (9-12 C)Describe relationships and make generalizations about patterns and functions. *(1) Identify, describe, create and generalize numeric, geometric and statistical patterns with tables, graphs, words and symbolic rules.* *(2) Make and justify predictions based on patterns.* 2.2 a. (9-12 C) Develop strategies for computation and estimation using properties of number systems to solve problems. *(1) Select and use appropriate methods for computing to solve problems in a variety of contexts.* (level 4 only) 4.3 a. (9-12 C) Understand and apply the principles of probability in a variety of situations. *(1) Determine outcomes and solve problems involving the probabilities of events.* *(2) Explore the concepts of conditional probability in real-	• a. (9-12 E) Describe relationships and make generalizations about patterns and functions *(3) Explore conic sections and their applications graphically and symbolically.* • a. (9- 12E) Relate the behavior of functions and relations to specific parameters and determine functions to model real-world situations. *(level 4 only)* *(2) Recognize the effect of changes in parameters on the graphs of functions or relations.* 3.2 a. (9-12 C) Verify geometric relationships using algebra, coordinate geometry and transformations. *(1) Interpret geometric*

	1.3 a. (9-12E) Use and extend algebraic concepts to include real and complex numbers, vectors and matrices. *(3) Use logarithms, vectors and matrices to solve problems.* 2.2 a. (9-12E) Investigate mathematical properties and operations related to objects that are not numbers. *(2) Perform operations with complex numbers, matrices, determinants and logarithms.* 4.1 a. (9-12C) Create the appropriate visual or graphical representation of real data. *(1) Collect real data and create meaningful graphical representations of the data.* *(2) Develop, use and explain applications and limitations of linear and nonlinear models and regression in a variety of contexts.*	2.1 a.(9-12 C) Extend the understanding of number to include integers, rational numbers and real numbers. *(1) Compare, locate, label and order real numbers on number lines, scales, coordinate grids and measurement tools.* 3.1 a. (9-12 C)Investigate relationships among plane and solid geometric figures using geometric models, constructions and tools. *(1) Use models and constructions to make, test and summarize conjectures involving properties of geometric figures.* 3.2 a. (9-12 E) Use a variety of coordinate systems and transformations to solve geometric problems in two- and three-dimensions using appropriate tools and technologies. *(2) Use Cartesian, (navigational,) polar and (spherical) systems to represent, analyze and solve geometric and measurement problems.* *(3) Represent translations, reflections, rotations and dilations of plane figures using (sketches, coordinates,) vectors, (function notation and matrices) to examine the effects of transformations and their composites and to solve related geometric problems.* 3.3 a. (9-12 E)Approximate measurements that cannot be directly determined with some	world contexts. *(3) Apply theoretical and experimental probabilities appropriately to solve problems and predict experimental results.* 4.3 a. (9-12 E) Solve problems using the methods of discrete mathematics. *(1) Understand and use permutations, combinations, recursion and mathematical induction to solve problems.*	*relationships using algebraic equations (and inequalities), and vice versa.* 3.2 a. (9-12 E) Use a variety of coordinate systems and transformations to solve geometric problems in two- and three-dimensions using appropriate tools and technologies *(1) Visualize three-dimensional objects from different perspectives and analyze cross-sections, (surface area and volume).* *(level 4 only)* *(2) Use Cartesian, (navigational), polar and (spherical) systems to represent, analyze and solve geometric and measurement problems.*

		degree of precision using appropriate tools, techniques and strategies. *(2) Use properties of similarity and techniques of trigonometry to make indirect measurements of lengths and angles to solve a variety of problems.* 4.1 a.(9-12 C) Model real data graphically using appropriate tools, technology and strategies *1) Investigate and solve relevant problems by designing statistical experiments and collecting, organizing, displaying and analyzing data in tabular, graphical and symbolic forms.* *(2) Apply and defend regression models for bivariate data and use them to formulate predictions.* *(3) Recognize the limitations of mathematical models based on sample data as representations of real-world situations.*		
ASSESSMENT	**PERFORMANCE TASK** You are a home builder that has constructed similar homes in two different cities of the country. You will need to analyze the cost values of the homes over a ten year period, and create a mathematical model for each one. Using your model, you will determine how long it will take for the homes to be the same value and predict future	**PERFORMANCE TASK** "Pre-Calculus Unit 2 Performance Task – World Temperature" **Synopsis** Students will be given a real world problem (World Temperatures of cities throughout the world) and will analyze the data to determine that it is periodic. Students will develop a trig equation to model	**PERFORMANCE TASK** **The Quiltmaker** The town newspaper ran a story about the local shelter. The shelter needs quilts for homeless people – each person receives a quilt to use in the shelter, then they take it with them when they move on and find a home. You've decided to make quilts to donate to the shelter and succeed in finding donors who	**PERFORMANCE TASK** Solve 4 problems using Kepler's Law to look at some objects in our solar system and the system that the researchers discovered. Note that because Upsilon Andromedae is slightly more massive than our sun, Kepler's law has a different proportionality constant. 1. Halley's Comet moves in a very

values of each house. In addition, you will need to explain the circumstances of the real world that have caused the changes in value of each house.

the data. Students will use the model to make a prediction about future performance of the data. Students will use a second data set from the same problem and will compare and contrast the attributes of the two data sets. They will use this information to speculate on the real life situation in which the data sets occur.

provide materials for the quilts.

You are able to make one quilt per month. Over the course of a year you would generate twelve quilts, in two years, twenty-four quilts, and so forth. **1a**: What type of sequence does this generate? **1b**: Define the sequence.

Now, a friend hears about your efforts and decides to help you. You teach your friend to quilt but it takes one whole year to do so. Since you are teaching the process, it takes you longer to make a quilt as well – one entire year per quilt. So, in the first year, you alone make a quilt while your friend learns.

In the second year, your friend enlists two more people to learn. So, you and your friend each make a quilt and each teach one person at the same time. Of course, this takes an entire year. After two years, there is a total of three quilts, but there are now four people capable of making quilts.

In the third year, all four off you take on a student quilter and make a quilt. Four more quilts are produced, for a total of seven. In the fourth year, there will be eight quilter/teachers. **1c**: What type of sequence does this generate? **1d**: Define the sequence.

elongated elliptical orbit, passing close to the sun every 76 years and then going off into the outer reaches of the solar system. Using Kepler's law, find the average distance of Halley's Comet from the sun. (By the way, the comet's next return is scheduled for the year 2062).
2. Pluto has an average distance from the sun of 39.5 AU. According to Kepler's law, how long does it take Pluto to make one circuit around the sun?
3. One planet orbiting Upsilon Andromedae has a period of 4.6 days. How far is it, on average, from Upsilon Andromedae? (*Hint*: Convert the time to years before you use Kepler's formula.)
4. The planet farthest from Upsilon Andromedae (called Companion d) has an average distance of 2.5 AU. Approximate its period in days.

	OTHER EVIDENCE - Stop on a Dime lab with CBR - M&M lab - Tennis Ball lab - Quizzes - Chapter Test	**OTHER EVIDENCE** - Quizzes - Worksheets - Fathom lab - Sketchpad (optional) - Musical Frequency lab (optional) "Tom Thumb" lab with CBR	**OTHER EVIDENCE** - Quizzes - Tests - Homework	**OTHER EVIDENCE** - Quizzes - Hands on derivations of certain conics.
SKILLS	- Vertically stretch or shrink a function. - Reflect functions over the x-axis or y-axis - Shift functions vertically and horizontally - Graph exponential and logarithmic functions - Use the properties of logarithms to manipulate logarithmic expressions - Evaluate logarithmic expressions, with or without using change of base - Solve exponential and logarithmic equations, including problems involving real-world problems - Model data using exponential and logarithmic equations - Use models of functions to estimate and make predictions	- Sketch an angle in standard position and convert between radian and degree measure. - Determine co-terminal angles. - Identify the unit circle and its relationship to the real numbers. - Evaluate trigonometric functions of any angle. - Use fundamental Trig Identities to verify and evaluate trigonometric expressions and solve equations - Sketch graphs of trigonometric functions - Evaluate inverse trig functions - Evaluate the composition of trigonometric functions(L4 only) - Use trigonometric functions to model and solve real-life problems	- Recognize patterns in sequences. - Use arithmetic sequences to solve real-life problems. - Use geometric sequences to solve real-life problems. - Prove by mathematical induction. - Use combinations and permutations to solve real-life problems. - Recognize the importance of calculating probabilities.	- Determine the type of conic from its equation. - Graph parabolas, circles, ellipses, and hyperbolas

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