Mathematics
Precalculus: B
Unit 2: Graphs of Trigonometric Functions

Essential Understandings	▪ Trigonometric functions have many applications in the real world.
Essential Questions	▪ How do you change from radian to degree measure? ▪ What is arc length and explain its relationship to the central angle? ▪ How are amplitude and period related to the graphs of functions? ▪ When are fundamental identities used? ▪ How are trigonometric functions graphed? ▪ What real-life problems are modeled by graphs of trigonometric functions?
Essential Knowledge	▪ One radian is the measure of a central angle that intercepts an arc equal in length to the radius of the circle. ▪ A unit circle is a circle with a radius of one unit. ▪ Phase shifts and vertical translations for sin and cos functions are essential. ▪ The angular and linear velocity is measured on the unit circle.
Vocabulary	▪ <u>Terms</u>: ○ Trigonometry, negative angles, central angles, linear speed, angular speed, unit circle, sine, cosecant, cosine, secant, tangent, cotangent, periodic, period, reference angle, amplitude, phase shift, inverse functions, radian, unit circle, co-terminal angles.
Essential Skills	▪ Describe an angle and convert between degree and radian measure. ▪ Identify a unit circle and its relationship to real numbers. ▪ Evaluate trigonometric functions of any angle. ▪ Use trigonometric functions to model and solve real-life problems. ▪ Change an angle from degree measure to radian measure. ▪ Use the unit circle to evaluate the six trigonometric functions of theta. ▪ Write the equation of sin and cos functions given the amplitude, period, phase shift, and vertical translation. ▪ Graph compound functions. ▪ Sketch the graph of a trigonometric function given the amplitude and period. ▪ Sketch the graph of an inverse function. ▪ Model trigonometric relationships.

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Related Maine Learning Results	Mathematics A. Number Real Number A1. Students will know how to represent and use real numbers. a. Use the concept of nth root. b. Estimate the value(s) of roots and use technology to approximate them. c. Compute using laws of exponents. d. Multiply and divide numbers expressed in scientific notation. e. Understand that some quadratic equations do not have real solutions and that there exist other number systems to allow for solutions to these equations. B. Data Measurement and Approximation B1. Students understand the relationship between precision and accuracy. a. Express answers to a reasonable degree of precision in the context of a given problem. b. Represent an approximate measurement using appropriate numbers of significant figures. c. Know that most measurements are approximations and explain why it is useful to take the mean of repeated measurements. Data Analysis B2. Students understand correlation and cause and effect. a. Recognize when correlation has been confused with cause and effect. b. Create and interpret scatter plots and estimate correlation and lines of best fit. c. Recognize positive and negative correlations based on data from a table or scatter plot. d. Estimate the strength of correlation based upon a scatter plot. B3. Students understand and know how to describe distributions and find and use descriptive statistics for a set of data. a. Find and apply range, quartiles, mean absolute deviation, and standard deviation (using technology) of a set of data. b. Interpret, give examples of, and describe key differences among different types of distributions: uniform, normal, and skewed. c. For the sample mean of normal distributions, use the standard deviation for a group of observations to establish 90%, 95%, or 99% confidence intervals.

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Related Maine Learning Results	B4. Students understand that the purpose of random sampling is to reduce bias when creating a representative sample for a set of data. a. Describe and account for the difference between sample statistics and statistics describing the distribution of the entire population. b. Recognize that sample statistics produce estimates for the distribution of an entire population and recognize that larger sample sizes will produce more reliable estimates. c. Apply methods of creating random samples and recognize possible sources of bias in samples. Probability B5. Students understand the relationship of probability to relative frequency and know how to find the probability of compound events. a. Find the expected frequency of an event. b. Find the expected value of events. c. Find the probability of compound events including independent and dependent events. D. Algebra Symbols and Expressions D1. Students understand and use polynomials and expressions with rational exponents. a. Simplify expressions including those with rational numbers. b. Add, subtract, and multiply polynomials. c. Factor the common term out of polynomial expressions. d. Divide polynomials by (ax+b). Equations and Inequalities D2. Students solve families of equations and inequalities. a. Solve systems of linear equations and inequalities in two unknowns and interpret their graphs. b. Solve quadratic equations graphically, by factoring in cases where factoring is efficient, and by applying the quadratic formula. c. Solve simple rational equations. d. Solve absolute value equations and inequalities and interpret the results. e. Apply the understanding that the solution(s) to equations of the form f(x) = g(x) are x-value(s) of the point(s) of intersection of the graphs of f(x) and g(x) and common outputs in table of values. f. Explain why the coordinates of the point of intersection of the lines represented by a system of equations is its solution and apply this understanding to solving problems.

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	D3. Students understand and apply ideas of logarithms. a. Use and interpret logarithmic scales. b. Solve equations in the form of $x + b^y$ using the equivalent form $y = \log_b x$. Functions and Relations D4. Students understand and interpret the characteristics of functions using graphs, tables, and algebraic techniques. a. Recognize the graphs and sketch graphs of the basic functions. b. Apply functions from these families to problem situations. c. Use concepts such as domain, range, zeros, intercepts, and maximum and minimum values. d. Use the concepts of average rate of change (table of values) and increasing and decreasing over intervals, and use these characteristics to compare functions. D5. Students express relationships recursively and use iterative methods to solve problems. a. Express the (n+1)st term in terms of the nth term and describe relationships in terms of starting point and rule followed to transform one terms to the next. b. Use technology to perform repeated calculations to develop solutions to real life problems involving linear, exponential, and other patterns of change.
Sample Lessons And Activities	▪ Graph various trig functions. ▪ Manipulate the equation of a trig function given the amplitude, phase shift, and translation. ▪ Find real life sinusoidal functions and graphs.
Sample Classroom Assessment Methods	▪ Tests ▪ Quizzes ▪ Evaluate homework ▪ Poster of sinusoidal function
Sample Resources	▪ Publications: ○ Advanced Mathematical Concepts: Precalculus with Applications