Unit 10: Trigonometric Graphs & Equations

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 4**
Length: **3 weeks**
Status: **Published**

Brief Summary of Unit

Students will solve and graph basic trigonometric equations. The students will see the connections and will use these topics to model periodic behavior. They will also learn the relationship that a trigonometric graph has with a trigonometric equation.

Revised Date: July 2025

Standards

ELA.L.SS.11–12.1	Demonstrate command of the system and structure of the English language when writing or speaking.
ELA.L.VL.11–12.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, including technical meanings, choosing flexibly from a range of strategies.
MATH.9-12.F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\ f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k(both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
MATH.9-12.F.BF.B.4	Find inverse functions.
MATH.9-12.F.BF.B.4.a	Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.
MATH.9-12.F.BF.B.4.b	Verify by composition that one function is the inverse of another.
MATH.9-12.F.BF.B.4.c	Read values of an inverse function from a graph or a table, given that the function has an inverse.
MATH.9-12.F.BF.B.4.d	Produce an invertible function from a non-invertible function by restricting the domain.
MATH.9-12.F.IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.
MATH.9-12.F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MATH.9-12.F.IF.C.7.a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MATH.9-12.F.IF.C.7.b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MATH.9-12.F.IF.C.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

MATH.9-12.F.IF.C.7.d	Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
MATH.9-12.F.IF.C.7.e	Graph exponential and logarithmic functions, showing intercepts and end behavior.
MATH.9-12.F.TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
MATH.9-12.F.TF.B.6	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
MATH.9-12.F.TF.B.7	Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Mathematical and computational thinking at 9–12 builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

Essential Questions

- How can this knowledge be used to better model periodic behavior in real-life applications?
- How does the periodic behavior of trigonometric functions affect the graphs and equations?

Enduring Understandings

- Graphing calculators can be used to solve trigonometric equations (as well as any other type) by looking at the x-intercepts.
- Since trigonometric graphs are periodic, there can be infinite solutions to the related equations.
- The graph of a sine curve is just a vertical translation of the cosine graph.
- Trigonometric equations are directly related to the graphs of trigonometric functions.

Students Will Know

- How the graphs of reciprocal trig functions are related (such as how y = sinx can be used to graph y = cscx).
- How to find equations of sine, cosine, and tangent curves and how to apply these equations.
- How to graph equations of sine, cosine, and tangent curves with amplitude, period, and phase shifts.

- How to graph the six basic trigonometric graphs
- How to solve simple trigonometric equations.
- How to use technology to solve more difficult trigonometric equations.
- How to use trigonometric functions to model periodic behavior, like tides and temperatures, including the statistical concept of curves of best fit.
- The graphs along with the domain and range of the inverse trigonometric functions.

Students Will Be Skilled At

- Applying trigonometric equations to curves on a graph.
- Graphing the original three trigonometric functions learned in Geometry, as well as their newly introduced reciprocal functions.
- Identifying the amplitude, period, and phase shifts of any trigonometric function.
- Identifying which of the trigonometric functions can be applied in real world situations.
- Using technology to identify information about more complex trigonometric functions.

Assessment

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Teacher Observation
- Tests and quizzes that assess the essential questions

Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate.

- Solve trigonometric equations using factoring and square roots.

- Find an unknown angle given any trigonometric ratio. Also include equations where students need to use u substitution (ie: sin(3x)=1).
- Graph the basic three trigonometric functions. Use the unit circle to map basic points for each function. Discuss domain and range for all graphs.
- Identify period and amplitude for each function. Use various equations to continue identifying these quantities.
- Introduce phase shifts and its impact on graphing period, but not amplitude.
- Introduce vertical shifts and its impact on graphing amplitude, but not period.
- Graph the three basic trigonometric functions using amplitude, period, and all shifts.
- Based on a given graph, determine the equation of the trigonometric function.
- Discuss how to apply this knowledge to real world scenarios.
- For advanced students: graph the reciprocal trigonometric functions using the same quantifiers.

Graphing calculators are encouraged to be used as an extension of these topics.

Materials

Core instructional materials: Core Book List including PreCalculus Enhanced with Graphing Utilities, Sullivan, Savvas

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes
- Whiteboard tables

Integrated Accommodation & Modifications

Possible accommodations/modification for CP PreCalc & Trig