

# Unit 09: Trigonometric Graphs and Equations

Content Area: **Mathematics**  
Course(s):  
Time Period: **Marking Period 4**  
Length: **2-3 weeks**  
Status: **Published**

## **Brief Summary of Unit**

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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

## **Standards**

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Students will analyze geometric designs which connects to various cultures. Embracing the diversity within society incorporates the following:

### Amistad Commission

This unit also reflects the goals of the Department of Education and the Amistad Commission including the infusion of the history of Africans and African-Americans into the curriculum in order to provide an accurate, complete, and inclusive history regarding the importance of of African-Americans to the growth and development of American society in a global context.

### Asian American and Pacific Islander History Law

This unit includes instructional materials that highlight the history and contributions of Asian Americans and Pacific Islanders in accordance with the New Jersey Student Learning Standards in Social Studies.

### New Jersey Diversity and Inclusion Law

In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including:

economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
MA.F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$ , $kf(x)$ , $f(kx)$ , 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.
MA.F-BF.B.4	Find inverse functions.
MA.F-BF.B.4a	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.
MA.F-BF.B.4b	Verify by composition that one function is the inverse of another.
MA.F-BF.B.4c	Read values of an inverse function from a graph or a table, given that the function has an inverse.
MA.F-BF.B.4d	Produce an invertible function from a non-invertible function by restricting the domain.
MA.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 $y = f(x)$ .
MA.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.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MA.F-IF.C.7b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MA.F-IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MA.F-IF.C.7d	Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
MA.F-IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
MA.F-TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
MA.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.
MA.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.
TEC.K-12.8.1	All students will use computer applications to gather and organize information and to solve problems.
TEC.K-12.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.
WORK.K-12.9.1	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
WORK.K-12.9.2	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.

## Transfer

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- Understanding sound waves and tidal waves by using transformations to the trigonometric functions to affect their period and height.

## Essential Questions

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- 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?

## Essential Understandings

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- 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

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- How the graphs of reciprocal trig functions are related (such as how  $y = \sin x$  can be used to graph  $y = \csc x$ ).
- 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

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- 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.

## Evidence/Performance Tasks

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### 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
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- Class discussion of daily topic
  - Classwork and homework that assess the essential questions
  - Graph and apply the inverse trigonometric functions.
  - Graph and apply the six trigonometric functions.
  - Have students collect data about temperature (or some other periodic function) over the course of a week at different time intervals and graph the curve of best fit and try to determine its equation.
  - Identify period, amplitude and phase shift for a given graph or equation.
  - Provide alternative means of assessments for certain students
  - Solve trigonometric equations involving linear techniques.
  - Students can graph functions such as  $y = \sin(x) + 1$ ,  $y = \sin(x) + 2$ , etc., through the use of a graphing calculator and discuss phase shifts, periods, and amplitudes. They will then be asked to link this knowledge to translations of other familiar functions (quadratics, cubics, etc.) and present a summary to the class.
  - Teacher Observation
  - Tests and quizzes that assess the essential questions
  - Utilize a graphing calculator to solve more complex trigonometric equations.
  - Written assignments that assess the essential questions that involves providing explanations

## Learning Plan

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- Preview the essential questions and connect to learning throughout the unit.
- Graph simple trigonometric functions.
- Graphing calculators will be used to enhance the understanding of the graphs. An emphasis will be placed on knowing how to use the calculator to graph in both degrees and radians.
- Inverse and reciprocal trigonometric graphs.
- Model periodic behavior.
- Solve more difficult trigonometric equations both algebraically and with the use of a graphing

calculator.

- Solving simple trigonometric equations.
- Utilize a graphing calculator to conjecture about period, phase shift, and amplitude.

## **Materials**

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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 activities
- Teacher created notes
- Whiteboard tables

## **Suggested Strategies for Modifications**

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[Possible accommodations/modification for CP PreCalc & Trig](#)