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### Exploring Trigonometric Functions on the TI calculator

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# Exploring Trigonometric Functions On the TI Graphing Calculator

Name: Wilson Burgos

Grade level(s)/Subject taught: Mathematics 10 – 12

## Essential Questions

- How do I graph trigonometric functions on the graphing calculator?
- What is the role of  $a$  and  $b$  in the function  $y = a \sin b\theta$  or  $y = a \cos b\theta$ ?

## Goals and Objectives

Students will:

- graph sine and cosine functions;
- observe what happens as they change the value of  $a$  (amplitude) and  $b$  (frequency);
- learn how to calculate the period of a sine or cosine function.

Mathematical Concept or “key idea” that modeling will be used to teach:

Students will:

- recognize, use, and represent algebraically patterns, relations, and functions;
- build new mathematical knowledge through problem solving;
- make and investigate mathematical conjectures.

Materials: TI graphing calculator, graph paper

## Overview

The lesson will begin with a review of trigonometric ratios. The lesson will build on their prior knowledge and ask students to predict what the graphs of these trigonometric ratios might look like. Students may complete this lesson using TI graphing calculators or teachers may use it as a demonstration using TI SmartView. Students will work in pairs to answer the questions below. The teacher will walk around to monitor students' progress and address misconceptions. They will learn how to graph trigonometric functions on the graphing calculator as well as explore the concepts of amplitude, frequency, and period. On graph paper, they will sketch their results for  $y = \sin x$ ,  $y = -\sin x$ ,  $y = \sin 2x$ ,  $y = \sin 4x$ ,  $y = \cos x$ ,  $y = -\cos x$ ,  $y = \cos 2x$ , and  $y = \cos 4x$ . They will make conjectures about the role of the coefficients and use them to calculate the amplitude, period, and frequency of each graph. At the conclusion, students will present their findings and compare them to other students' findings. The goal of the lesson is to make a connection between the graphical, numerical, and algebraic representations of trigonometric functions.

## Procedure

1. Change the Mode to radians. Adjust the window values. X should range from  $-2\pi$  to  $2\pi$  with a scale of  $\pi/2$ . Y should range -4 to 4 with a scale of 1.
2. Graph the function  $y = \sin x$ . Find  $\sin \pi/6$  and  $\sin 5\pi/6$ .
3. For what values is  $y = \sin x$  equal to 0? Where is there a minimum? Maximum?
4. Graph  $y = -\sin x$ . What effect does a negative value of  $a$  have on the graph of  $y = a \sin b\theta$ ?
5. Graph  $y = 2\sin x$  and  $y = 4\sin x$ . What do you observe? What is the role of  $a$  in the function  $y = a \sin b\theta$ ?
6. Repeat steps 2 through 5 for  $y = \cos x$ . How are your results similar? How are they different?
7. Graph  $y = \sin 2x$  and  $y = \sin 4x$ . What is the role of  $b$  in the function  $y = a \sin b\theta$ ?
8. Repeat step 7 for  $y = \cos 2x$  and  $y = \cos 4x$ . How are your results similar? How are they different?
9. Students share solutions and conjectures. Teacher helps to solidify concepts of amplitude, frequency, and period.

## Assessment (Rubric)

Category	1	2	3
Use of Graphing Calculator	Did not use the graphing calculator to model the problem.	Graphing calculator was used but the data generated was not used effectively.	Graphing calculator was used effectively, including appropriate calculations.
Use of model to make conjectures and test their validity	Conclusions are not consistent with the model and the evidence provided is irrelevant.	Conclusions may be inconsistent with the data generated by the model due to minor errors.	Able to describe the relationship between the changes made to the initial parameters and the resulting graphs.

Accuracy of Calculations	Many flaws in calculations or shows no understanding of the task.	Calculations are inaccurate or show partial understanding of the task.	Calculations are accurate, well organized, and demonstrates full understanding of the task.
Application and understanding of graphical, numerical, and algebraic concepts	Does not show any understanding of the relationship between the model and the concepts being studied.	Partial understanding of the concepts and the implications of the activity.	Fully understands the concepts, is able to make generalizations, and can apply the results of the activity.

Expected Screenshots of Student Work



