Math Objectives

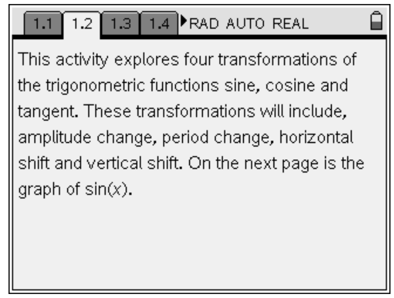
- Determine the amplitude and period of the sine, cosine, and tangent functions.
- Use graphs to explore transformations of trigonometric functions, such as amplitude changes, period changes, vertical shift, and horizontal shift.
- Determine equations to represent trigonometric transformations.

Vocabulary

- transformation
- amplitude
- period
- vertical shift
- horizontal shift

About the Lesson

- This lesson is a follow-up lesson to the activity *Trigonometric Transformations*.
- This activity uses graphs to explore transformations of the trigonometric functions sine, cosine, and tangent. The transformations include amplitude changes, period changes, vertical shift, and horizontal shift.



TI-Nspire™ Technology Skills:

- Download TI-Nspire document
- Open a document
- Move between pages
- Graph a trigonometric function

Tech Tips:

- *Make sure the* ***font size*** *on your TI-Nspire handhelds is set to Medium.*

Lesson Materials:

Student Activity

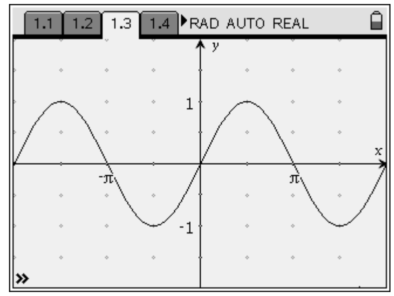
Trigonometric_Transformation_Exercises_Student.PDF

Trigonometric_Transformation_Exercises_Student.DOC

TI-Nspire document

Trigonometric_Transformation_Exercises.tns

Discussion Points and Possible Answers:



<u>TI-Nspire Problem/Pages 1.3, 1.8, 1.11, and 1.14</u>

Tech Tip: *Press ctrl G to access the function entry line.*

1. Looking at the graph of sin(*x*), what are the amplitude and period? Explain how you can tell by looking at the graph.	**The amplitude is half the difference between the upper and lower bounds of the function. In this case, the amplitude is 1, as found below:** $=\frac{1}{2}(1-(-1))=\frac{1}{2}(1+1)=\frac{1}{2}(2)=1$ **The period is the distance it takes on the *x*-axis for the function to complete one cycle. In this case, the period is 2π.**
2. Change the function to graph cos(*x*). What are the amplitude and period of this graph? Explain.	**The amplitude is half the difference between the upper and lower bounds of the function. In this case, the amplitude is 1, as found below:** $=\frac{1}{2}(1-(-1))=\frac{1}{2}(1+1)=\frac{1}{2}(2)=1$ **The period is the distance it takes on the *x*-axis for the function to complete one cycle. In this case, the period is 2π.**
3. Now change the function to graph tan(*x*). What are the amplitude and period? Explain.	**The tangent function is not bounded above or below, so it does not have an amplitude.** **The period is the distance it takes on the *x*-axis for the function to complete one cycle. In this case, the period is π.**
4. How has the sin(*x*) graph changed? Write an equation in the form of *f*(*x*) = sin(*Bx*) to represent the transformed graph. To check your equation, graph it on the same page.	**The period has changed in such a way that the transformed graph has been horizontally compressed. The period of the transformed graph is π. Therefore, the equation to represent the transformed graph is *f*(*x*) = sin(2*x*).**

5. How has the cos(x) graph changed? Write an equation in the form of $f(x) = A*\cos(x)$ to represent the transformed graph. To check your equation, graph it on the same page.	**The amplitude has changed in such a way that the transformed graph is vertically stretched. Instead of the upper and lower bounds being 1 and –1, they are now 2 and –2. Therefore the transformed graph can be represented by the equation $f(x) = 2\cos(x)$.**
6. Write an equation in the form of $f(x) = A*\cos(Bx)$ to represent the graph. To check your equation, graph it on the same page.	**This graph represents a period and amplitude change of the cosine graph. The graph can be represented by the equation $f(x) = 0.5\cos(3x)$.**
7. Now, how can you represent the graph on page 1.14 using the sine function? Write an equation in the form of $f(x) = A*\sin(Bx + C)$ to represent the graph. To check your equation, graph it on the same page.	**Since the sine and cosine graphs have the same period and amplitude, it is possible to represent this graph using the sine function with a horizontal shift. The graph can be represented by the equation $f(x) = 0.5\sin\left(3x + \frac{\pi}{2}\right)$.** ***Teacher Tip:*** *There is more than one equation that would work to represent the graph on page 1.14 using the sine function. The one shown above is the most obvious.*

Wrap Up:

Upon completion of the discussion, the teacher should ensure that students are able to:

- Understand and find the amplitude and period of the sine, cosine, and tangent functions.
- Use graphs to determine transformations such as amplitude change, period change, vertical shift, and horizontal shift.
- Determine equations to represent trigonometric transformations.