

Objective: To discover patterns in graphing trigonometric functions.

Review:

When provided with an absolute value function written in standard form ($y = a|x - h| + k$), we can create a graph by identifying the transformations. List the transformations for each of the following:

a.) $y = 2|x - 4| + 3$

- stretch by a factor of 2
- right 4 units
- up 3 units

b.) $y = |x + 5| - 1$

- left 5 units
- down 1 unit

c.) $y = -|x - 1| + 6$

- reflect over the x-axis
- right 1 unit
- up 6 units

d.) $y = -\frac{1}{2}|x + 2| - 2$

- reflect over the x-axis
- compress by a factor of $\frac{1}{2}$
- left 2 units
- down 2 units

Predict:

Using the same process, predict how the sine function ($y = a \sin(bx - c) + d$) is transformed below:

a.) $y = 2 \sin(x - 4) + 3$

- stretch by a factor of 2
- right 4 units
- up 3 units

b.) $y = \sin(x + 5) - 1$

- left 5 units
- down 1 unit

c.) $y = -\sin(x - 1) + 6$

- reflect over the x-axis
- right 1 unit
- up 6 units

d.) $y = -\frac{1}{2} \sin(x + 2) - 2$

- reflect over the x-axis
- left 2 units
- down 2 units
- compress by a factor of $\frac{1}{2}$

Explore:

We will now explore these transformations further. Go to student.desmos.com and enter in the class code **5SPWRJ**. Follow all of the prompts on the screen.

Slides 1 and 2: In your own words, determine what the various parts of the equation do by using the sliders. When given a sine function in the form $y = a \sin(bx - c) + d$ or a cosine function in the form $y = a \cos(bx - c) + d$

a changes vertical stretch or compression
reflection

b changes horizontal stretch or compression

c changes horizontal shift

d changes vertical shift

Vocabulary:

Phase Shift: The number of units the graph has been shifted in the horizontal direction from its usual position

Amplitude: The height of the function from its midline

Vertical Shift: The number of units the graph has been shifted in the vertical direction from its usual position

Period: The shortest repeating portion of the graph is called a cycle and the horizontal length of each cycle is called the period.

Slide 3: Changing the value of a best describes the:

- A. Phase Shift
- B. Amplitude
- C. Vertical Shift
- D. Period

Slide 6: Changing the value of b best describes the:

- A. Phase Shift
- B. Amplitude
- C. Vertical Shift
- D. Period

Slide 9: Changing the value of c best describes the:

- A. Phase Shift
- B. Amplitude
- C. Vertical Shift
- D. Period

Slide 12: Changing the value of d best describes the:

- A. Phase Shift
- B. Amplitude
- C. Vertical Shift
- D. Period

Extension: Navigate to <https://www.desmos.com/calculator/rusqxyr4ux>. Make your graph match the sound wave, as instructed on Desmos. Record the values that made your graph match the sound wave below:

$$a = 2.6$$

$$b = 1.65$$

$$c = 1.87$$

$$d = -2.27$$

Reflect:

1. Write an equation for a sine graph that has an amplitude of 2.

$$y = 2 \sin(x)$$

2. Write an equation for a cosine graph that has been vertically shifted.

$$y = \cos(x) + 5$$

3. Provide the equations for two sine graphs that have the same period.

$$y = 3 \sin(2x)$$

$$y = 7 \sin(2x)$$