[Module 7 Overview Document]

Table 1: Timeline of Tasks in the Module

Timeline of tasks in the Module	Day 0	Homework	7.1 Engage in Introduction to the Sine Graph Desmos Activity
	Day 1	20 min	7.1 Discussion of Introduction to the Sine Function Desmos Activity Optional: Extend the Discussion: Task Design
		35 min	7.2 Launching a Technology-Mediated Math Task
		20 min	7.3 Noticing Student - Teacher Interactions
		Homework	7.4 Monitoring Student Thinking: Introduction to the Sine Function
	Day 2	15 min	7.4 Discussion of Introduction to the Sine Function: Monitoring Student Thinking
		20 min	7.5 Noticing Student Thinking about Amplitude
		40 min	7.6 Noticing Student Thinking about Period
	Day 3	40 min	7.7 Designing a Sequence of Tasks (optional project)

7.1 Facilitation Notes

Day 0 (Homework)

Create a class code for the Introduction to the Sine Graph Desmos activity and provide the link to your teachers. We recommend asking teachers to log in so that the activity will appear in their history and they can revisit it at any time. In addition, they must be logged in to receive any feedback you provide.

[Create a Class Code for the Introduction to the Sine Graph Desmos Activity]

Day 1

Discussing the Mathematics

Have the teachers login to their Desmos account and review their work on the Introduction to Sine Graphs activity. We suggest allowing small groups of teachers to discuss prior to opening the discussion to the whole class. Have the teachers discuss the characteristics of sine graphs they found most difficult for themselves as a learner and those they expect to be difficult for students.

As you are discussing the activity we recommend displaying the teacher dashboard and using the student view and teacher view to display the prompts and teacher responses. Doing so will help the teachers understand what a teacher using this with high school students would have access to as they monitor their students' work.

When discussing as a whole group, discuss pages 3 and 4 of the activity first. Share that this task was designed to be an introduction to the sine function and was designed for use during remote instruction. Students had previously learned about many function families (e.g., linear, quadratic, exponential, absolute value) through similar parameter explorations, but had not been formally introduced to the graph of the sine function prior to this activity. However, students have seen that the sine function creates a "wave" through looking at models of a cart moving around a Ferris Wheel over time (like in Module 3: Desmos Function Carnival).

Have teachers share their informal ideas on pages 3 and 4 of the activity. The purpose of these pages was to first notice what makes the sine graph different from other functions they have studied (i.e., The range is between two values – it is cyclic), and then to describe its transformations using prior knowledge about how the parameters are related to vertical/horizontal shifts, vertical stretch/compression, and reflection before introducing the related vocabulary specific to trigonometric functions.

At this point, we recommend sharing the task planning guide that Ms. Fye (the teacher who designed this activity) created to guide her instruction and discuss the mathematics in the task and how it aligns to Ms. Fye's stated goals.

[Task Planning Guide]

When you discuss the mathematics in the task with teachers it is important to bring in language of direct and inverse relationships. For example, the value of the amplitude is directly related to the absolute value of the value of parameter a (where $k = 1$). The value of the period is inversely related to the value of b (where k is 360). You might have them describe these relationships in many ways, but be sure to bring in this connection as they are going to see it in the video clips. We recommend opening by asking teachers to share the strategies they used to figure out how the parameters were related to each of amplitude, midline, and period – and how those strategies changed (if they did) as they worked through the activity.

Extending the Discussion: Task Design

If it is appropriate for the goals of your course and you have extra time (we anticipate around 20 minutes), after discussing the big mathematical ideas in the activity, you might discuss the design of the task. For example,

- Provide teachers with a list of Ms. Fye's learning goals (they are at the top of the task planning guide linked above) and ask them to reflect on the ways in which the activity does (or does not) support students in meeting those goals.
- This task was created in a Desmos Activity, but it did not have to be. Have teachers consider the same activity designed using a worksheet and a preconstructed NCTM interactive applet (link below). Have them compare and contrast the experience from both the teacher and student perspective and consider the pros and cons of each.

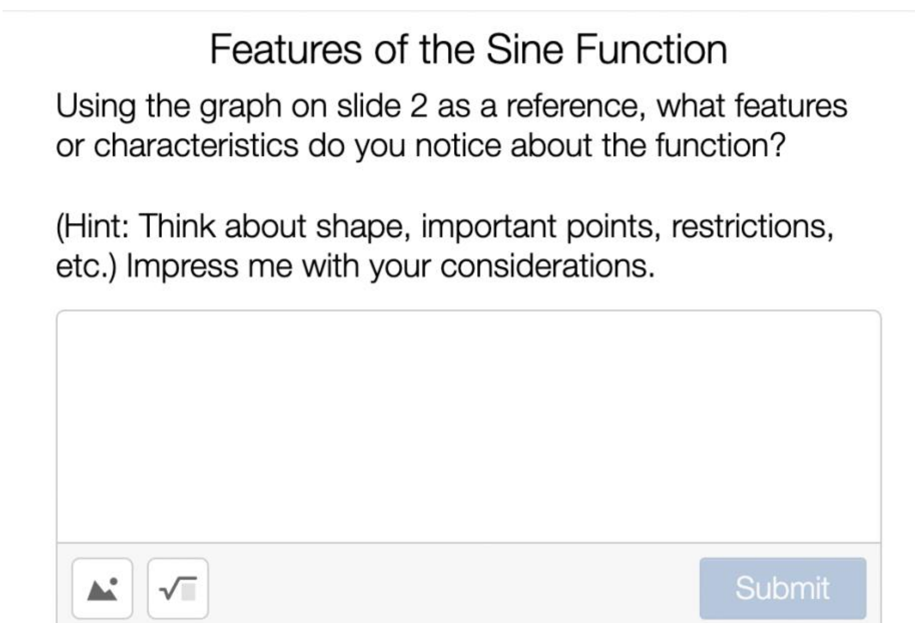
Here is a link for the [Introduction to Sine Graphs Task] designed using a worksheet and a preconstructed NCTM interactive applet.

- Ask about different design decisions the teachers might make to improve the task (either the Desmos or NCTM applet version) and to justify their ideas. (Note: make sure they know the Desmos Activity version was designed to use during remote instruction.)

7.1 Sample Responses

Below are some sample responses that you might expect teachers to give for some of the key prompts (i.e., pages) in the Introduction to the Sine Function Desmos activity.

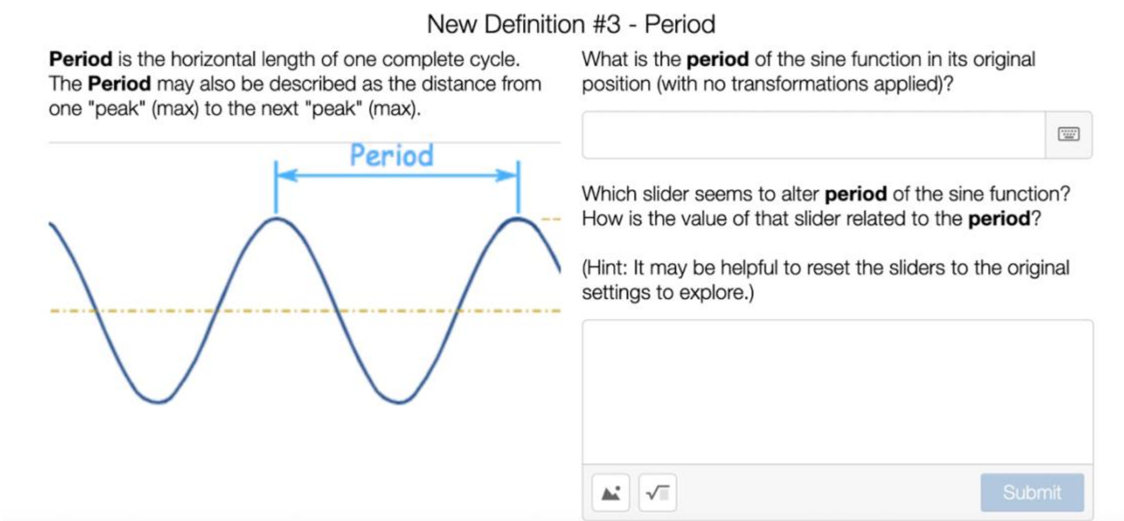
Page 3:



Most teachers will note key characteristics they would be expected to point out for any function family (e.g., x and y intercepts, maximum and minimum values) with varying levels of precise mathematical language. For example,

- This is a periodic function that alternates between the y-values 1 and -1. It crosses the x-axis every 180 degrees and is increasing when it goes thorough (0,0).
- The minimums and maximums of the graph fluctuate between $y = 1$ and $y = -1$. It intersects the x-axis at the origin, and continues to intersect the x-axis every 180 degrees, with a maximum or minimum at 90 or 270 degrees. The graph seems to repeat this pattern infinitely in both directions.
- The graph goes through the origin. The y -values don't go higher than 1 nor less than -1. The graph reminds me of a rollercoaster because it is always going up and down.
- It is curvy and has an x intercept and y intercept of zero. The max and the min show up multiple times.

Page 8:

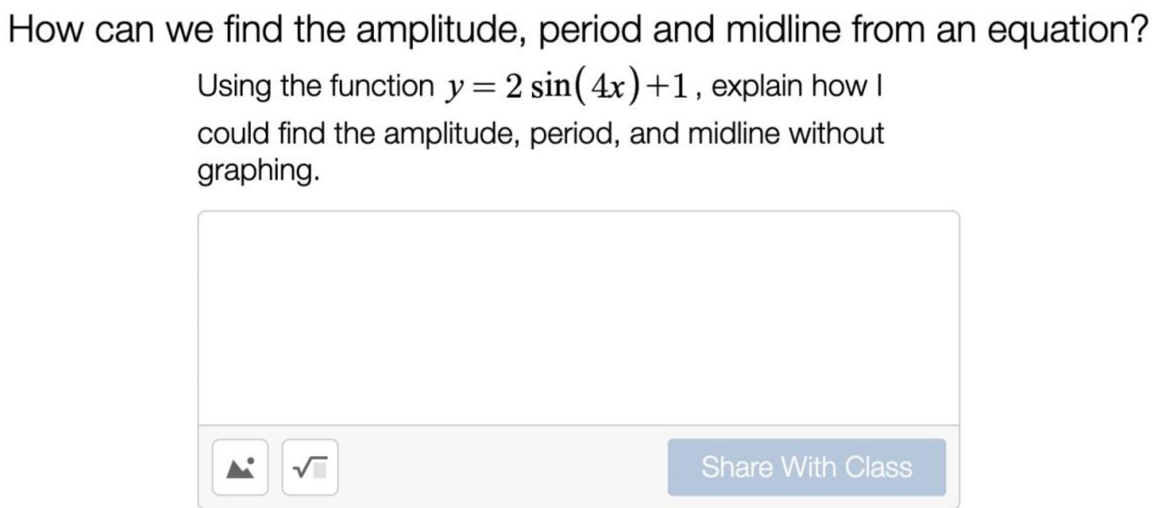


Teachers typically identify the correct period of the parent function, but while some descriptions of the relationship between the b slider and the period are precise (e.g., The slider b affects the period. The period is equal to 360|b|), it is more typical for teacher descriptions to be somewhat vague. For example,

- b slider alters the period
- b alters the period of the sine function. The closer the b value is to 0 the longer the period, the closer b is to negative and positive infinity the shorter the period.
- Slider b alters the period of the function. b stretches and compresses the function horizontally and when b is negative the function flips over the y axis.

Note: Teachers' responses to pages 6 and 7 (i.e., amplitude and midline) are similar to page 8 in that some are quite vague and some are mathematically precise. Though they tend to lean more precisely than they did for the period on page 8.

Page 9:



Without a graph to identify the amplitude, midline, and period by inspection (as they could on prior pages), teachers sometimes struggle to identify the period of this function. However, given this is prior knowledge for teachers many look up how to determine the period and successfully do so. It is important to push on their understanding of why the period is found by dividing 360 by the value of b.

Sample responses include:

- The amplitude would be 2 because that is what our a is in this equation. The period would be 4 because that is what our b is. The midline would be 1 because that is what our k is.
- To find the amplitude, we should look at the a-value, which is 2. This implies the amplitude is 2. The b-value of 4 can help us in determining the period. The period of this equation should be $\frac{360}{4} = 90$. Finally, the midline for this equation is $y = 1$ as the k-value of 1 moves the entire function up one.
- By the equation, the coefficient in front of the sin is the amplitude, the period can be found by dividing 360 by the coefficient in front of the x, and the midline is equal to the line $y =$ the variable added/subtracted outside the parentheses. In this case, the amplitude is 2, the period is 90, and the midline is $y = 1$.