[Module 7 Overview Document]

*Table 1: Timeline of Tasks in the Module*

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| **Timeline of tasks in the Module** | Day 0 | Homework | 7.1 Introduction to the Sine Graph Desmos Task |
| | Day 1 | 20 min | 7.1 Discussion<br>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 |
| | | 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) |

## 7.3 Facilitation Notes

We imagine this task taking place during class. The purpose of the task is to notice (attend, interpret, and decide) student thinking in the context of teacher-student small group interactions. This will provide teachers an opportunity to not only make sense of student thinking in a technology-mediated learning environment, but also consider the ways in which teacher responses to student thinking can support students' progress toward learning goals.

It is important that teachers have engaged with 7.1 Introduction to the Sine Graph prior to engaging in this task. In addition, it is important to emphasize the context of this lesson—that it took place in Spring 2021 in a remote environment (Zoom). Prior to beginning the task, it is helpful to let teachers know that most students have elected to not turn on their cameras, so they are not surprised by this.

If teachers have not used the Desmos Teacher Dashboard before, it is important to show them what it looks like, so they are aware of the information that Ms. Fye (the teacher in this video clip) has access to as she is monitoring the students' progress. Ideally this view was used when discussing 7.1. In addition, you might consider sharing Ms. Fye's completed dashboard (linked below), but it is important to note that her dashboard is now complete (i.e., the students finished the task); it does not represent what she saw as the students were working.

[Completed Teacher Dashboard]

This task could be facilitated in multiple ways. You might have teachers work through both scenarios in pairs or small groups and then come together to discuss them both. Another option is to have teachers (again working in pairs or small groups), complete only scenario 1 (discuss responses to Q1 and then do Q2 as a whole class) and then do the same for scenario 2. If time allows, we recommend the second option.

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# 7.3 Sample Responses
# Noticing Student-Teacher Interactions

## Context

Ms. Fye is using the Introduction to the Sine Desmos task in a remote synchronous class session. There are eight students present for the lesson. After the task is launched, Ms. Fye put students in breakout rooms in pairs to work together on the task. Ms. Fye is monitoring the students' work on the Desmos teacher dashboard and by moving in and out of the breakout rooms.

Introduction to the Sine Desmos Task

Ms. Fye's learning goals for the activity are listed below:

- Students will recognize the connection between the structure of a sine function equation (i.e., $y = a\sin(bx) + k$) and its related graph with respect to amplitude, midline, and period. Specifically,
    - Amplitude is $|a|$
    - Midline is $y = k$
    - Period is $\frac{360}{|b|}$

Specific performance goals include:

- Given a sine function equation, students will determine the amplitude, period, and midline without graphing.
- Given the amplitude, midline, and period, students will determine the function equation.
- Given the graph of a sine function, students will determine the amplitude, period, and midline.
- Given the graph of a sine function, students will determine the function equation.

## Scenario 1:

A pair of students, Allison and Jonathan, are working on page 8 of the activity and have just called Ms. Fye into their breakout room for help.

Watch the first minute of Ms. Fye monitoring Allison & Jonathan

## Transcript of the first Minute

| | |
|---|---|
| Jonathan: | I have a question for number 8. I don't like really know the exact value. |
| Ms. Fye: | I was just going to ask you about number 8. Ok, so what are your initial thoughts about period? |
| Jonathan: | We said 360, but like I feel like. |
| Allison: | I think its 360. |
| Ms. Fye: | Yeah. |
| Jonathan: | Ok. |
| Allison: | Because when you're looking at the number 1, like the points its like, so that first one for example, is at 90 comma 1, and then the next one is at 450. So like, the distance between that is 360 when I subtract it. |
| Ms. Fye: | Yes, good reasoning |
| Allison: | 270 and 90, so you would be adding that instead and that's 360 |

**Q1.** How would you use the technology and respond to the students addressing their questions? Be specific.

Most teachers do a good job of posing assessing and advancing questions, but fewer of them are explicit about how they will use the technology to support the students. Example responses are shown below:

- Ask students to share their screen and ask where the students got 270 and 90 from. Does the adding strategy work for finding periods between further peaks?
- Show how they found the period from the graph. What specific points on the graph did you look at? Address Jonathan directly to make sure that he understands since he seems to have some confusion about what the period is.
- We might ask Jonathan to explain what he was thinking, because he started to explain something but Allison started talking then. We could ask them to explore the function on slide 5 and see how the distance between the peaks changes as they change the equation.
- Which points did you look at to find the period? Click both of these points on your sine graph so that both their x and y coordinates are visible. Our definition tells us that period is the distance from peak to peak. What direction is this distance in? How would you find this distance? What else do you notice about the coordinates of the peak points you have selected? What can you tell us about the period?

**Q2.** Now watch the rest of the video and take note the way that Ms. Fye elicits and uses the students' thinking as well as the technology to support them in making sense of the period of the function. Write down two things Ms. Fye does in her interactions with the students that you particularly like, and explain why you like it.

Watch Allison & Jonathan

Teacher responses typically include the following:

- I like that she shares her screen with the graph and sliders. This way she knows that Jonathan and Allison are looking at the same thing.
- I like that she asked what kind of relationship it is. This is connecting to the students' prior knowledge of direct and inverse relationships.
- I like that she asks the students what values they want to try for $b$ to test it. This is allowing them to drive the discussion and what they are curious about.
- I like that she pushes the students to look at more values to see if what they are conjecturing holds true.
- She shares her screen and the graph and highlights points on the graph. This is helpful because she is supporting the students to continue to explore.
- I like that she goes back and has students look at what the found for each $b$ they had tested and asks about the relationship again. This might support them in looking for a pattern (to predict) rather than having just a bunch of separate examples.
- I like that she shows on the graph where the function starts and finishes and asks how many times the function cycles. This supports the students' in making sense of the period and the graph.

## Scenario 2:

Imagine a pair of students, Martina and Omar, are working on page 14 of the Activity (shown below). They call you into their breakout room for help.

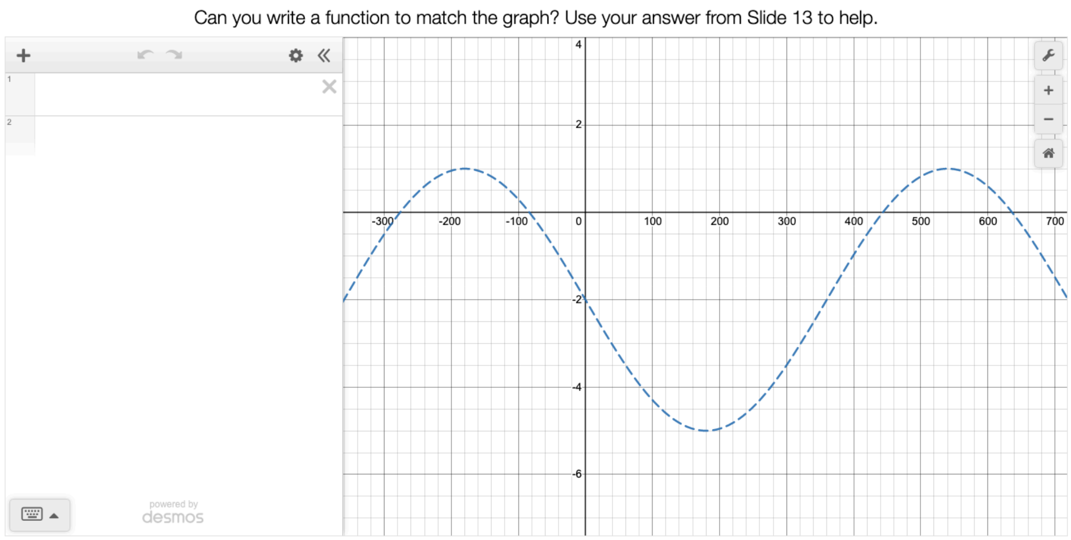


Figure 1. Page 14 of the Introduction to Sine Desmos Activity

Omar: We're just a bit confused about page 14. Amplitude? Is that 3? Or is it -3?

Martina: Yeah, we're not sure which it should be.

Teacher: How might we use the sliders to help us figure this out?

**Q3.** Imagine you are the teacher. Write the next 8–10 lines (i.e., talk turns) of dialogue for how you would continue this discussion towards supporting the students in figuring out the answer to their question.

Sample 1:

Student: We can change the sliders to see how the functions moves.

Teacher: Right! So is there a certain type of movement we are looking for regarding amplitude?

Student: Well, we are looking specifically at amplitude on this slide, so would we look at how that changes?

Teacher: We would definitely want to pay attention to how that changes.

Teacher: What's something that stands out about the amplitude when you move the slider?

Student: The amplitude changes based on the number the slider is.

Teacher: That's right! Is there anything else? What about the signs of the slider? Does that change anything?

Student: Well, it looks like the amplitude is always a positive number even if the slider is negative.

Teacher: That's a really good point! Amplitude is the ***distance*** from the maximum point to the midline, so can we ever travel a negative distance?

Student: No. So then the answer would be 3 not -3 since amplitude is positive.

Sample 2:

Omar: We're just a bit confused about page 14. Amplitude? Is that 3? Or is it -3?

Martina: Yeah, we're not sure which it should be.

Teacher: Hmm, what was the definition of amplitude that you were given?

Student: Let me go back and look.

Student: It is the height from the center line to the peak or we can measure the height from highest to lowest points and divide that by 2.

Teacher: Okay. Now, let's go back to the page where we have our sine graph and the sliders

Teacher: Given the definition we looked at, I want you to play with the sliders and tell me which changes amplitude

Student: The $a$ slider does.

Teacher: Nice! So, if $a = 2$, then what is your amplitude?

Student: 2.

Teacher: How do you know?

Student: I took the distance from the minimum to the maximum and divided it by 2.

Teacher: Now, set $a$ to -2 and tell me the amplitude.

Student: It is the same because the distance from the min to the max divided by 2 is still 2.

Teacher: Now, keeping this definition in mind, go back to page 14 and find the amplitude.

Sample 3:

Student: We could try changing the values on the sliders.

Teacher: Since we're looking at the amplitude on Page 14, which slider did you two decide corresponds with the amplitude? Which one changes the amplitude?

Student: $a$ changes the amplitude.

Teacher: Slider $a$ changes the amplitude. How did you two decide that? How do you know that it's slider $a$?

Student: Because page 6 says that the amplitude is the height of the function, and slider $a$ changes how tall or how short or compressed the curve is, so $a$ has to change the amplitude.

Teacher: Nice, I like that line of thinking. Back to what you were asking, you're debating 3 or -3, right? Try changing the value of $a$ to 3 and -3. What do you notice?

Student: Well, when $a$ is 3, the curve is going up after the $y$-axis. When $a$ is -3, the curve is going down after the $y$-axis.

Teacher: That's a really good observation. Now check back with page 14. What does that graph look like?

Student: The graph on page 14 is going down after the $y$-axis, so the amplitude must be -3, because then that function will be going down at the same parts.

Teacher: It's true that the function needs a -3 to be decreasing at the same places, so you're right in that regard. However, I just want to point out something with the notation of it. You said the amplitude is the height of the function, right? Go back to page 5 with the sliders, and try 3 and -3 again, and this time compare the height of the functions. What do you notice?

Student: Even though one goes up and one goes down after the $y$-axis, both of them have the same height. They both go from -3 as their minimum and 3 as their maximum, just at different times.

Teacher: Great observation. So what does this tell us about the amplitude of these functions?

Student: Even though the function needs a -3 in front, the negative just changes when the function increases and decreases, and doesn't change the amplitude or height of the function. The amplitude is always positive.