Module 3 Overview Document

Table 1: Timeline of Tasks in the Module

Timeline of tasks in the Module	Day 0	Homework	3.1 Function Carnival Task
	Day 1	15 min	3.1 Discussion
		60 min	3.2 Anticipation of Student Work and Introduction to Desmos Teacher Dashboard
			3.2a Anticipate Cannon Man
			3.2b Anticipate Cars
			3.2c Anticipate Ferris Wheel
		Homework	3.3 Noticing Student Thinking: Function Carnival Task
	Day 2	30 min	3.4 Analyzing & Supporting Emergent Student Thinking (Only the Cars Simulation of Function Carnival)
		45 min	3.5 Monitoring Students' Work on the Function Carnival Task (Only the Cars Simulation of Function Carnival) Either needs to be homework or completed as a whole class through discussion and watching the videos.

3.1 Facilitation Notes

Day 0 (Homework)

Create a class code for the Function Carnival Desmos Task and provide the link to your teachers. We recommend asking teachers to log in so that the task 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.

Function Carnival Desmos Task

NOTE: This version of the Function Carnival Task is slightly different from the version used in the rest of the module. We recommend doing the newer version linked here as a learner. We will point out in other tasks (via the facilitation guide) when it is helpful to examine the original version.

We recommend assigning Johnson, Hornbein, & Azeem (2016) as a reading for AFTER teachers complete the task as a learner. This practitioner article focuses on the mathematics in a similar Ferris Wheel task and will help teachers make sense of the overarching mathematical goals in this module.

See the Sample Responses below to prepare yourself for a whole class discussion the following day.

Day 1

Have the teachers login to their Desmos account and review their work on the different carnival tasks. We suggest allowing small groups of teachers to discuss prior to opening the discussion to the whole class. Have the teachers discuss the task they found most difficult for themselves as a learner and then which students' thinking they found to be the most difficult to interpret.

3.1 Sample Responses
Engage in Function Carnival Task

Below are sample solutions that teachers might provide for the prompts in the Function Carnival Desmos Task.

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The first simulation that teachers will model is Cannon Man. In Cannon Man, a man is shot vertically out of a cannon, reaches maximum height, starts to fall, and then a parachute opens, so the man falls more slowly to the ground.

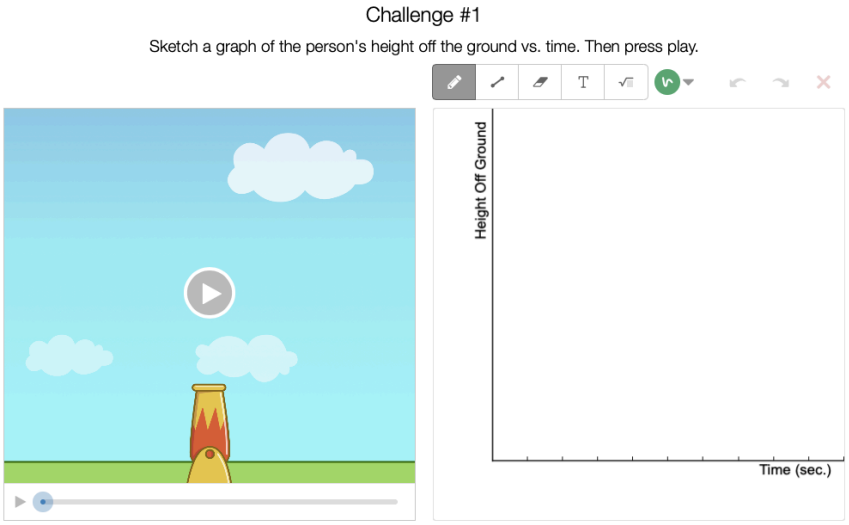

Figure 1. Blank Graph of Cannon Man's Height v. Time

Most teachers will create relatively accurate graphs within the first few tries. The picture below shows a class of solutions along with the precise graph (in green).

Notice there is one graph that is tracing the path of the Cannon Man rather than the height vs. time. This picture was taken when a teacher joined the task late, and this was their first attempt. We include this to note that some teachers might begin by drawing the path of the man, much like younger students may do.

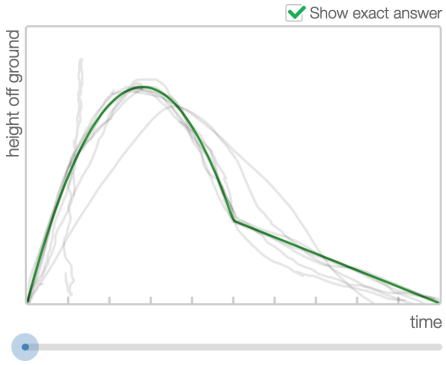

Figure 2. Class of Responses along with a Precise Graph

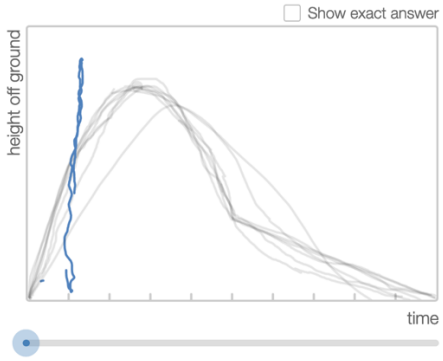

Figure 3. Graph Tracing Cannon Man's Path

Page 3:

Students are asked to consider Alejandro's graph of the Cannon Man simulation.

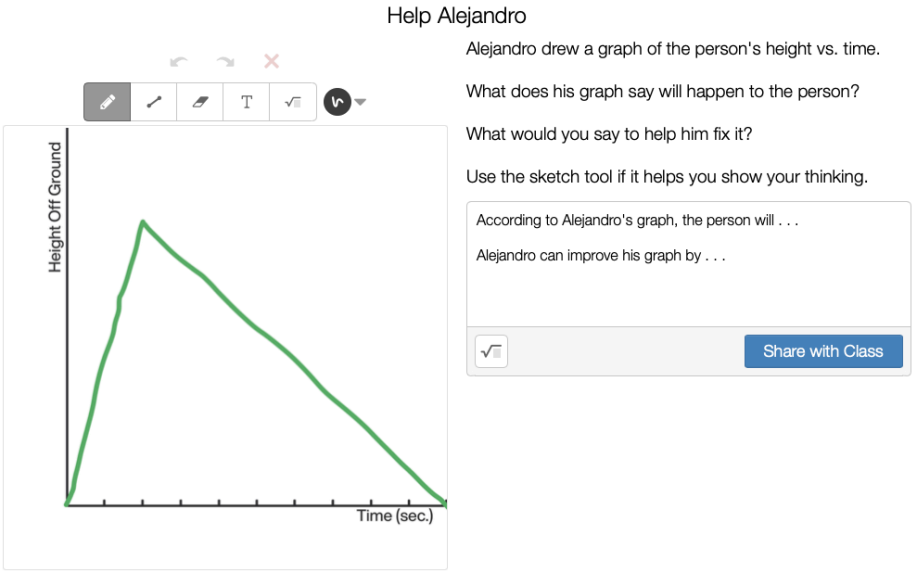

Figure 4. Alejandro's Graph of Cannon Man

Responses to this item ideally address Alejandro directly, describe what his graph says will happen to Cannon Man and suggest something that will help Alejandro think about the connection between his graph and the context.

Sample teacher responses to this item include:

According to Alejandro's graph, the person will…

- Reach the highest point at about 2 seconds. It also looks like the person falls at a constant rate.
- Go up at a constant rate until s/he reaches the peak, then come back down at a slightly slower rate.

- Go straight up at a consistent, fast rate and then come back down at a consistent slower rate.

Alejandro can improve his graph by…

- Making the graph's peak located at 2. The person falls quickly at first and then slower once the parachute pops out.
- Changing the slope of her/his descent to go faster when the person does not have the parachute out, then go much slower once the parachute is out.
- Observing the person goes up and down at the same rate until s/he pulls out the parachute, and goes at a slower rate and that happens at about half way down, not when s/he reaches the max point.
- Making the going upwards less steep and make a better curve near the top

Page 4:

Students are asked to watch the video of bumper cars and note quantities that might be interesting to look at on a graph.

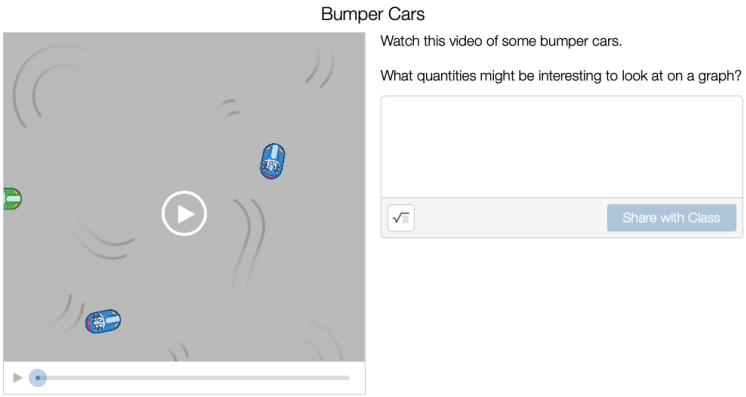

Figure 5. Observe the Bumper Cars

Sample teacher responses to this item include:

- The distance vs. time. Where was the car when it crashed and at what time stamp?
- The movement of the green car and the blue car
- The speed of the different cars
- The speed and acceleration of each car.

Page 5:

The second simulation that teachers will model is Bumper Cars. In Bumper Cars, a green car is driving in a curved path among other cars and eventually crashes with another car and stops moving.

An overlay of sample teacher graphs of the distance traveled vs. time for the green bumper car is shown below.

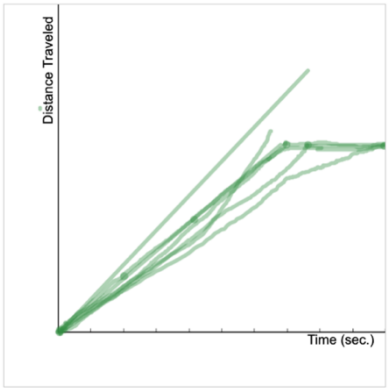

Figure 6. Class of Responses

Page 6:

Students are asked to consider Tameeka's graph of the Bumper Cars simulation.

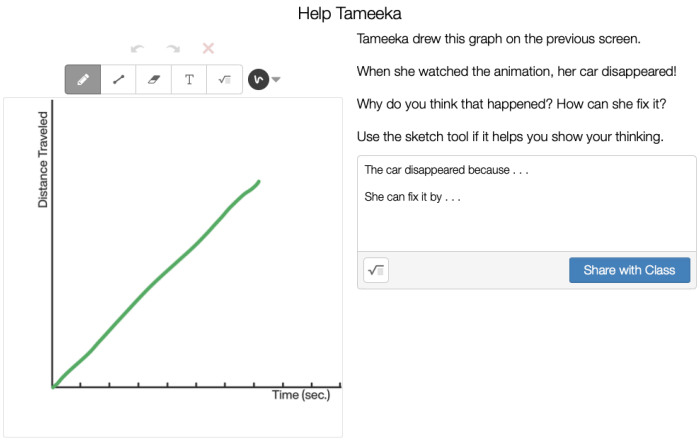

Figure 7. Tameeka's Graph of Bumper Cars

Sample teacher responses to this item include:

The car disappears because…

- She has no data graphed for it after about 7 seconds.
- Her graphs ends before time ends.
- She cut off her graph instead of showing that the car did not go anywhere after it crashed.

She can fix it by…

- Making the graph from x=7 to the end of the domain a straight line with zero slope.
- Continuing the graph of the distance traveled with a horizontal line at the peak to show that the car did not move any more, but still existed at those points in time.
- Lengthening the time.

Page 7:

The last simulation that teachers will model is a Ferris Wheel. Before modeling it, teachers are asked to describe what happens in the simulation.

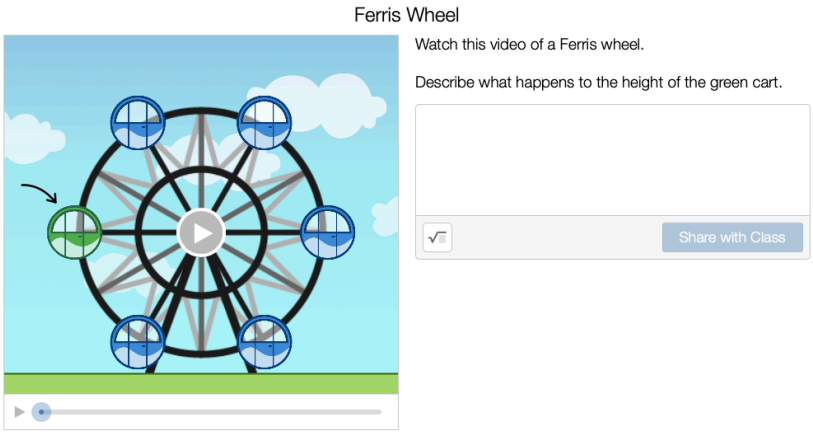

Figure 8. Observe the Ferris Wheel

Sample teacher responses to this item include:

- The height starts decreases, reaches a minimum, and then begins increasing until it reaches a max. Then it begins decreasing again until it reaches the height it began at.
- The height of the green cart is halfway between the height of the Ferris Wheel. The Ferris Wheel moves counterclockwise at a constant speed. It goes in a cycle and comes back to place.
- If goes down at a constant speed and then up at a constant speed and then down again.

Page 8:

Next, teachers are asked to graph the green cart's height from the ground over time as it travels around the Ferris Wheel.

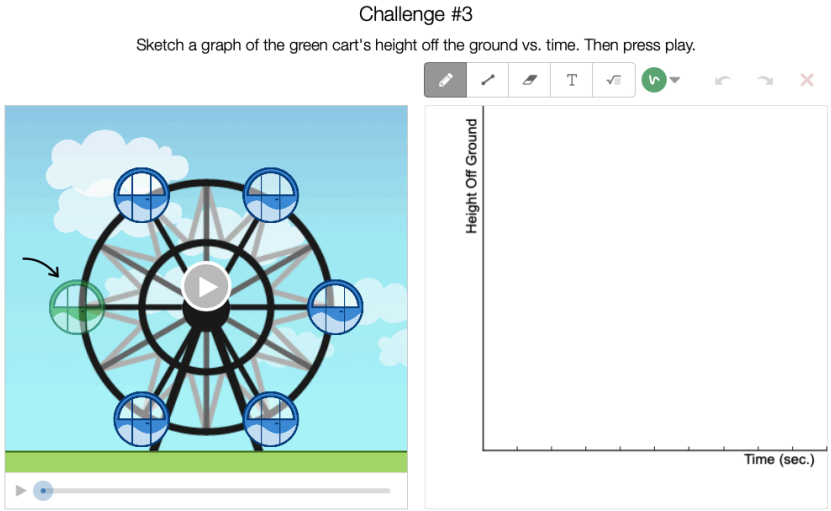

Figure 9. Blank Graph of Green Cart's Height v. Time

Most teachers will create relatively accurate graphs within the first few tries. The picture below shows a class of solutions along with the precise graph (in green).

Notice there is one graph that includes “sharp turns” at the local maximum and minimum points. This is not uncommon as most teachers refinements will be focused on making sense of how to represent the cart's changing height at those time intervals.

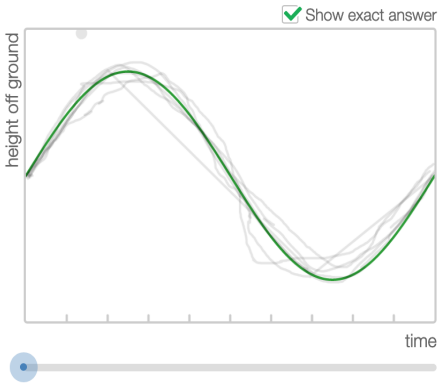

Figure 5. Class of Solutions Along with a Precise Graph

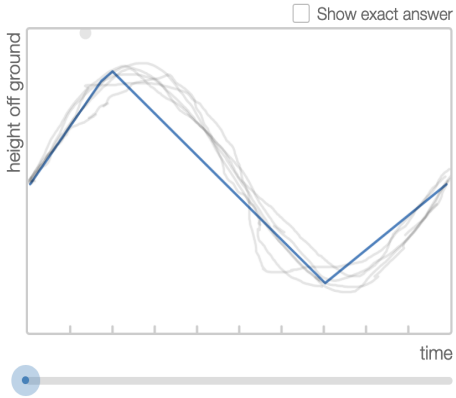

Figure 6. Graph with Sharp Turns at Maximum and Minimum Points

Page 9:

Students are asked to consider Liam’s graph of the Ferris Wheel simulation.

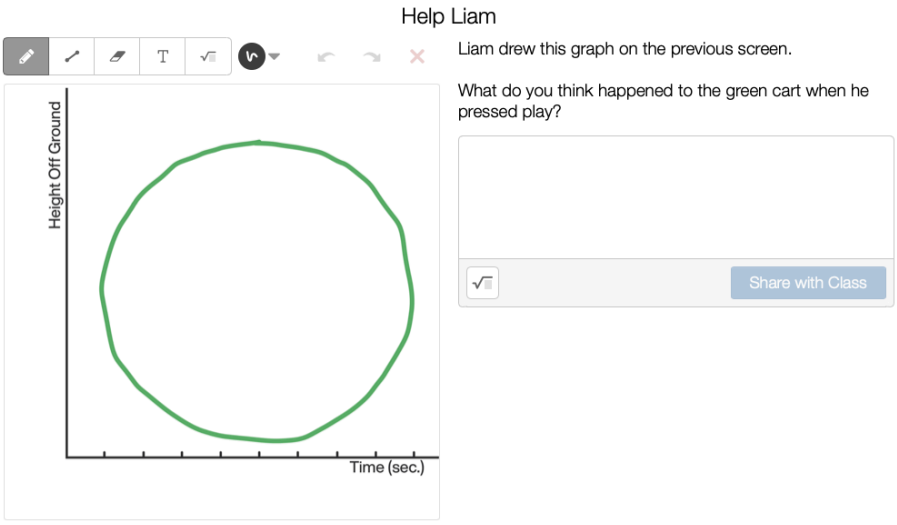

Figure 7. Liam’s Graph of the Ferris Wheel Simulation

Sample teacher responses to this item include:

- I do not think this would work because there are multiple y values for one x. The cart cannot be in 2 places at one single time.

- I think the green cart probably did not move at all because it could not simultaneously go in two different directions like the circle suggests.
- The green cart split in 2?