

## MacroLab Lesson 3

### Mean, Median, & Mode: Student Guide

This lesson builds on the previous 2 in a more open-ended, experiment-based way. You are going to be using Sphero to knock over an object that your teacher has set up a few feet away. In this lesson you will use division to see how much delay is needed for sphero to reach a target at different speeds. At the end of the lesson you will use Sphero to knock over whiteboard markers, or other objects in a bowling challenge that explores Mean, Median, and Mode. The Macrolab commands you are going to use in this lesson are:

 Roll – Makes the Sphero roll at a given speed and heading.

First you have to connect Sphero to the iPad (Part 1), then aim it (Part 2), and then there are two activities (Part 3 and Part 4), and finally a challenge to see if you can apply what you've learned (Part 5).

### Review of Milliseconds, Rate, Distance, and Time:

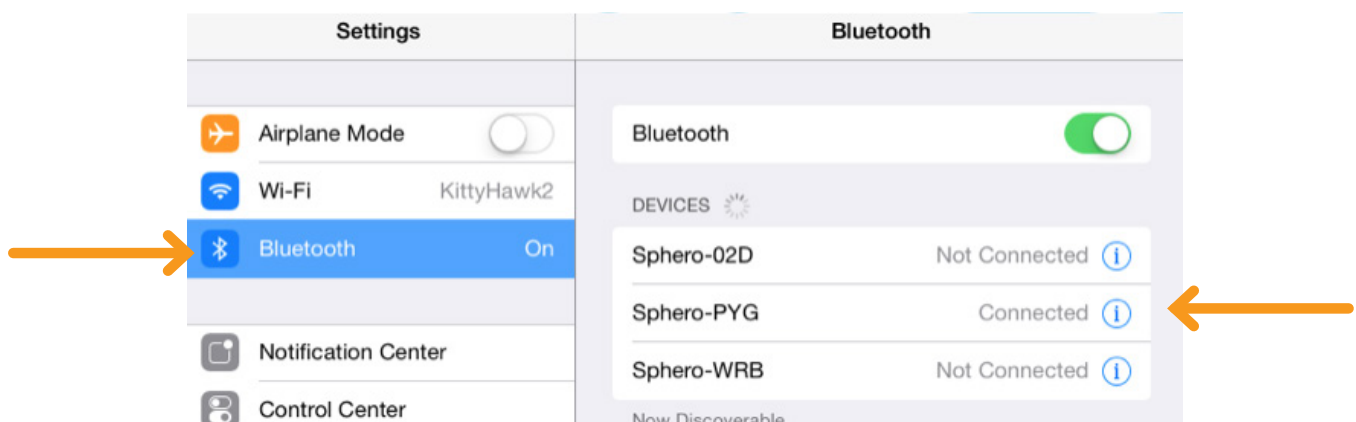
Remember from MacroLab Lesson 1 that Sphero delays are programmed in milliseconds, or 1/1000 of a second, so to roll for 1 second you will use delay of 1000 ms. Also from MacroLab Lesson 1, rate, time and distance are all related and you can calculate any one of them using the other two.

Rate (speed) = Distance / Time (delay)

### Part 1: Connect the Sphero

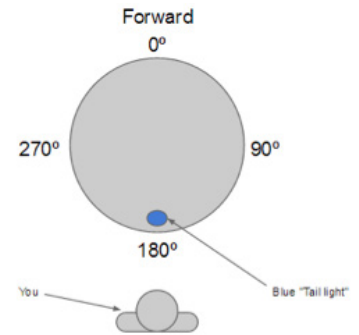
First thing you need to do is to connect the iPad to Sphero. Here's how:

1. Pick up Sphero from its charging station and tap it twice on the logo to wake it up. You may have to tap it hard. It will start flashing colors when it is awakened out of its "sleep" state.
2. On your device, make sure Bluetooth is enabled. From the home page, click on Settings at the bottom. Then choose Bluetooth.
3. You will be shown a list of Spheros. Connect to the appropriate Sphero by tapping it. You can tell which Sphero is which by the names, which relate to the colors the ball is flashing. For example, if it flashes purple, then yellow, then green, then that is ball PYG. Select the one you want. Once successfully connected, it will say "Connected".



## Part 2: Aiming Sphero

Sphero has a direction built into it that it thinks of as “straight ahead”. This is called the orientation. The first thing we want to do is to aim the Sphero so that the orientation is on the path we want it to go. Each Sphero has a blue light inside of it called the “taillight”, which is always on the exact opposite side of the straight ahead direction. You are going to set the taillight so that it’s pointing right at you when you look down the path you want Sphero to go. Then, when it goes straight ahead, it will be on that path.



Follow these steps to aim the Sphero:

1. Go to the home screen and open MacroLab.
2. Have one of you hold the Sphero and stand at the beginning of the path you will use for your experiments. Have them face the direction the Sphero should roll, and hold the Sphero directly in front of them.
3. Now, you will aim the Sphero in that direction. Have a second member of the group use the iPad. In MacroLab, you will see a circle with two arrows at the bottom center of the screen. Tap on it and hold it.



4. A white circle will appear. Move your finger slightly to rotate the insides of the Sphero. You will see a blue light inside the ball. Move it around until the blue light is directly facing the person holding the Sphero. This is the “taillight”, and shows the direction opposite where the Sphero will move when moving straight ahead.



## Part 3: Reaching the Target

1. Now that we have the Sphero going in the right direction, follow these steps to reach the object that your teacher set up for you to knock over such a whiteboard marker. Tap the + button at the bottom to create a new macro.



2. Where it says Macro Name, call it Bowling. Click Create Macro.

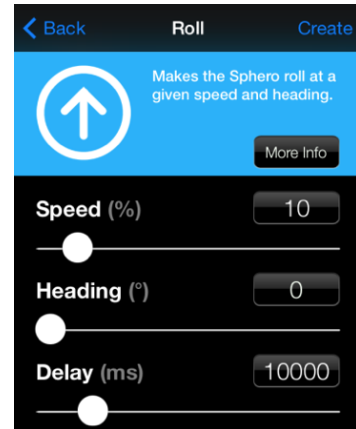


## Part 3: Reaching the Target (Continued)

3. Add a new command by clicking the + button.
4. Choose Roll

Using only 10% speed, test different delays to see what the delay should be so that Sphero knocks over the target object and stops within 6 inches of that object.

5. To do this set the speed to 10% and the delay to a value of your choice, keep the heading at 0 degrees. Click Create.
6. Record on your worksheet each delay value that you try.
7. Record on your worksheet the delay value that was successful in knocking over the object.



## Part 4: Calculations

Once you have identified the right amount of delay it is time to make some calculations to figure out how long of a delay will be needed to reach the same target when moving at higher speeds.

1. Now that you know the delay needed at 10% speed, use math to figure out how much delay is needed to reach the object when moving at higher speeds.
2. Fill in the table in your worksheet, there is an example calculation already done for you for 20% speed
3. Test out your math and run trials to see if you can knock over the object at 30%, 50%, 80%, and 100% speeds. Only do 3 trials for each speed and see if you can be successful at all speeds.

## Part 5: Challenge

As a group you will have 5 tries to knock over all 5 whiteboard markers (or other object used for pins).

1. As a team, determine what speed and delay you want to use to knock over as many objects as possible
2. Once you are ready, let the teacher know you want to run your tests. You will have 5 minutes to run your trials; you can make adjustments after each run.
3. Keep track of how many markers you knock down for each trial on your worksheet.
4. Once you have these trials complete and have recorded your results add them to the master list for the class
5. Once the master list is complete, on your worksheet record all the trial results in order from lowest to highest.
6. Determine the Mean, Median, and Mode of this data set.

## MacroLab Lesson 3 Mean, Median, & Mode: Teacher Guide

### Names:

Part 3:

List the delays are you trying to just reach the target at 10% speed:

What delay worked best to reach the target?

Delay	Result
(Example 20,000 ms)	(Moved too far past target)

Part 4:

Using the delay value you found and the fact that Sphero is moving at 10% speed can you figure out what the delay should be at 30%, 50%, 80% and 100%. to reach the same target.

Remember: Delay X speed = distance

% speed	10	30	50	80	100
delay (ms)					
delay that knocked over object (ms)					

Part 5:

What speed and delay will you use to knock over the pins? \_\_\_\_\_

Trial #	1	2	3	4	5
Pins knocked over					

List all bowling results from the class, from lowest to highest:

What is the median?

What is the mode?

What is the mean?