SPHEROS TO THE RESCUE

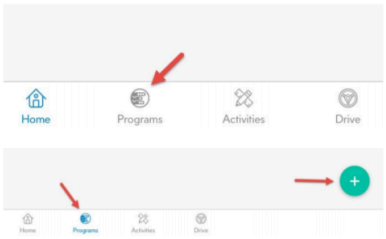
Objectives: With your group of 3 people, program your Sphero to allow you to examine the following situations.

Questions to Think About:

- How do you calculate the velocity of a moving object? (What information do you need? How are you going to get it?)
- How do you calculate the acceleration of a moving object? (What information do you need? How are you going to get it?)
- What should the motion map of objects undergoing different types of motion look like?
- What should the D/T graphs of objects undergoing different types of motion look like?
- What should the V/T graphs of objects undergoing different types of motion look like?

PRE LAB: Getting to know your sphero

1. You will bring your ipad to the teacher to be paired with a sphero.
2. Open the sphero EDU app and connect
3. On the bottom you will see a box labeled programs, open this, tap create and give a title- Eglite group __ (one members last name)



4. Tap the movement icon, you will drag the roll up under this there are three options: time (per segment), heading (keep 0) and speed (0-255 cm/sec = approx up to 2.5m/s) (**you can use your finger to move the speed marker up and down, or it is easier to tap on it and manually put in the speed)**

***this is a great tutorial to also get you started
https://drive.google.com/file/d/0B8I5sVYmaiiiUjAtWkdvVEZyTDA/view?usp=sharing

A few tips to make things easier!

→ use the roll function to bring the sphero to a stop, NOT the stop button. This seems to give better data (ex: bring to 0 cm in 5 sec)

→ use the backwards to turn the sphero around.

→ aim the blue light on the sphero so that it is pointing to the starting point/you before you begin and that will help keep it straight

→ DON'T use the drive function to move the sphero

→ If you lose connection- you are probably too close to other spheros--give some space so the signals aren't getting mixed up!

5. now take about 5-10 minutes to play around with your new friend to make sure you are able to get him/her to behave the way you would like before you begin Part 1
6. Jot down any notes/reminders as you are experimenting with the Sphero

Part One - Constant Velocity

Part 1: How Fast Does Sphero Move?

Objectives

- Using the Sphero EDU App, students will program Sphero to move at specific speeds over a fixed distance.
- Students will record distance and time data and then calculate Sphero's actual speed.
- Students will be able to translate Sphero's speeds into meters/second.

Procedure ~ Speed Setting 50 (out of 255):

1. Mark out 0, 1, and 2 meter on the floor using a meter stick and masking tape.
2. Create a program that will move Sphero **at a constant speed of 50** for at least 2 meters. *This is important because Sphero must be moving at full speed before it reaches the starting mark of the timing zone.*
3. Test out your program to make sure that;
    a. Sphero reaches full speed before reaching the starting mark.
    b. You have aimed Sphero correctly to go straight through the timing zone.
4. Run your program and record the amount of time it takes Sphero to move from the 1 meter to 2 meter marks using the stopwatch function on a smartphone or tablet. Record the data in Figure 1. **Do not round the data.**
5. Repeat step 4 *at least* two more times. (Re-do any trial that results in an outlier).
6. Calculate the average of all trials and record that value in Figure 1 [Average Speed at 50].

Procedure ~ Speed Setting 100 (out of 255):

7. **Prediction:** Based on the speed calculated for 50, predict Sphero's speed in meters/second at 100 _____. Record your prediction in Figure 1 [Prediction at Speed Setting 100].
8. Repeat Steps 2-5, but change Sphero's speed to 100.
9. Calculate the average of all trials and record that value in Figure 1 [Average Speed at 100].

Procedure ~ Speed Setting 150 (out of 255):

10. **Prediction:** Based on the speeds calculated for 50 and 100, predict Sphero's speed in meters/second at 150 _____. Record your prediction in Figure 1 [Prediction at Speed Setting 150].
11. Repeat Steps 2-5, but change Sphero's speed to 150.
12. Calculate the average of all trials and record that value in Figure 1 [Average Speed at 150].

Figure 1: Time Trials and Average Speeds

	Prediction (m/s)	Time Trial 1 (s)	Time Trial 2 (s)	Time Trial 3 (s)	**Average Time**	**Average Speed** (m/s) (d=1 m)
Speed Setting 50	X					
Speed Setting 100						
Speed Setting 150						

Analysis:

1. How accurate was your prediction of Sphero's speed at 100? (Almost exact? Less than 0.2 m/s different? More than 0.2 m/s?).

2. How accurate was your prediction of Sphero's speed at 150? (Almost exact? Less than 0.2 m/s different? More than 0.2 m/s?).

3. Based on your data, predict Sphero's speed in meter/second at speed setting 255. Explain your reasoning and show your work!

4. Ask two other groups for the Average Speeds they calculated. Record that information in Figure 2.

Figure 2: Average Speed Comparison

	Average Speed (m/s) (Your Group)	Average Speed (m/s) Station _____	Average Speed (m/s) Station _____
Speed Setting 50			
Speed Setting 100			
Speed Setting 150			

4. Do the speeds your group calculated match the speeds calculated by the other groups? Are they even close? Explain any differences or similarities in detail.

Conclusion:

1. Spheros are manufactured so that each one performs exactly the same. Identify a source of experimental error and explain how that error could have impacted the results. Make sure to use the data collected to support your explanation.

Part Two - Acceleration (Speeding Up)

Question: How does the speed of an object affect its velocity, acceleration and force?
Materials: Sphero, trundle wheel or meter stick, stopwatch/timer, iPad, Sphero cover, Graph Paper

Procedure:

1. Using the trundle wheel measuring tape, measure and mark off ten meters on the floor.
2. Open the Sphero EDU APP and set Sphero to 25% speed (63.75 in Speed settings). (remember you can tap on the number to manually change the speed settings)
3. Drive the sphero with no cover recording the time at 6 meters.
4. Repeat the test 2 more times and calculate the average time.
5. Next, set Sphero to 50% speed (127.50 in Speed settings).
6. Repeat it two more times and calculate the average time.
7. Next, set Sphero to 75% speed (191.25 in Speed settings).
8. Repeat it two more times and calculate the average time.
9. Next, set Sphero to 100% speed (255 in Speed settings).
10. Repeat it two more times and calculate the average time.
11. Using the data collected from the experiment, calculate Final Velocity, Acceleration and Force
12. Answer question: How does the speed of an object affect its velocity, acceleration and force

Set Sphero speed to 25%	Time (s)	Distance (m)	Final Velocity (v=d/t)	Acceleration ($a=v_f-v_i/t$)	Mass (kg)	Force (mass*a)
Trial 1 time:		6m			.453492	
Trial 2 time:		6m			.453492	
Trial 3 time:		6m			.453492	
Average:		6m			.453492	

Set Sphero speed to 50%	**Time (s)**	**Distance (m)**	**Final Velocity (v=d/t)**	**Acceleration ($a=v_f-v_i/t$)**	**Mass (kg)**	**Force (mass*a)**
Trial 1 time:		6m			.453492	
Trial 2 time:		6m			.453492	
Trial 3 time:		6m			.453492	
Average:		6m			.453492	

Set Sphero speed to 75%	**Time (s)**	**Distance (m)**	**Final Velocity (v=d/t)**	**Acceleration ($a=v_f-v_i/t$)**	**Mass (kg)**	**Force (mass*a)**
Trial 1 time:		6m			.453492	
Trial 2 time:		6m			.453492	
Trial 3 time:		6m			.453492	
Average:		6m			.453492	

Set Sphero speed to 100%	Time (s)	Distance (m)	Final Velocity (v=d/t)	Acceleration ($a=v_f-v_i/t$)	Mass (kg)	Force (mass*a)
Trial 1 time:		6m			.453492	
Trial 2 time:		6m			.453492	
Trial 3 time:		6m			.453492	
Average:		6m			.453492	

1. Create a graph for each of the following: Average Velocity (d/t graph) and Acceleration (v/t graph)
2. How does the Sphero´s set speed affect the time it takes for the Sphero to travel the 6 meters

3. Using the average numbers only, explain how the set speed affects acceleration

4. How did the force change with an increased speed?