MacroLab Lesson 5
Patterns & Colors: Student Guide

You are going to be using Sphero to program patterns. Sphero can be programmed to change colors for different durations. You are going to be creating Macros that do just that. This lesson will challenge you to solve and generate patterns as well as send a message in Morse Code by programming your Sphero to light up in the correct series.

The Macrolab commands you are going to use in this lesson are:

RGB – Changes the color of the Sphero.

Delay – Waits for a while before doing the next step.

First you have to connect Sphero to the iPad (Part 1), and then there are three activities
(Part 2 - Part 4), and finally a challenge to see if you can apply what you've learned (Part 5).
An extra challenge using math patterns is provided in Part 6.

Colors and Patterns

For review, feel free to refer back to MacroLab Lesson 2 where you first explored programming Sphero to change colors. Patterns are all around us and it is important to be able to recognize and analyze as well as create patterns.

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".
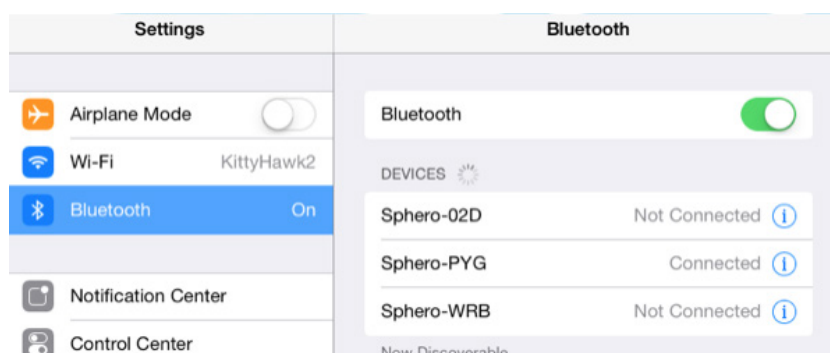
Part 2: Colors

Now that we have Sphero connected, follow these steps for the first experiment:

1. Select the preloaded program called Rainbows
2. Press play and watch the program
3. Click Macros in the top left corner to move back to the main MacroLab screen.
4. Now we are going to try to create a better rainbow
5. Tap the + button at the bottom to create a new macro.

6. Where it says Macro Name, type my rainbow. Click Create Macro.
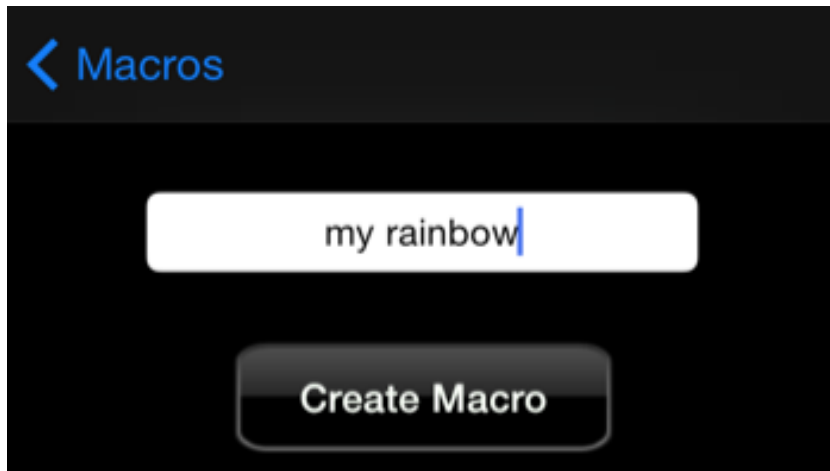
7. Add a command by tapping the + button at the bottom right.
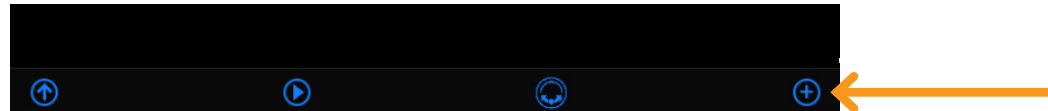
8. Tap the Add (+) button at the bottom of the screen. Tap on RGB (which stands for "Red, Green, Blue"), the third command in the list.

9. Drag the slider for red to the right for 100% in order to make a red color. Slide the green and blue sliders to the left for 0%. Slide the delay to 0, we will use the next command to make the color delay for 1 second. Click Create.
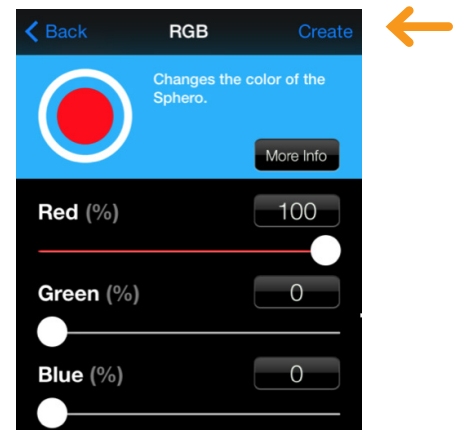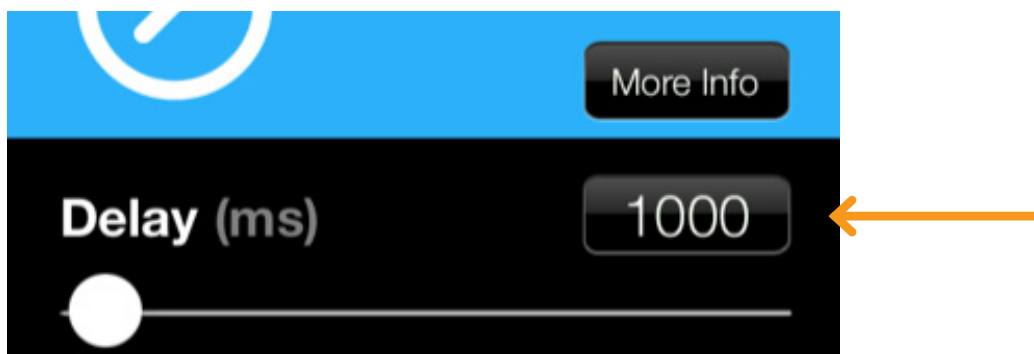
Part 2: Colors (continued)

10. Now let's add a one second delay so that you can see the color for one second. Tap the + button to add a new step.

11. Tap the Delay button.

12. Choose 1000 ms delay. It may be easier to click on the box and type in 1000 than using the slider. Click Create.

13. Now you will create the next color. Tap the add (+) button, then tap on RGB. Drag the slider for red to the right to around 83% and drag the green slider to around 40% in order to make orange. The blue slider should be at 0%. Slide the delay to 0, we will use the next command to make the color delay for 1 second. Click Create.
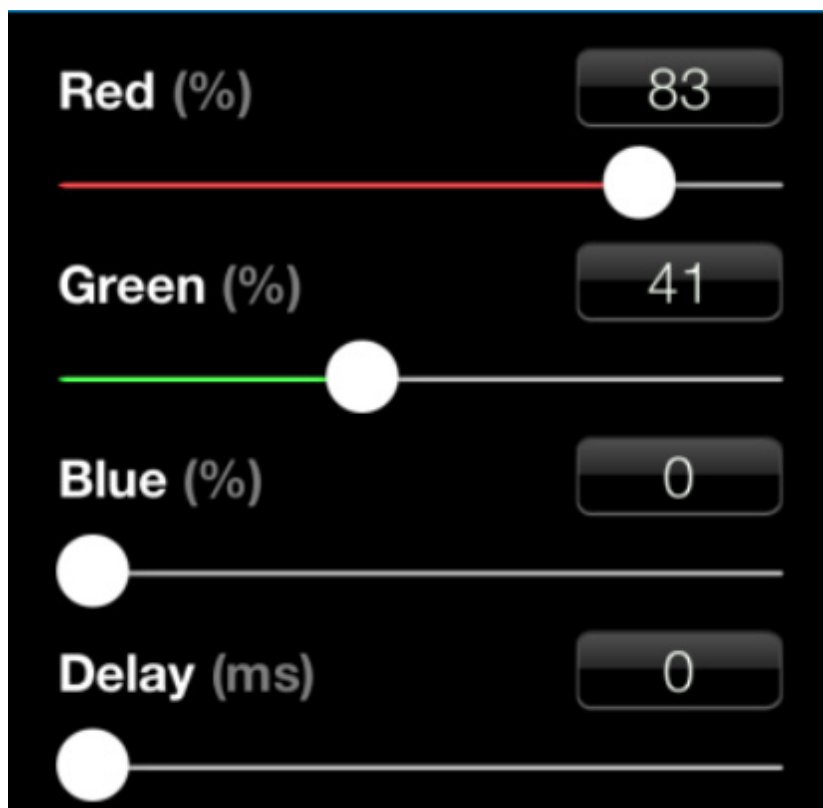
Part 2: Colors (continued)

14. Tap the + button to add a new step.
15. Tap the Delay button.
16. Choose 1000 ms delay. Click Create
17. Repeat steps 8-12 above and look on the screen as you move the slider bars until you have created yellow.
18. Record on your worksheet what the slider bar values were to create yellow.
19. Repeat steps 8-12 for green.
20. Repeat steps 8-12 for blue.
21. Repeat steps 8-12 above and look on the screen as you move the slider bars until you have created purple.
22. Record on your worksheet what the slider bar values were to create purple.
23. Set Sphero on a table. Tap Play.

Do you see the rainbow?

Part 3: Pattern Solving

What colors are missing in the patterns?

1.

2.

Part 4: Make your own pattern for Sphero

1. Using the color key below, program your own unique pattern with Sphero. In the table a dot represents a short delay (200 ms) and a rectangle represents a longer delay (600 ms). Add periods of no light in between each shape to help recognize the pattern. Write your pattern on your worksheet.

   *Note: when setting color delays, the max delay that you can set on the RGB screen is 255, so when programming 600 ms of a color, use a separate delay command after the RGB command.

An example of using the key to program:

A red dot would be coded as:

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RGB->Red command with delay 200 ms
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A red rectangle would be coded as:

```
RGB->Red command with delay 200 ms
Delay 400 ms
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A break between colors would be coded as

```
RGB->No color command with delay 200 ms
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2. Once you have built your Macro, see if another team member can solve your code and then try to solve theirs.

Part 5: Challenge

For our challenge, we will program Sphero to light up to send a message in Morse Code.

1. Use the table below to help figure out how to code the word your teacher gives you. The table says a dot is used for 1 unit, for us that will be 200 ms and a dash will be 3 units, or 600 ms.

Part 5: Challenge (continued)

2. Use a different color for each different letter
3. After you have coded your word let the teacher know
4. As a group try to figure out the entire secret message by going around to the different groups and figure out what each word is.

International Morse Code

1. The length of a dot is one unit.
2. A dash is three units.
3. The space between parts of the same letter is one unit.
4. The space between letters is three units.
5. The space between words is seven units.

A ● ▬		U ● ● ▬	
B ▬ ● ● ●		V ● ● ● ▬	
C ▬ ● ▬ ●		W ● ▬ ▬	
D ▬ ● ●		X ▬ ● ● ▬	
E ●		Y ▬ ● ▬ ▬	
F ● ● ▬ ●		Z ▬ ▬ ● ●	
G ▬ ▬ ●			
H ● ● ● ●			
I ● ●			
J ● ▬ ▬ ▬			
K ▬ ● ▬		1 ● ▬ ▬ ▬ ▬	
L ● ▬ ● ●		2 ● ● ▬ ▬ ▬	
M ▬ ▬		3 ● ● ● ▬ ▬	
N ▬ ●		4 ● ● ● ● ▬	
O ▬ ▬ ▬		5 ● ● ● ● ●	
P ● ▬ ▬ ●		6 ▬ ● ● ● ●	
Q ▬ ▬ ● ▬		7 ▬ ▬ ● ● ●	
R ● ▬ ●		8 ▬ ▬ ▬ ● ●	
S ● ● ●		9 ▬ ▬ ▬ ▬ ●	
T ▬		0 ▬ ▬ ▬ ▬ ▬	

Part 6: Optional Extra Math Pattern Challenge

If we assign each number to a shape, as in the table below, we can make mathematical patterns.

1	=	● (red)	7	=	▬ (red)
2	=	● (orange)	8	=	▬ (orange)
3	=	● (yellow)	9	=	▬ (yellow)
4	=	● (green)	10	=	▬ (green)
5	=	● (blue)	11	=	▬ (blue)
6	=	● (purple)	12	=	▬ (purple)

Use the Key above to figure out the missing
colors in the patterns below:

1. The first couple numbers are given for this first pattern. What are the missing shapes? What is the mathematical pattern?

12   9   10   7

__ ▬(yellow) ▬(green) ▬(red) __ ●(blue) ●(purple) ●(yellow) __ __ ●(orange)

2. What are the missing shapes? What is the mathematical pattern?

▬(purple) ●(purple) ▬(green) ●(blue) ▬(orange) __ ●(purple) __ ●(green) ●(orange) __ ●(red)