Activity

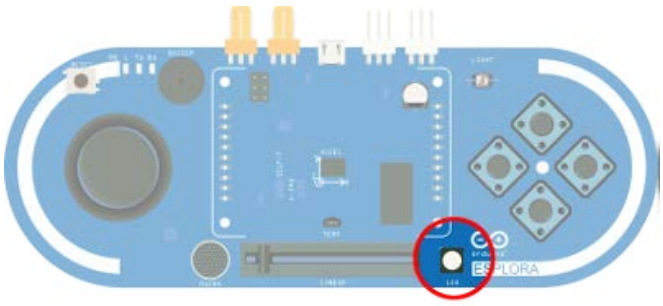
1. What colour will the light be with the following code?

```
int a = 0;
int b= 1;
a=a+1;
if (a==b){
Esplora.writeRed(255);
}
else {
Esplora.writeGreen(255);
}
```

2. What colour will the light be with the following code?

```
boolean proceed = TRUE;
if (!proceed){
   Esplora.writeRed(255);
}
else {
  Esplora.writeGreen(255);
}
```

Button LIGHTS



Upload the following program onto your Esplora Board. Try pressing the buttons and observe what colours light up on the RGB LED.

```
#include <Esplora.h>
 void setup() {
  }
void loop() {
  if (Esplora.readButton(SWITCH_1) == LOW) {
    Esplora.writeRed(255);    // turn red led on
  }
  else {
    Esplora.writeRed(0);      // turn red led off
  }
  if (Esplora.readButton(SWITCH_2) == LOW) {
    Esplora.writeGreen(255);  // turn green led on
  }
  else {
    Esplora.writeGreen(0);    // turn green led off
  }
  if (Esplora.readButton(SWITCH_3) == LOW) {
    Esplora.writeBlue(255);  // turn blue led on
  }
  else {
    Esplora.writeBlue(0);    // turn blue led off
  }
}
```

Activity

1. Which buttons correspond to producing which colours on the LED?

Let's now mix some colours together. When we make combinations of Red, Green and Blue together, which colours do they produce?

Make sure to test this with your Esplora board. Hold down each of the buttons at the same time and see which colours they produce:

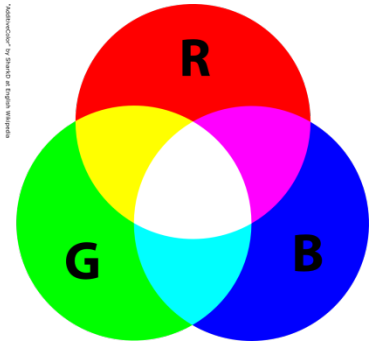
2. Red + Green =
3. Green + Blue =
4. Blue + Red =
5. Red + Green + Blue =

HACKTIME!

6. See if you can hack and edit the code given, to make the Esplora's LED produce white for whenever the right button (SWITCH_4) is pressed (making sure that the LED stays off if there are NO buttons pressed).

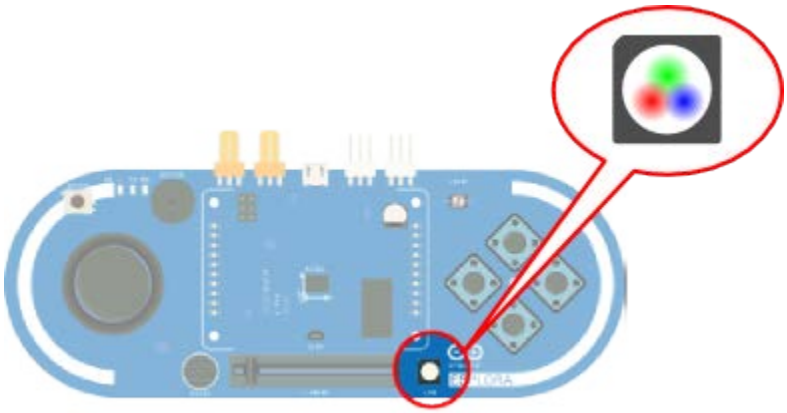
Primary Colours

The diagram below summarizes the answers from the previous questions.



As you can see, the RGB LED is used so that we can program the Esplora board to produce different colours by mixing different combinations of red, green, and blue together.

The RGB LED is infact, made up of three separate Light Emitting Diodes, one responsible for lighting up Red, one Green, and the other Blue.



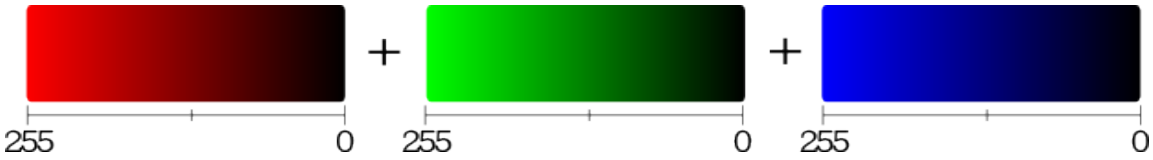
So using the functions Esplora.writeRed(), Esplora.writeGreen(), Esplora.writeBlue() (with input values of 0 to 255) correspond to telling the Esplora how bright we want each of these small individual LEDS to be. From the distance that we view the LEDS, they are observed to have ADDED together.

Activity

1. The colours Red, Green and Blue are known as our **primary colours** because of how they can mix to form other varieties of colours. But what makes them so special? Why not pink, yellow and turquoise?
2. How are primary colours distinguished from other colours?
    a. It's something unique and inherent about the colours themselves.
    b. It's determined by what colours our eyes are sensitive to seeing
    c. Objects tend to reflect red, green, and blue more than any other colour.
    d. Red indicates how hot things are, blue indicates how cold things are, and green is to show how neutral things are.

Making more Colours

So far we know how to show red, blue, green, magenta, cyan, yellow and white. But what about all the colours in between? What about the midtones?



Primary colours are used in varying *brightness* to mix for a wide variety of colours.

While sometimes we have creative ways of referring to colours of paints and dyes by names like *aquamarine,* or *gunmetal,* we can refer to a variety of colours objectively simply by specifying the intensities of red, green and blue we are *adding together*. This can be written in a format we call **8-bit RGB code**. 8-bit means that the brightness is subdivided into 256 discrete levels (0, 1, 2,3, ... through to 255).

Activity

Calculating the Number of Colour Combinations

1. How many different shades of colours can we express with 8-bit RGB colour coding? (given that 8-bit means that each primary colour has 256 levels of brightness (0-255))
2. Go to the website: http://www.imagecolorpicker.com/

Pick out the colour of a pixel, and try and reproduce it on your Esplora board, by using the **RGB Code**. You can either edit the Button Colour code or starting a new sketch.

There are two ways of setting colour on your Esplora board. One way is by setting the intensity of the each LED colour:

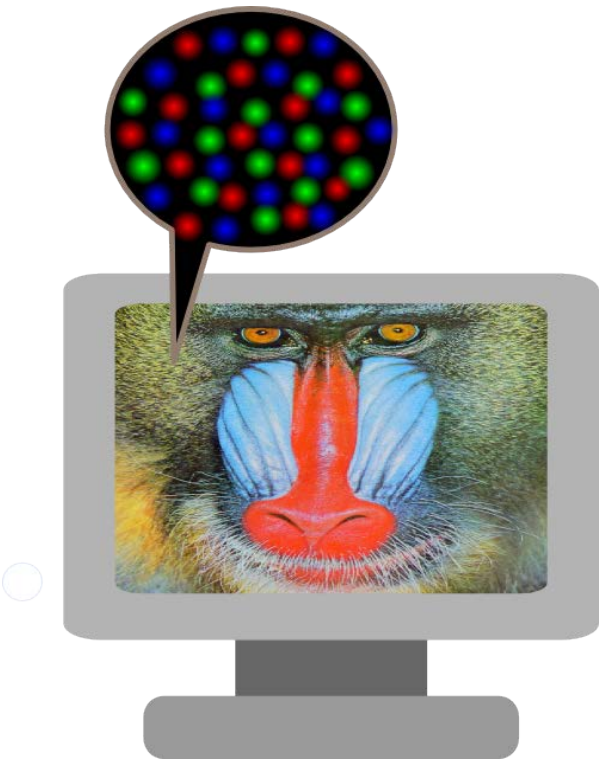
Esplora.writeRed(value);
Esplora.writeGreen(value);
Esplora.writeBlue(value);

where value replaces the value for each Red, Green, and Blue as a number between 0-255.

Or we can condense all of this with one function :

Esplora.writeRGB(redvalue,greenvalue,bluevalue);

Note: Try not to look directly into the LED as it can be very bright. Instead try to diffuse the light with a piece of paper covering the LED, to help soften it.



The LED on your Esplora board can be thought of as just one *pixel*. Each pixel on your computer monitor has a *red*, *green* and *blue* value to make up your display. If you have a HD monitor, it might have up to 1920x1080 pixels, a total of 2 073 600!

Esplora Colour Picker

We've made your Esplora board turn into your very own Colour Picker. Have a play! Upload the following program onto your Esplora Board. You'll need to read the comment to find out how it works. You can find the RGB value that you produce by looking at the Serial Monitor, click the icon on the top-right of your window.


```
/*
  How to use:  In its initial state, the LED shines the colour
which is stored in memory (default is white). If you hold down
the bottom button it will readjust the intensity of the red
light accordingly with the position of the slider (with far-
right being 0). Holding the left does the same for the green,
and top for the blue. When the right button is pushed, the
light turns off. Do not look directly at the light, as it can
be bright. Instead use a piece of paper to help diffuse it.
 */

#include <Esplora.h>

// What State are we in. 0 for playback, 1 for write.
int state = 0;
```

```
boolean upSwitchWasPress = false;
boolean leftSwitchWasPress = false;
boolean rightSwitchWasPress = false;

// start off with white value
int red = 255;
int green = 255;
int blue =255;

void setup() {
  Serial.begin(9600);
}

void loop() {
  detectState();
  showColour();
  offColour();
  printColour();
}

void printColour(){ //prints the colour stored to the Serial
Monitor
  Serial.print("RGB:");
  Serial.print(red);
  Serial.print(",");
  Serial.print(green);
  Serial.print(",");
  Serial.println(blue);
```

```
}

void showColour() {
  if (state==0) {
    Esplora.writeRGB(red,green,blue);
  }
    int sliderPosition = Esplora.readSlider();
    byte brightness = map(sliderPosition, 0, 1024, 0, 180);
      if (Esplora.readButton(SWITCH_DOWN) == LOW) {
        red = brightness;
        Esplora.writeRGB(red,green,blue);
      }
      else if(Esplora.readButton(SWITCH_LEFT) == LOW){
        green = brightness;
        Esplora.writeRGB(red,green,blue);
      }
      else if(Esplora.readButton(SWITCH_UP) == LOW){
        blue = brightness;
        Esplora.writeRGB(red,green,blue);
      }
  }


void offColour(){
  if (state==1){
    Esplora.writeRGB(0,0,0);
  }
}
```

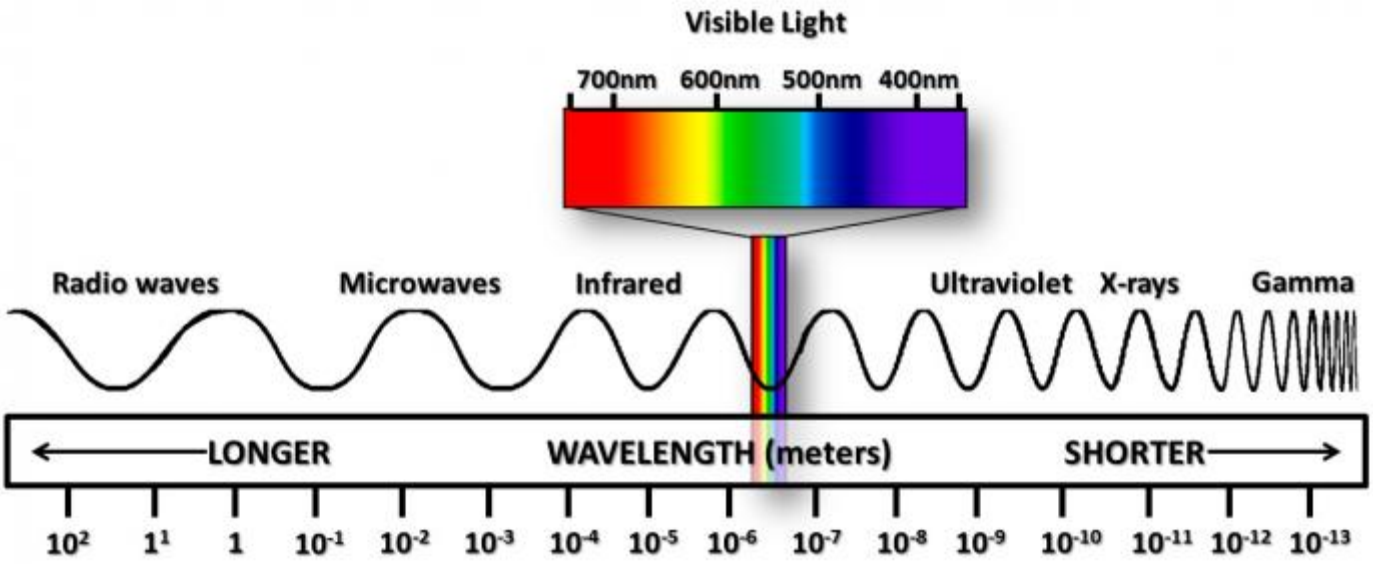
```
/*
 * Detect State
 */
void detectState() {
  // Change State
  // Edge Detection Switch Up
  boolean rightSwitch;
  int rightSwitchPress = Esplora.readButton(SWITCH_RIGHT) ==
LOW;
  rightSwitch = rightSwitchWasPress && !rightSwitchPress;
  rightSwitchWasPress = rightSwitchPress;

  if (rightSwitch) {
    state = state == 1 ? 0 : state + 1;
  }

  if (state == 0) {
    // Remove Mode
    Esplora.writeRGB(red, green, blue);
  } else  {
    // Add Mode
    Esplora.writeRGB(0, 0, 0);
  }
}
```

Light Beyond Sight

When we look through a range of different colours, we are observing different types of light.

Light is a form of energy which is transferred in the form of a *wave.* Like waves in the image below. Each wave has a *wavelength*, which is just the distance between the peaks next to each other.

However, our eyes can only see a very tiny proportion of all the different ranges of light that exist. This specific group of colours or varieties of light we can see is referred to as *visible light.* While other types of light can't be seen with our eyes, we can detect them with other instruments that make them useful for certain applications. Even radio waves that you listen to on radio are like light waves, the only difference is they have a much longer *wavelength.*



Activity

Extension: Slider Choosing Colour

Modify the program below, the task is to do two things:

1. The colour of the LED is determined by the position of the slider. Red when it is left, green in the middle, blue on the right.
2. After that is working, make the LED blink on and off using the position of the slider to determine how fast the LED blinks

```
#include <Esplora.h>


int redvalue = 0;   // modify these values
int greenvalue = 0;      // modify these values

void setup() {
}

void loop() {
  int slider = Esplora.readSlider();
  // slider gives values of 1023 on left and 0 on right
```

```
  // choose an appropriate threshold to change colour
  if (slider > redvalue) {
    // make LED red
  }
  else if (slider > greenvalue) {
    // make LED green
  }
  else {
    // make LED blue
  }
  // Add blinking portion here.
}
```