

Color Lab:

Instructions:

On your computer, create a folder called Lab2. Download all files from my web site into that folder, including:

- LearningColors.html
- LearningColors.css
- PlayingWithColors.html
- PlayingWithColors.css

You will be editing the html files. Then you will upload to the server the folder Lab2 and submitting via sakai the URL for Lab2.

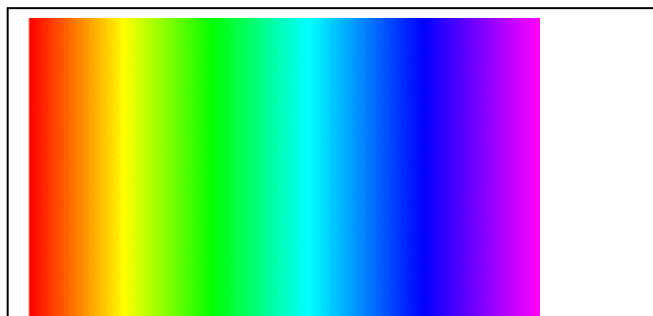
Lab

Almost everything you design for the web or mobile apps today involves color in some way. We've gone from monitors with 2 colors to monitors with 256 colors to monitors and screens today that are able to display millions of colors (technically we are working with 16.8 million colors). This lab is designed to help you understand and work with color on your computer.

In this lab we'll go over the basics of how color works, and then we'll experiment with using color in different ways on web pages.

Color Basics:

Color is light, either viewed directly or as a reflection off of objects we're looking at. We are only able to zmicrowave, radio and TV waves along with x-rays, gamma rays, etc. The frequency of a light wave



The spectrum of all visible frequencies of light, from the lowest (red) to the highest (purple)

determines the color we're seeing. The lowest color frequency we can see is red. This color's waves travel the farthest, which is why we use it to signal 'stop' in a stoplight. The highest frequency we can see is violet. White light is a combination of all the visible light frequencies. When we see white, we're seeing a reflection of all light frequencies equally. Black is the absence of any light. We see colors when some frequencies are absorbed into a surface and some are reflected back.

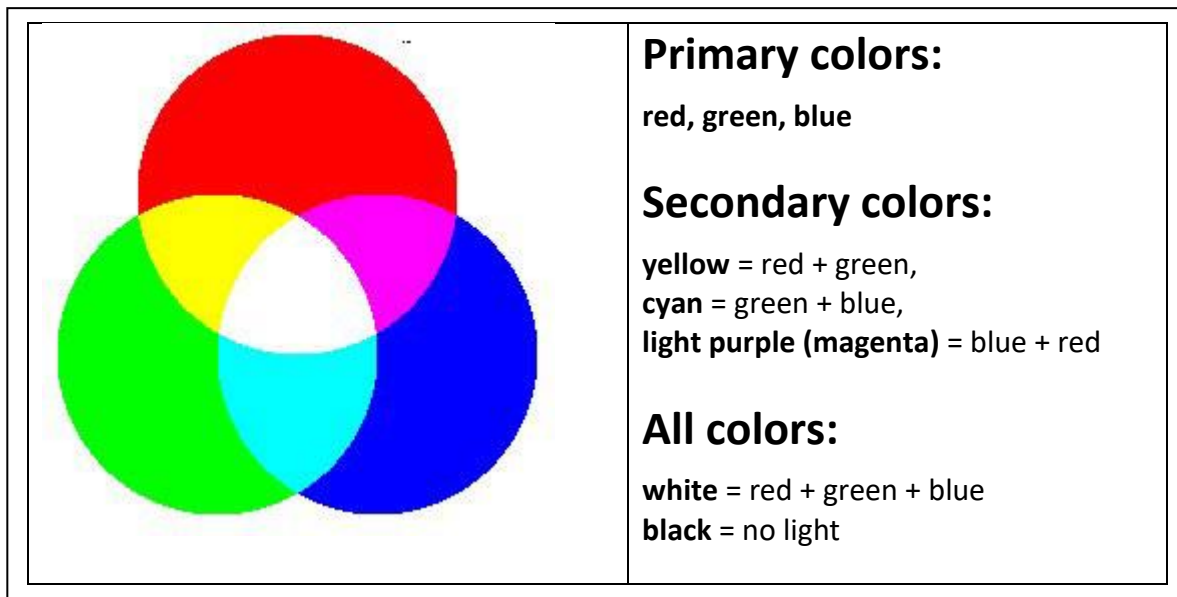
RGB: red, green, and blue

When you deal with colors on the computer, the scheme you will most likely be dealing with is the RGB color scheme. It's possible you've heard this term before. RGB refers to the primary colors in an

additive color scheme. It is called an additive color scheme because are adding light from the primary colors in the light scheme to make new colors. I've also heard of it referred to as a light-based color scheme.

As an aside, you've probably spent your childhood painting with those tempura or acrylic paints. The primary colors you dealt with were red, yellow, and blue. That color scheme is a subtractive color scheme because when you put two colors together, the combined color absorbed different frequencies of light. The more paint colors that were combined, the less light that was reflected.

With a light based color scheme, the color combinations are somewhat surprising if you are used to subtractive (paint-based) color combinations. In light-based color, red and blue make purple. Blue and green make aqua. Red and green make yellow. Shall I say that again? Red and green make yellow in the light-based color scheme. Think of the color red glowing as brightly as it can, combined with the color green glowing as brightly as it can. You may not quite get yellow in your head, but if you picture colors



glowing brightly, the idea of yellow being created from red and green makes a bit more sense.

To create the color white, all the primary colors should glow as brightly as they can. So you'd combine red, green and blue to get white (again, this may go against your subtractive paint-based thinking that white is the absence of color. Technically white occurs when an object doesn't absorb any light, meaning all light is reflected back off of an object. So all red, green and blue are reflected back at full force).

In contrast, black occurs when no light glows. So the complete absence of red, green, and blue light make black. Yet again, this goes against those days of painting in elementary school when you were taught that combining all the primary colors will make a very dark color – it was supposed to make black, but it really always made a muddy, gross brown color. In a light based color scheme, we don't get that gross brown (or black, for that matter), when we combine red, green, and blue (see the above paragraph). To get black, we must have a complete absence of red, green, and blue light.

To define a color using the RGB color scheme, you always specify the amount of red you want first, followed by the amount of green, and then finally the amount of blue. The values for red, green, and blue may be specified in percent (0–100); this scale is useful for conversion from the CMYK model (a subtractive-based color model frequently used for printing). So, for instance, if I wanted to specify the color red, I'd specify it using the following percentages:

```
rgb(100%, 0%, 0%)
```

Note that the first amount specified is the amount of red, and in the above example red is glowing at 100%. The second amount specified is the amount of green, and that amount is not glowing at all (it is at 0%). The third amount is the amount of blue, and that also is not glowing at all at 0%.

The following chart shows how we'd represent all the primary and secondary colors, as well as black and white, using percentages:

<code>rgb(100%, 0%, 0%)</code>	red
<code>rgb(0%, 100%, 0%)</code>	green
<code>rgb(0%, 0%, 100%)</code>	blue
<code>rgb(100%, 100%, 0%)</code> <code>rgb(100%, 100%, 0%)</code>	Yellow yellow
<code>rgb(0%, 100%, 100%)</code>	cyan
<code>rgb(100%, 0%, 100%)</code>	purple (magenta)
<code>rgb(100%, 100%, 100%)</code>	white
<code>rgb(0%, 0%, 0%)</code>	black

Exercise:

Let's try this. First, load LearningColors.html into your browser. You should be able to double-click (or the mac equivalent) on it and it should automatically open in your default browser. You should see twelve separate paragraphs, all in black in white. We're going to change the colors of the first four paragraphs.

Now open LearningColors.html in either Notepad++ or TextWrangler. (Either right-click on it and chose "edit with Notepad++/TextWrangler" or open TextWrangler or Notepad++ and then open LearningColors.html. You are only going to change the colors. Currently in the head section should look like this (I've highlighted the colors you are going to change to rgb values in red):

```
<style>
  /*****
  /* edit only the colors below here */
  /* Part 1: change colors using rgb percent values */
  #p1 { color: black; /* change the word black to the color red using % values */
        background-color: white; /* change the word white to the color blue using % values */
        border-color: black; /* change the word black to the color green using % values */
  }
  #p2 { color: black; /* change the word black to the color yellow using % values */
        background-color: white; /* change the word white to the color purple using % values */
        border-color: black; /* change the word black to the color cyan using % values */
  }
  #p3 { color: black; /* change the word black to the color white using % values */
        background-color: white; /* change the word white to the color gray using % values */
        border-color: black; /* change the word black to the color black using % values */
  }
```

```

}
#p4 { color: black; /* change the word black to the color specified in the lab */
      background-color: white; /* change the word white to the color specified in the lab */
      border-color: black; /* change the word black to the color specified in the lab */
}

```

Change the colors to the rgb values using % values as specified. So the colors for p1 should be changed to red, then blue, then green. You would do that like this:

```

#p1 { color: rgb(100%,0%,0%); /* change the word black to the color red using % values */
      background-color: rgb(0%, 0%, 100%); /*change the word white to the color blue using % values */
      border-color: rgb(0%,100%,0%); /*change the word black to the color green using %
values*/
}

```

Note that right after the rgb value closing parenthesis, there's a semi-colon. Make sure you don't overwrite that semicolon.

Once you've made the changes above, save your LearningColors file and load it into the browser. The first paragraph on the web page should have a red font color, with a blue background color, and a green border. The colors should be pure and almost garish.

Change #p2 so that it uses the %rgb values for secondary colors. For #p2, change the color to be yellow, the background color to purple, and the border-color to be cyan using the %rgb values. Save your file, then load it into your browser. Notice the color changes in the second paragraph on the web page.

Change #p3 so that it uses the %rgb values for black, white, and gray. For #p3, change the color to be white, the background color to gray (using rgb(50%, 50%, 50%)), and the border-color to be black using the %rgb values. Save your file, then load it into your browser. Notice the color changes in the third paragraph on the web page.

Next, change #p4 using the following values:

- (30%, 80%, 10%) for the color, (can you guess about what color this is?)
- (5%,20%,30%) for the background-color (again, can you guess the color? Dark or light?)
- (10%,40%,100%) for the border-color (color guess?)

Save your file, then load it into your browser. Notice the color changes in the fourth paragraph on the web page.

RGB Colors using numbers

While using % values to represent RGB colors makes for easy conversion from CMYK values, it isn't very commonly used on the web. The reason is that your computer's monitor and video card can represent many more colors than can be specified using just the percent values (e.g., 100x100x100, or 1,000,000 (1 million)). Most monitors and video cards today can represent over 16 million colors. In order to do this, you need a different scheme for representing RGB values.

The first way is to use a value between 0 and 255 to represent each of the colors that go into the RGB color. This allows us to represent 256*256*256 colors, or 16.8 million colors. (256 is a binary number, and almost everything on your computer uses binary numbers)

The number 0 represents no color, or no light, whereas 255 represents the largest amount of a color, or the color glowing at full-blast. To represent a color using this scheme, you'd use:

rgb(255,0,255)

The above color would be purple, or magenta (full red, no green, and full blue)

The following is a chart of RGB colors (including black and white) represented using numeric values:

rgb(255, 0, 0)	red
rgb(0, 255, 0)	green
rgb(0, 0, 255)	blue
rgb(255, 255, 0); rgb(255, 255, 0)	Yellow yellow
rgb(0, 255, 255)	cyan
rgb(255, 0, 255)	purple (magenta)
rgb(255, 255, 255)	white
rgb(0, 0, 0)	black

Exercise:

Oprn LearningColors.html in either Notepad++ or TextWrangler. For this part of the lab, you will be modifying Part 2:

```
/* Part 2: change colors using numbers (between 0 and 255) to represent the red, green, and blue amounts */
#p5 { color: black; /* change the word black to the color red using number values */
      background-color: white; /*change the word white to the color blue using number values*/
      border-color: black; /* change the word black to the color green using number values */
}
#p6 { color: black; /* change the word black to the color yellow using number values */
      background-color: white; /*change the word white to the color purple using number values */
      border-color: black; /* change the word black to the color cyan using number values */
}
#p7 { color: black; /* change the word black to the color white using number values */
      background-color: white; /*change the word white to the color gray using number values*/
      border-color: black; /* change the word black to the color black using number values */
}
#p8 { color: black; /* change the word black to the color specified in the lab */
      background-color: white; /* change the word white to the color specified in the lab */
      border-color: black; /* change the word black to the color specified in the lab */
}
```

Change the colors to the rgb values using number values as specified. Change the values in #p5 to red, blue, and green using number values. Save and notice the changes to the 5th paragraph in your browser.

Note the semi-colon. Make sure you don't overwrite that semicolon.

Change #p6 so the colors are yellow, and cyan using number values. Save your file, then load it into your browser. Notice the color changes in the sixth paragraph on the web page.

Change #p7 so the colors are white, gray (figure out how to represent gray using number values) and black using the number values. Save your file, then load it into your browser. Notice the color changes in the seventh paragraph on the web page.

Next, change #p8 using the following values:

- (250,222,5) (Guess the color?)
- (235,0,80) (color guess?)
- (86,94,165) (color guess?)

Save your file, then load it into your browser. Notice the color changes in the eighth paragraph on the web page.

RGB Colors using hex numbers

On the web it is most common to use hex numbers to represent RGB values on the web. Hex numbers appear intimidating when you first start using them, but they're actually fairly straight-forward to understand.

In our counting system, we count as follows:

0,1,2,3,4,5,6,7,8,9 and then we go to two digits: 10

In hex counting, we keep going past 9:

0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F and then we go to two digits.

(Aside: The reason for this is that now we can use 1 digit to represent 16 different numbers. 16 is a power of 2 (or 2^4). 10 is not a power of 2.)

Just as 8 is greater than 7 and 0 is the smallest single digit number and 9 is the largest single digit number in our counting system, 8 is greater than 7, A is greater than 9, and F is greater than E in the hex counting system. Equally, 0 is the smallest single digit number and F is the largest single digit number in the hex counting system,

You use 2 hex numbers to represent the amount of red, then two more to represent the amount of green, and then the final 2 represent the amount of blue. So there are a total of 6 hex digits representing each color. So, for example, a hex RGB value might look like this:

#740199

74 represents the amount we want red to glow on the computer, 01 represents the amount we want green to glow, and 99 represents the amount we want blue to glow. The above color is a dark purplish, with a bit more blue than red in the purple.

As another example:

#009911

00 represents the amount red should glow (not at all!), 99 represents the amount of green that should glow, and 11 represents the amount of blue that should glow (not much). Thus this color is pretty much a solid green.

And another example:

#000000

Has no red glowing, no green glowing, and no blue glowing, nothing is glowing, which means that there is no color whatsoever. With nothing glowing, the color we'd see would be black.

Using hex numbers (with red, green, and blue are still each represented with 2 digits), the color:

#FF00FF

Has A LOT of red glowing, no green glowing, and A LOT of blue glowing, giving you a pure purple (magenta) color.

Another example would be:

#CA210D

Has CA red glowing, which is a lot of red, 21 green glowing, which isn't much green, and 0D blue glowing, which isn't much blue (just like 09 wouldn't be a lot of blue). Thus this color is a pretty bright, but not completely pure, red color.

#21F3DA

Has very little red glowing (21) a lot of green (F3) and a lot, but not quite as much blue glowing (DA). Thus the color would be Bluish Green.

Always keep in mind that letters represent more (larger amounts) than numbers, and letters represent more sequentially, so F represents more than E, which represents more than C, which represents more than B, which represents more than A, which represents more than 9, which represents more than 8, etc.

Equally, keep in mind that in every pair the left digit is MUCH more important than the right digit. Just as 91 is much greater than 19 (because then 9 is on the left side in the first pair), F3 is much greater than 3F.

The color chart using hex numbers to represent the primary and secondary colors and white and black is as follows:

#FF0000	red
#00FF00	green
#0000FF	blue
#FFFF00 #FFF000	Yellow yellow
#00FFFF	cyan
#FF00FF	purple (magenta)
#FFFFFF	white
#000000	black

Exercise:

Open LearningColors.html in either Notepad++ or TextWrangler. For this part of the lab, you will be modifying Part 3:

```

/*****
/* Part 3: change colors using hex numbers to represent the red, green, and blue amounts */
#p9 { color: black; /* change the word black to the color red using hex numbers */
background-color: white; /*change the word white to the color blue using hex numbers */
border-color: black; /* change the word black to the color green using hex numbers */
}
#p10 { color: black; /* change the word black to the color yellow using hex numbers */
background-color: white; /*change the word white to the color purple using hex numbers */
border-color: black; /* change the word black to the color cyan using hex numbers */
}
#p11 { color: black; /* change the word black to the color white using hex numbers */
background-color: white; /*change the word white to the color gray using hex numbers */
border-color: black; /* change the word black to the color black using hex numbers */
}
#p12 { color: black; /* change the word black to the color specified in the lab */
background-color: white; /* change the word white to the color specified in the lab */
border-color: black; /* change the word black to the color specified in the lab */
}

```

Change the colors to the rgb values using hex numbers as specified. Change the values in #p9 to red, blue, and green using number values. Save and notice the changes to the 9th paragraph in your browser.

Note the semi-colon. Make sure you don't overwrite that semicolon.

Change #p10 so the colors are yellow, and cyan using hex values. Save your file, then load it into your browser. Notice the color changes in the 10th paragraph on the web page.

Change #p11 so the colors are white, gray (figure out how to represent gray using hex values) and black using the hex values. Save your file, then load it into your browser. Notice the color changes in the 11th paragraph on the web page.

Next, change #p12 using the following values:

- #FDF3E7 (Guess the color?)
- #7E8F7C (Guess the color?)
- #C63D0F (Guess the color?) }

Save your file, then load it into your browser. Notice the color changes in the 12th paragraph on the web page.

Part 2: Playing with colors

Download the following files into your Lab2 folder from my web site:

- PlayingWithColors.html
- PlayingWithColors.css
- butterfly.png
- Coffee.gif
- cow.png
- flower.png
- madscientist2.png
- minion2.png
- terra.png

- tree2.gif
- wings.png

First, open PlayingWithColors.html in your browser. You should see a web page with 9 paragraphs on it, each with a different picture in the background. If you don't see a different picture in the background of each paragraph, you must move all the images you've downloaded into the Lab2 folder, and make sure that both your PlayingWithColors.html and PlayingWithColors.css files are in the Lab2 folder as well. If only one picture isn't showing up, download it again and copy it into the Lab2 folder.

You are going to modify the colors for each of the paragraphs, just like you did in LearningColors.html above. You must follow the following rules:

1. You cannot use any primary or secondary colors when modifying colors. Nor can you use black or white. The point is to play with colors to see what you can come up with.
2. The first 3 paragraphs (#p1, #p2, and #p3) must be modified using %rgb values
3. The second 3 paragraphs (#p4, #p5, and #p6) must be modified using number values (0-255).
4. The third 3 paragraphs (#p7, #p8, and #p9) must be modified using hex numbers.

To Turn In:

Upload your Lab2 folder to the web server, and submit the URL of Lab2 on sakai. Lab2 should contain: your modified LearningColors.html file

1. the LearningColors.css file (that you haven't modified)
2. your modified PlayingWithColors.html file
3. the PlayingWithColors.css file (that you haven't modified)
4. All the image files (there should be 9)

Make sure you modify permissions so that the lab TA and I can see the files.