

Colors and the Web

September 16

Unit 5

Primary Colors

- In grade school taught that red, yellow and blue are primary
 - Works okay for mixing paint
 - Colors are dulled when mixed
 - Not so good for mixing light
- Cones in the retina perceive color in three different wavelength ranges
- Red, green, and blue are typically considered primary colors for dealing with light

Perceiving Color

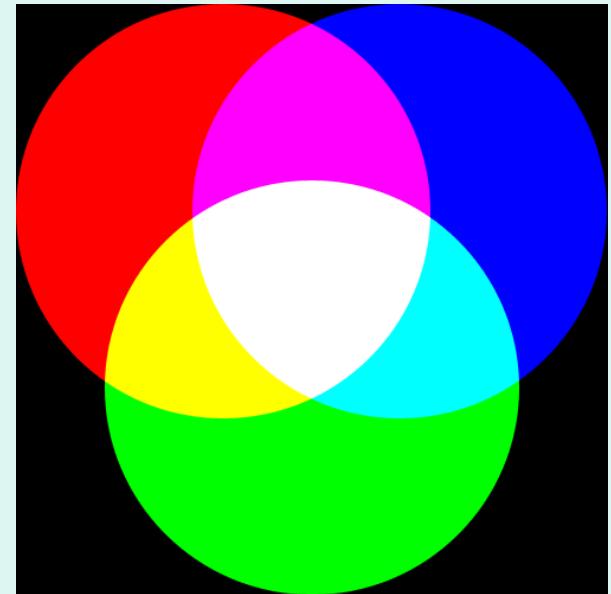
- *Tristimulus* theory attempts to explain how humans perceive color
- A color is defined by three coefficients for red, green, and blue
 - Coefficients act as a percentage as the sum of the coefficients must equal 1
- Natural light is a mixture of all visible wavelengths
- If all 3 types of cones sense equal amounts of light, we perceive white
- Simulate white by having R,G, and B in equal amounts

Color Models

- Humans can distinguish between 1 and 2 million colors
- Impossible to describe them in words
- Instead, color models are used
- Common color models include:
 - RYB
 - RGB
 - CMYK
 - HSB

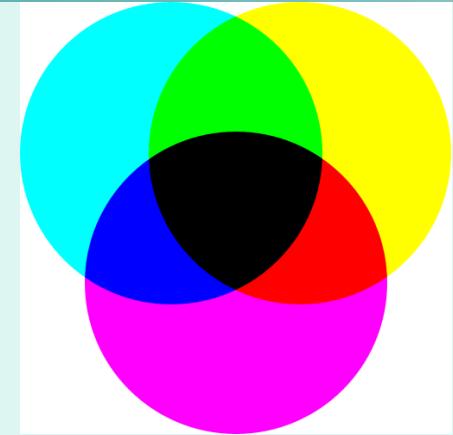
RGB Color Model

- *Additive* color model
 - No colors = black
 - All colors = white
 - Used for systems which emit light
 - Monitors
 - Lights
 - TVs
- Values for RGB often range from 0 – 255
- Can also be expressed in percentages
- Secondary colors for RGB are CMY



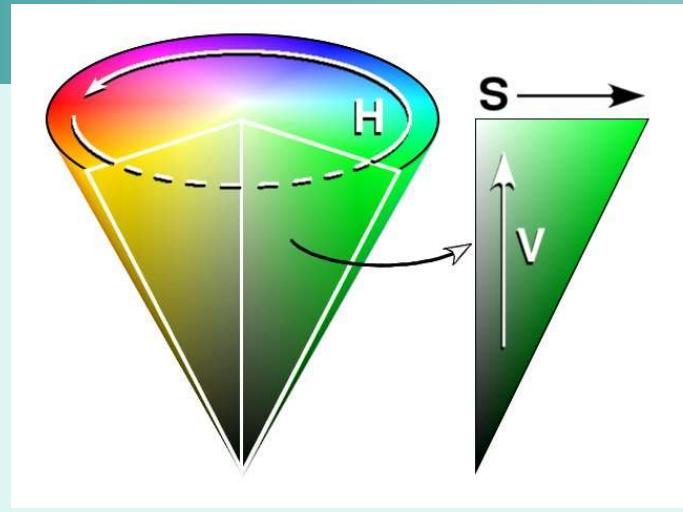
CMYK

- *Subtractive* color system
 - All colors = black
 - No colors = white
 - Describes systems which must reflect light for us to perceive
 - Used most often for printing
- Secondary colors for CMY are RGB
- The K is for black
 - Mixing CMY with inks doesn't produce a good black
 - Usually black is a separate ink
- On your computer, the RGB colors are converted by software to CMYK



HSB

- Represented as a cone
- *Hue*: color name
 - Often shown like a color wheel
 - Numeric value is the degree the color is at on the wheel
- *Saturation*: how pure the color is
 - Expressed as a percentage
 - White, black, and gray all are 0%
- *Brightness*: where the color falls between white and black (aka *Value*)
 - Expressed as a percentage
 - As brightness decreases, less of a range for saturation
 - We can't perceive differences hue and saturation differences in dark colors



Limitations of Color Models

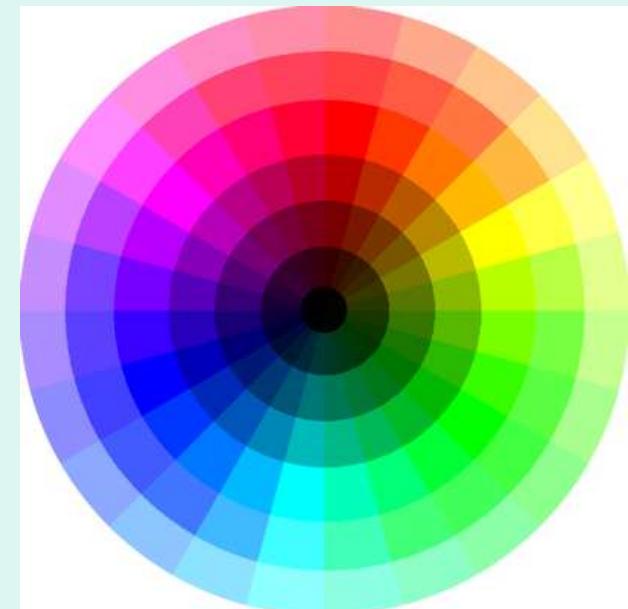
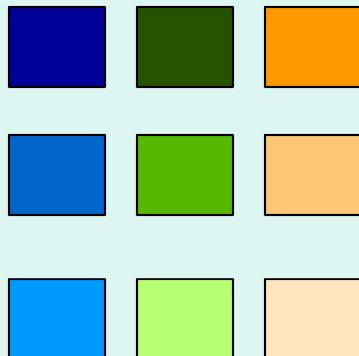
- Not all color models are equal
- RYB is good for picking colors
- RGB is great for monitors and hardware
- Difficult to figure what values for RGB and CMYK without a tool to help
- Not all colors can be expressed in all models
 - CMYK has problems with colors with high saturation and brightness (think true red)
- RYB and HSB use circular system for visualizing colors
 - Good for selecting colors to work well together

Color-Harmony Schemes

- What we find attractive is not just based on theory, but can be personal and cultural
- How to pick colors to appeal to a lot of people?
- Can make use of color-harmony schemes
 - Monochromatic
 - Complementary
 - Analogous
 - Triadic
 - And more...

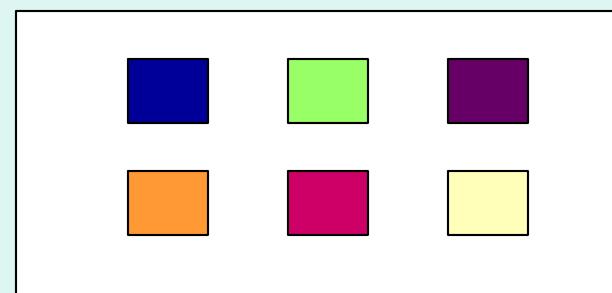
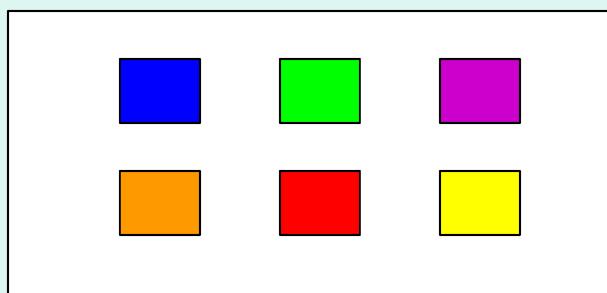
Monochromatic

- Hue is constant (or very close)
 - Saturation and brightness can vary
- Same color, different shades



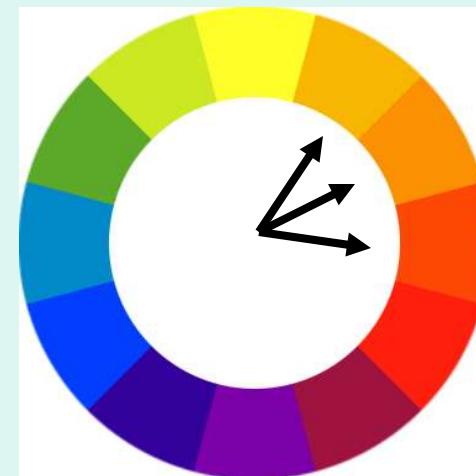
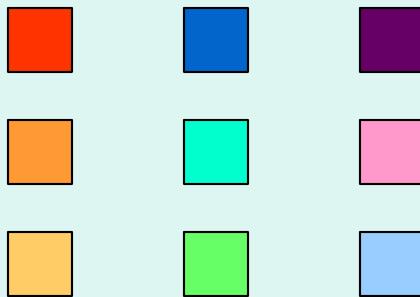
Complementary

- Pair of colors on opposite sides of the color wheel
- The hues must be complementary, saturation and brightness can vary
- Produce high-contrast colors



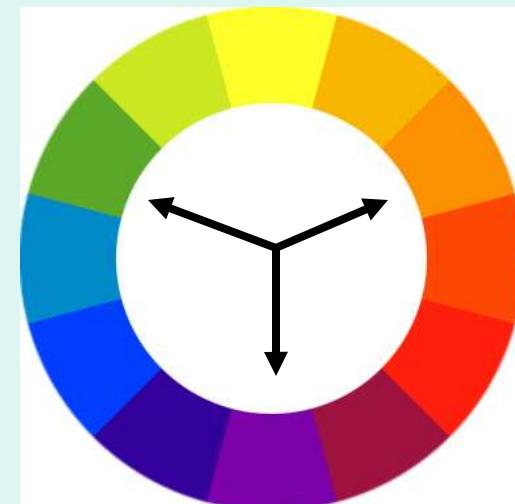
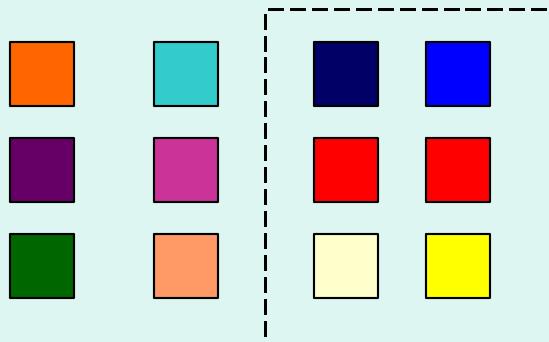
Analogous

- Colors close to each other on the color wheel
- Easy to get right!
- Can often be more visually interesting if not all colors have same saturation or brightness



Triadic

- 3 evenly spaced colors on a wheel
- Hues form a triangle
- Can be overpowering
 - Again, perhaps choose differing levels of brightness and saturation



Other Color Schemes

- <http://www.worqx.com/color/combinations.htm>
- Split-complementary
 - 1 color, plus two other colors equidistant from the complement of the first
- Double-complementary
 - 2 pairs of complementary colors

How Many Colors?

- One guideline is to use no more than 7 colors on a page (plus white and black)
- This does not mean use 7 different hues
 - Between 2 and 4 hues is a good guide
 - Use different saturation and brightness to get other colors (if needed)

Background, Text and Legibility

- Text must be legible
- Best way to achieve this is through high contrast between text color and background color
- Black text on a white background is best
 - Dark text on a light background works well in general
- White text on black background has good contrast
 - Creates problems for some people

Other Color Concerns

- Don't use a text and background color which only differ in the blue component in the RGB model
 - White and bright yellow
 - Human eye is less sensitive to blues
- Don't choose highly saturated colors
 - Text will “float” and sort of vibrate

Can you read this?

This isn't any better

Yellow on white is bad!

How to Use Color

- Useful for organizing a page
 - Navigation sections are a different color
 - Portions of the text with the same color are perceived as being related
 - Headings, links, etc. are easy to spot
- If you want to use a dark background, perhaps use a white area surrounding the text with dark text to make it more readable
- Use highly saturated colors sparingly
 - People's attention goes to these bright colors
 - Use them to get attention, not as the main color

Background Images

- May be tempting to use
- But:
 - Static images can make the text look like its floating
 - Hard to get readable text on bright, patterned backgrounds
- In general, it's a bad idea

HORRID!

- This is so annoying
 - Imagine a smaller font...
 - Or, even smaller, like on a webpage

This Is better

- But still please don't do it!
- Backgrounds like this are made up of images
- Many people don't use image-enabled browsers
 - Or they turn off the pictures
- Now they can't read your site because it's white text on a white background

Dying to Use the Background?

- Why not use a white table cell for your text then?
- You can see the pattern without preventing people from reading your page
- Can still be irritating, like this background

Web-safe Colors

- 216 web-safe colors
- 6 values for red, green, blue
 - 0%, 20%, 40%, 60%, 80%, 100%
- Driven by monitors which could only display 256 colors (compared to the millions today)
- HTML uses hexadecimal notation for colors
- Have to convert 0-255 RGB to 00-FF Hex

Hexadecimal Numbers

- We normally represent numbers in base 10
 - 0-9 are the digits we use
- Hexadecimal is base 16
 - 0-9, A, B, C, D, E, F
 - A = 10
 - B = 11
 - C = 12...
 - F = 15

Converting to Different Bases

- In class example

Hex example

- In base 10 the number 123 =
$$(3 \times 1) + (2 \times 10) + (1 \times 100)$$
Or
$$(3 \times 10^0) + (2 \times 10^1) + (3 \times 10^2)$$
- In base 16 the number 123 =
$$(3 \times 1) + (2 \times 16) + (3 \times 256)$$
Or
$$(3 \times 16^0) + (2 \times 16^1) + (3 \times 16^2)$$

Which is the number: 803 in base 10

Hex and Colors

- RGB is represented as a triplet of three numbers from 0 – 255
 - e.g.(143, 0, 25)
- Same values can be represented in Hex with 2 digits:
 - 00 – FF for each of the three parts of the color
- So an arbitrary color can be 1A2F53
- Web-safe colors are have values of:
 - 00, 33, 66, 99, CC, FF for each of the RGB values

HTML and Colors

- Some colors have predefined names
 - Red
 - Blue
 - Black
- Colors are specified using
 #hexNumber
- #FF0000 red
- #00FF00 green
- #0000FF blue
- #000000 black

Using Web-safe Colors

- Most people have monitors that can display more than 256 colors
- You don't have to use only web-safe colors
- Remember that different monitors will display color differently

Colors and Usability

- Take into account those with color-blindness
 - Most common is red-green
- Good idea to use colors with different brightness
 - Printing a color image on a black and white printer

Colorblindness Websites

- <http://colorlab.wickline.org/colorblind/colorlab/>
 - Color lab
 - Can see a color palette in all the different forms of colorblindness
- <http://colorfilter.wickline.org/>
 - You can view any webpage (including yours) with different colorblindness filters
 - If your pages meets their criteria, you can put their logo on your site to show that its suitable for those with colorblindness

Questions?

- Most of the content from this lecture is taken from :

User-Centered Website Development A
Human-Computer Interaction Approach

Daniel McCracken, Rosalee Wolfe.

Pictures are from www.wikipedia.com as well as some content