Color Intro

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CPS 1/296

What is color?

- Some seeming contradictions in what we are taught:
  - All color is composed of three primary colors: red, green and blue
  - All color is composed of three primary colors: red, blue and yellow
  - The spectrum contains 7 colors: ROYGBIV
- Can these all be correct?
- Are any of them correct?

What Hits our Eyes I

- Eyes are sensitive to a range of wavelengths
- Observation 1: For each person, specific wavelengths reliably produce specific sensations
- Observation 2: There is general agreement on this within 90-98% of the population

What Hits our Eyes II

- In almost all cases our eyes are subjected to a mixture of wavelengths
- Observation 3: The spectral power distribution (SPD) determines our perception of color – color is scale invariant
- Observation 4: Roughly the same 90-98% of the population will agree on this

From SPDs to Color

- Color = Our perception of the SPD
- How do we measure this?
- Are our eyes spectrometers?
- Our eyes cannot detect specific wavelengths:
  - Take 3 weighted average measurements of the SPD
  - 3 types of "cone" cells, each with a specific sensitivity profile
- http://www.unm.edu/%7Etoolson/human_cone_response.htm

Color as a 3-vector

- 3 types of cells imply that color can be summarized through the response of these cells
- (most) humans are "trichromats"
- Some humans are bichromats or weak/anomalous trichromats:
  - 3-10% depending upon whom and how you ask
  - Much higher rate in males
  - Typically some failure to distinguish red and green in the "normal" way
- Some animals are bichromats or weak trichromats
- Some birds are purportedly quadchromats

Perceptual Aliasing

- Many different SPDs can produce the same perception of color
- Pick 3 wavelengths with good spread:
  - Some overlap is useful
  - Red, Green and Blue work well (why not violet?)
  - Minimal overlap in absorption for our cones
- By varying amounts of these three "primary" stimulant colors, we can simulate the effect of some pure, spectral colors

Combining Colors

- Red + Green =…
- Red + Blue = …
- Blue + Green = …

Is there a difference???

- Is it correct to say that yellow=red+green?
- At the level of our cone response, yes.
- In the physical world, no.
- Philosophical difference between is of predication and is of identity…

What about art class?

- Art class primaries better thought of as cyan, magenta, and yellow (also your printer's primaries)
- These are subtractive
- Example on board…