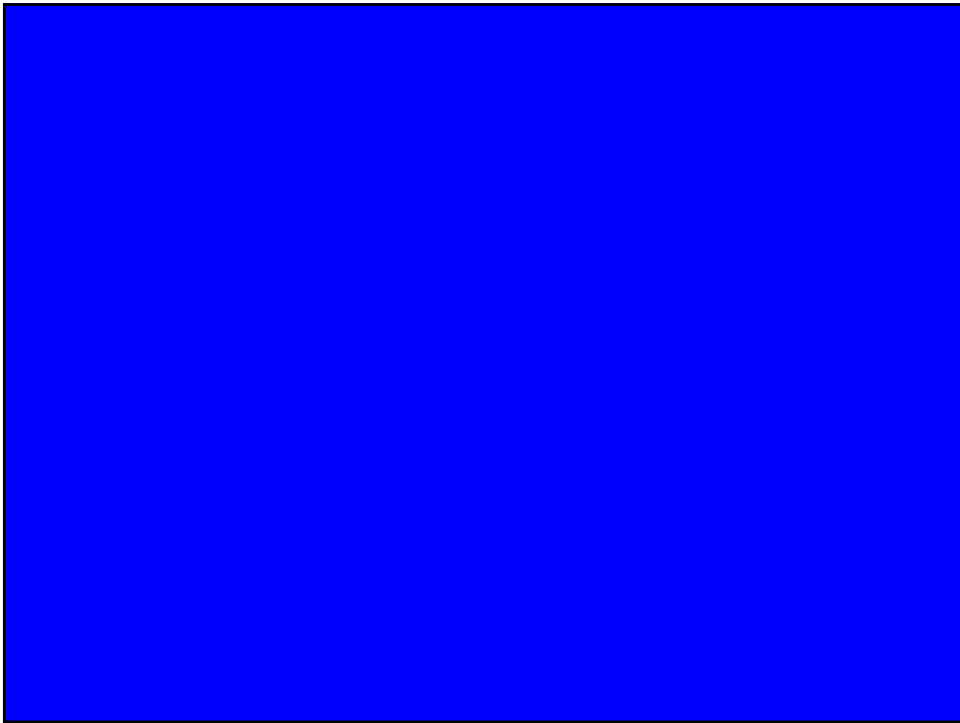
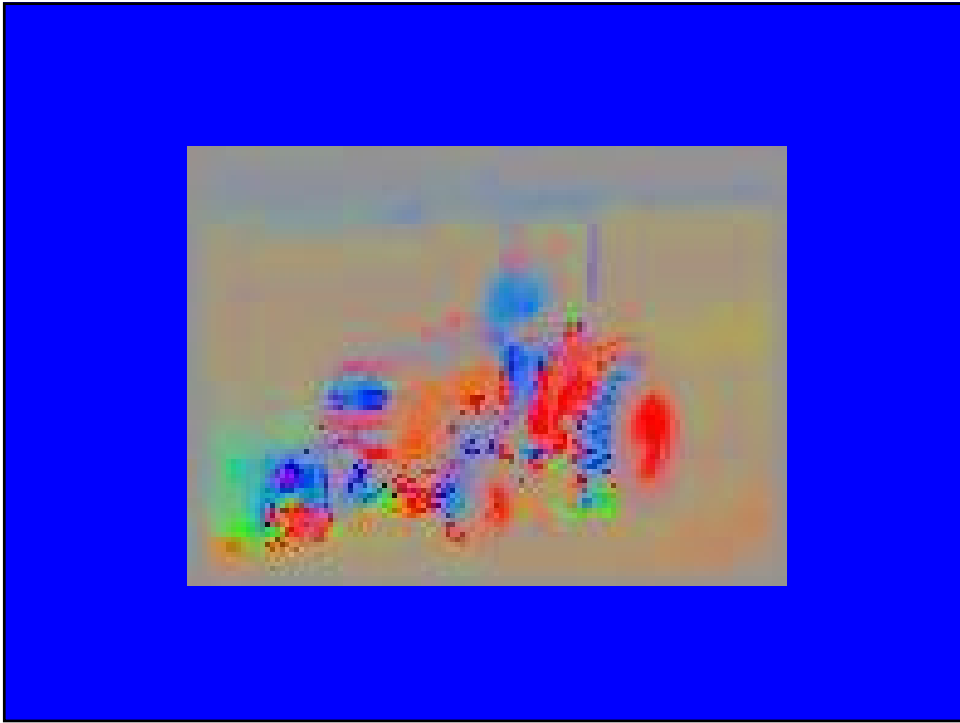
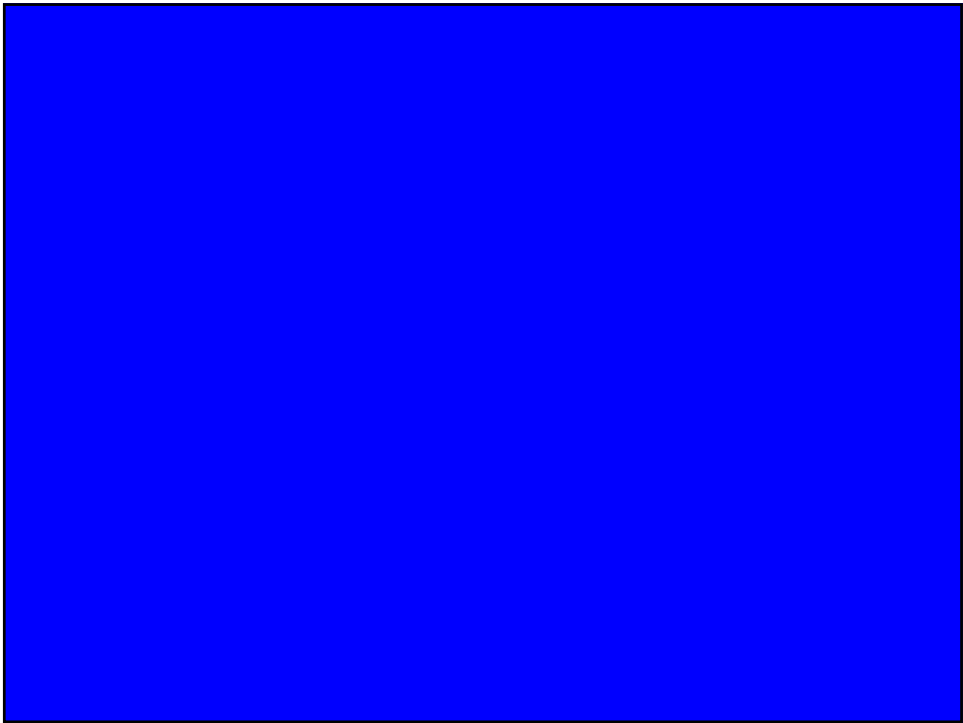


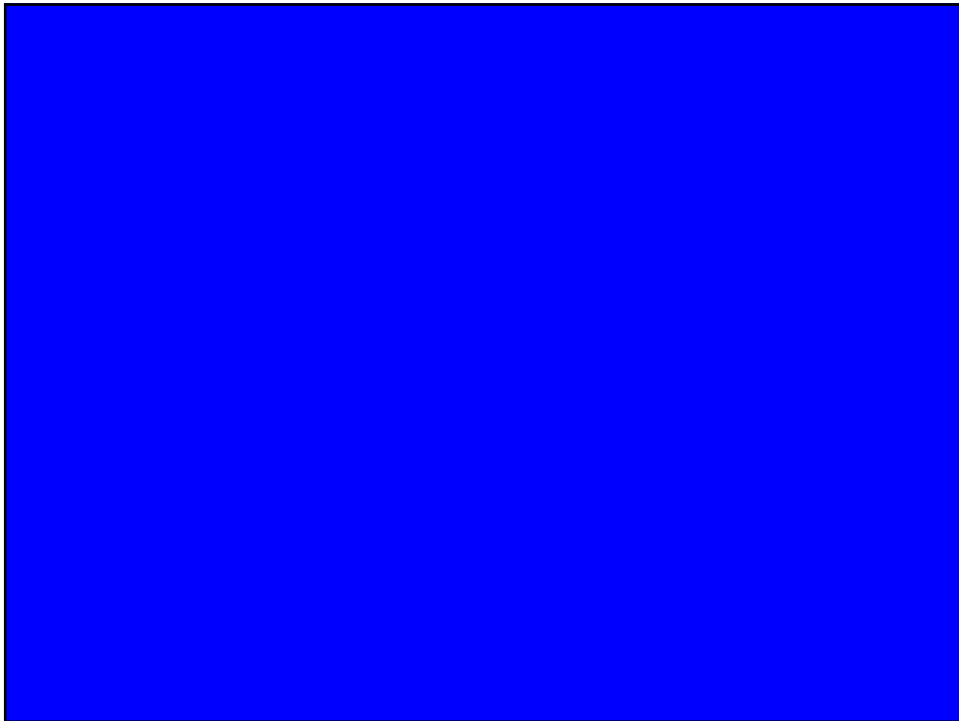
What is color for?

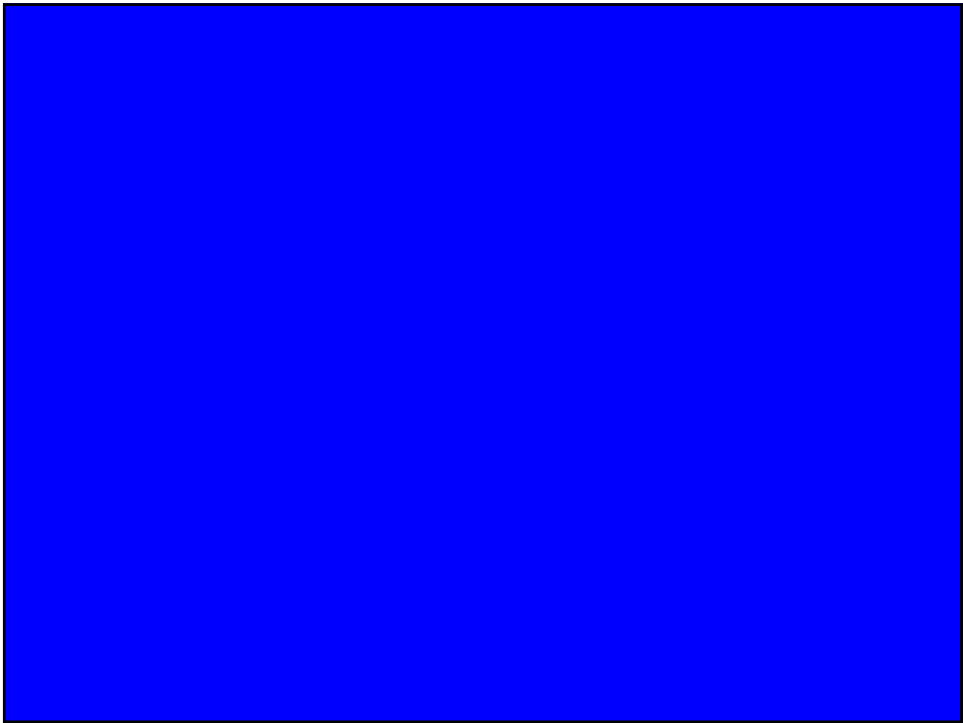


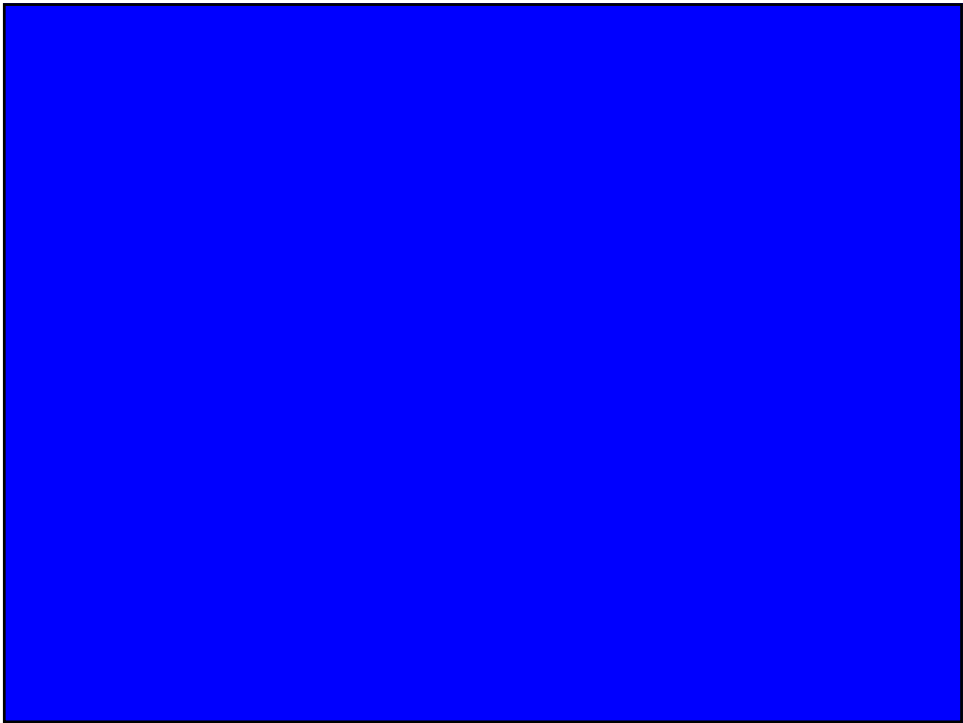
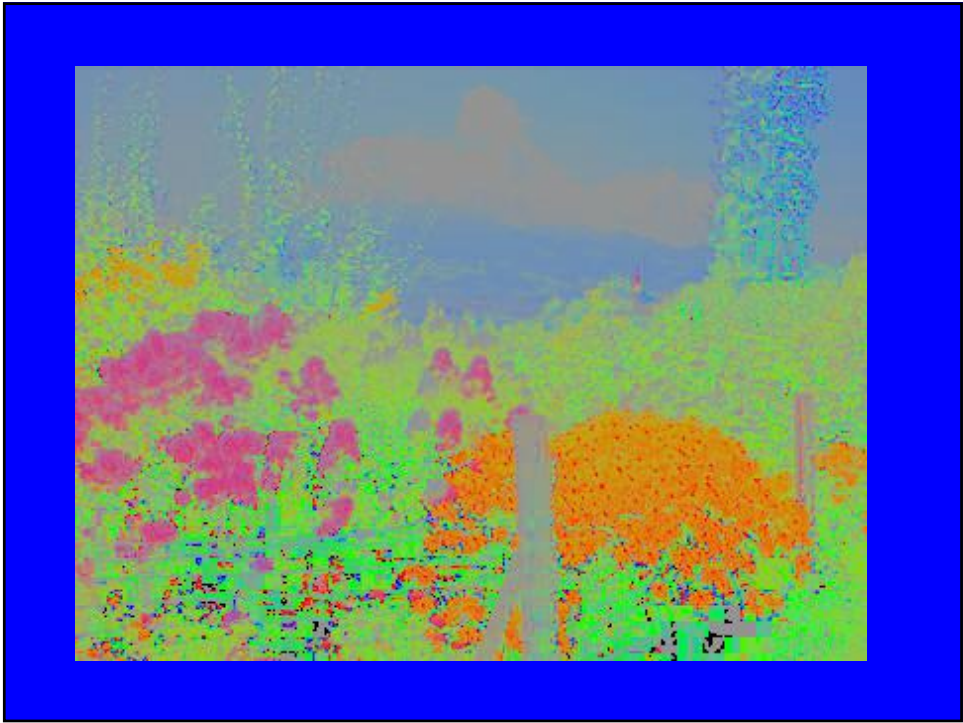


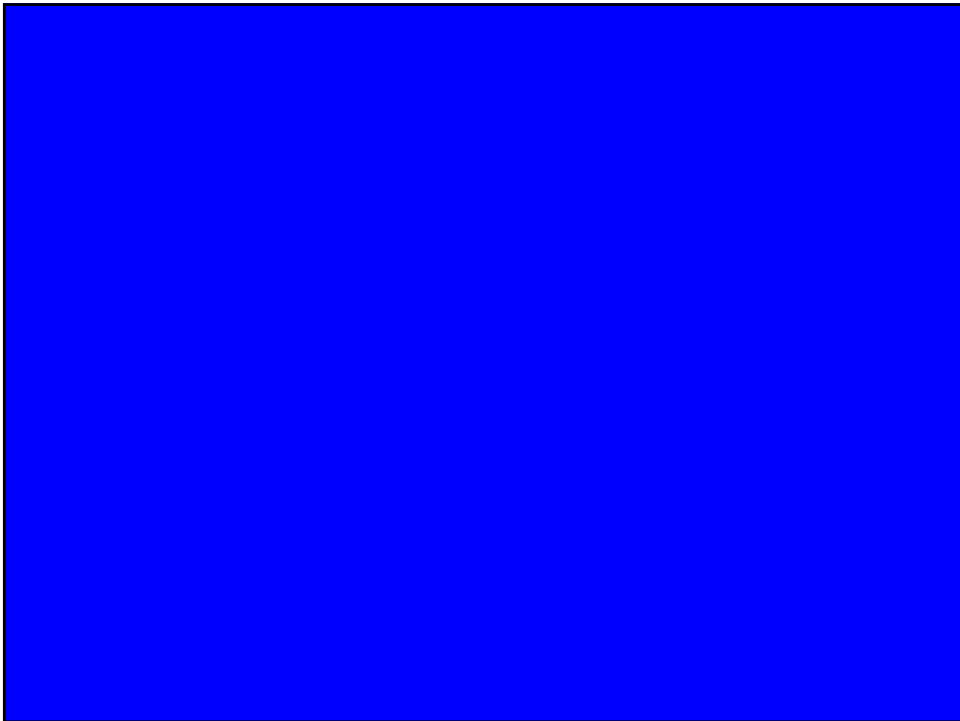










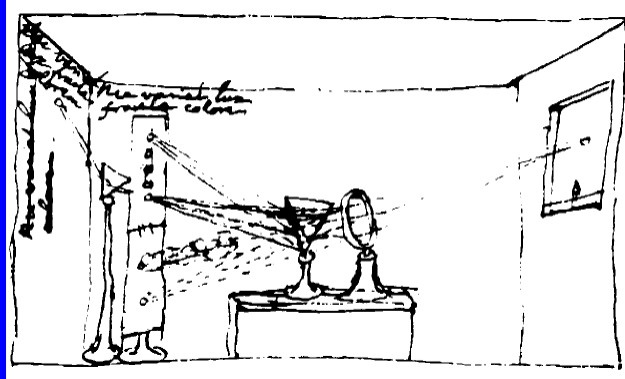




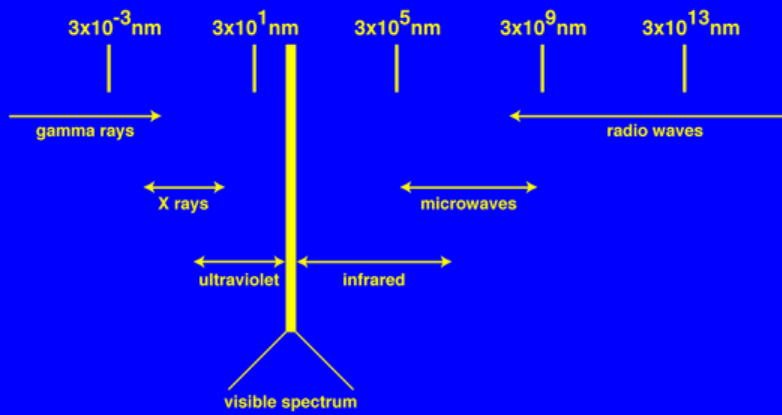
Color

- Physics
 - Light is E-M radiation of different frequencies.
 - Superposition principle
- Perception
 - 3 cones -> 3D color space. (Metamers).
 - Convex subset of 3D linear space.
 - Color matching: can't represent w/ 3 primaries.
- Color Spaces
 - CIE – a standard
 - RGB – a bit more intuitive, Monitors, OpenGL
 - CMYK – subtractive, what we learn in art class.
 - HSV – More intuitive
- More Perception
 - Perceptual distance
 - Context
- Refs: H&B Chapter 12; "The Foundations of Color Measurement and Color Perception", by Brian Wandell:
<ftp://white.stanford.edu/users/brian/ise/sid-colornotes.pdf>

Newton's drawing:



(Wandell)



(Varshney)

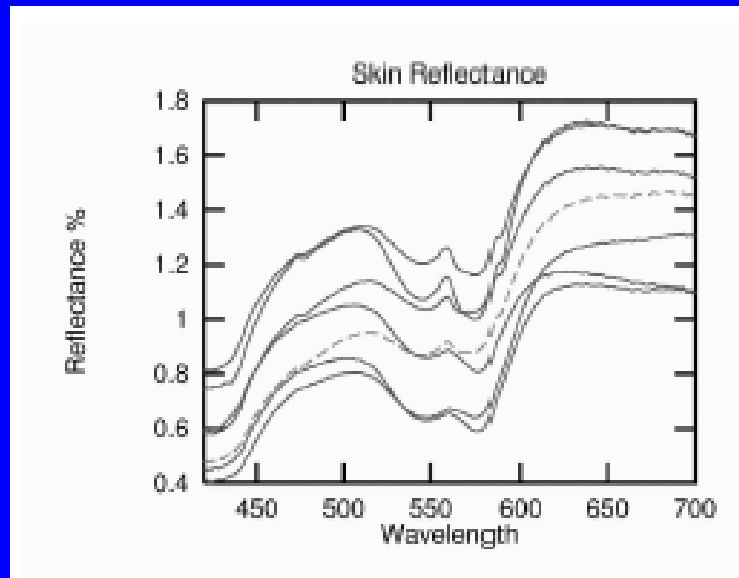


Achromatic light is light without color



Colored light is electromagnetic energy between 400 and 740 nanometers (nm)

Color is a function



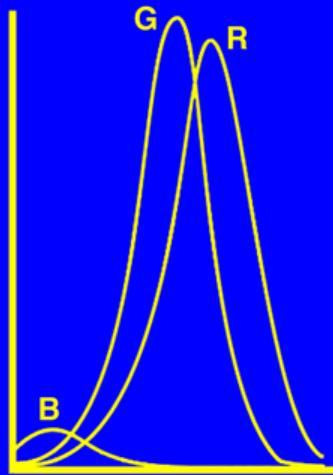
(Angelopoulou)

Superposition

- Light is linear.
- Light from source A + light from source B = Light from sources A & B.
 - Any color is a combination of pure colors.
- Doubling intensity of source doubles amount of light reaching us.

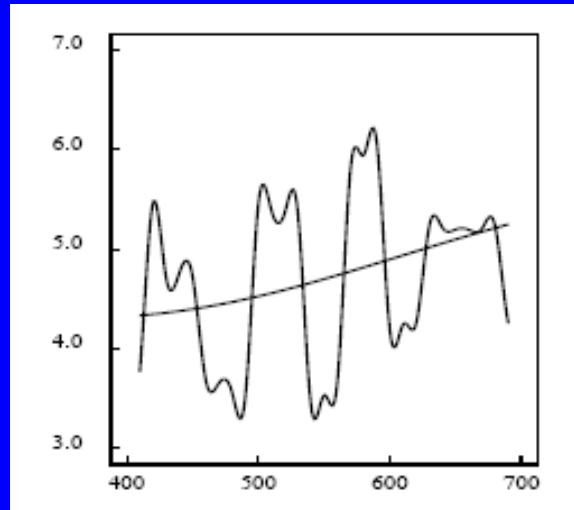
Human Color Perception

- Cones allow color perception.
- 3 types of cones sensitive to different frequencies
- Perceptual color depends on how these are stimulated.



tristimulus theory

Metamers

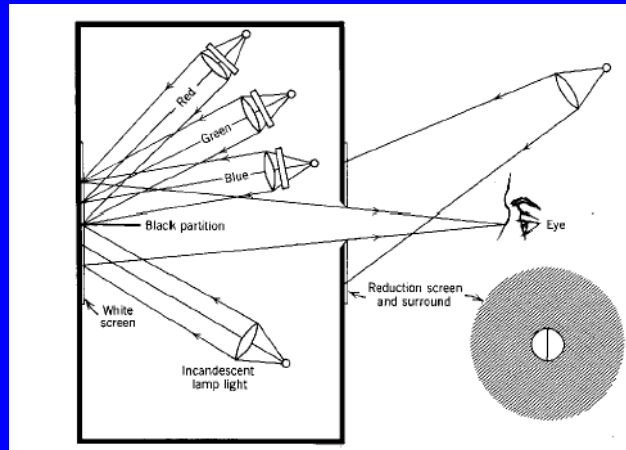


(Wandell)

Perceptual color space

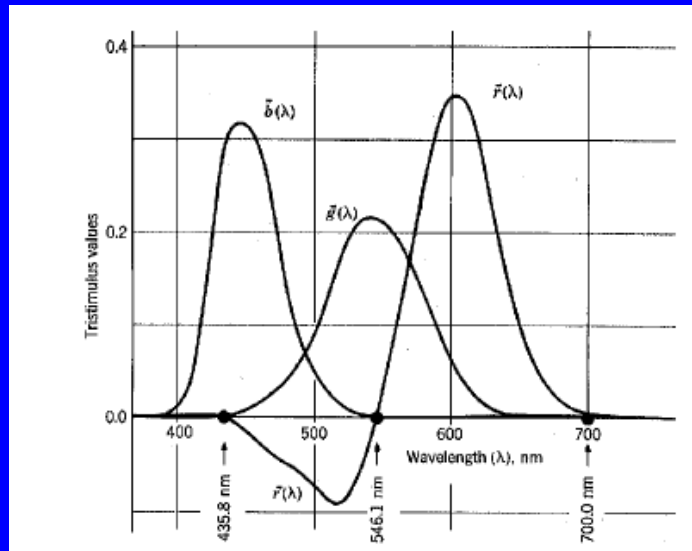
- 3D
- Convex subspace
 - Cones don't have negative response
- In general, any three colors projected onto this space span it.
 - But not with non-negative coefficients.

Color Matching



Some colors can't be matched

- There isn't a unique color for each cone.
 - "Green" light also excites "red" cones.
 - So to produce some greenish lights we need negative red light.
- But we can match that color + a primary color, using the other two primaries.
- Adding red to our color is like matching it with negative red.
- All colors can be matched like this
 - Shows perceptually color is 3D
 - But we can't have negative light in a display.
 - Display space is convex too, but can't match perceptual convex space.



(Wandell)

Grassman's Additivity Law

- Color matching follows superposition
- If we know how to produce all pure colors, we can produce any color.