Friedrich-Alexander-Universität
Technische Fakultät

Lecture 2, Part 2

Color 1/2

Computer Vision
Summer Semester 2023

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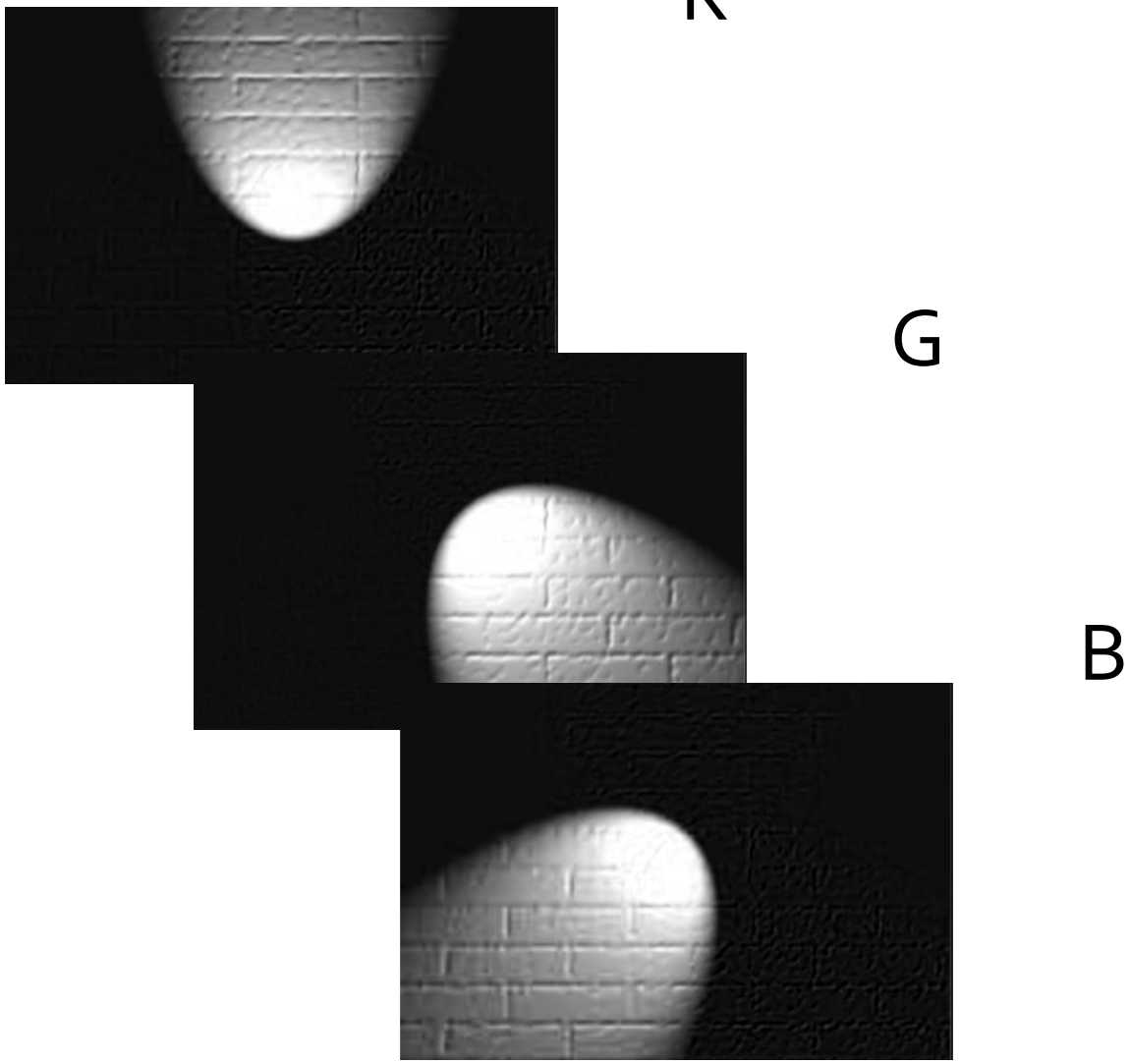
Color



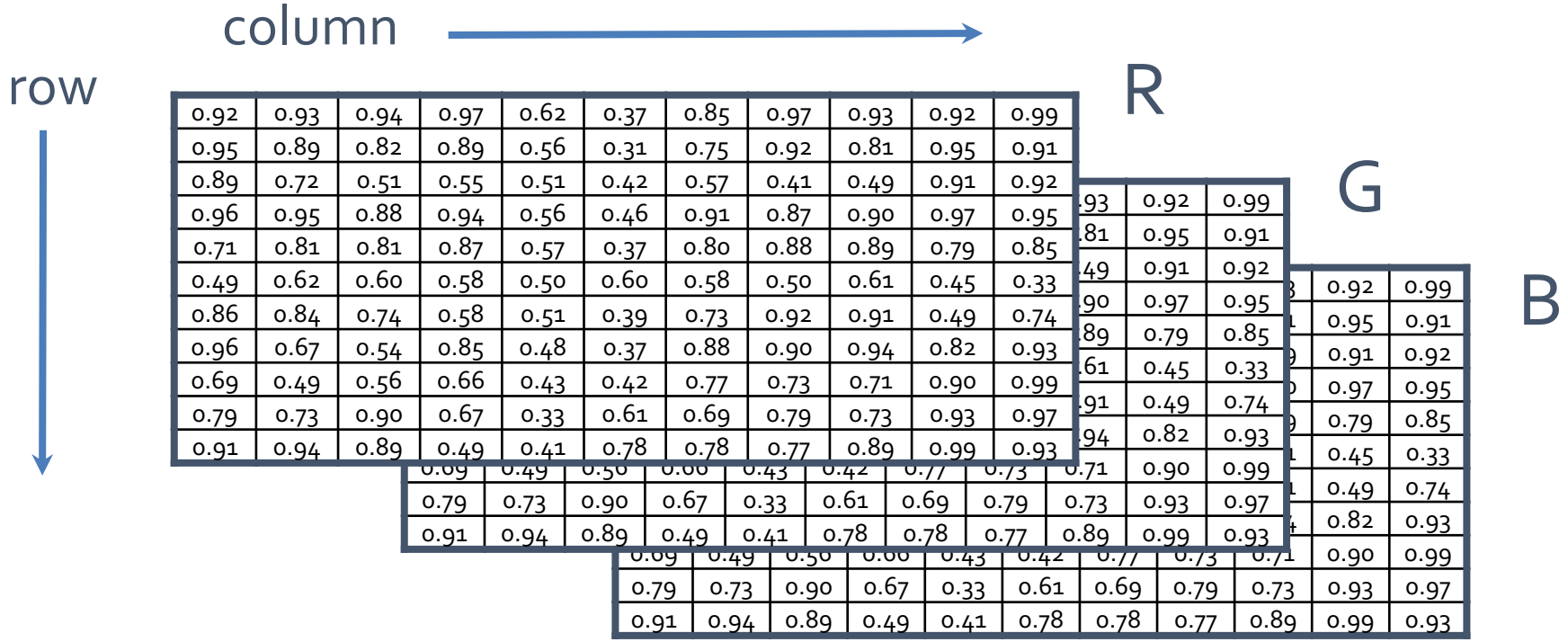
James Hays

Images (Matlab Notation)

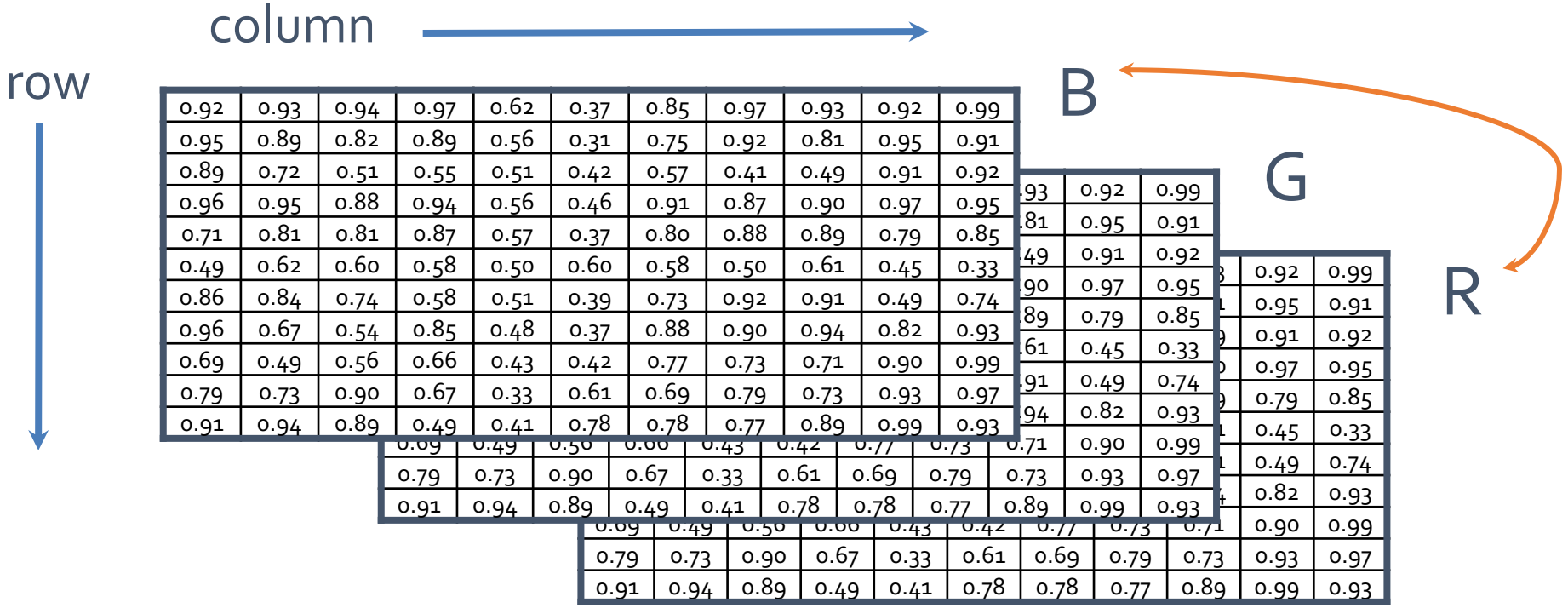
- *n*×*m* RGB "im"
  - im(1,1,1) = top-left pixel value in R-channel
  - im(y, x, b) = y pixels down, x pixels to right in the bth channel
  - im(*n*, *m*, 3) = bottom-right pixel in B-channel

- imread(filename) returns a uint8 image (values 0 to 255)
  - Convert to double format (values 0.0 to 1.0) with im2double()

Images (Matlab Notation)



Images (OpenCV Notation — Exercises!)

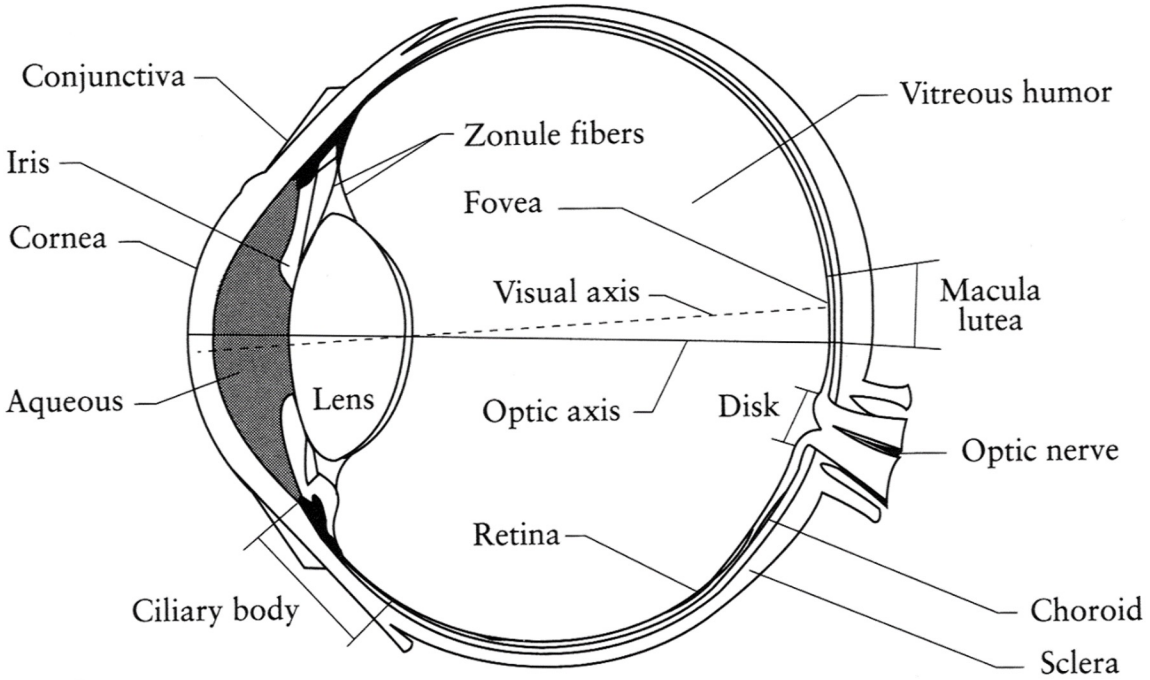


What is Color?

Anatomy of the Eye

- The human eye is a camera
  - **Iris** - colored annulus with radial muscles
  - **Pupil** - the hole (aperture) whose size is controlled by the iris
  - What's the sensor?

photoreceptor cells (rods and cones) in the retina

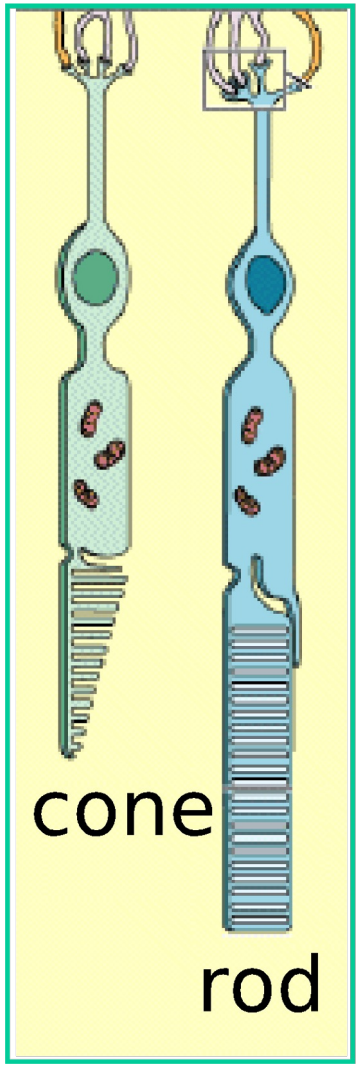


Steve Seitz

Two types of light-sensitive receptors

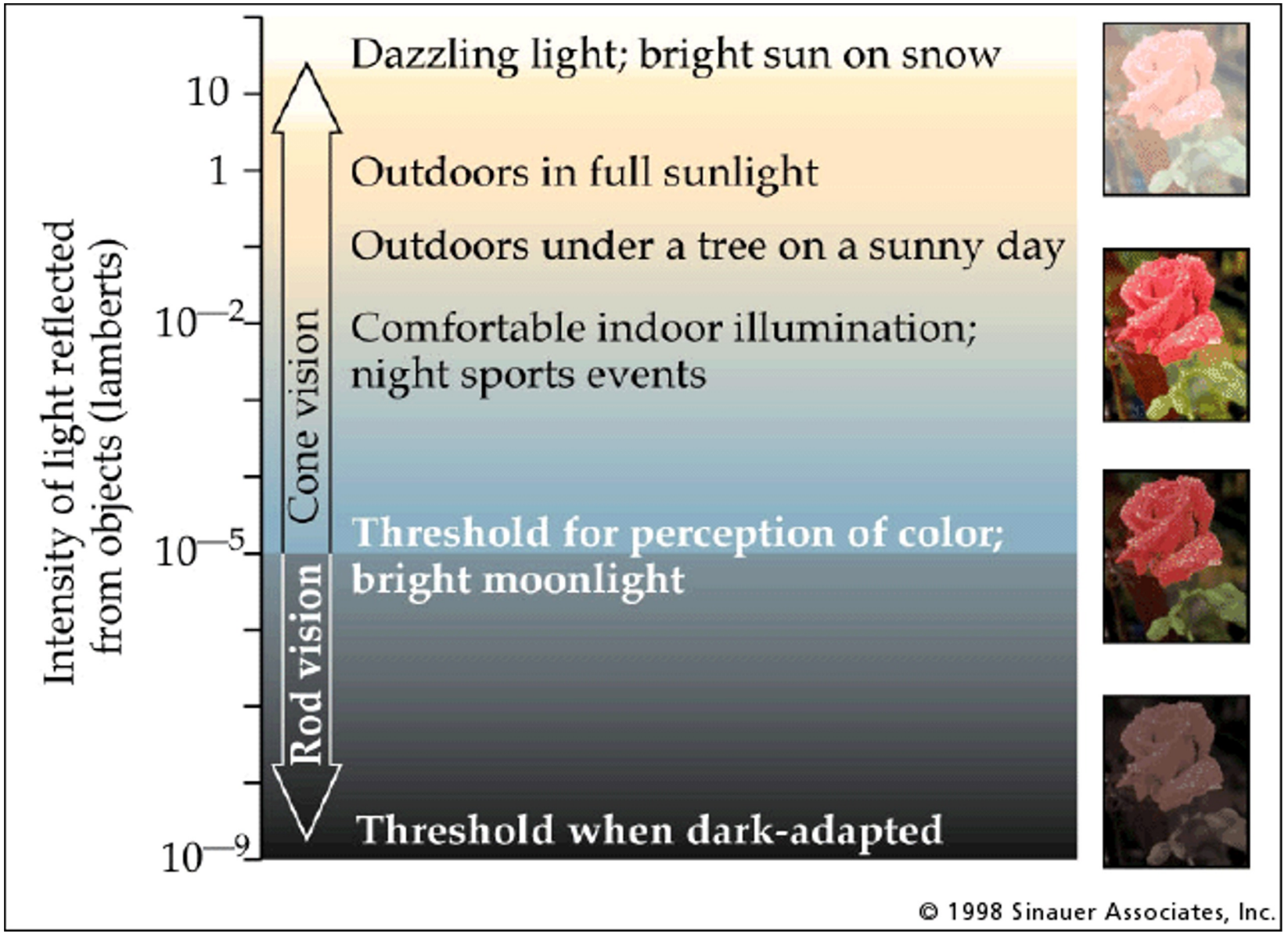
Cones (5 Million)
- cone-shaped
- less sensitive
- operate in high light
- color vision

Rods (120 Million)
- rod-shaped
- highly sensitive
- operate at night
- gray-scale vision



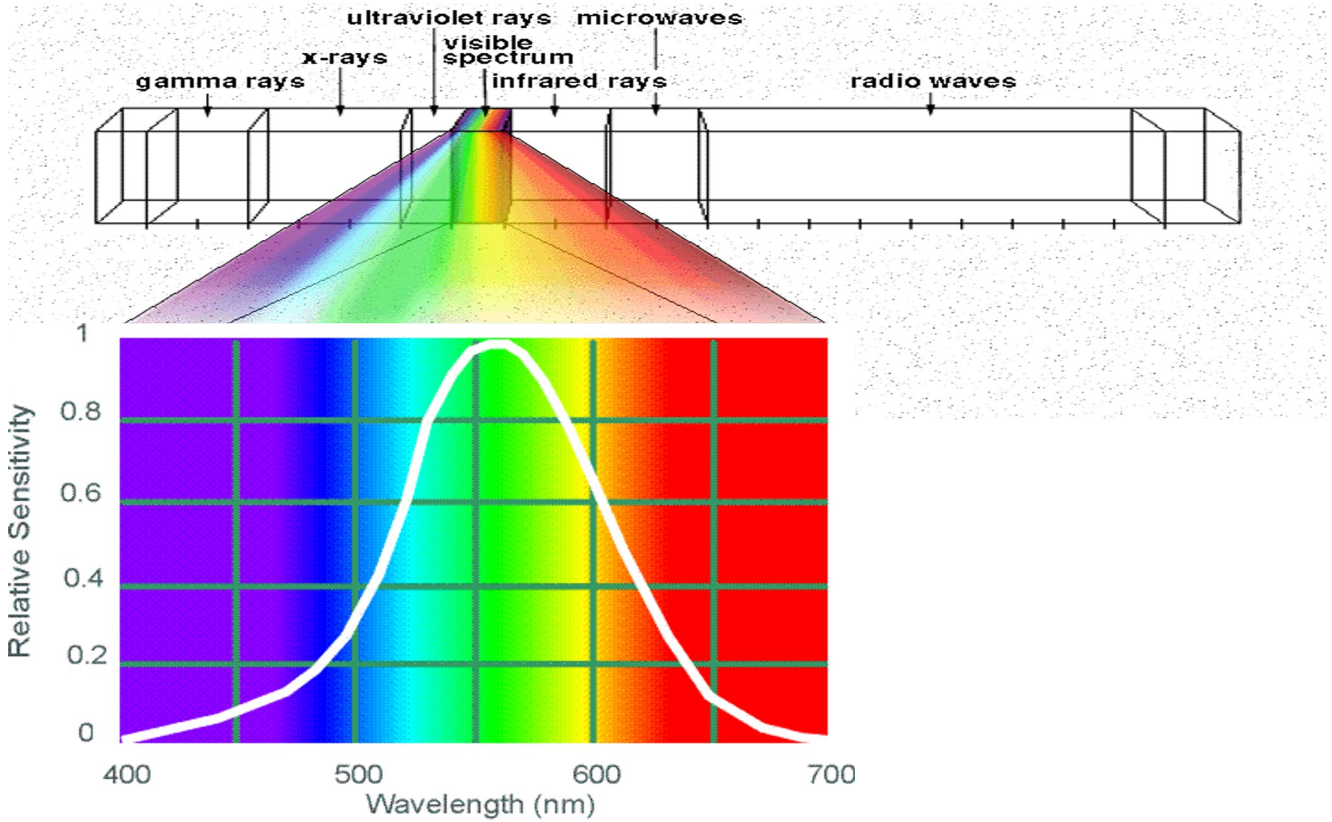
James Hays

Rod and Cone Sensitivity



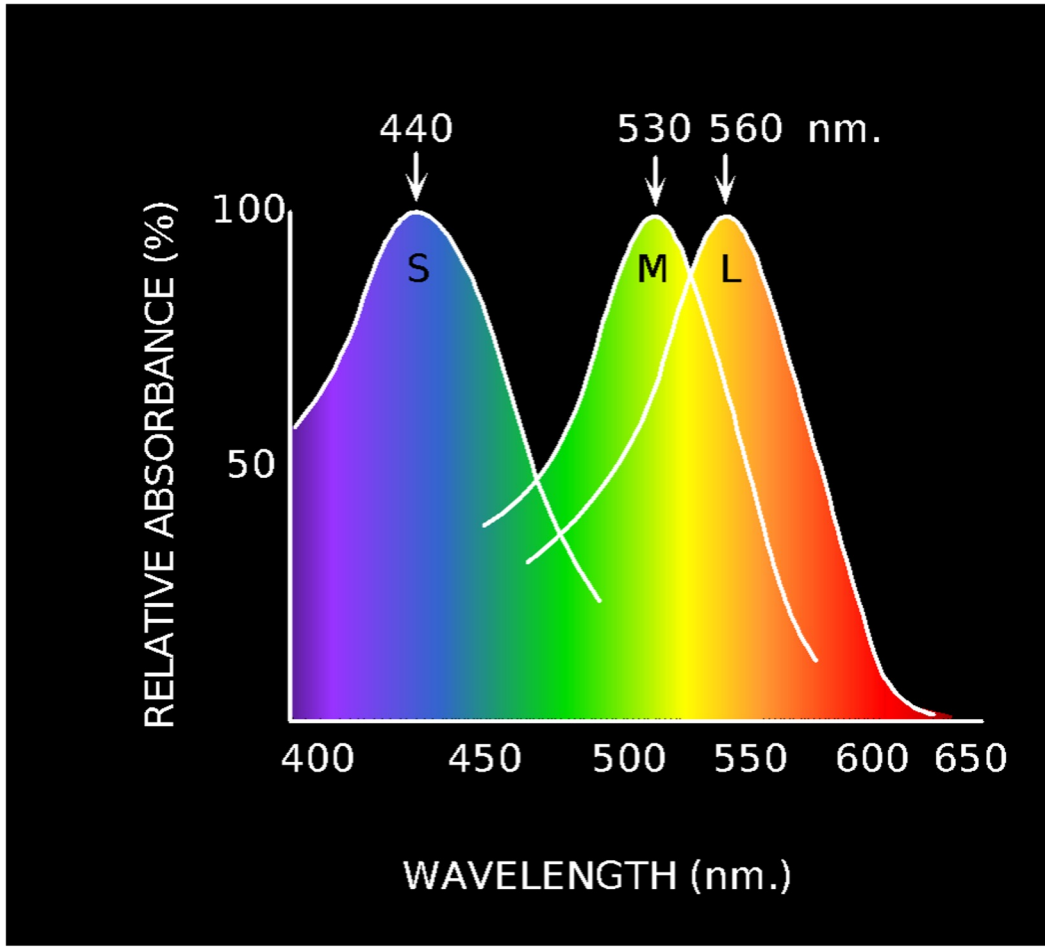
Human Luminance Sensitivity Function

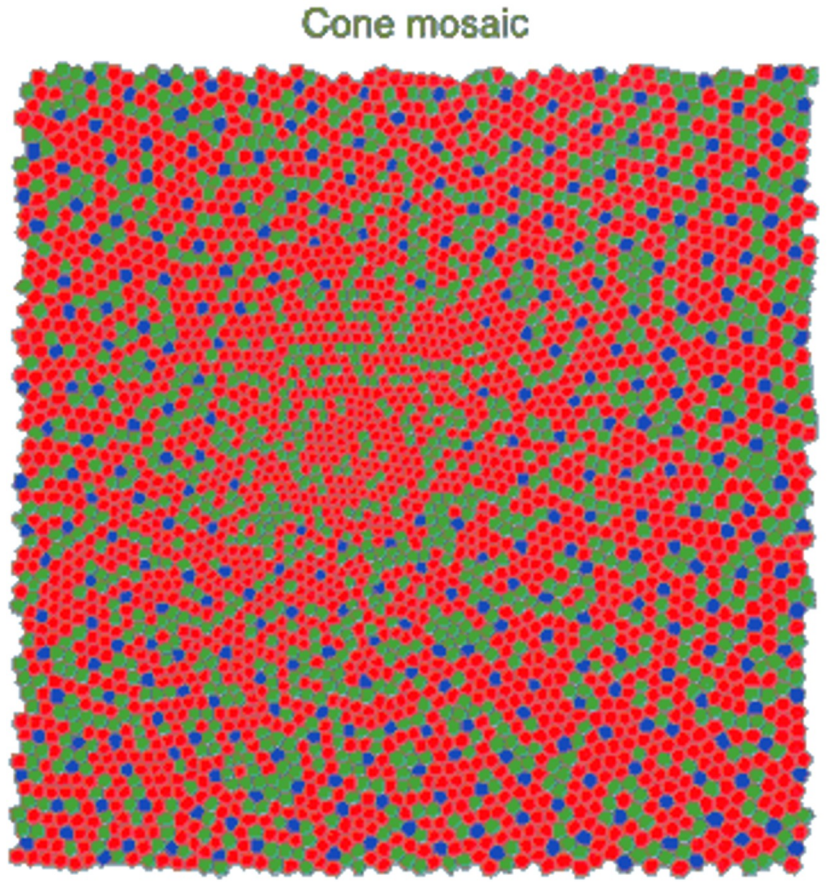
Electromagnetic Spectrum



Physiology of Color Vision

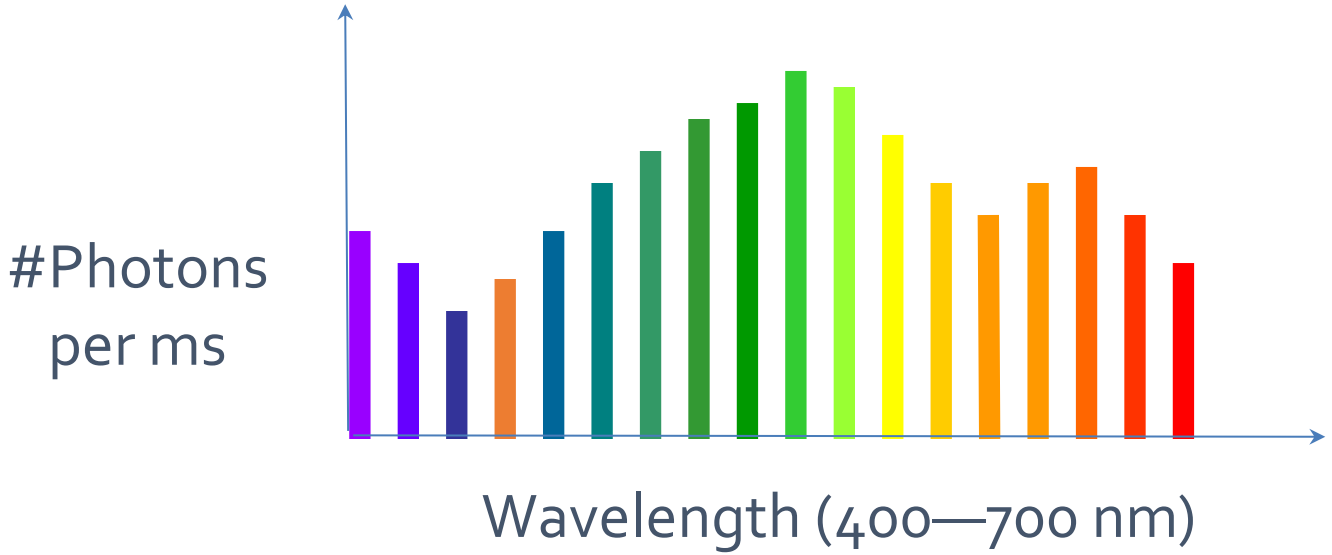
Three kinds of cones





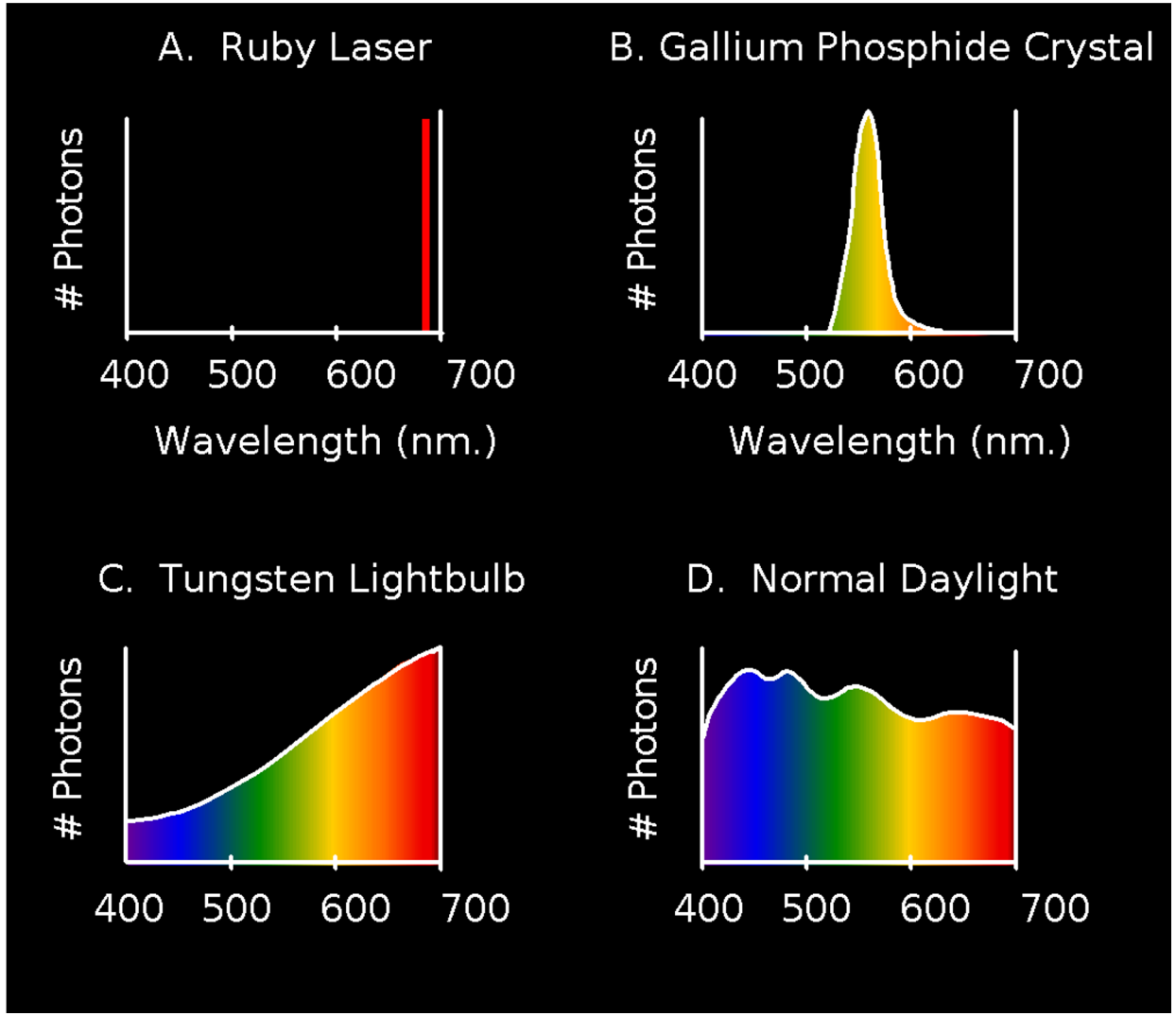
The Physics of Light

Any patch of light can be completely described physically by its spectrum: the number of photons (per time unit) at each wavelength 400–700 nm.



The Physics of Light

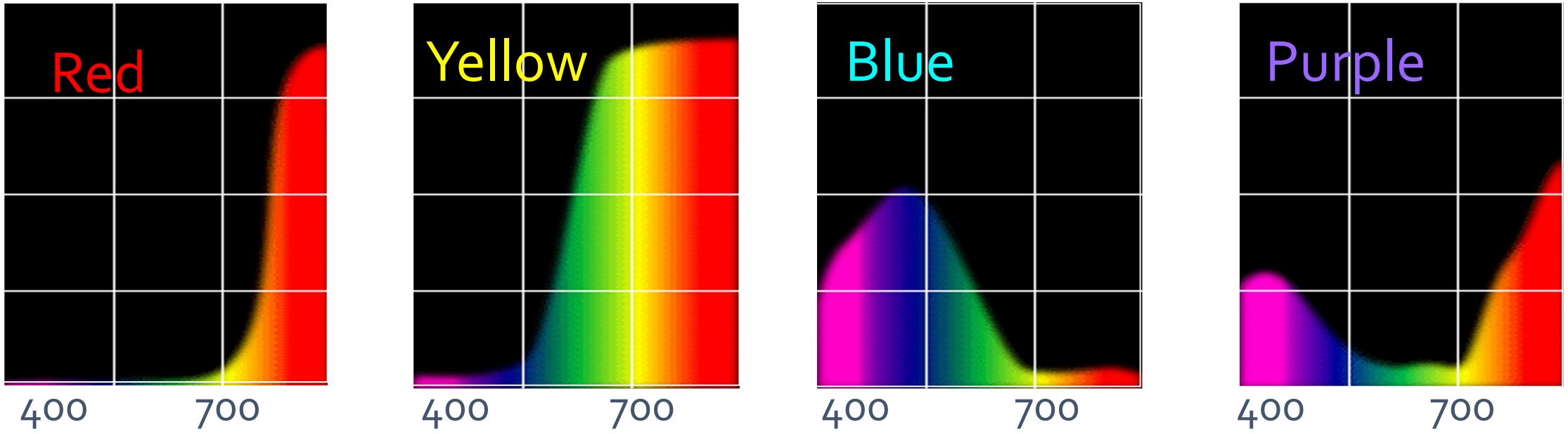
Some examples of the spectra of light sources



The Physics of Light

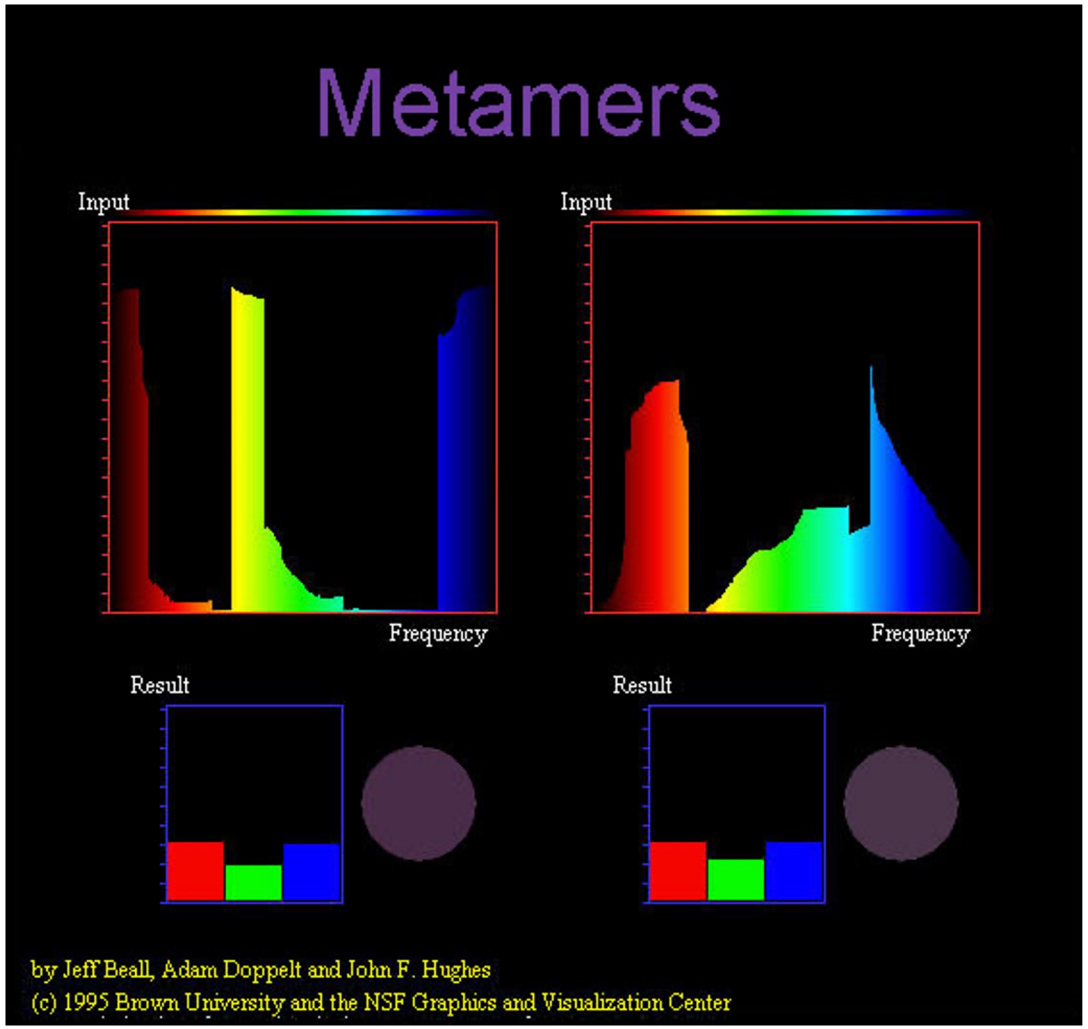
Some examples of the reflectance spectra of surfaces



Stephen E. Palmer

Metamers

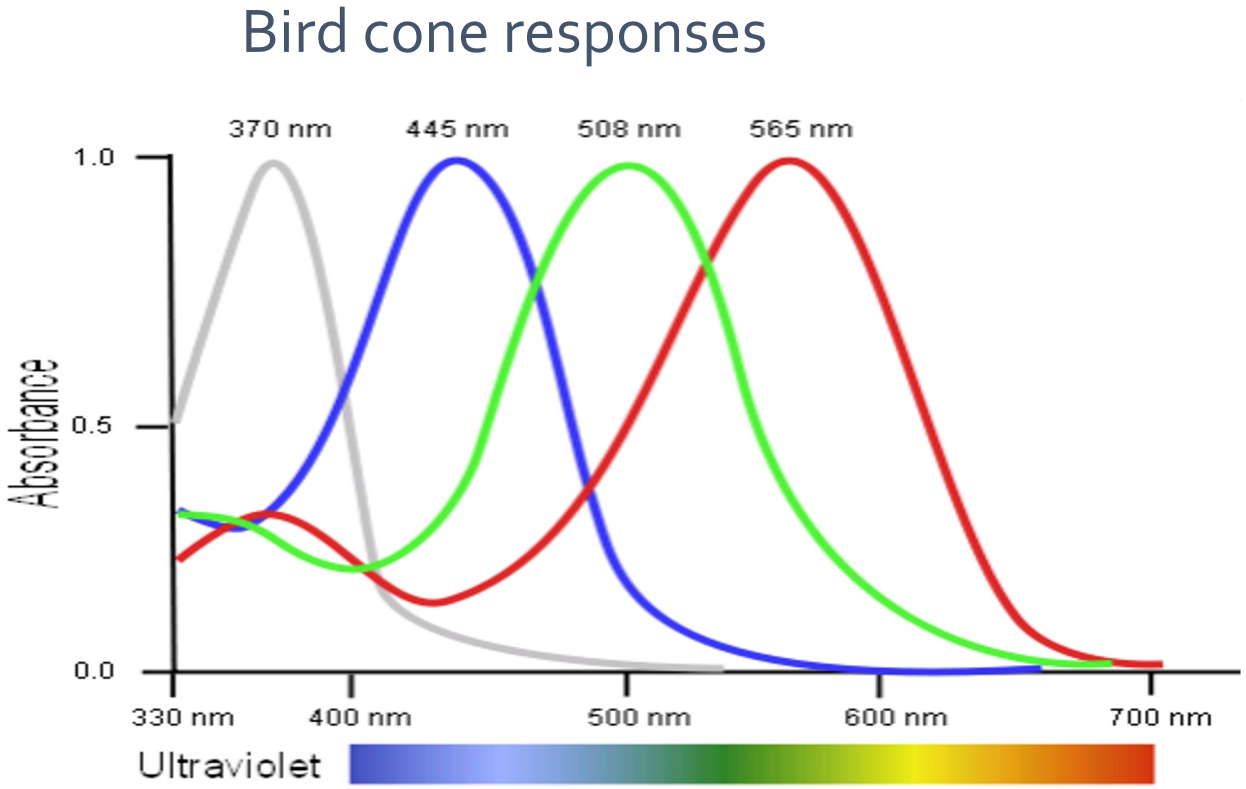


Do colors exist?

1. Free will, Colors, Promises, Euros! -- https://www.youtube.com/watch?v=G8DQfYV49gI
2. https://www.askamathematician.com/2012/06/q-do-colors-exist/

Tetrachromatism

- Most birds, and many other animals, have cones for ultraviolet light.
- Some humans seem to have four cones (~12% of females).
- True tetrachromatism is rare; requires learning.



Bee vision