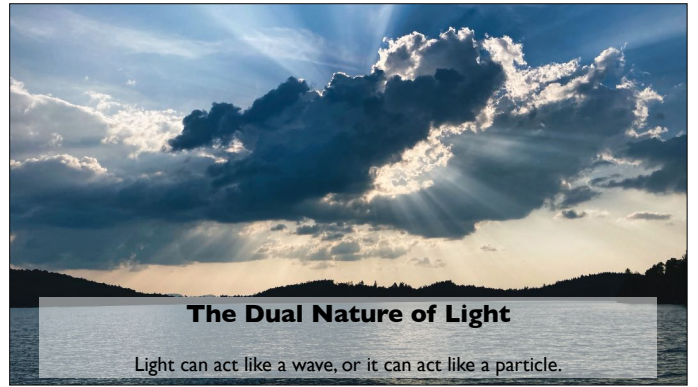
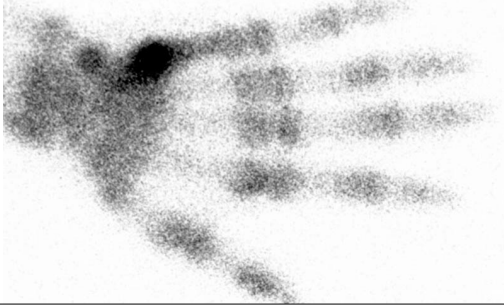
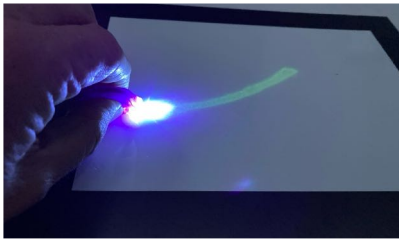


Electromagnetic waves are also *photons*:
 Particles of light, with a certain amount of energy.



Writing with Light

Touch (gently!) different color flashlights to the glow-in-the-dark surface.
 Which colors leave trails?

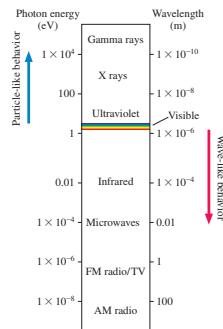


The electromagnetic spectrum

Long wavelength
 Low energy
 700 nm
 1.8 eV

Short wavelength
 High energy
 400 nm
 3.1 eV

There is more to the rainbow.



Near the rainbow.

Beyond the red:
 Infrared
 800 nm
 1.5 eV

Beyond the violet:
 Ultraviolet
 360 nm
 3.4 eV

Fluorescence

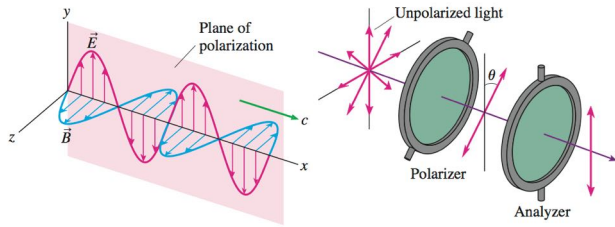


Far from the rainbow.

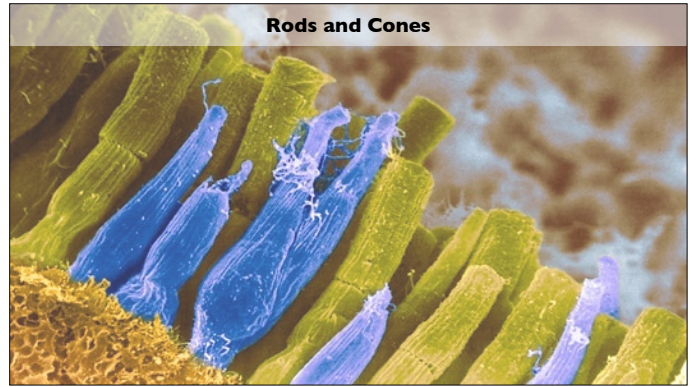
Thermal radiation
 10,000 nm
 .12 eV

Visible light
 600 nm
 2 eV

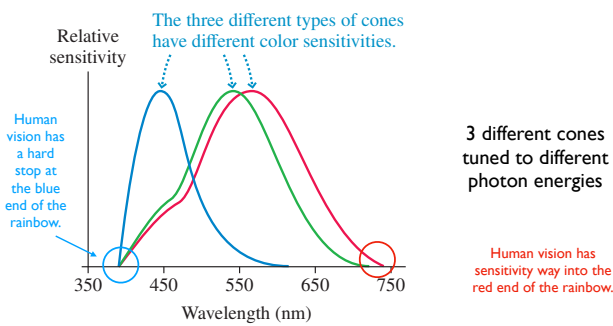
Polarization



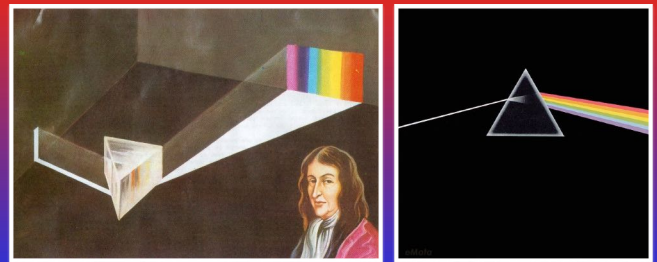
Rods and Cones



Human Vision



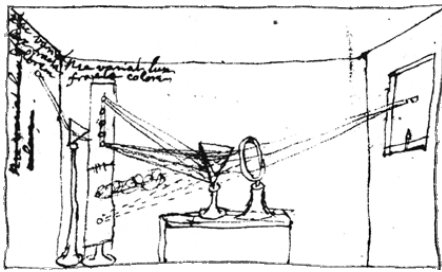
How Many Colors in the Rainbow?



Newton says 7.

Floyd says 6.

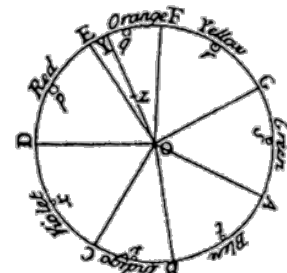
The First Experiments: Isaac Newton



Why Seven?

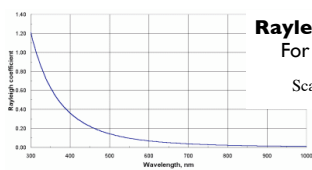
Newton originally had five colors:

Red
Yellow
Green
Blue
Purple



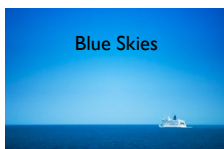
Why seven?
Correspondence with music.

Scattering from Small Objects



Rayleigh scattering
For small objects:

$$\text{Scattering} \propto \frac{1}{\lambda^4}$$

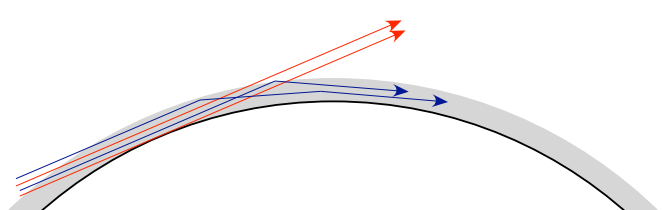


Blue Skies



Red Sunsets

After Sunset...





Question

Put the answer on your whiteboard

Think of all of the animals that might live on a farm. Who has the best color vision?

Most Mammals (Including Dogs & Cats)

They can see colors—including colors beyond the violet end of the rainbow.

But they can't see red. They don't have any sensitivity at this end of the spectrum.

Dog Vision

Look at the different color objects through the cyan glasses. How do things appear?

Discussion Question

Why would dog's color sensitivity be tipped toward the short wavelength end of the spectrum?

