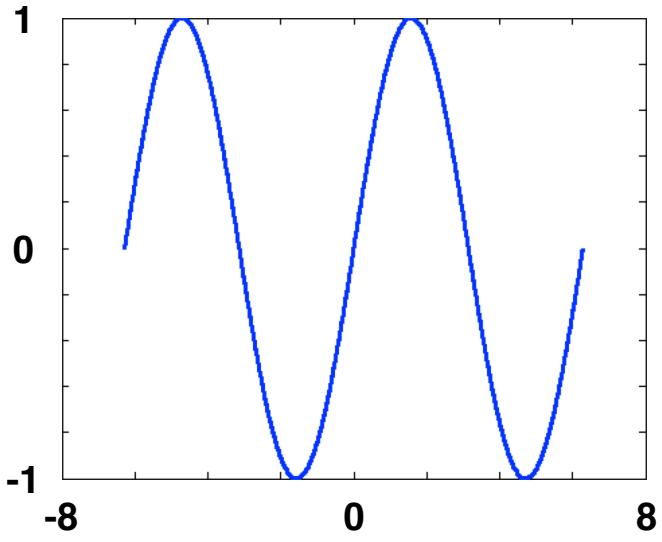
Fundamentals

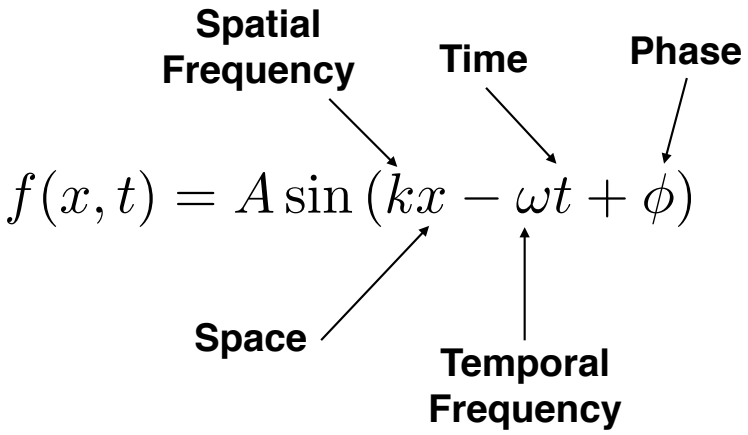
Physics Lecture 1

Nicholas Dwork

Sine



Sinusoidal Wave Propagation



Frequency Relationships

$c = \lambda \nu$ c **is the speed of light**

The speed of light is 3×10^8 **m/s in a vacuum.**

λ **is the wavelength of the light wave**
ν **is the frequency of the light wave**

Sinusoidal Wave Propagation

A single color of light is a sinusoidal waveform.

Color

$$f(x,t) = A\sin\left(kx - \omega t + \phi\right)$$

400 nm **Wavelength** **700 nm**

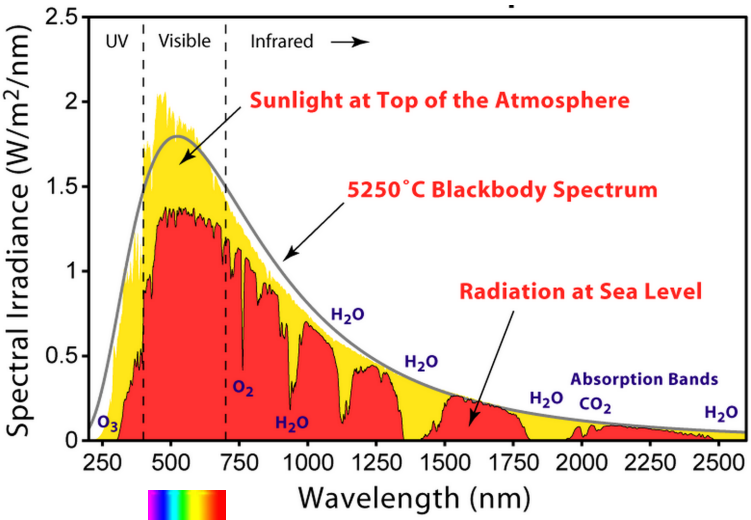
Types of Light

A laser is a light beam of a single (or very few) color.

Broadband light is light that is made up of many colors.

White light is light that is made up of all visible frequencies.

Sunlight Spectrum



Cats and Dogs can see Ultraviolet light

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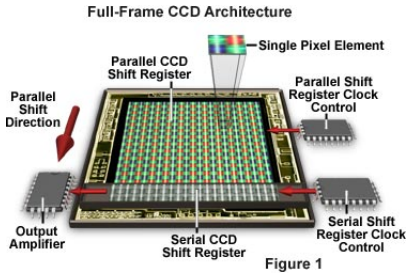
http://graphics.stanford.edu/courses/cs178/



http://www.olympusmicro.com/primer/digitalimaging/concepts/fullframe.html

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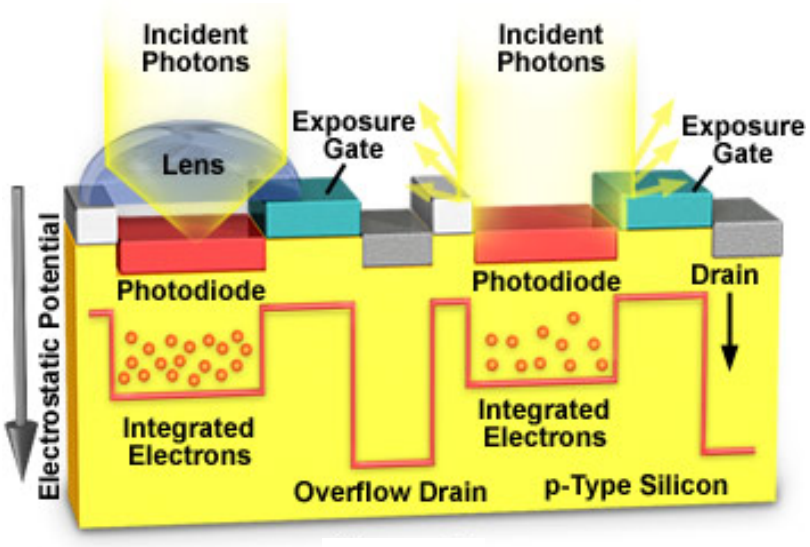
Micro Lens



http://hamamatsu.magnet.fsu.edu/articles/images/microlensarray.jpg

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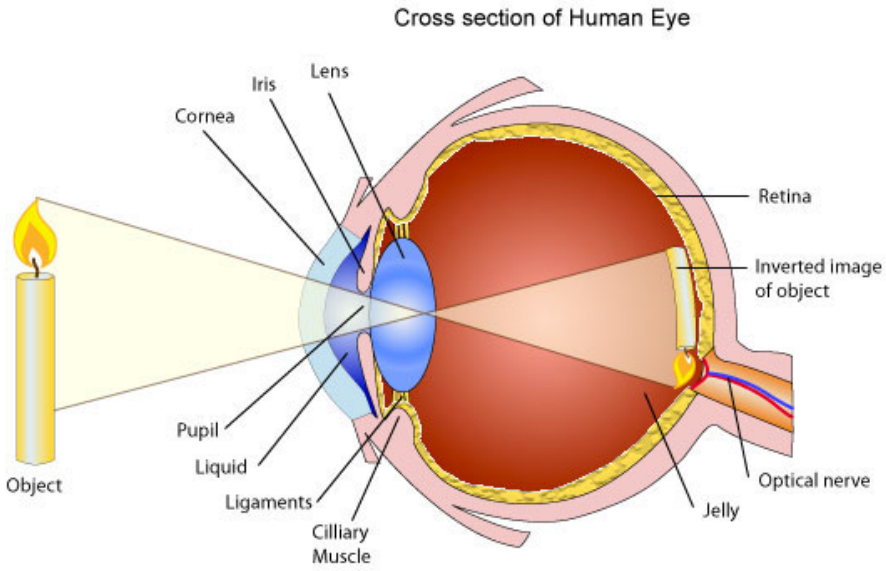

http://www.passmyexams.co.uk/GCSE/physics/images/eye_xsection_01.jpg

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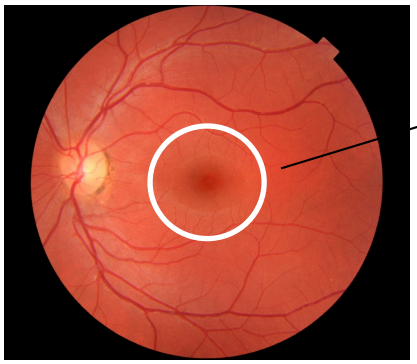
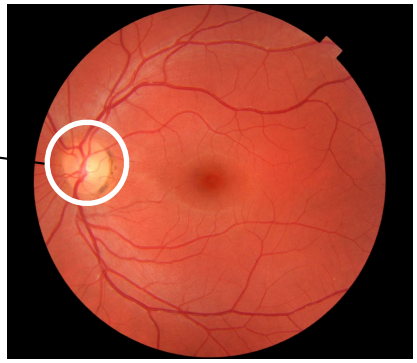
The Retina



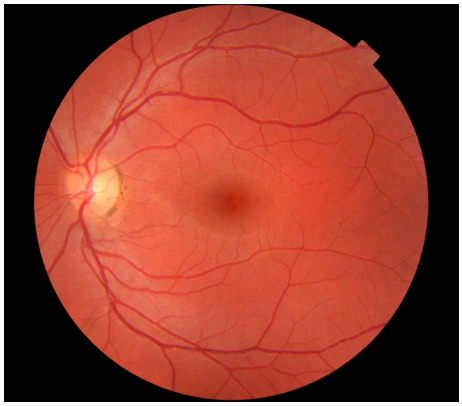
The Fovea is made of cones (color receptors).
Very high resolution.
It sees in daylight.

The Retina



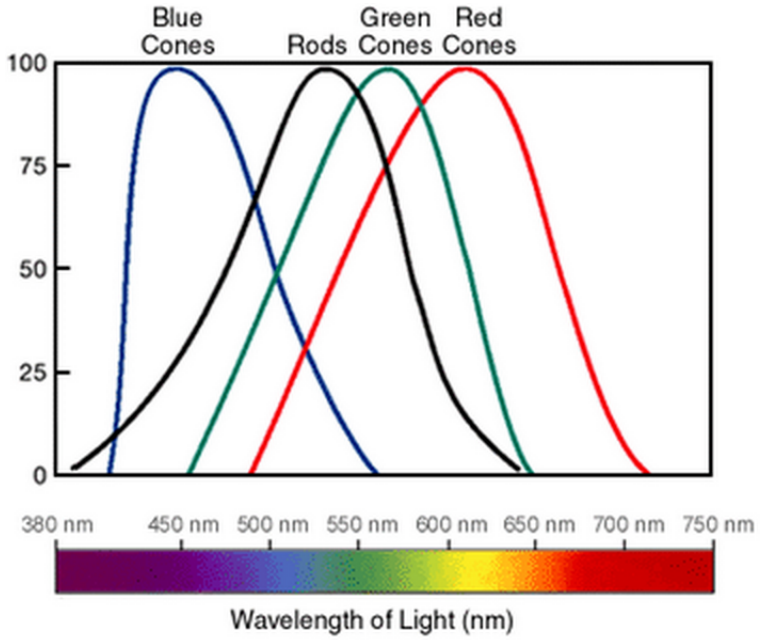
The optic nerve takes information from the eye to the occipital region in the brain.

The Retina



Outer region of the retina is made of rods.
Rods are much more sensitive than cones, and they see at night or in dim light.
Lower resolution than rods.

What the Eye Sees



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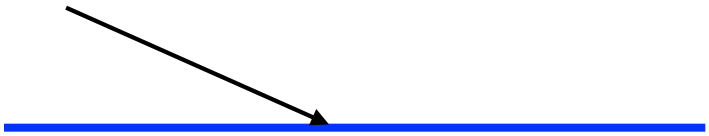
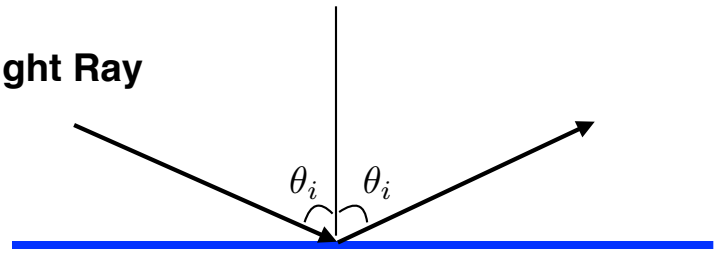
Light Ray



A light ray comes in and hits a surface of something.
Where does that light ray go?

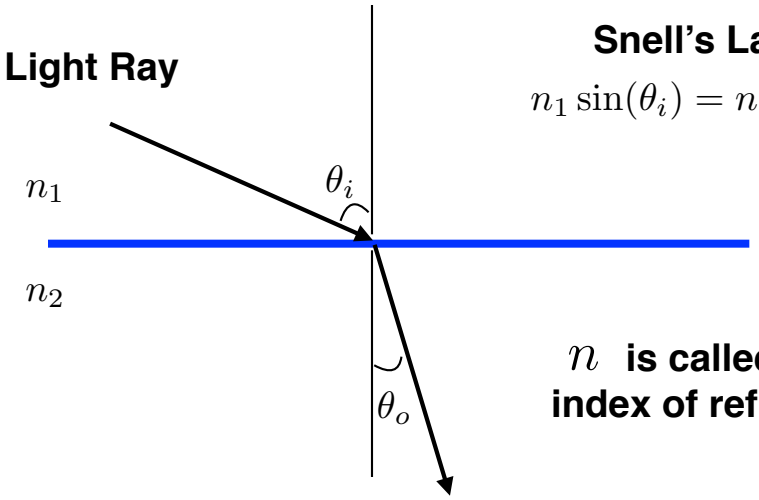
Reflection

Light Ray



Part of the light gets reflected.
The angle of incidence equals the angle of exit.

Refraction



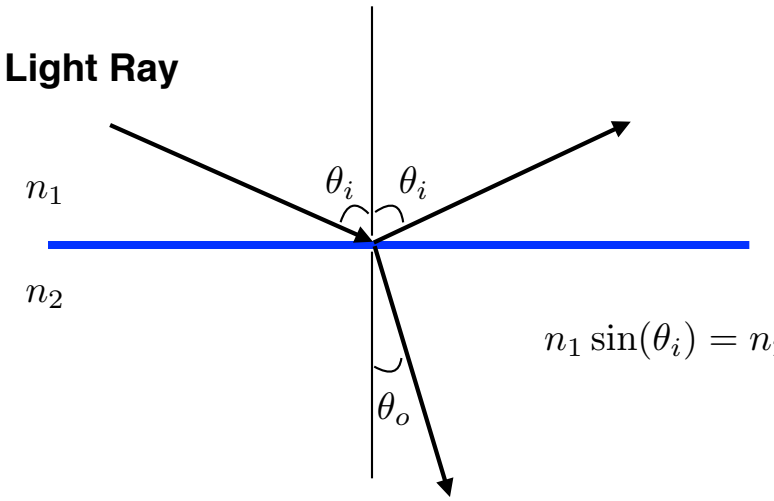
Snell's Law

$$n_1 \sin(\theta_i) = n_2 \sin(\theta_o)$$

n **is called the index of refraction.**

Part of the light gets refracted.
The angle of exit follows Snell's Law.

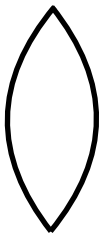
Reflection and Refraction



$$n_1 \sin(\theta_i) = n_2 \sin(\theta_o)$$

Index of refraction changes with frequency.

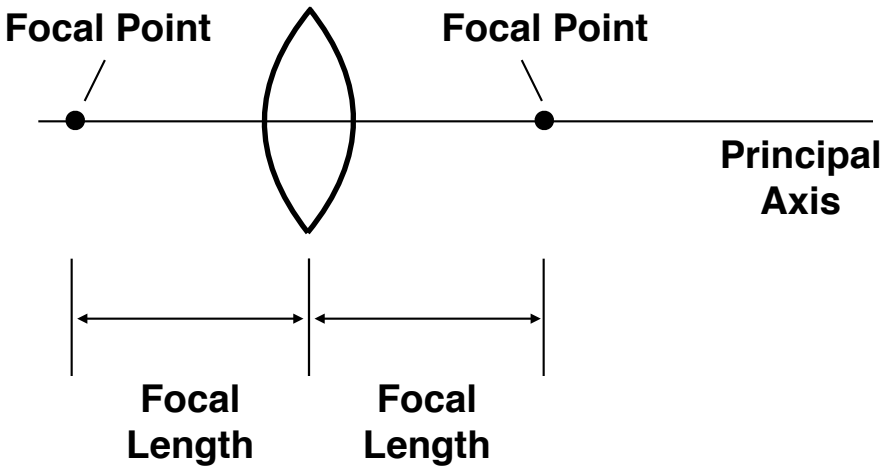
Lens



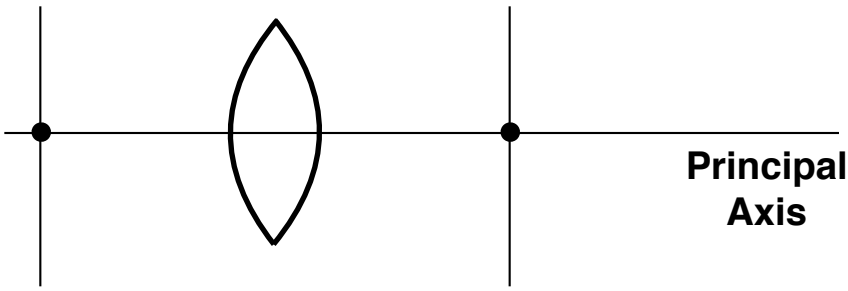
A lens is made from two semi-spherical pieces fused together.

Their effect is a function of the index of refraction of the material (e.g. glass or plastic).

Lens



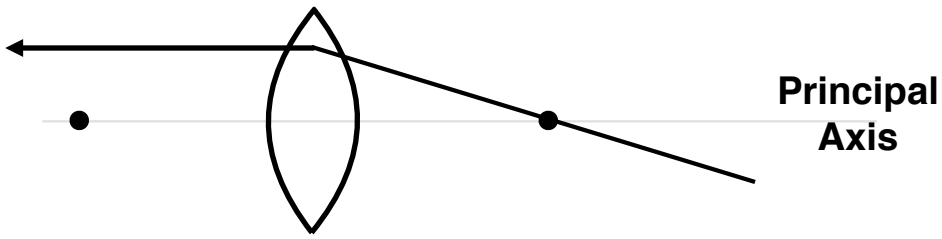
Lens



Focal Plane

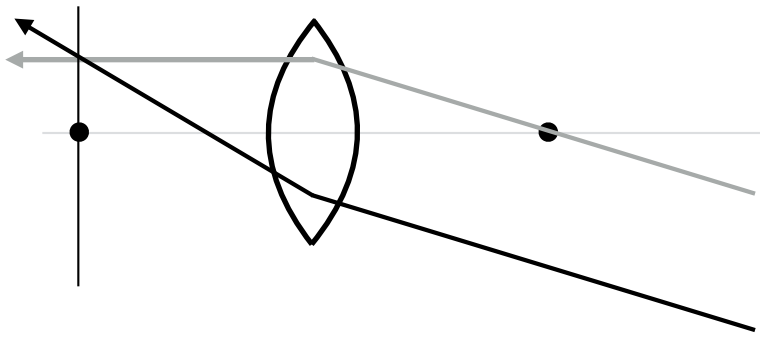
Focal Plane

Lens



Light rays that come in through the focal point diverge parallel to the principal axis.

Lens



Parallel light rays are focused at the focal plane.

Geometric Distortion

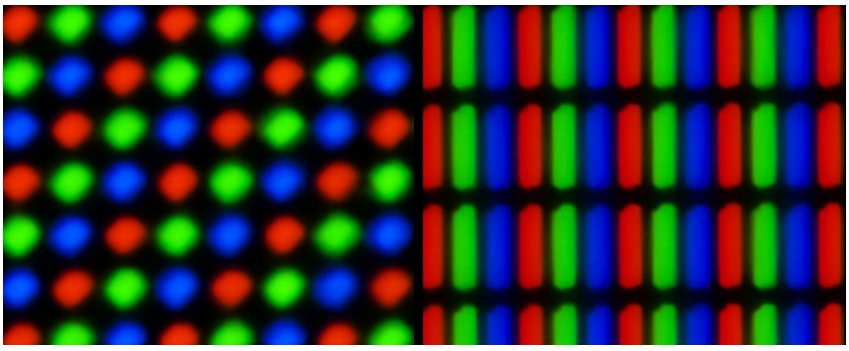
https://kbuck092207.wordpress.com/

Vignetting

http://www.discoverdigitalphotography.com/2013/what-is-vignetting-how-to-remove-or-add-vignetting-to-a-photo/

Liquid Crystal Display

If we were to magnify a liquid crystal display, we would see individual red, green, and blue spots.



They're so close together that when we turn them all on, our eye sees them as white.

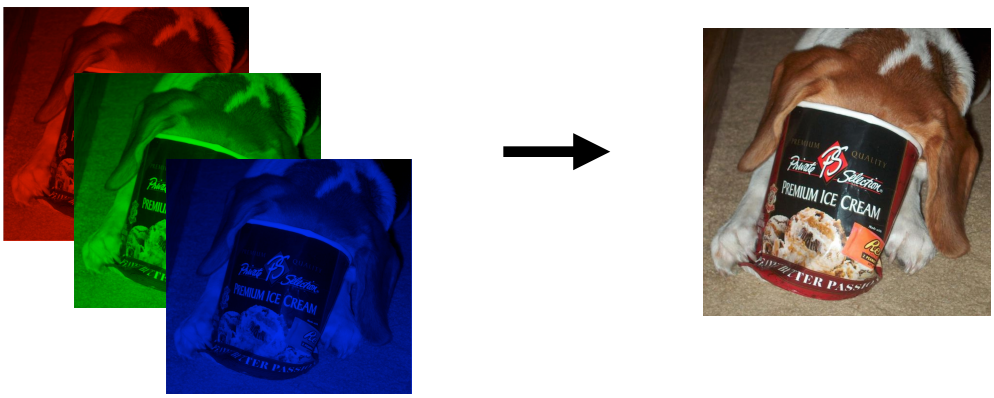
Liquid Crystal Display

LCD Video

https://www.youtube.com/watch?v=1sc-ldtLySA

Color Image

A color image is three different arrays.
The computer displays one of the arrays for red, one for green, and one for blue.



RGB Color Codes

Here are some colors and their associated Red-Green-Blue color code.

	138 43 226
	165 42 42
	255 64 64
	127 255 0
	118 238 0
	102 205 0
	69 139 0
	210 105 30
	255 127 36