PHYSICS

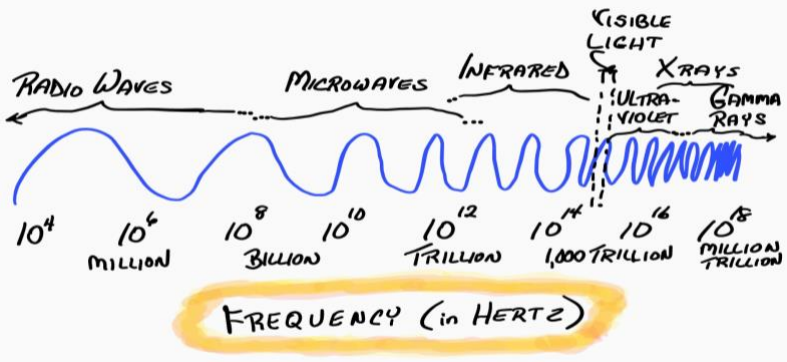
Light

- ## What is Light?
  - One way to answer this question is that "light is the only thing we can see".
  - Sources of light: _____ , _____ , _____ .
  - Origin of light: accelerated _____ .
  - Visible Light is one small part of the *electromagnetic spectrum*.

- ## Electromagnetic Waves in General
  - A moving electric charge has a moving electric _____ around it.
  - A moving magnetic charge has a moving magnetic _____ around it.
  - A moving electric/magnetic field produces a new magnetic/electric field.
  - This is an electromagnetic field and it moves outward in electromagnetic waves.

- ## The Speed of Electromagnetic Waves
  - EM waves move at _____ m/sec (or 3 x 10^5 km/sec, or 186,000 miles/sec); perhaps ALWAYS!
  - We think 'the speed of light' ('c' from celerity from Latin celeritatum – swiftness) is CONSTANT!

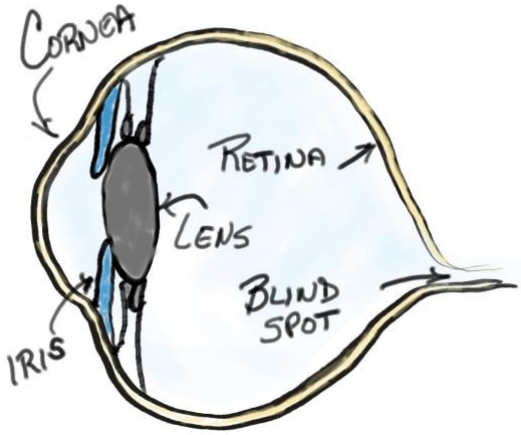
- ## The Electromagnetic Spectrum
  - Visible light is red to violet (4.3x10^{14} to 7x10^{14} Hz).
  - You can refer to EM waves by frequency or wavelength. They are inversely proportional. The exact relationship is [_____].
  - Space – both outer space and right here – is filled with EM radiation or waves or field.

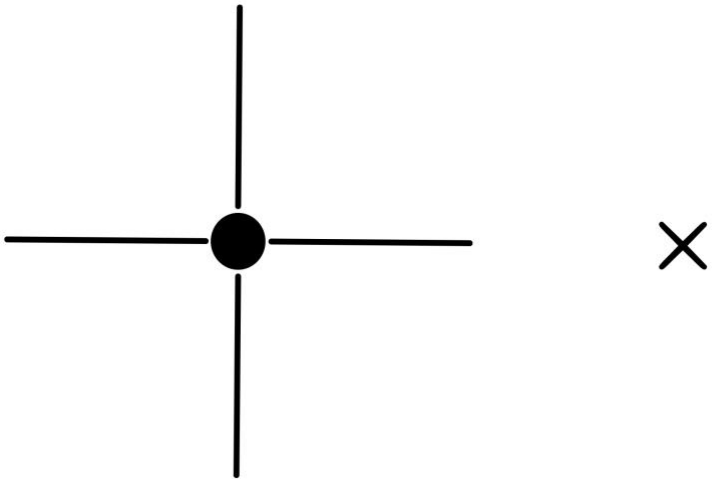


- ## Transparency
  - _____ = light passing through in straight lines. _____ = light passing through; but not in straight lines; thus distorting images. Window glass is transparent; frosted glass is translucent. Think of the electrons in a glass window being moved as light passes through like people doing 'the wave' in a stadium.
  - Light slows down in anything other than a vacuum. This is actually because light gets absorbed and re-emitted. In: water = .75c, glass = .67c, diamond = .41c, air = just about c.
  - _____ = absorbs light but does not re-emit it. Most things are opaque.
  - The Earth's atmosphere (with clouds) is transparent to visible light, some ultraviolet (sunburns), and some infrared. It is opaque to high frequency ultraviolet; otherwise we would fry.

- ## Shadows
  - Since light travels in straight lines we think of _____. Actually light spreads continuously over an area. We seldom stop to ponder this. How does the Sunlight cover the Earth without one missing spot?
  - Shadows can be sharp if caused by the Sun, since the distance causes virtually parallel rays, which in turn cast a shadow that is geometrically similar to the object blocking the light.
  - Blurry shadows have close or multiple light sources.
  - Total shadow = _____. Partial shadow = _____.
- Full & New Moon, Lunar & Solar Eclipse are all a matter of geometry.

- **The Eye**





- **Sight is our dominant sense!**
  - **Approximately 70% of body's sense receptors are in the eyes.**
  - **Over 1/3 of our sensory awareness is from vision.**
  - **Over 1/2 of information in the brain is from vision.**

- **The _____ bends 70% of the light, then the _____ lets enough in, then the _____ bends the other 30% so the light reaches the _____.**
- **The _____ and _____ are in the retina; they are antennae that resonate to EM waves at frequencies in the visible range (light). The rods are more on the periphery of the retina. Three types of cones are more in the center, by the _____. The most distinct vision and the color vision is perceived there. Most mammals primarily have rods and therefore black and white vision. Primates and a species of ground squirrel have all 3 types of cones and see full color vision. Rods are good at seeing low light – this is why stars (which are low light) appear white. Stars are actually brightly colored. You can see this in magnified photos. Rods see the blue end of the spectrum better – cones see the red end better. Rods will bring out blues at dusk and cones will bring out reds by daylight.**
- **Rods and cones are not directly connected to the optic nerve – but they are connected to many cells that are interconnected – some of which then carry signals to the optic nerve and then the brain. Thus a kind of 'thinking' about sight is done out in many parts of the eye.**
- **The optic nerves (which leave a _____) take signals to the brain about the image seen. Close your left eye. Stare at the dark circle above and move your head toward the page. When the X is in your blind spot, it will disappear. You can also use your left eye, watching the X.**
- **_____ vision reaches past 180° but at the edges is only sensitive to motion. Some think that this was a key evolutionary development.**
- **The _____ is the opening left by the iris. The iris opens to let more or less light in. But it also opens in response to pleasing tastes, smells, sounds, or emotions. A card player's hand or a person's feelings about you may be revealed by the pupils!**
- **The range of brightness we can see is from barely visible to 500 million times that! We have a *lateral inhibition* that brings down bright objects that are in the same field of vision so that we can take in the whole scene. Cameras often get over exposed when bright lights are near darker areas.**