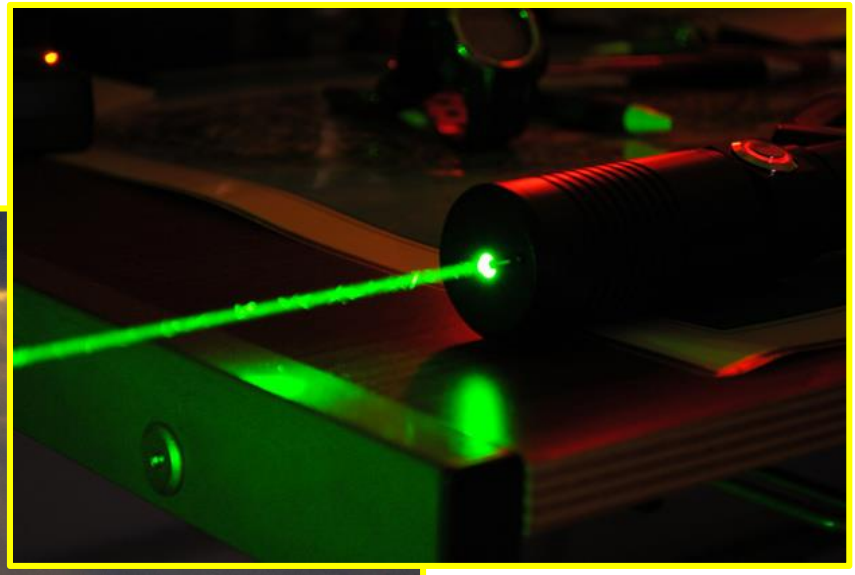
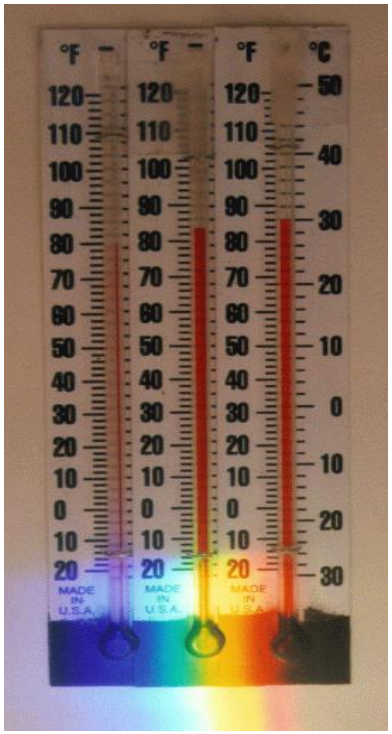
Rays of Light…



what are they made of ?



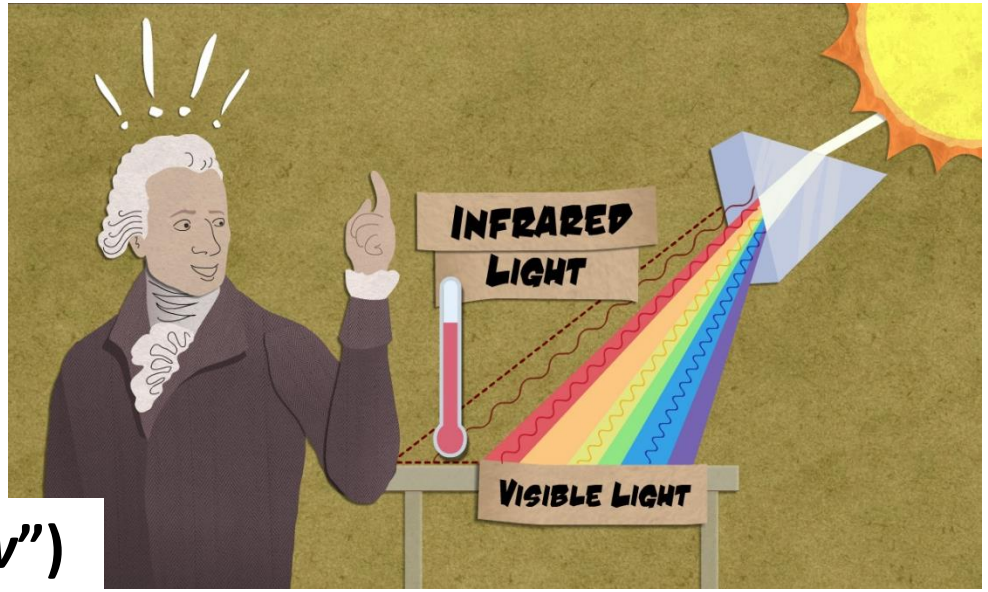
Infrared Light Discovery

Friedrich Herschel, 1800

Measured <u>temperature</u> of different colors of light.

- **Observed the increase in temperature as he moved the thermometer <u>from violet</u> through blue, green, yellow, and orange <u>to red</u> where it reached its peak…**
- **…and moved the thermometer just outside the red portion of the spectrum in an area that – to the human eye – contained no light at all…**

- **"Invisible rays" in this area had the highest temperature of all.**
- **First time anyone had demonstrated that there were forms of radiation that humans couldn't see.**



Infrared (from Latin "*below*")

Ultraviolet Light Discovery

Johann Ritter, 1801

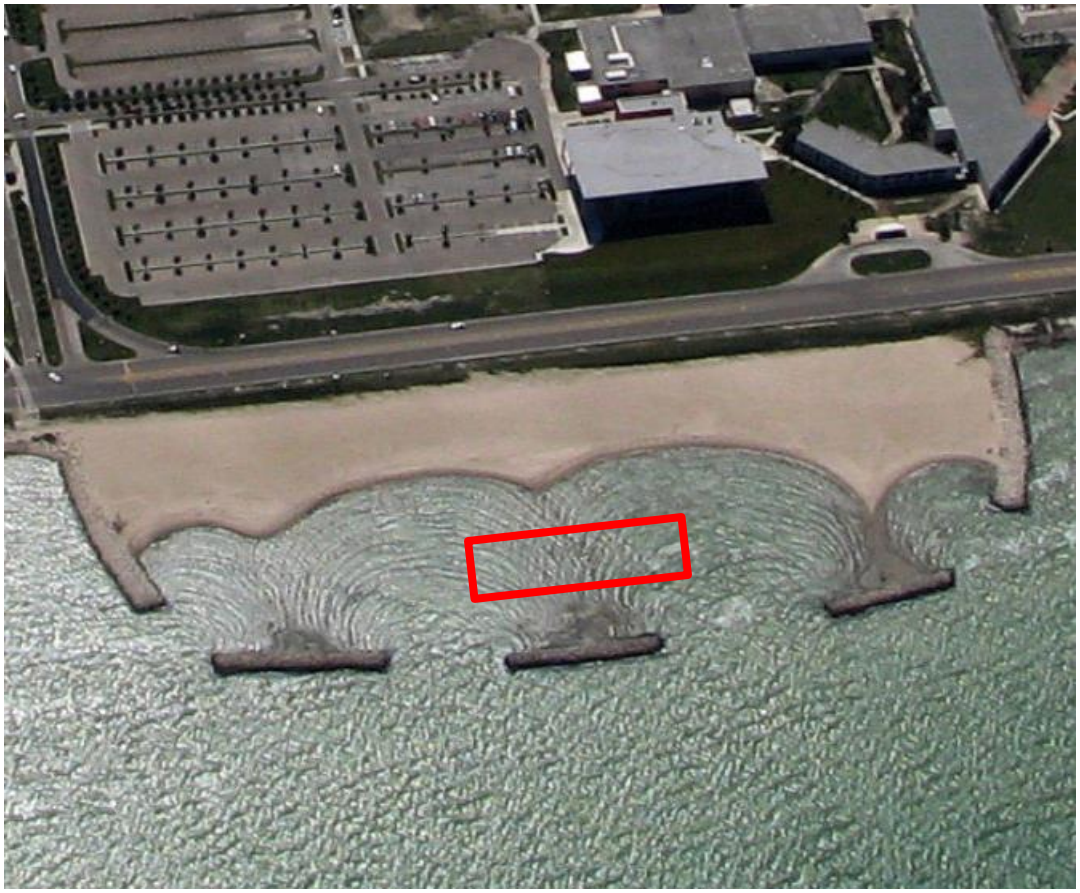
Measured the effect of different colors of light on a light-sensitive chemical, silver chloride.

- In the **red** portion of the spectrum **darkening of the chemical was relatively slow.**
- **Progressing through orange, yellow, green, blue, and violet, he observed that each new batch of silver chloride grew darker faster…**
- **…and placed the chemical just outside the violet portion of the spectrum in an area that – to the human eye – contained no light at all…**
- **"Invisible rays" in this area had the greatest effect (fastest darkening) of all.**
- **Same experiment can be done using a sheet of photographic paper.**

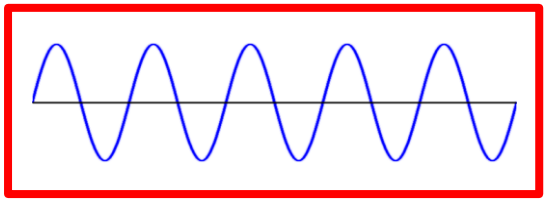
Ultraviolet
(from Latin "*beyond*")

Is This a Familiar Sight?

Waves in the Ocean



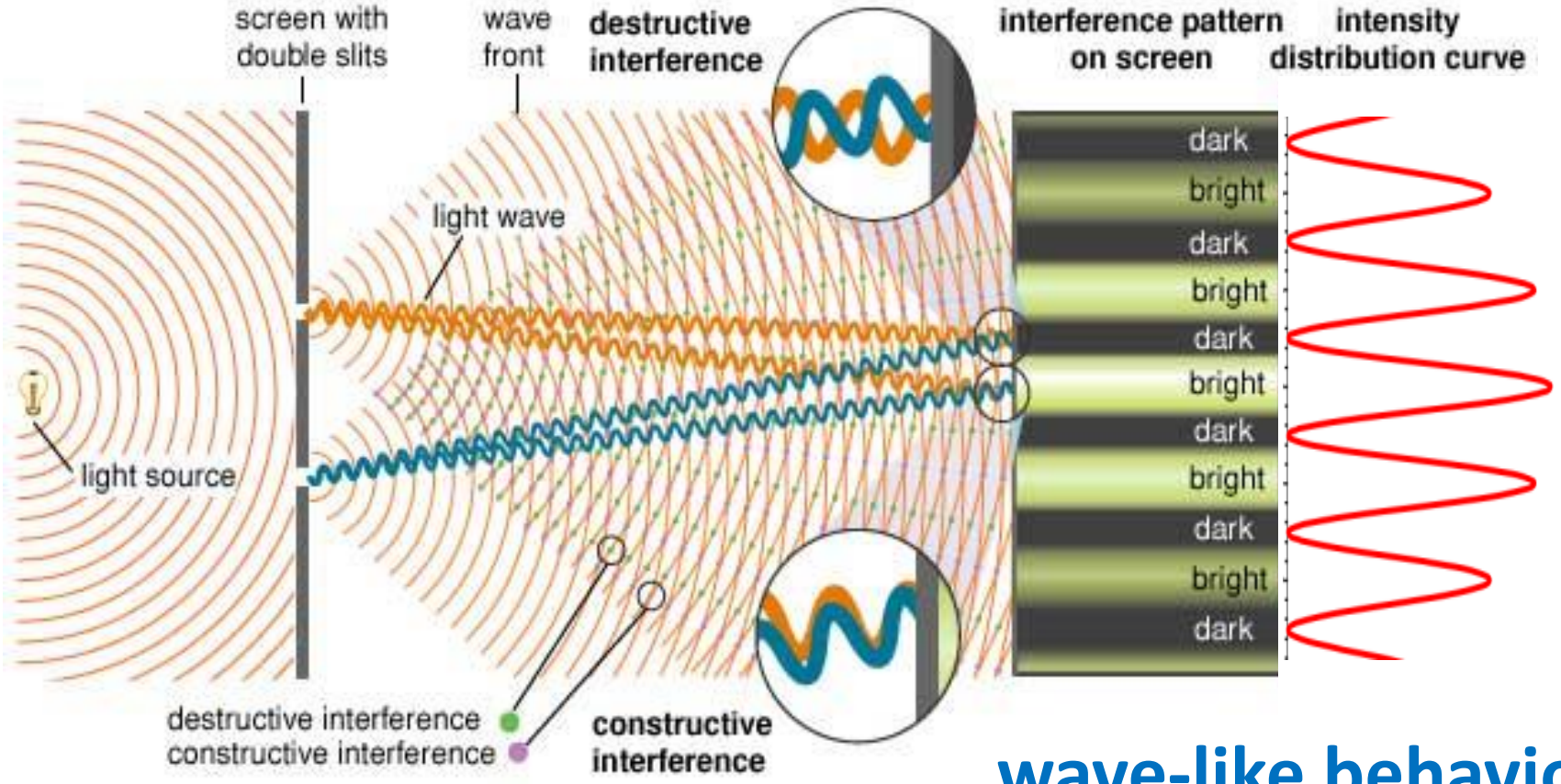
"High-low" pattern behind the obstacle



Double-Slit Experiment

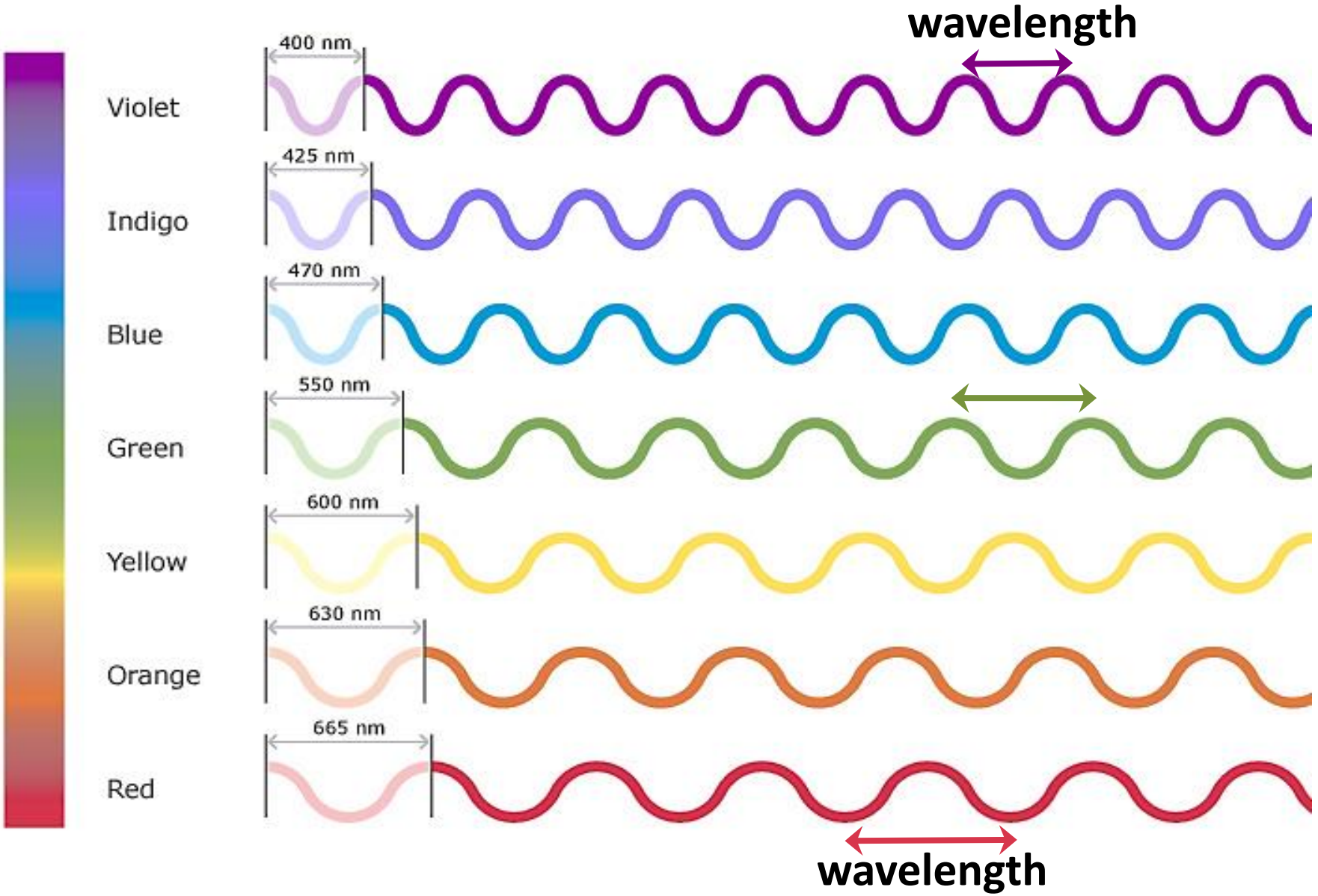
Thomas Young, 1803

Light passing through two parallel slits will interfere, producing a *pattern of bright and dark fringes*.



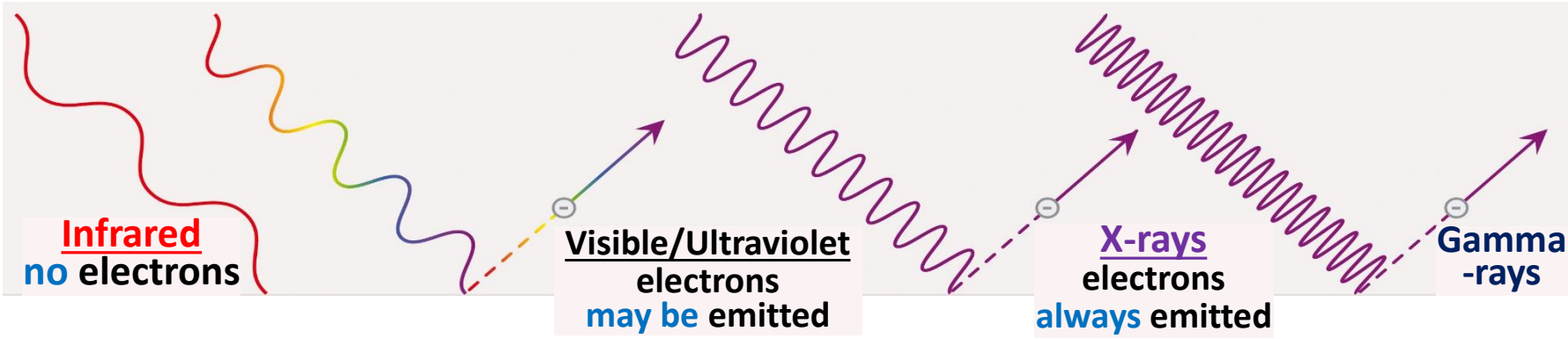
wave-like behavior

Light as a Wave



Photoelectric Effect

- The photoelectric effect is the ejection of electrons from the surface of a material (most commonly, *metal*) in response to incident light.
- Can be observed as *an increase of electric current* between two terminals when one of them is illuminated.
- For each material, it occurs only for light beyond a certain color.

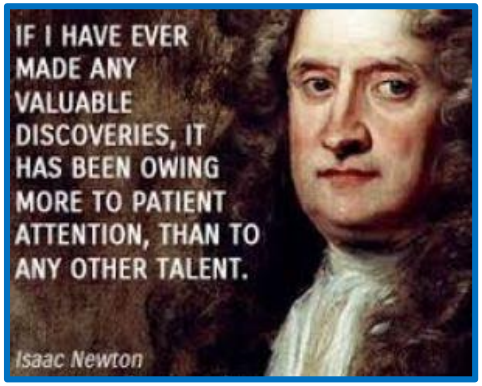


- Can not be explained by classical physics (light as a wave).
- Einstein, 1905: photons, the particles of light.

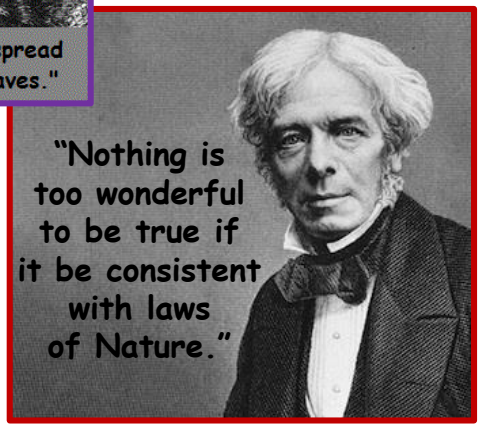
1921 Nobel Prize in Physics

Nature of Light Debate

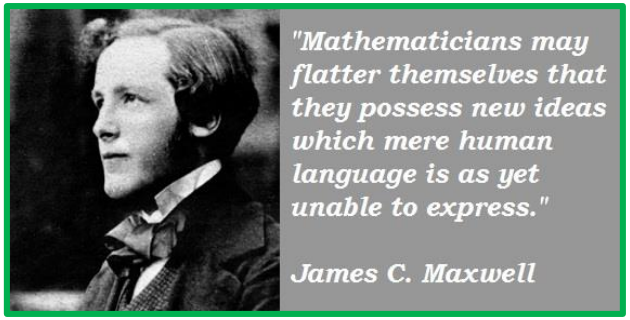
Isaac Newton, 1675:
light is made of particles of energy (corpuscles). Explained reflection, shadows, traveling in straight lines.



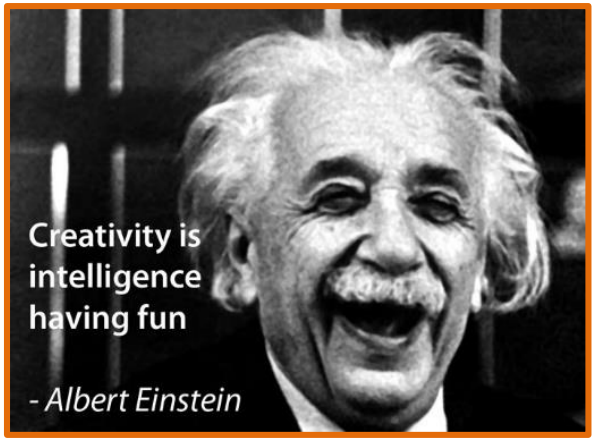
Christiaan Huygens, 1678:
light is made of waves in ether. Explained diffraction, interference.



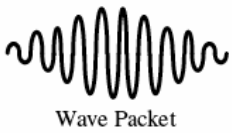
Michael Faraday, 1847:
light is a high-frequency electromagnetic vibration, which could propagate even in the absence of a medium.



James Maxwell, 1864:
light is an electromagnetic wave.



Albert Einstein, 1905:
a beam of light is not a continuous wave propagating through space, but rather a collection of discrete wave packets, photons.



What is Light: Current View

- **Light is a form of energy that travels.**
- **Light has a dual nature:**
  - **wave properties (propagation)**
  - **particle properties (emission/absorption)**
- **Light waves do not need a medium to propagate.**
- **Light waves are electromagnetic radiation.**
- **Light particle, called a photon, has *zero mass*.**

The actual nature of the photon is not really describable in terms that are very descriptive… …and not fully understood yet.