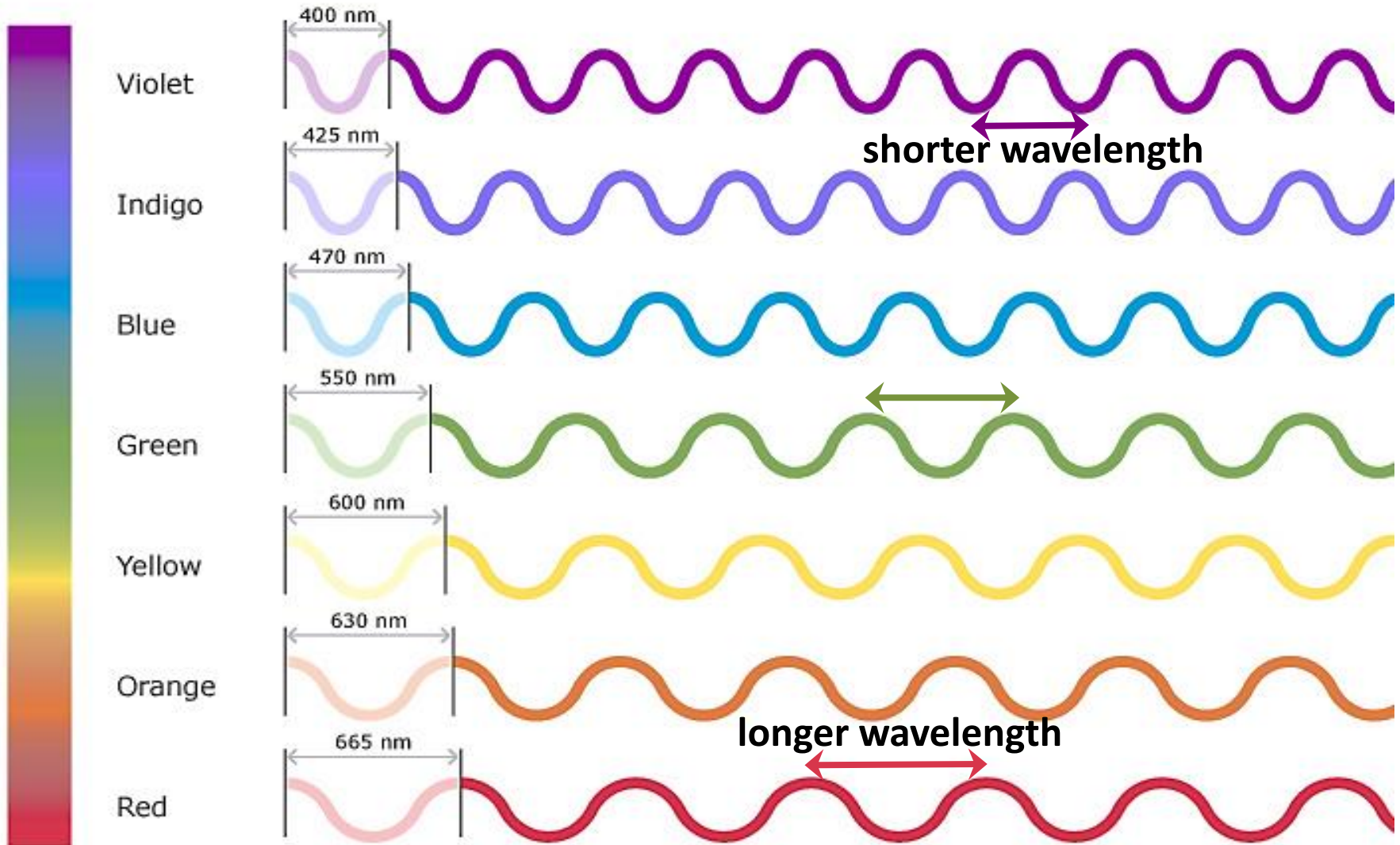


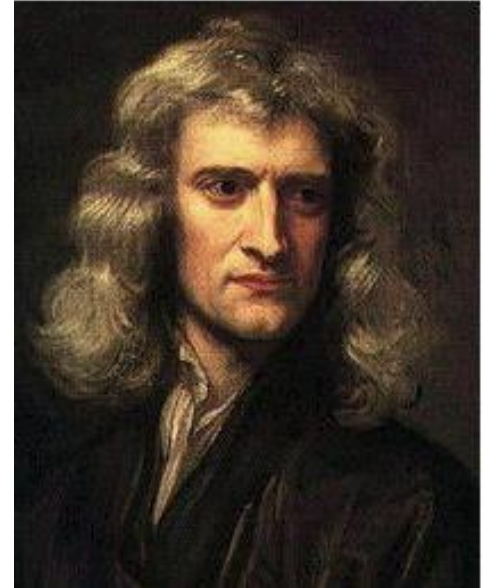
Light Waves: Color

determined by the **wavelength(s)** of light waves



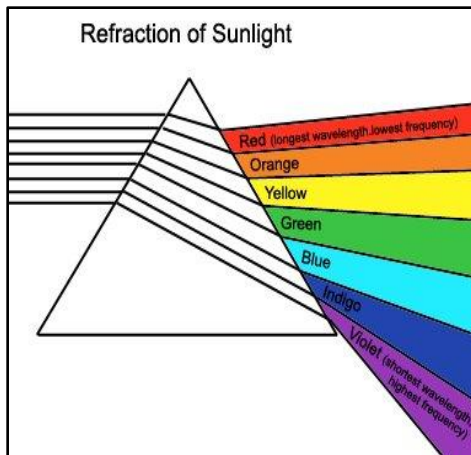
Decomposition of Sunlight

Isaac Newton, 1665

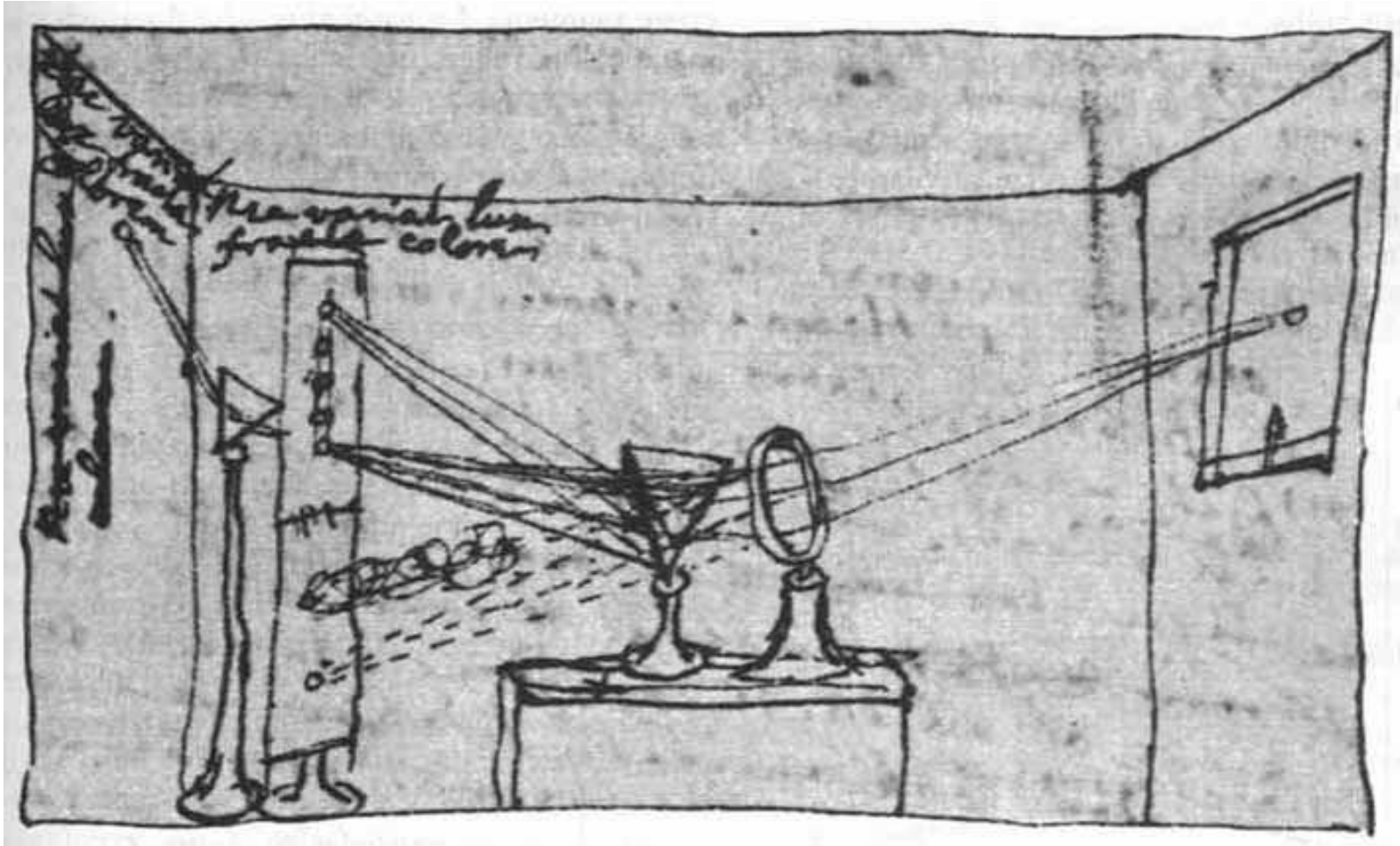


Common (Aristotle) wisdom:
white light is the purest form - colored light must therefore have been altered somehow...

- Newton **shined a beam of sunlight through a glass prism** and showed that it decomposed into a **spectrum** cast on the wall – therefore all the colors were together in the sunlight.
- He thought he then should be able to **combine the colors** of the spectrum and **make the light white again**: he placed another prism upside-down in front of the first prism. The band of colors combined again into white sunlight.
- Newton was the first to prove that **white light is made up of all the colors that we can see**.



A drawing Isaac Newton made of the prism experiment he conducted in his dorm room in Cambridge.



The Prism Experiment

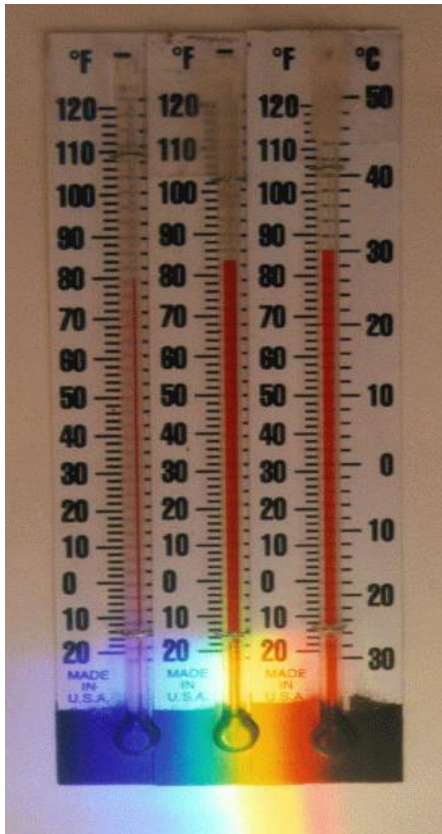


Infrared Light Discovery

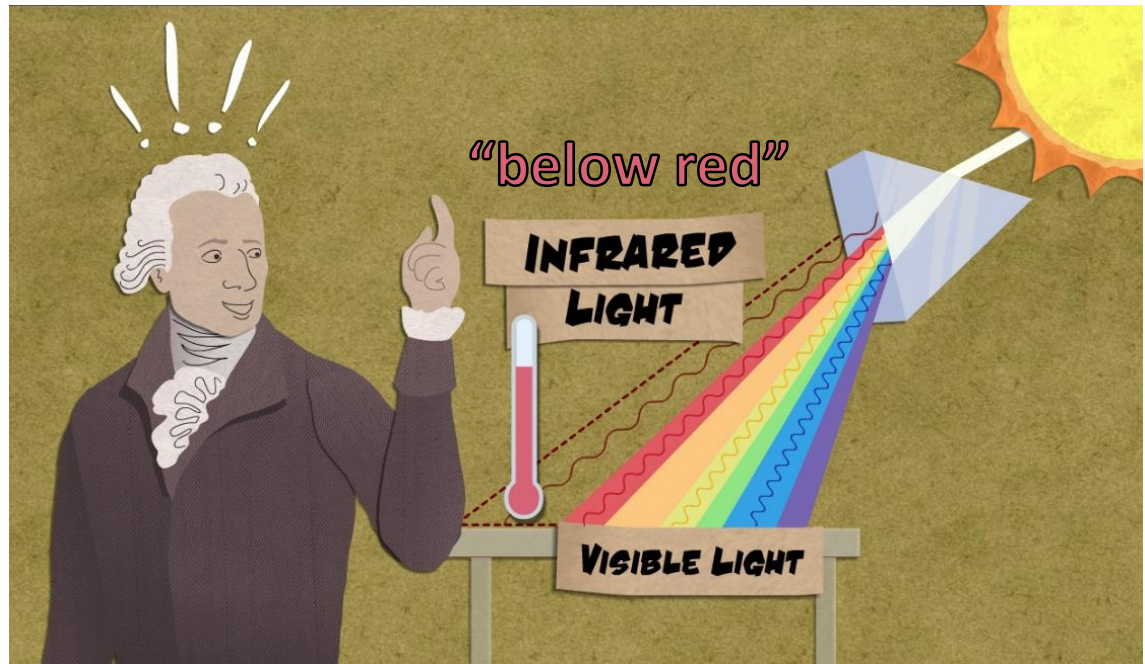
Friedrich Herschel, 1800

Measured temperature of different colors of light.

Temperature increased as he moved the thermometer from violet through blue, green, yellow, and orange to red ...and **further increased just outside** the red portion of the spectrum in an area that – to the human eye – contained no light at all!



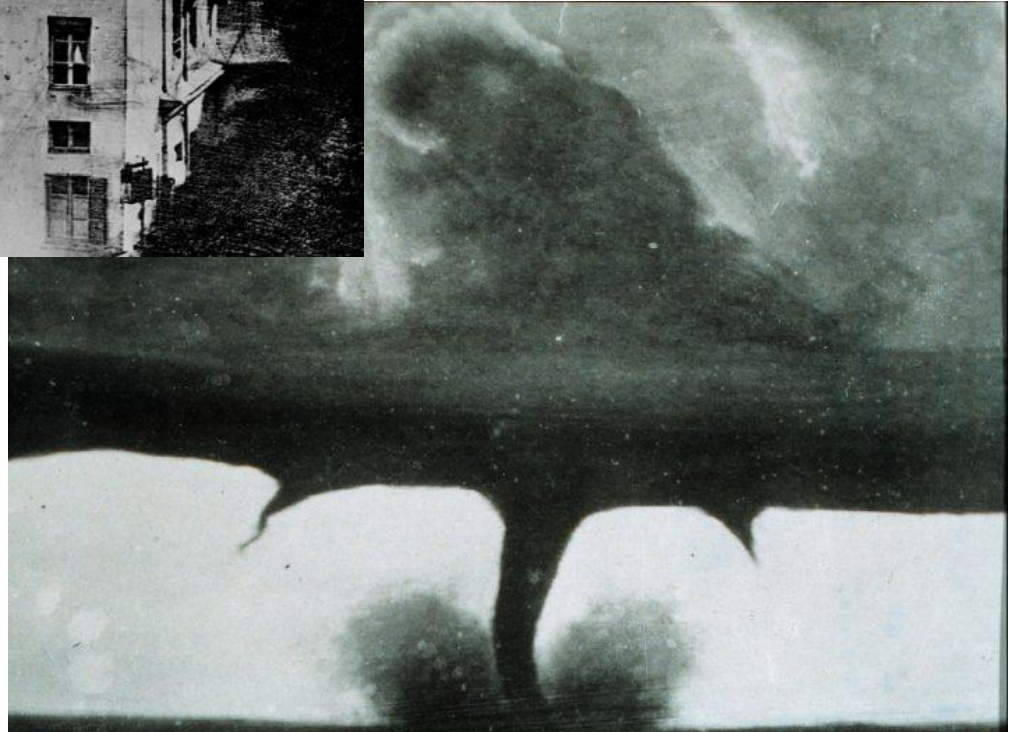
- First time anyone had demonstrated that there were **“invisible rays”**, forms of radiation that humans could not see.





First ever
photograph
of a *person*,
1838

First ever
photograph
of a *tornado*,
1884



Ultraviolet Light Discovery

Johann Ritter, 1801

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

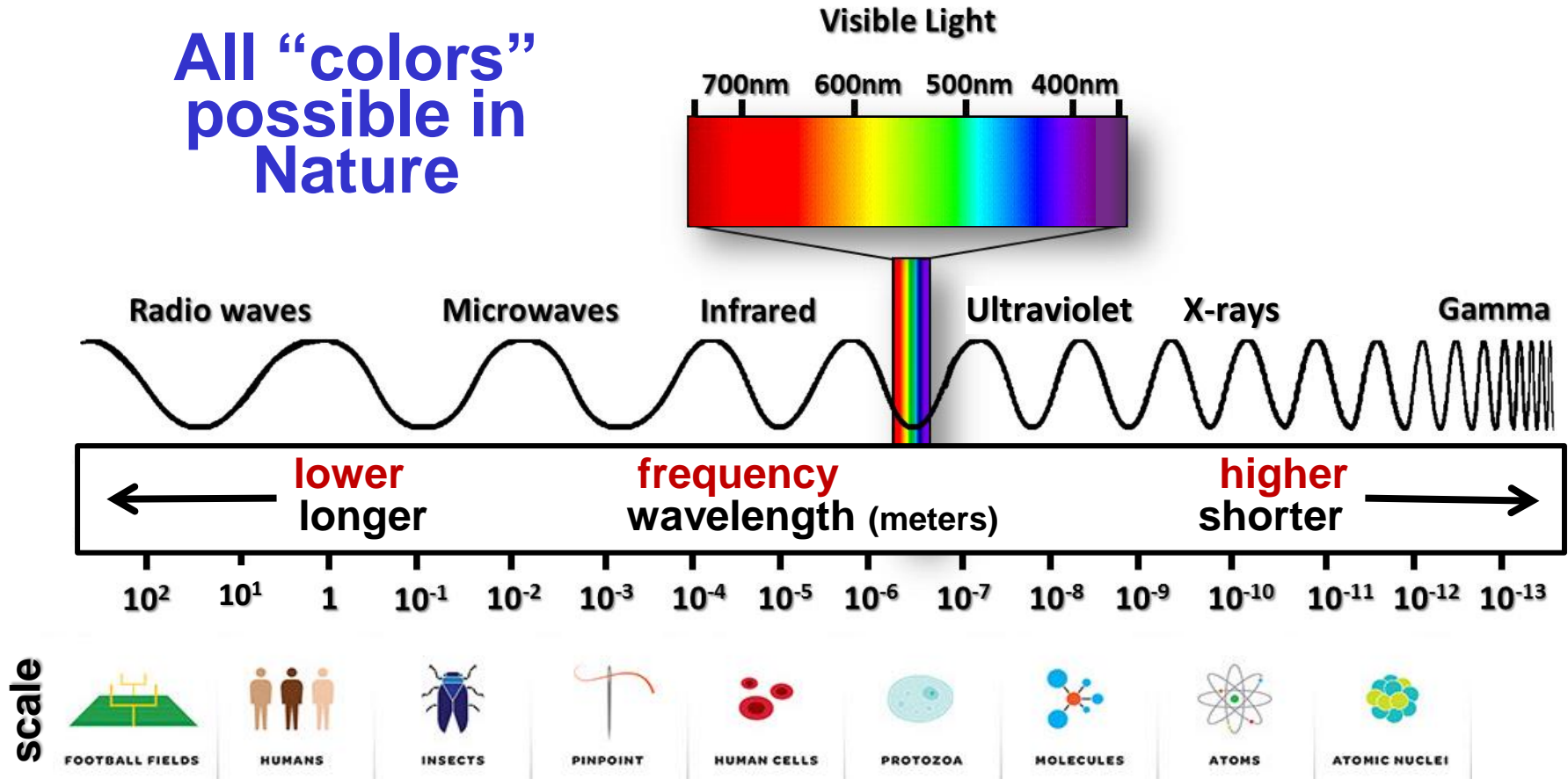
- In the **red** portion of the spectrum darkening of the chemical was relatively **slow**.
- Darkening grew faster through orange, yellow, green, blue, and violet...

....and the **greatest effect** was observed **just outside the violet** portion of the spectrum in an area that – to the human eye – contained **no light at all...**



Electromagnetic Spectrum

All “colors” possible in Nature

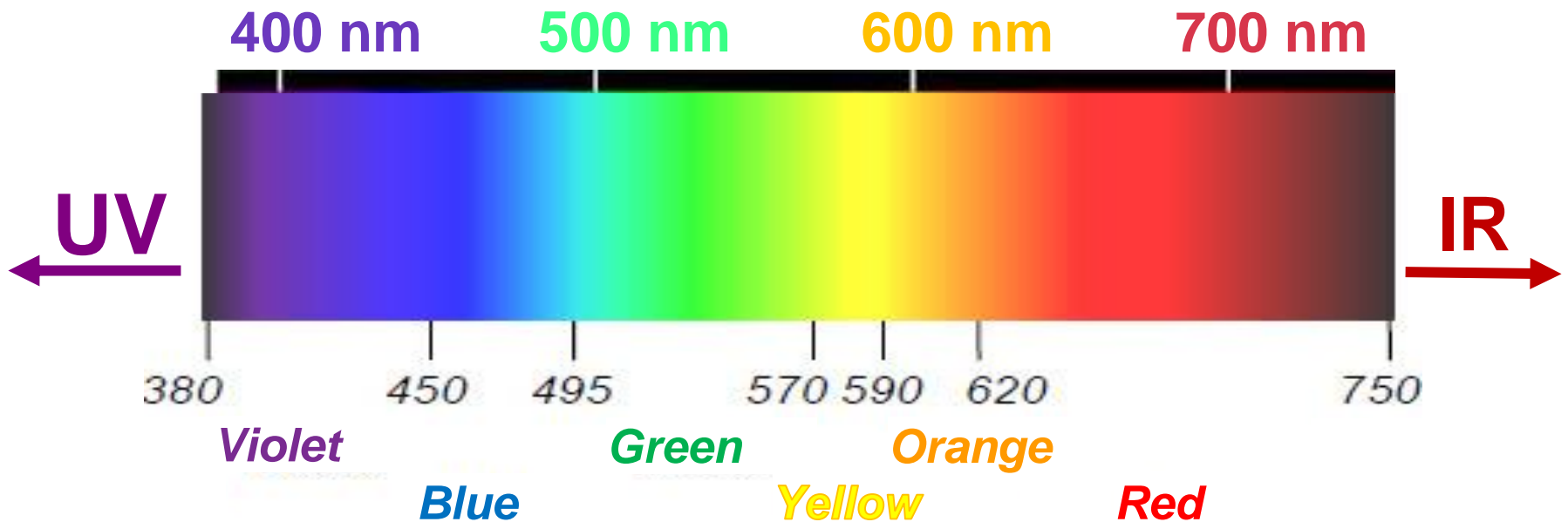


$$\text{Wavelength} = \frac{c}{\text{Frequency}}$$

where **c** is the speed of light

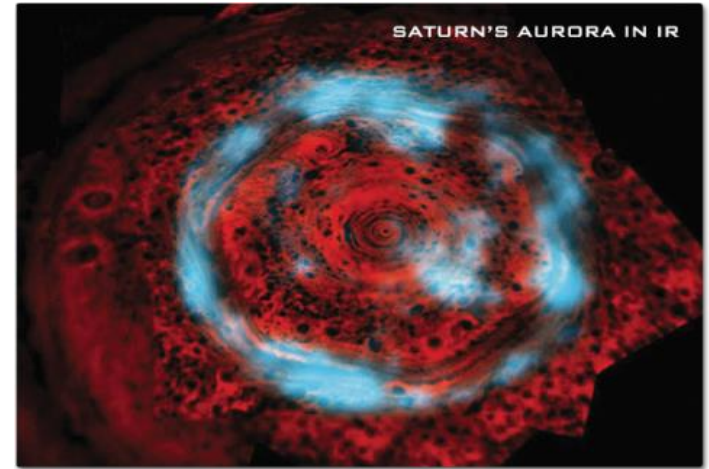
Visible Light

Only a small fraction of electromagnetic spectrum is visible to human eye.



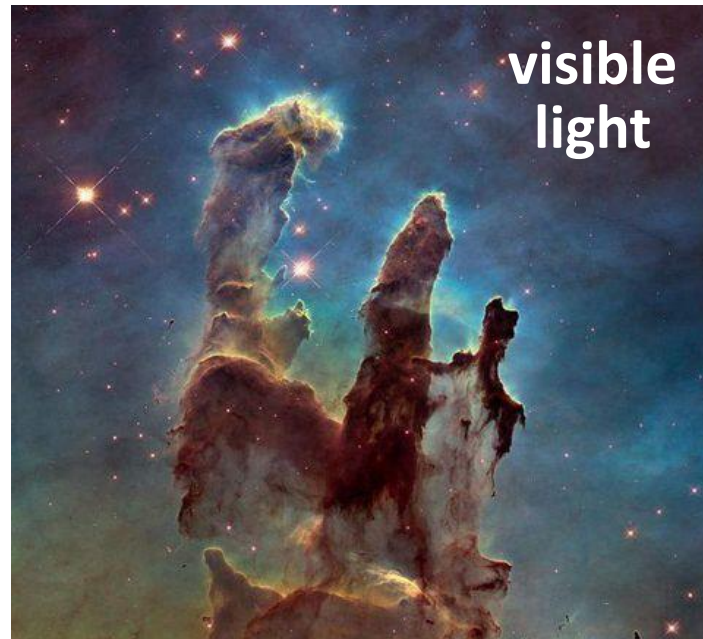
A typical human eye will respond to wavelengths from about 380 to 750 nanometers.

“Seeing” the Invisible with Infrared



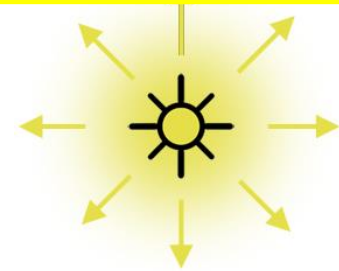
From
elusive
leopards...

...to hiding
young
stars!

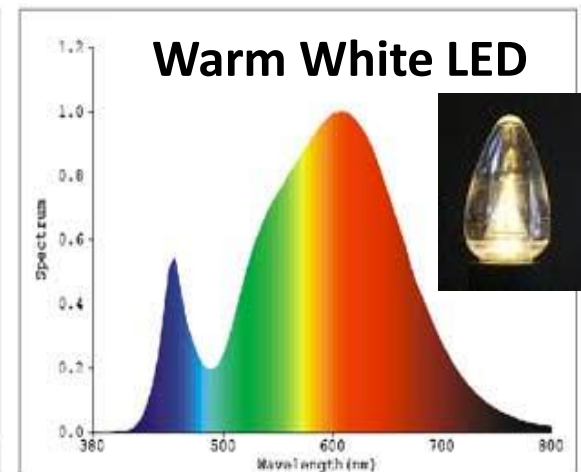
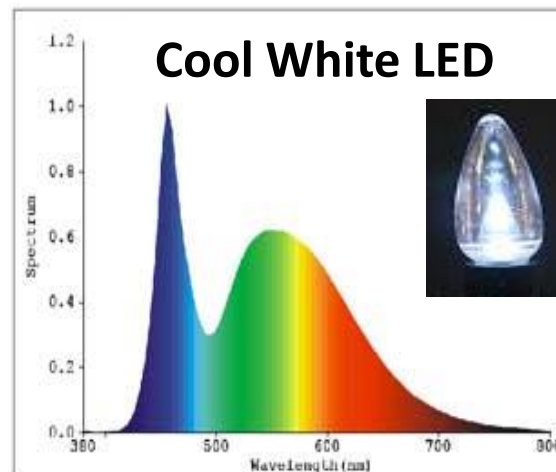


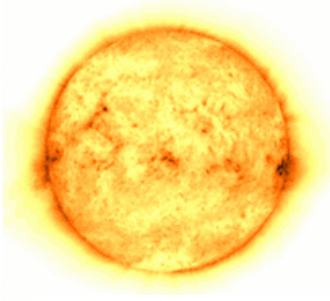
Summary: how to describe light?

- “What color?” The apparent color of light is determined by the wavelength(s) of light waves.
- “How much?” The intensity of light is the amount of light energy falling on a surface per a unit of time.
- **“How much of each color?”**



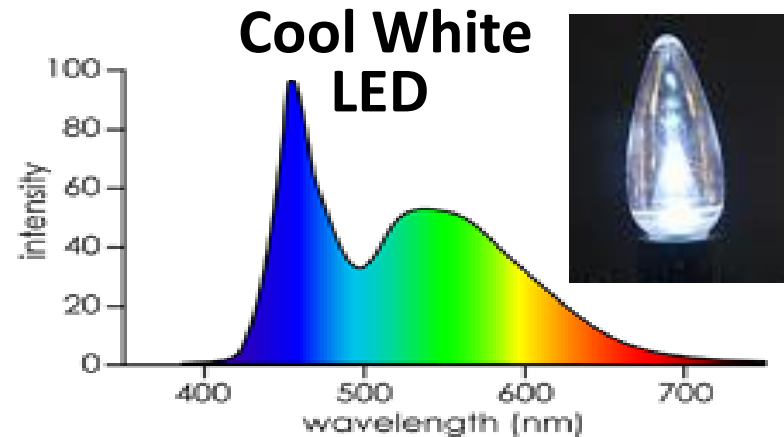
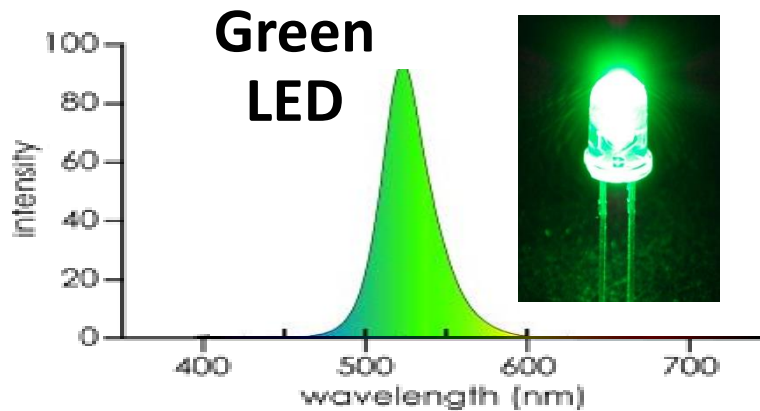
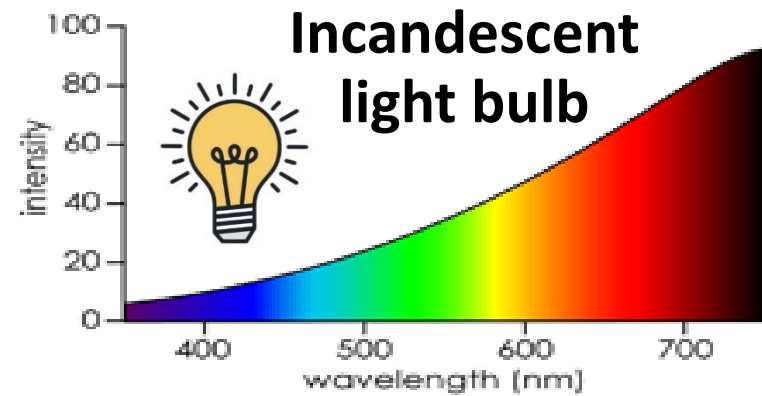
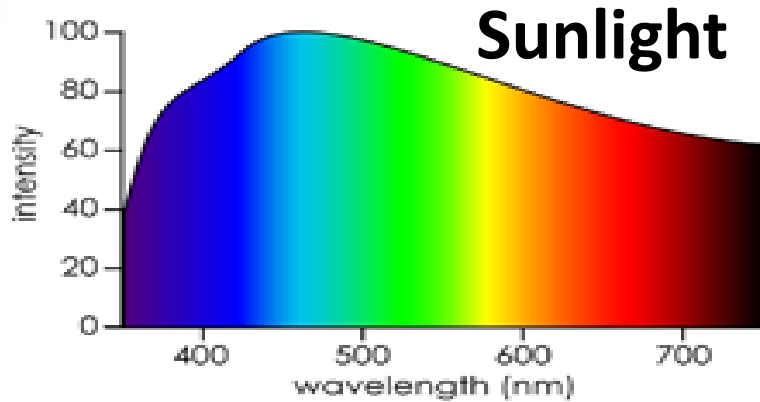
The spectrum (spectral composition) of light is the relative light intensity for each wavelength present.





Light Source Spectrum

“How much of each color is made?”



- X-AXIS: **wavelength**
- Y-AXIS: **relative light intensity**