Refraction *in Water*

Rainbows…in your backyard!

All you need is small water droplets and bright sunlight!

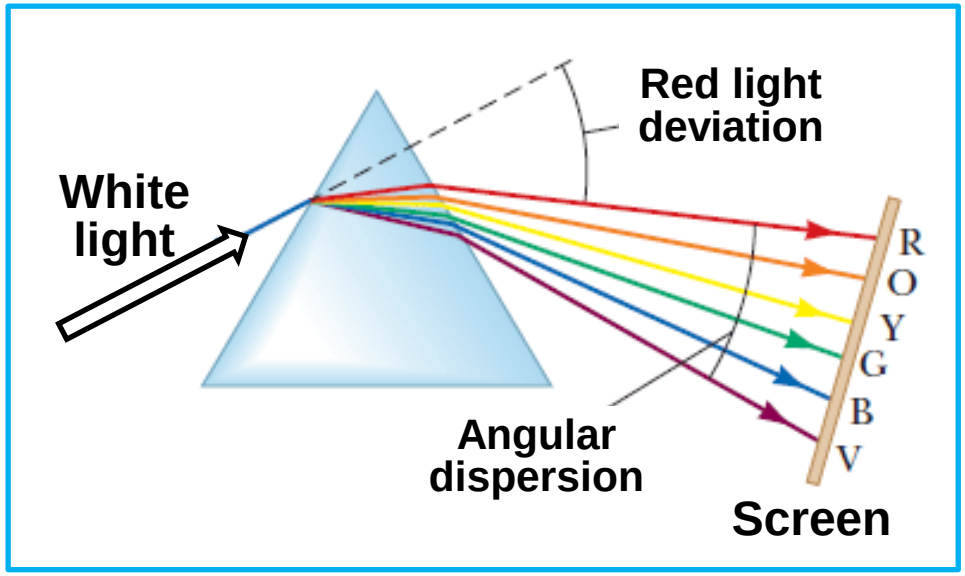
Dispersion of Light

splitting of light into its component colors

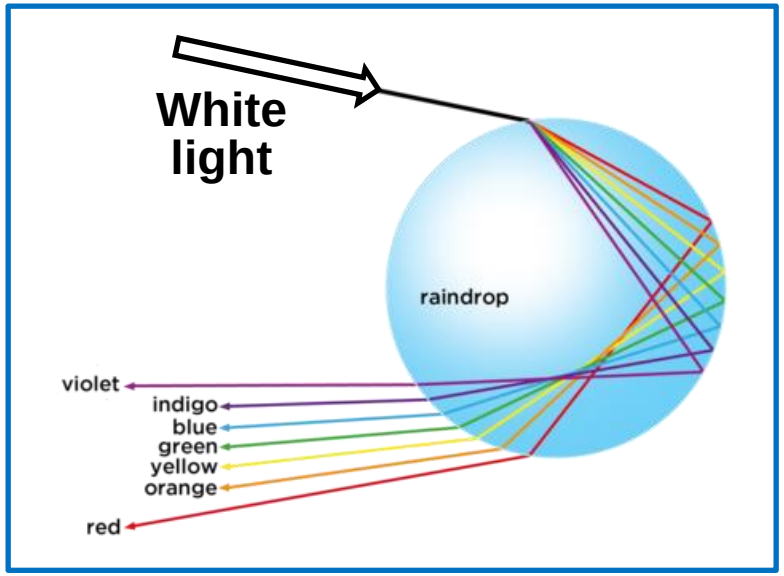
Different colors (wavelengths) of light *travel at different speed in the same material* and therefore refract differently:

- **Red (longer wavelength) is bent less.**
- **Violet (shorter wavelength) is bent more.**
- **This allows for separation of colors in certain geometries.**

Glass prism



Water droplet



Rainbows result from **refraction of sunlight** in falling water droplets **plus reflection of the light from the back of the droplet**.

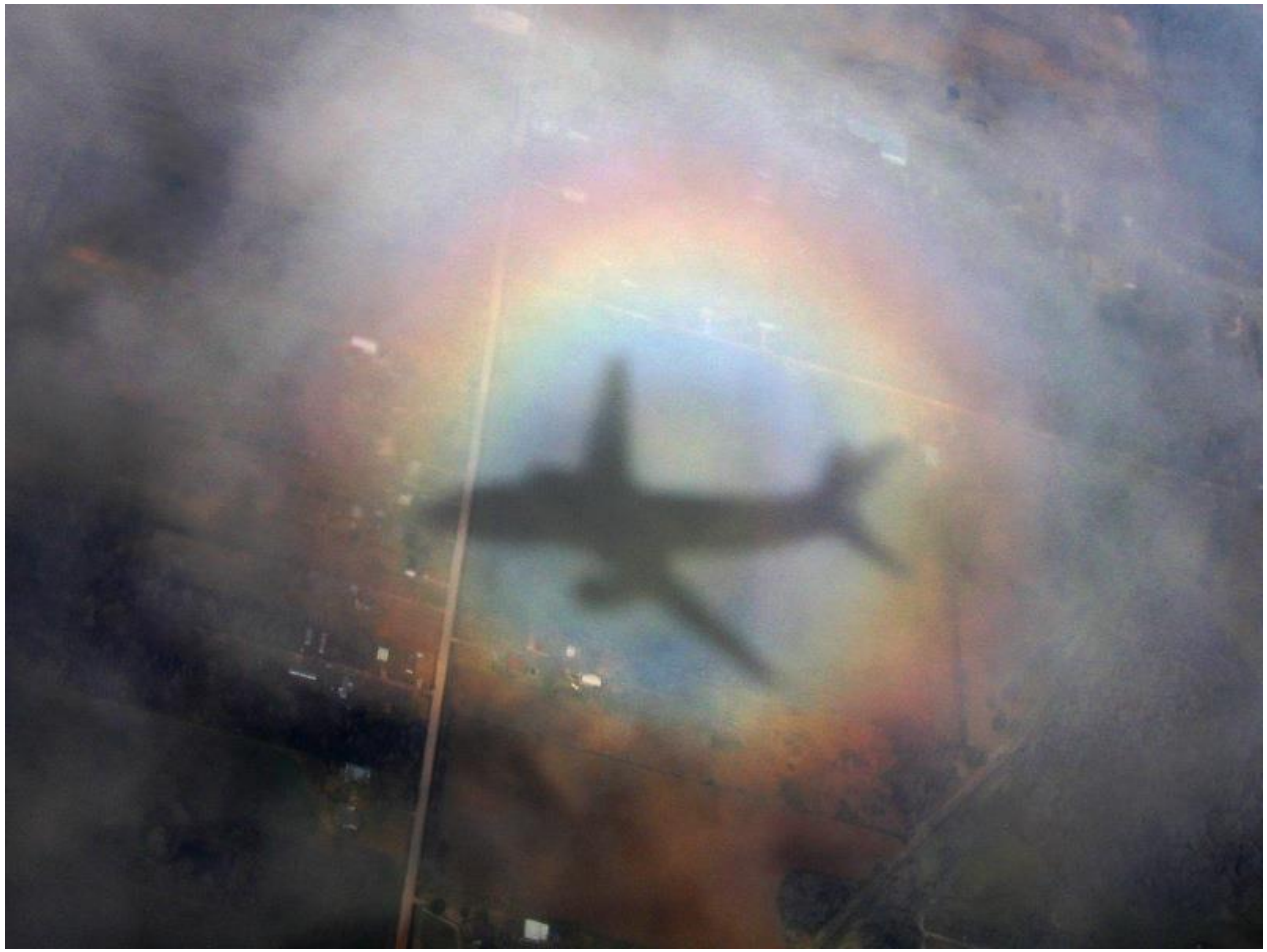
The **size of the droplets** influences the rainbow appearance: **large** droplets (>1mm) result in **lack of blue color**, **small** droplets make **red disappear**; fine mist and fog (<0.05mm) produce white or "fog" bow.

Can you see the rainbow when the **Sun is overhead**?

Can you see the **full circle**?

Think again ☺

All you need to do is position yourself between the Sun and the raincloud and look down!

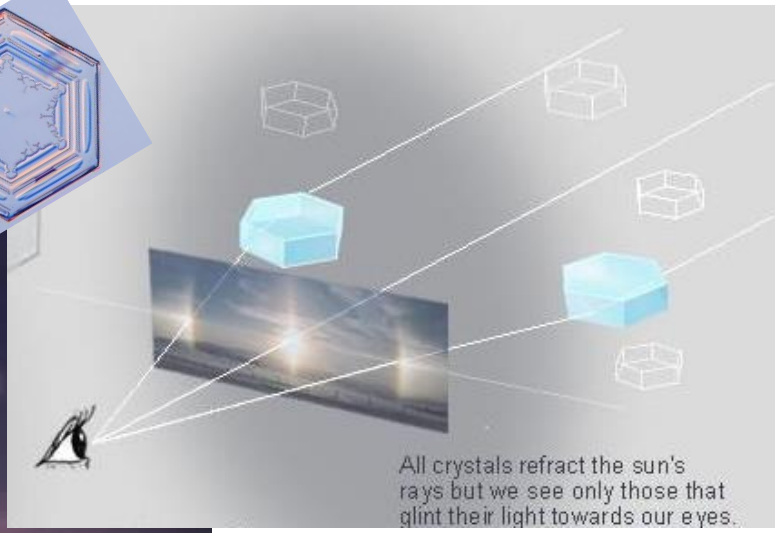


The Glory

What happens to light if we have ice crystals in the air instead of water droplets?

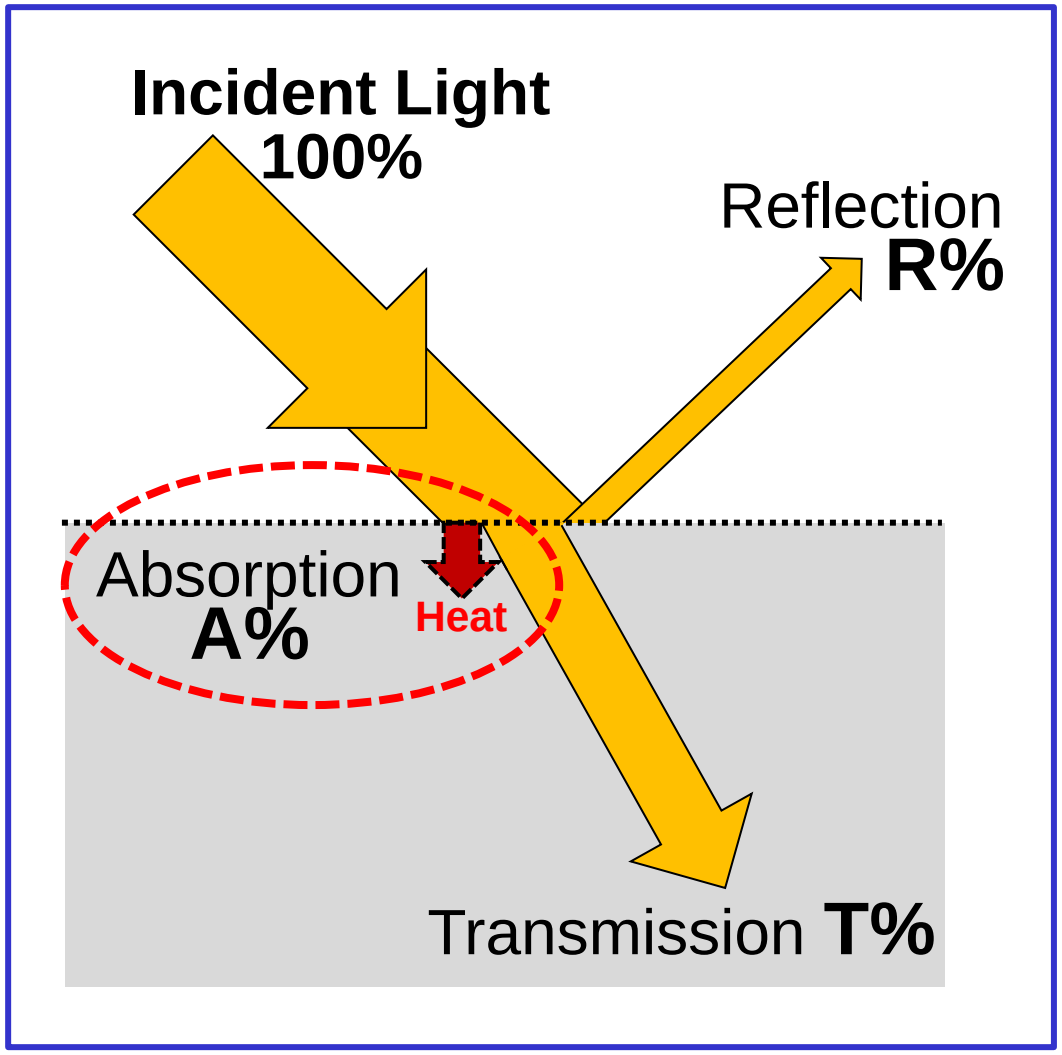
The Sun Halo and the Sun Dogs

formed by light refraction in horizontally floating hexagonal plate ice crystals high in the cirrus clouds.



The Sun Halo and the Sun Dogs occur world-wide but more common in cold climates.

Light Interaction with Non-Luminescent Matter



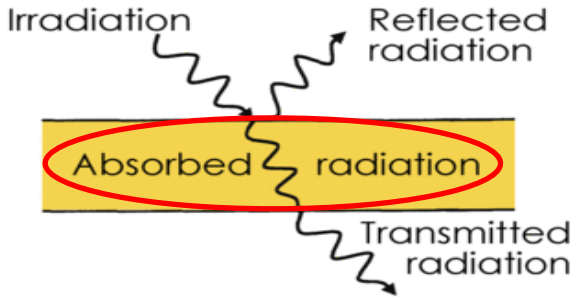
- **<u>Combination</u> of transmission, reflection, and absorption:**

T%+R%+A%=100%

- **No material is 100% transparent.**
- **No material is 100% absorbing either.**

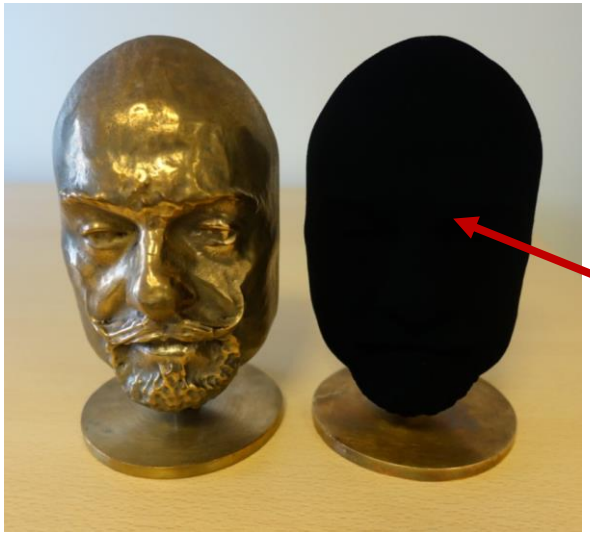
Absorption

disappearance of a light wave



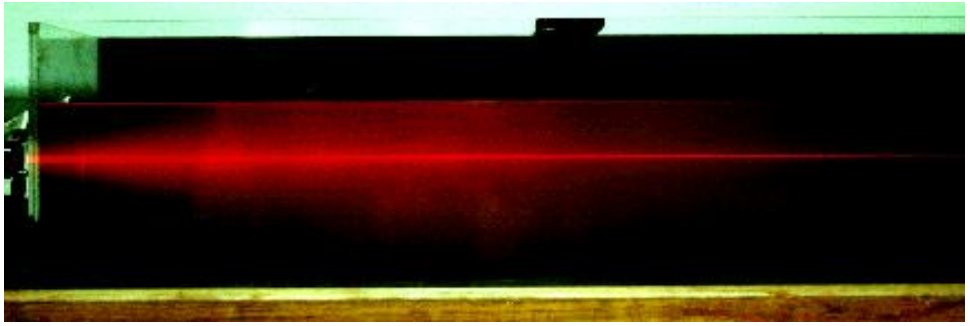
- The <u>energy of a light wave is taken up by matter</u> and in most cases converted into heat.

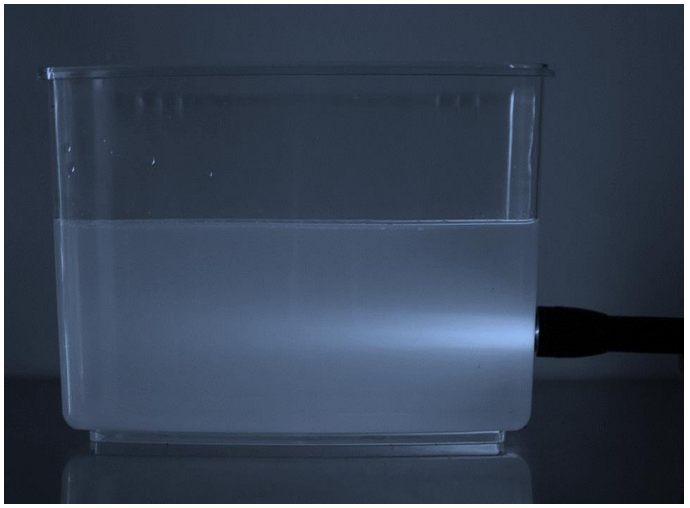
- **Dark opaque** objects **absorb most** of the incident light.



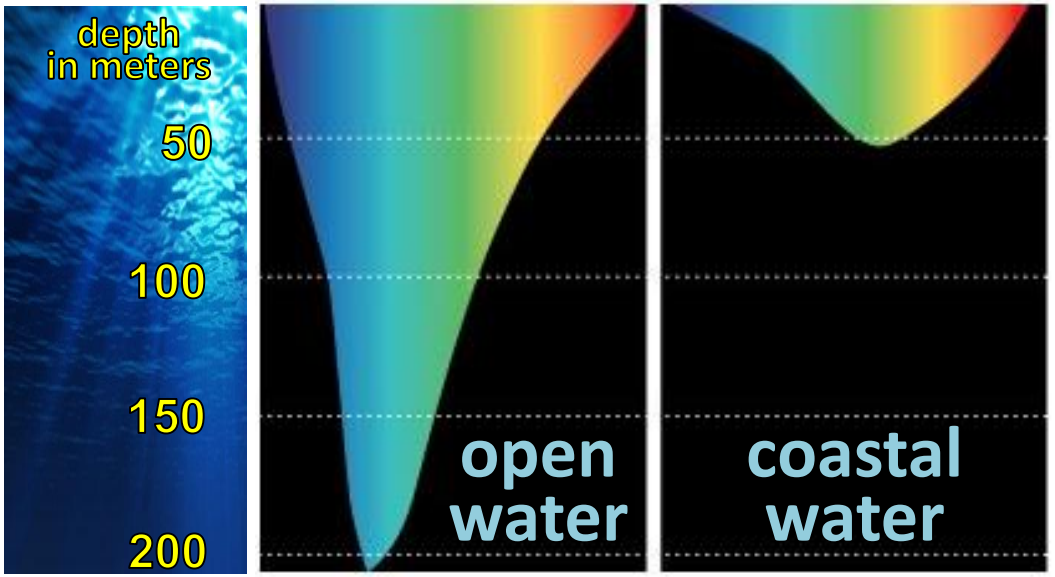
Vantablack – one of the darkest substances known, absorbing up to 99.965% of visible light!

Transparent and translucent objects always absorb some part of the incident light.



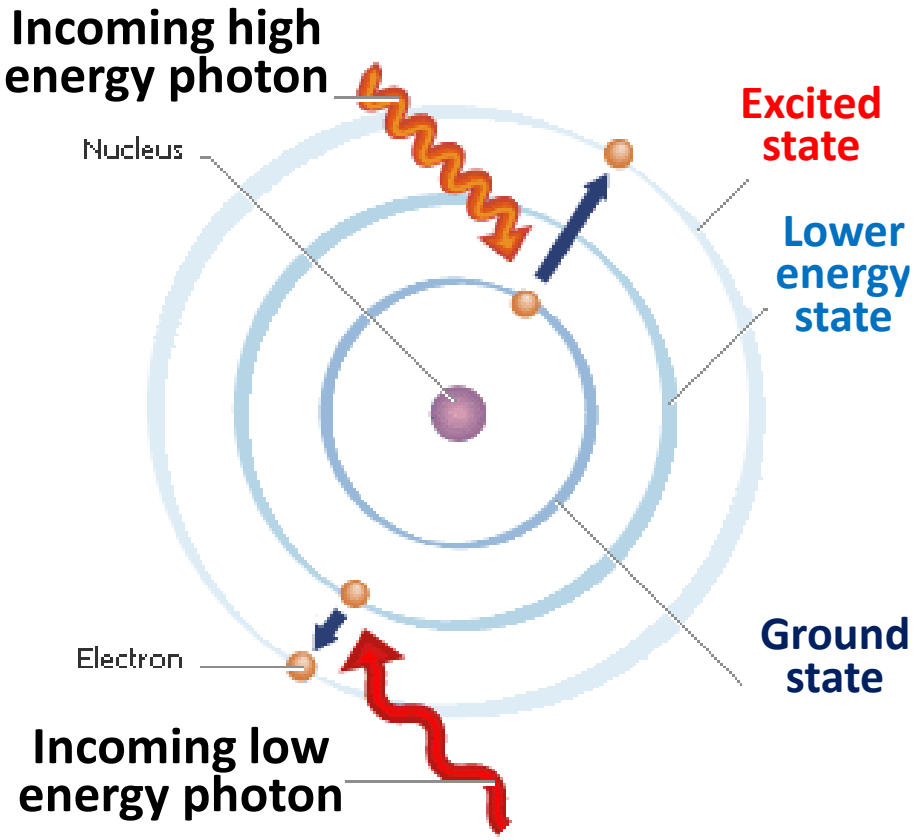


Absorption of Sunlight by Water



Absorption Spectrum

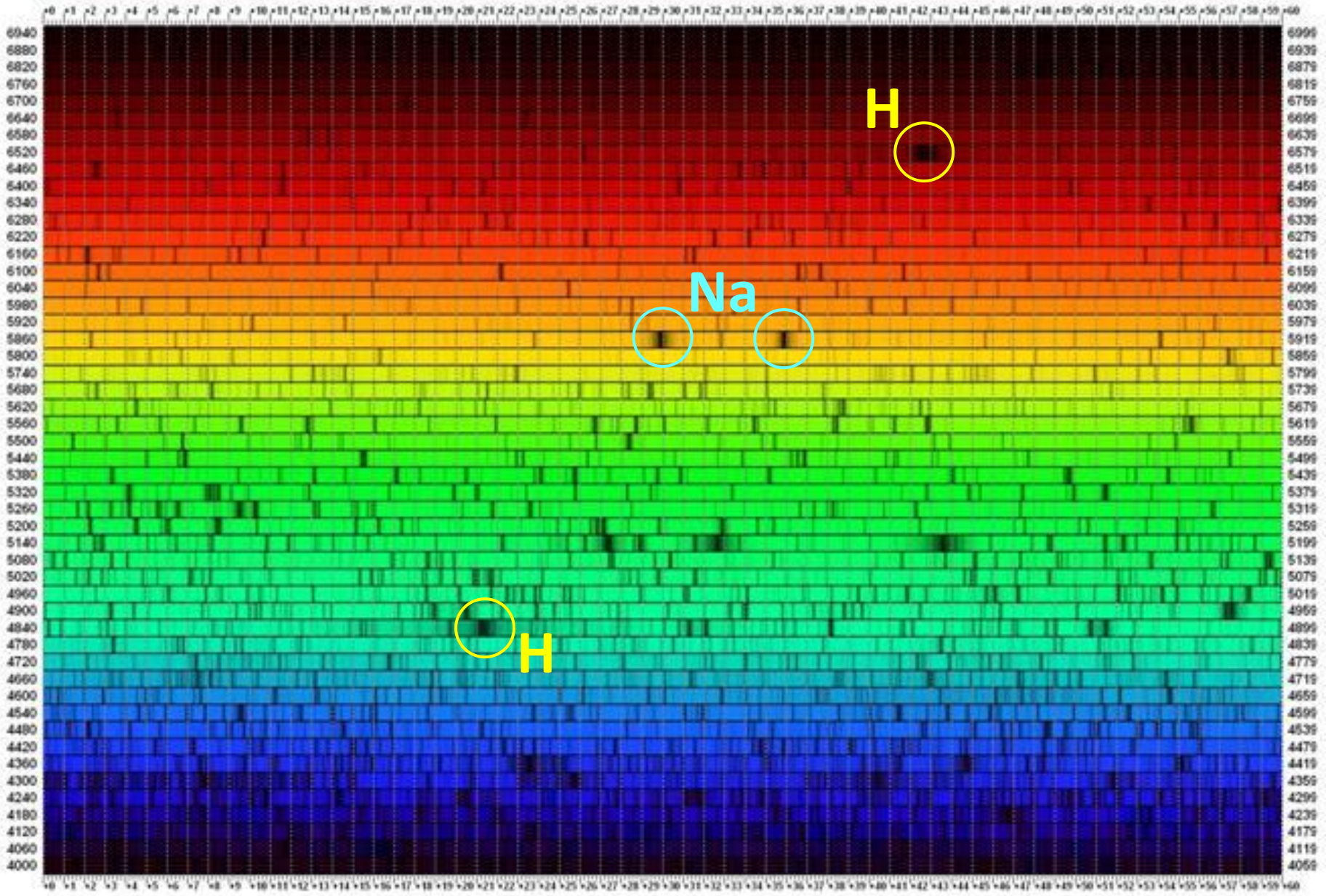
Absorption of light can happen when the photon energy (i.e. *frequency*) matches one of the allowed transitions between energy levels of that particular atom.



Example: Hydrogen

A star will create an absorption line spectrum because the continuous spectrum emitted by the dense, opaque gas that makes up most of the star passes through the cooler, transparent atmosphere of the star.

Absorption Spectrum of the Sun



Sunlight Filtered through Atmosphere

Absorption of sunlight by various gas molecules that are present in the Earth's atmosphere is seen as absorption bands in the Sun spectrum.