

Refraction of Light

Refraction is the change in direction of light propagation due to a change in its transmission medium.

It is governed by the **Snell's Law**:

$$n_1 \sin \sigma_1 = n_2 \sin \sigma_2$$

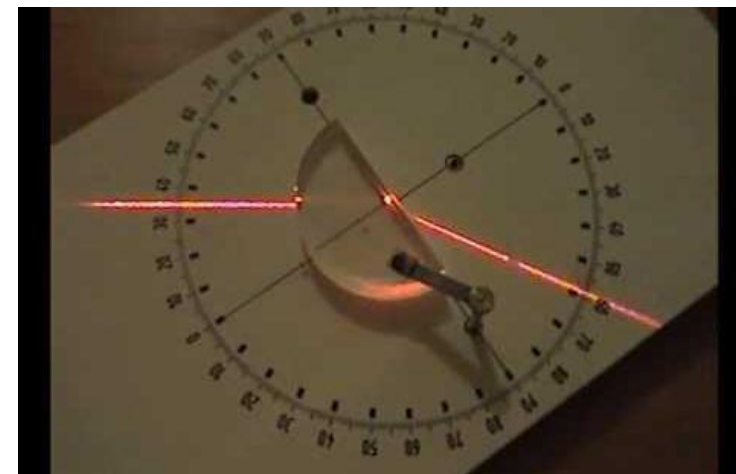
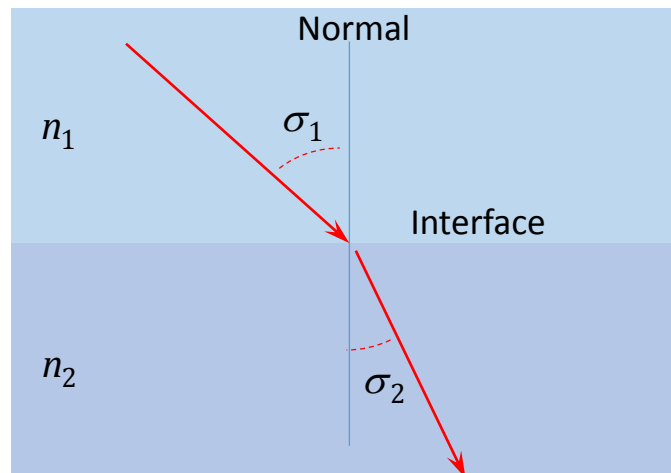
n_1 = refractive index of the medium of incidence;

σ_1 = angle of incidence;

n_2 = refractive index of the medium of transmission;

σ_2 = angle of refraction;

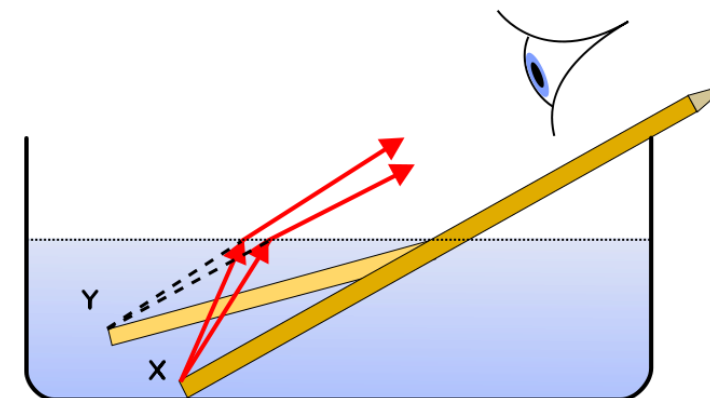
Refraction causes deviations of the aparent position of objects viewed from a different media.



<https://i.ytimg.com/vi/8VZHym6HqVU/hqdefault.jpg>



<http://hyperphysics.phy-astr.gsu.edu/hbase/geoopt/refr2.html>



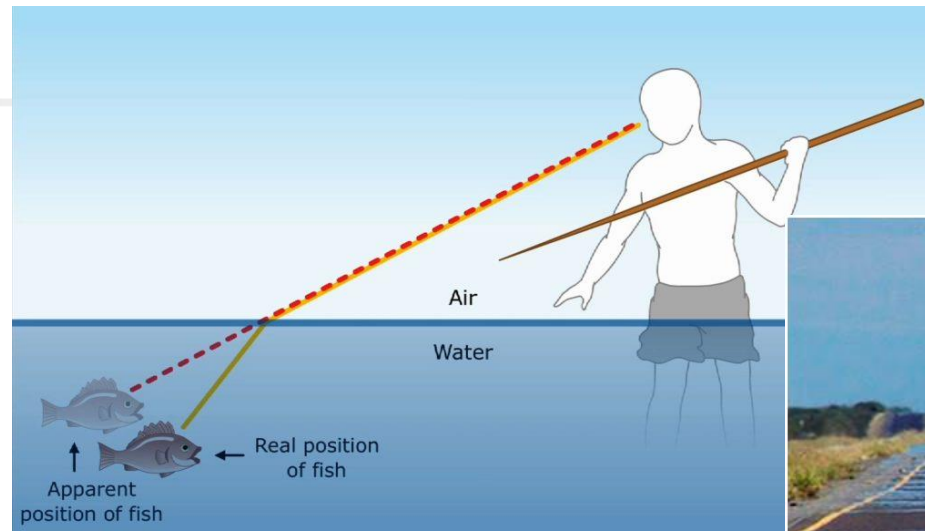
<https://commons.wikimedia.org/w/index.php?curid=13712912>

Refraction of Light

Refraction occurs in a myriad of situation. For instance, fishermen know that fishes apparent location differs form the actual position of the fish when looked from outside.

Terrestrial refraction is the cause of mirages.

Astronomical refraction is the angular displacement of astronomical objects from their true position, due to the bending of the light entering the Earth's atmosphere; it causes for instance the apparent flattened sunrise or sunset.



Refraction in water while looking from outside

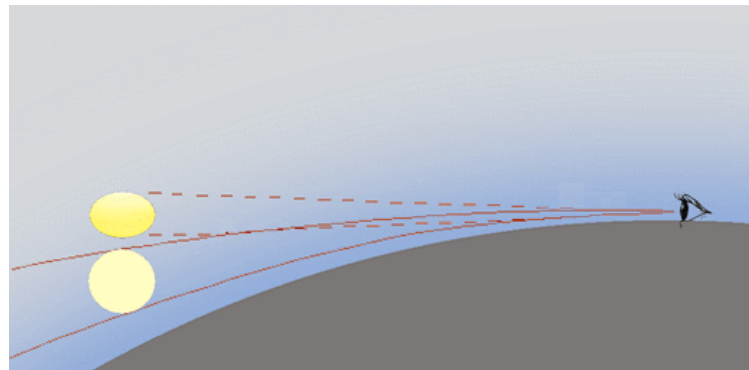
<http://awesomeocean.com/news/say-dont-know-study-finds-fish-can-recognize-human-faces/>



Mirage by terrestrial refraction

<https://paginadepesca.files.wordpress.com/2014/06/espejismo-auto-ruta.jpg/>

Flattened Sunset by astronomical refraction



<http://www.atoptics.co.uk/atoptics/sunflat.htm>



https://upload.wikimedia.org/wikipedia/commons/thumb/3/3d/Sunset_mirage.jpg/800px-Sunset_mirage.jpg

Refraction at a plane-parallel plate

A plane-parallel plate is a piece of glass with parallel sides. Therefore, light traversing the plate suffers two refraction.

When the refractive indices are the same on both sides of the plate, the ray emerging has the same direction as the input beam, but it is displaced laterally.

This displacement depends on the refractive index (n) and the thickness (L) of the plate as:

$$d = L \sin(\sigma) \left(1 - \sqrt{\frac{1 - \sin^2(\sigma)}{n^2 - \sin^2(\sigma)}} \right)$$

