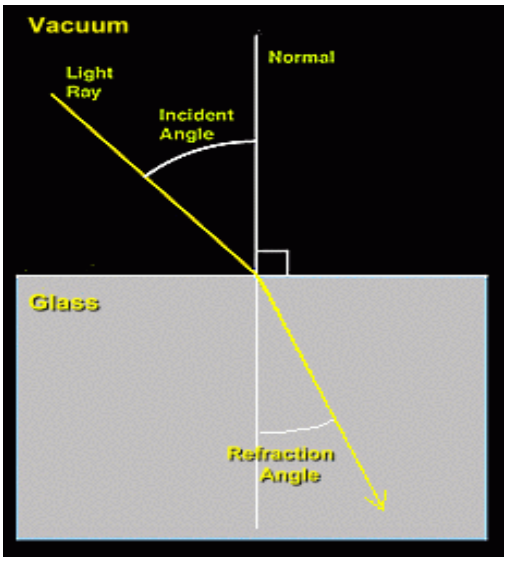
The Law of Refraction

Refraction is the process in which light is bent, when it travels from one medium to another. Light bends because it changes speed when it moves through materials that have different densities. The bending of light makes the object's image appear to be in a different position than it really is.

How Light Refracts



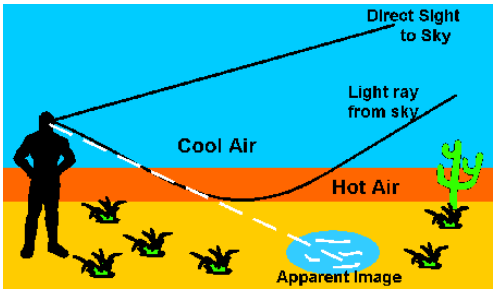
Light travels slower in materials that are denser, because there are more particles.

The ***Law of Refraction*** states that when light travels from one medium, to a more dense medium, the light will be bent ***toward*** the normal, and when it exits the denser medium into a less dense medium it will bend ***away*** from the normal. The new direction of light is called the ***angle of refraction***.

Mirage

Refraction can also occur when light travels through air at different temperatures, because warm air is less dense than cold air.

The refraction of light through air is called a *mirage*.

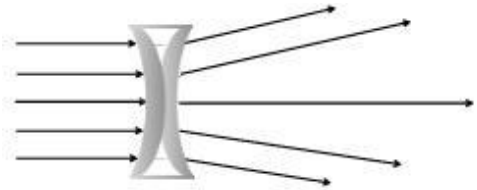


What happens when light strikes a surface?

Type of behavior	What happens to light striking a surface	Nature of surface	What else happens?
Absorption	Energy Transformation	rough, dark, opaque	some light is reflected
Reflection	Bounces off	smooth, shiny	some light is absorbed
Refraction	Travels through in a new direction	different transparent medium	some light is reflected

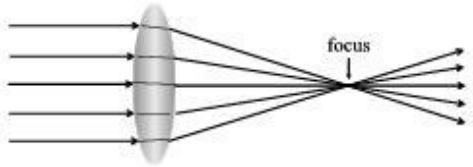
Lenses Refract and Focus Light

A **lens** is a curved piece of transparent material (glass/plastic).
When light rays pass through it, the light is refracted, causing the rays to bend.



A **double concave lens** is thinner and flatter in the middle than the edges.
Light passing through the thicker more curved areas of the lens will bend more than light passing through the thinner areas, causing the light to spread out or **diverge**.

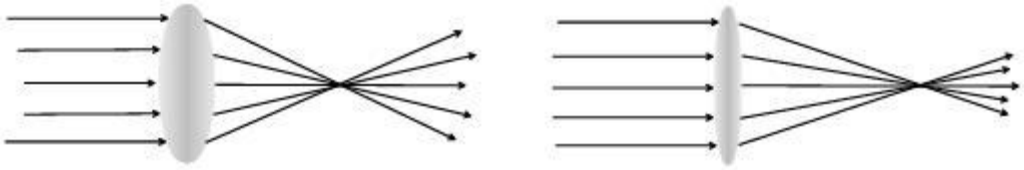
A **double convex lens** is thicker in the middle than around the edges.
This causes the light to come together at a focal point, or **converge**.



Lenses and Mirrors

Lenses are useful optical devices. Eyeglasses, have been made from lenses since the thirteenth century. A convex lens refracts the light rays from an object so they can be focused.

Different size lenses can converge the light rays at different distances, enabling corrections to be made to focal points.



However, light from the left portion of the object is directed to the right and the light from the top is directed to the bottom. This **inverts** the image. Overhead projectors and film projectors do this.

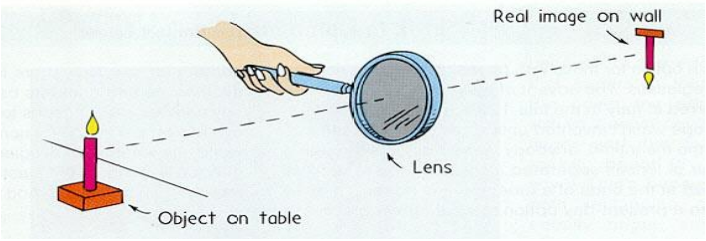
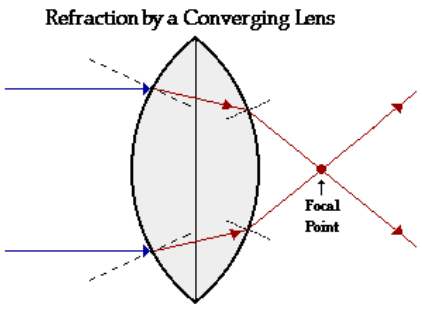
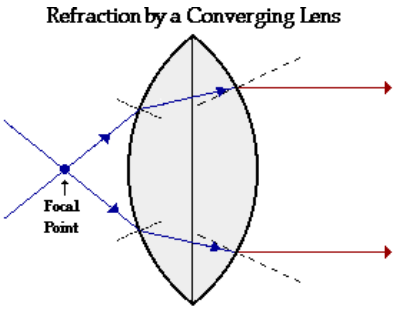


Image Formation With A Convex Lens



Incident rays which travel parallel to the principal axis will refract through the lens and converge to a point.



Incident rays which travel through the focal point will refract trough the lens and travel parallel to the principal axis.

The formation of an image with a double convex lens depends on where the object is placed and the orientation of the light source.