Reflection

Wave behavior:

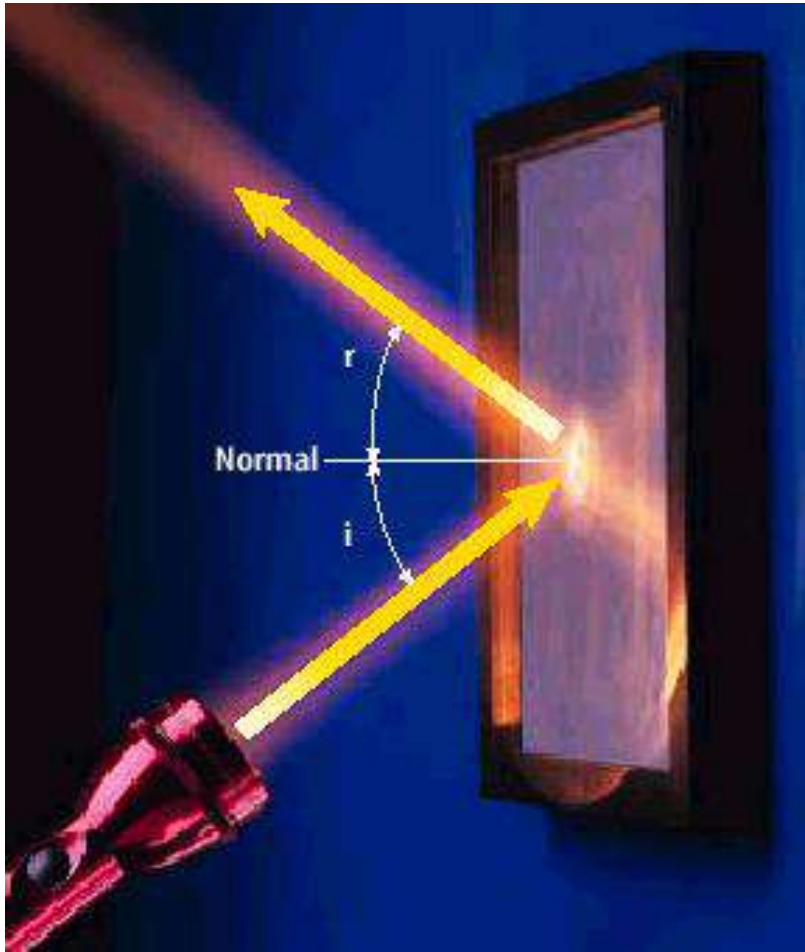
Reflection - the ***bouncing back*** of a wave.

1) Sound echoes

2) Light images in mirrors

3) Law of reflection

$i = r$



Reflection

- Light always travels in a straight line.
- However, when light hits another substance, it will change direction.
- If a material is opaque, the light will not pass through but instead bounce off.
- The change in the direction of the light is called reflection.

Texture of Surface

- The manner in which the light reflects depends on the surface's smoothness.
- Light that hits a rough surface is reflected in many directions. This is called **diffuse** reflection. (Aluminum foil Demo)
- Light reflected off a smooth surface is reflected in one direction and is called **specular** reflection. (disco ball/cd Demo)

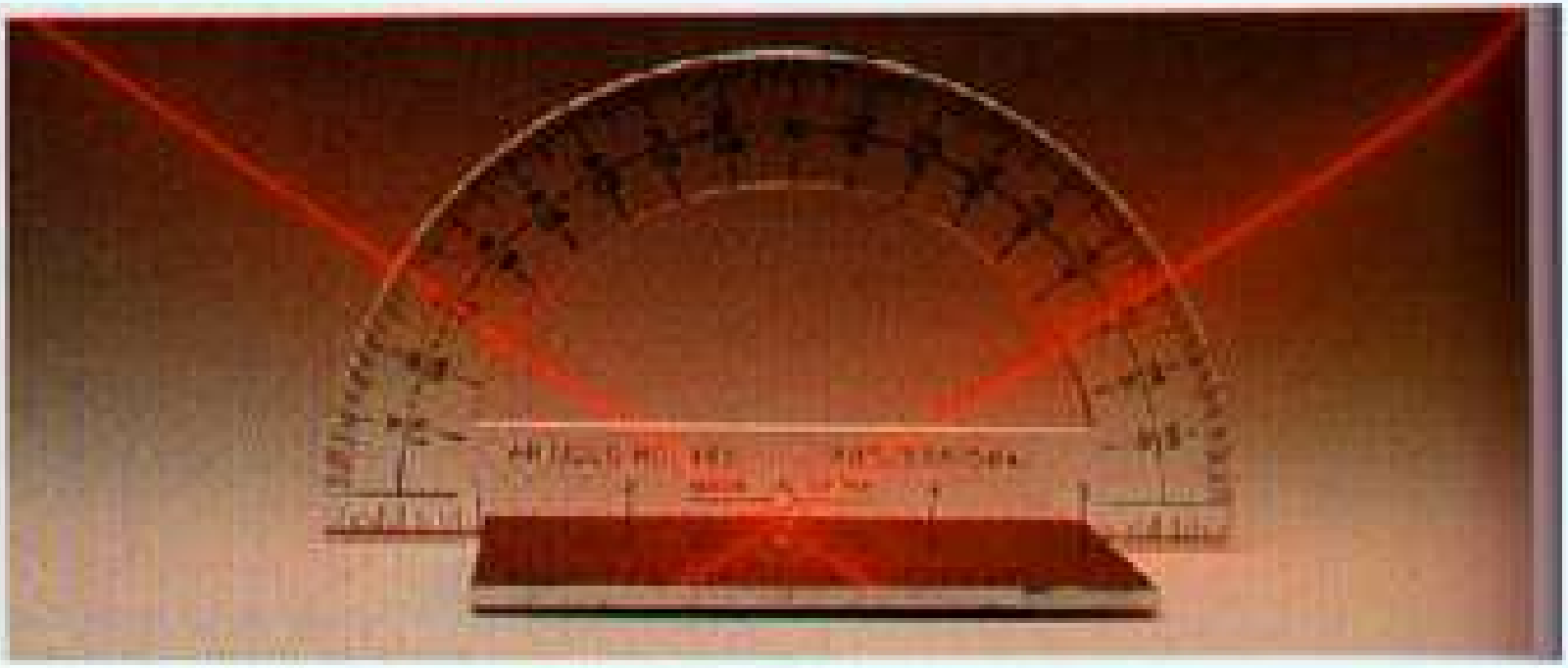
Incoming and reflected angles are equal.

Protractor, Laser, Mirror Demo

Law of Reflection

Reflection:

The angle of incidence = the angle of reflection.

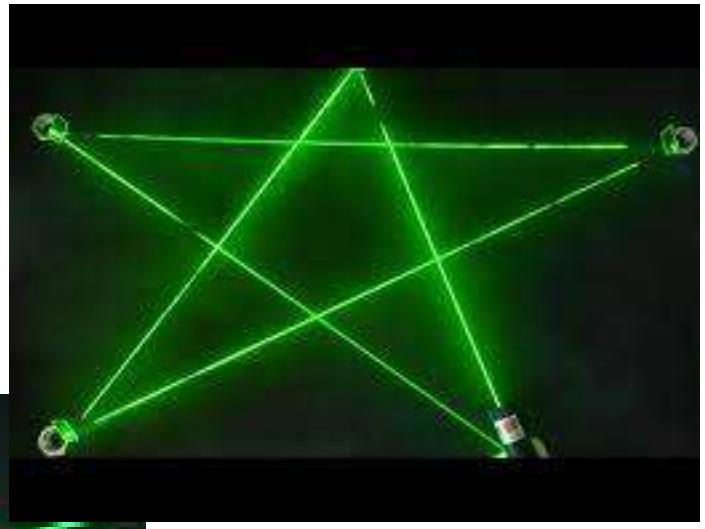


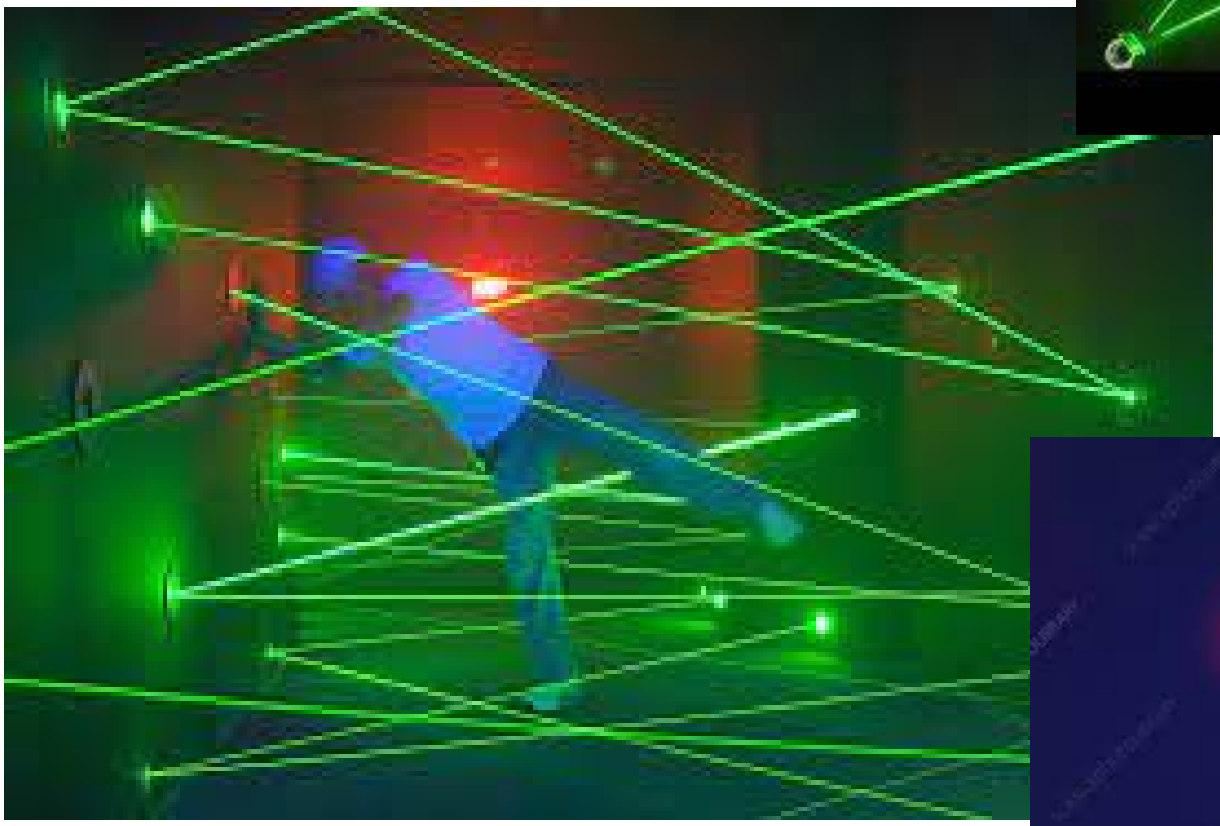
Laser Show Demo with fog


How Periscope works
Reflection of Light

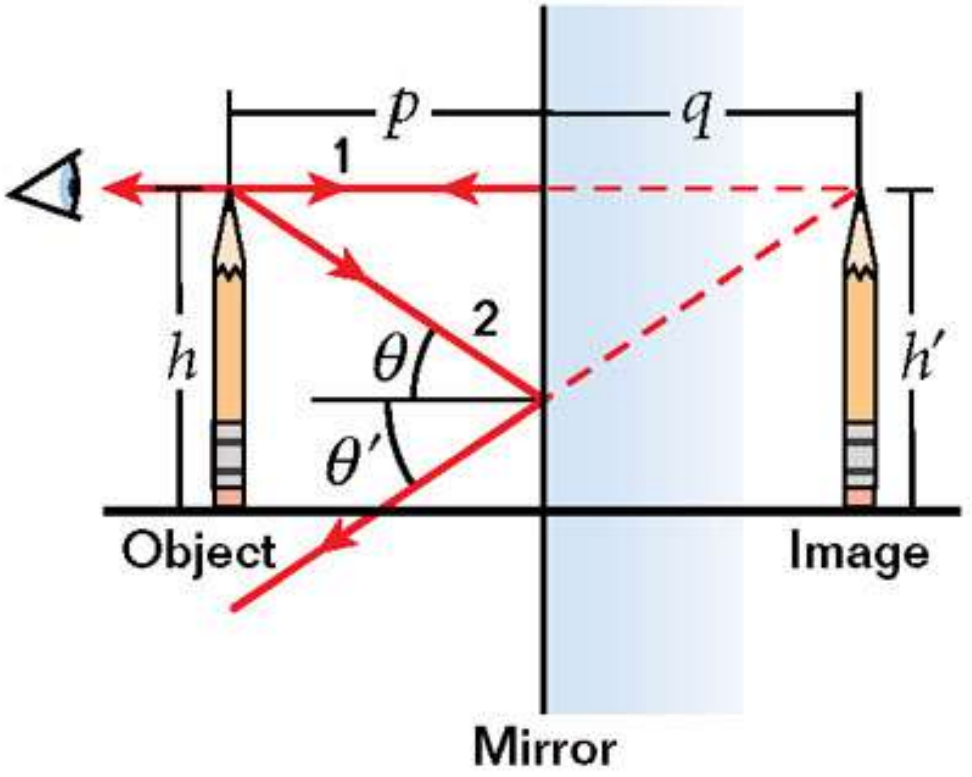
Demo

- Laser and Mirrors





Flat Mirror Reflection



Reflection Rules

- Angle 1 = Angle 2
- H1 = H1 but on opposite sides
- p = q but on opposite sides
- The image formed by a flat mirrors has right to left reversal. The are **Virtual** images

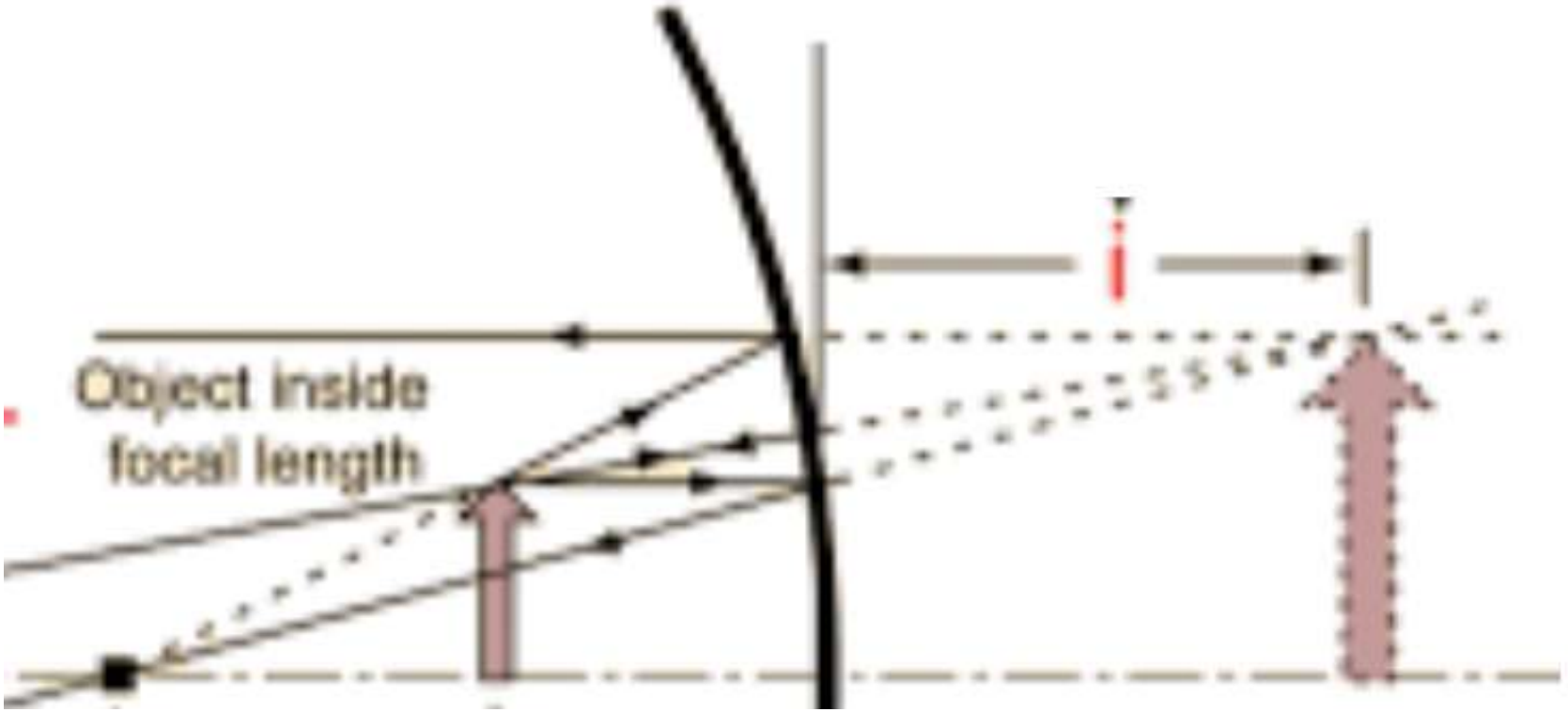
- **Concave Mirror** – An inwardly curved, mirrored surface that is a portion of a sphere and that converges incoming light.
- Concave mirrors create a **magnified image.**
- How big the image appears depends on how curved the mirror.
- Spoon Concave Mirror Demo

- $1 / p + 1 / q = 1 / f$
- $1 / p + 1 / q = 2 / R$
- p = object distance
- q = image distance
- f = focal length
- R = Radius

- Unlike flat mirrors, the images formed are not the same size as the original image.
- How big or small they appear can be calculated:
- $M = h' / h$
- $M = q / p$
- M = Magnification; h’ = image height
- h = object height; q = image distance
- p = object distance

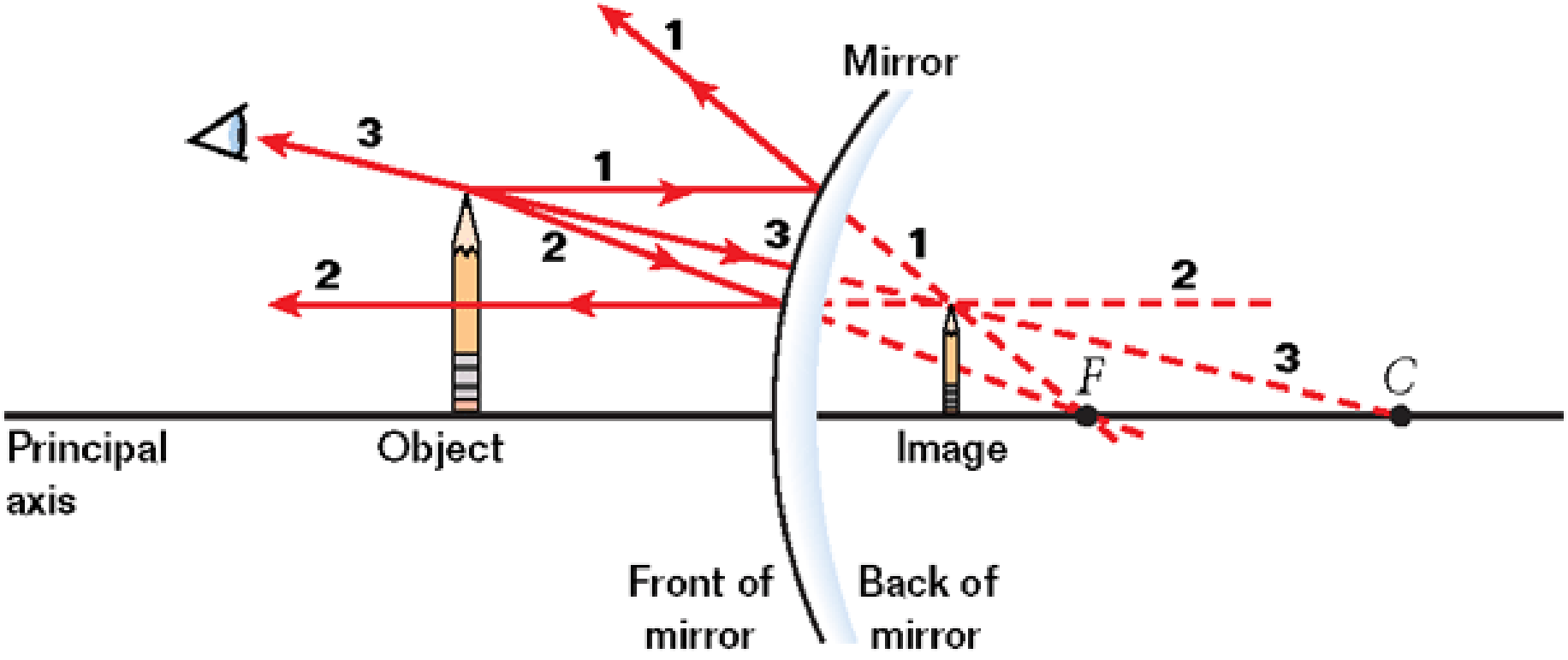
- If M is + then the image is Upright and Virtual.
- If M is – then the image is Inverted and Real

Must draw the concave mirror



- **Convex Mirror** – An outwardly curved mirror that diverges incoming light rays.
- The image appears smaller.
- Convex Spoon Demo

- Must Draw for test: Convex



Demo

Concave / Convex mirrors

- Adding primary colors of **light** creates white light
- An object of a particular color, such as a **green leaf**, absorbs Red, Orange, Yellow, Blue, Indigo, and Violet the leaf **reflects Green**.
- For test you must list the colors absorbed and colors reflected. Remember colors by ROYGBIV.

Flame Test

- We can’t travel to the sun so how do we know what chemicals make it up?
- So what’s causing this fire? What chemical is burning?

Adding Paint (colors) is different then adding light (colors).

Refraction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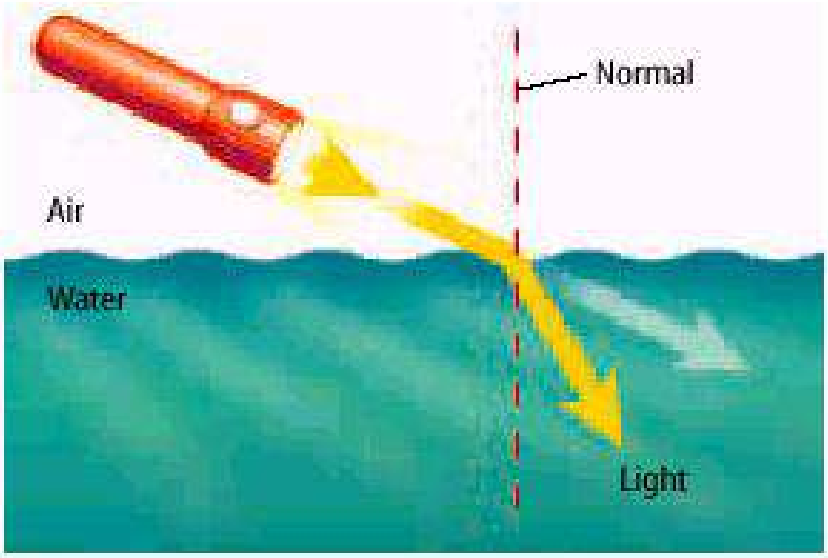
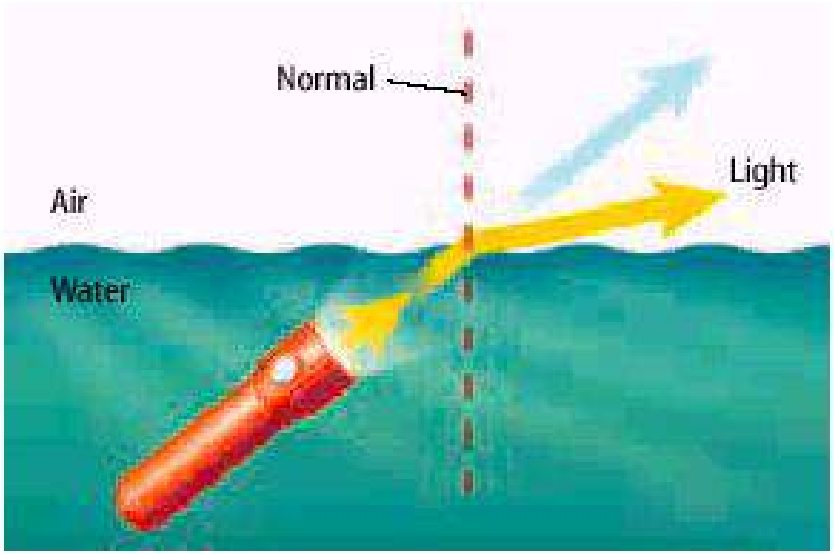
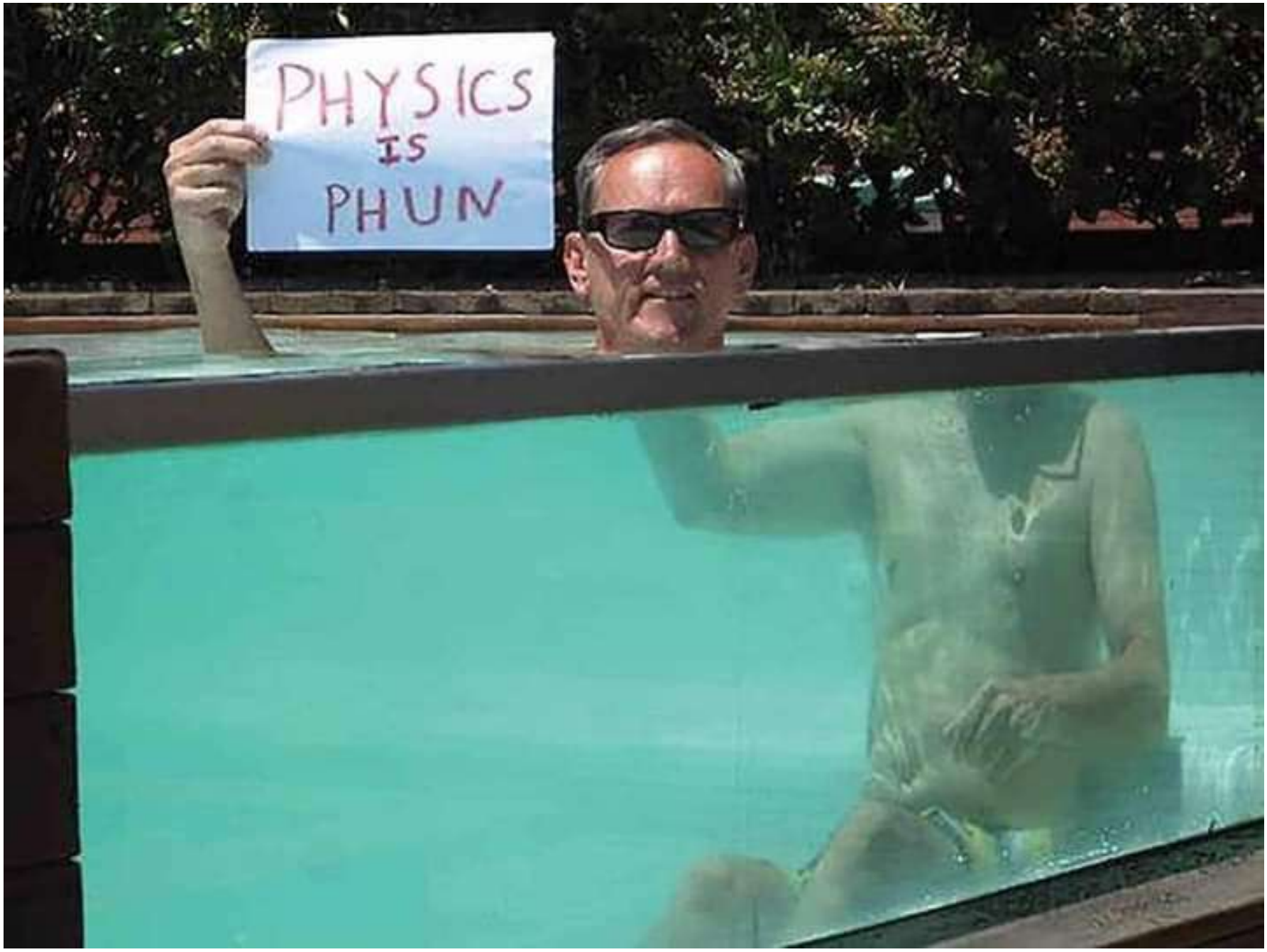
Refraction - the *bending* of light due to a change in medium.

(air into water)

Light travels slower in water than in air.






PHYSICS
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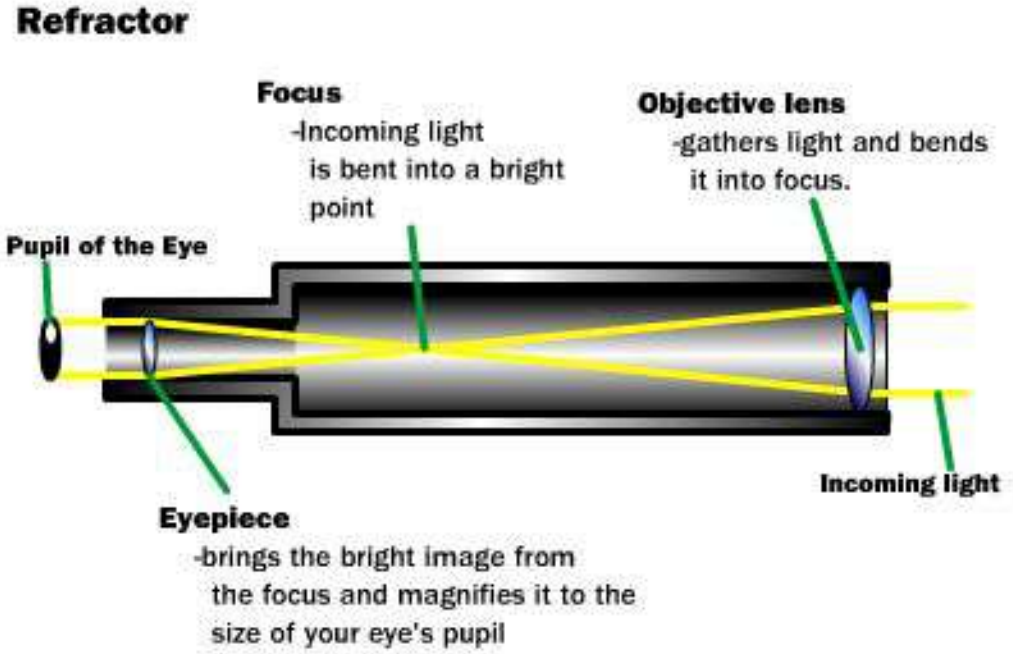
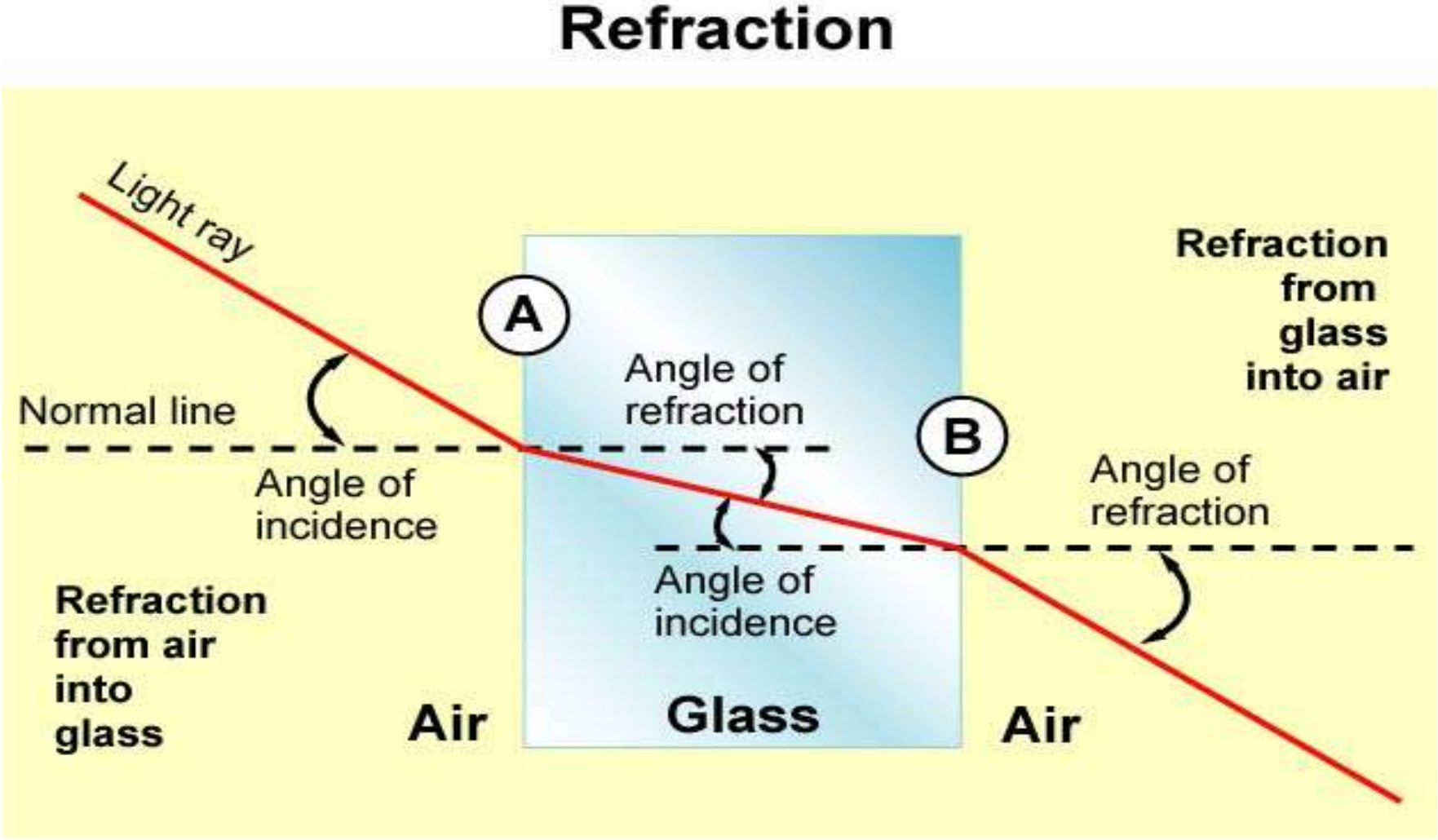
Lenses

- Like mirrors, lenses form images, but lenses do so by refraction rather than reflection.
- Lenses are transparent objects that refract light.
- Examples include, magnifying glasses, contact lenses, microscope, telescope.



Snell's Law

- Index of refraction$_I$ ($\sin\theta_I$) = Index of refraction$_R$ ($\sin\theta_R$)



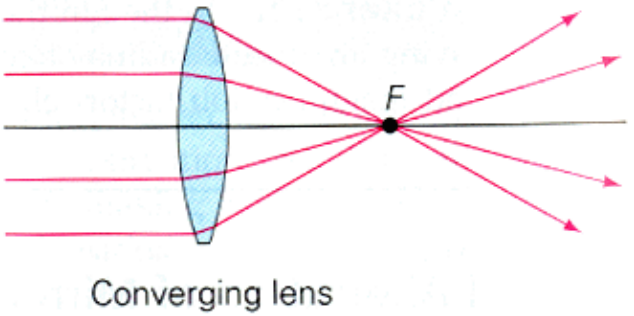
Reflection and Refraction of Light

Refraction/Lenses Demo

- Refraction goggles

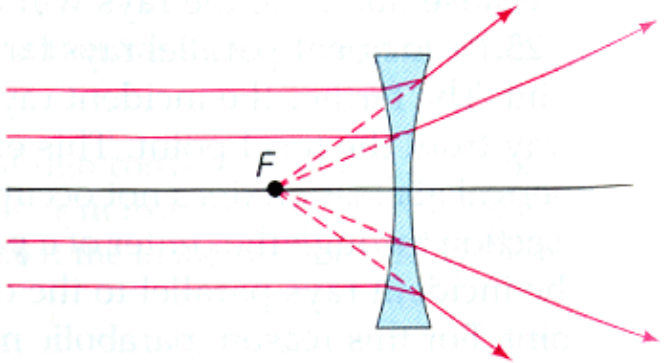
2 Types of Lenses

- Converging lenses – Thicker at the middle and thinner at edges



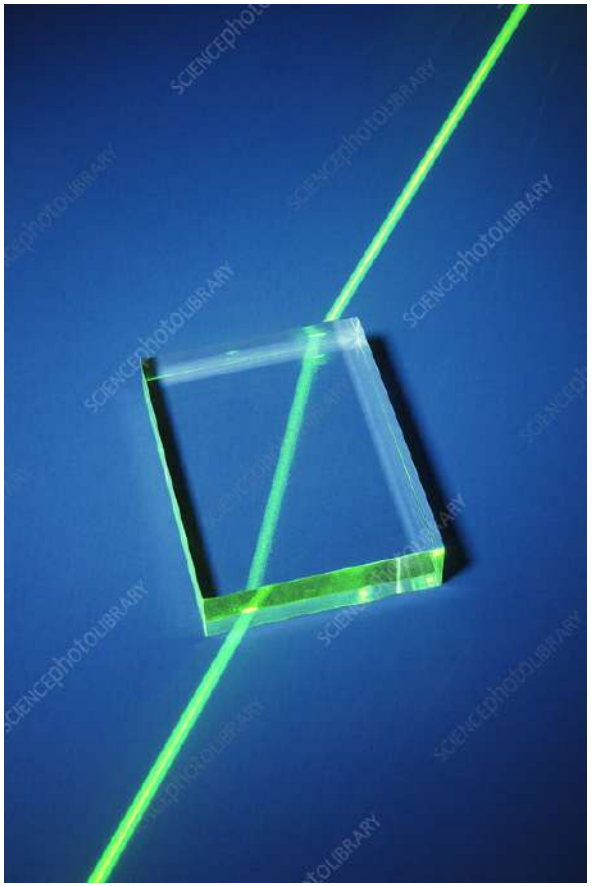
Converging lens

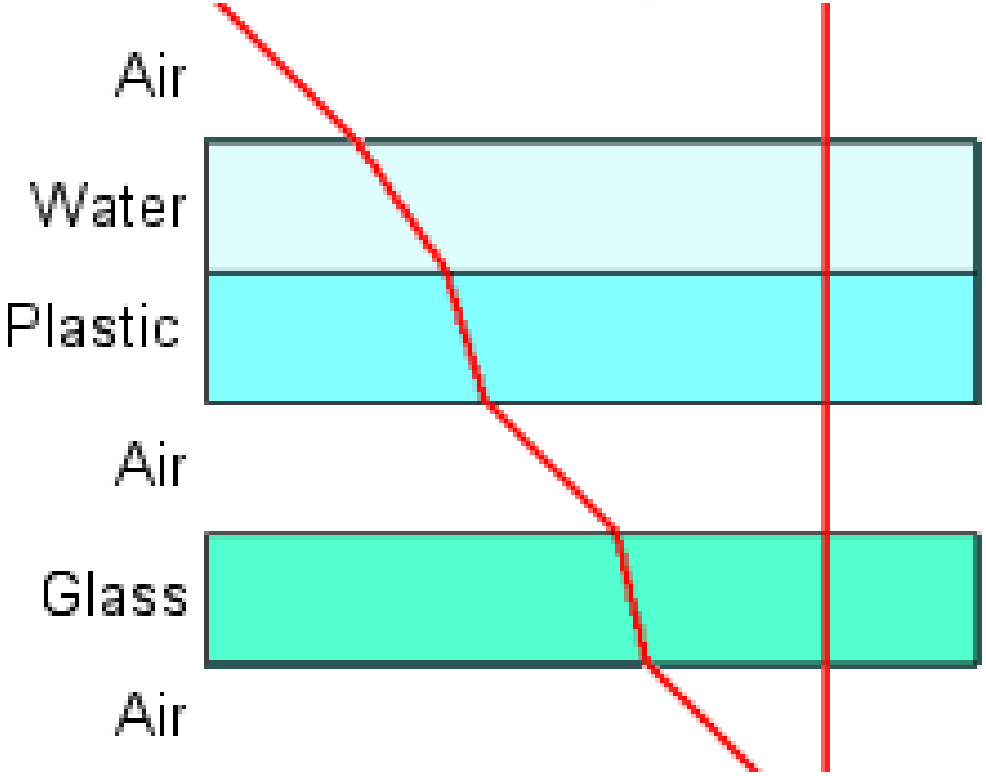
- Diverging lenses – Thinner at the middle and thicker at the edges



Diverging lens

- Glass, water, ice, diamonds, and quartz are all examples of transparent media through which light can pass. The speed of light in each of these **materials** is different. The **angle** in impacts the angle out. Laser in lenses and water demos





Examples of Converging

- Magnifying Glasses
- Microscope – Work by using several converging lenses to focus light
- Far sightedness (Glasses)

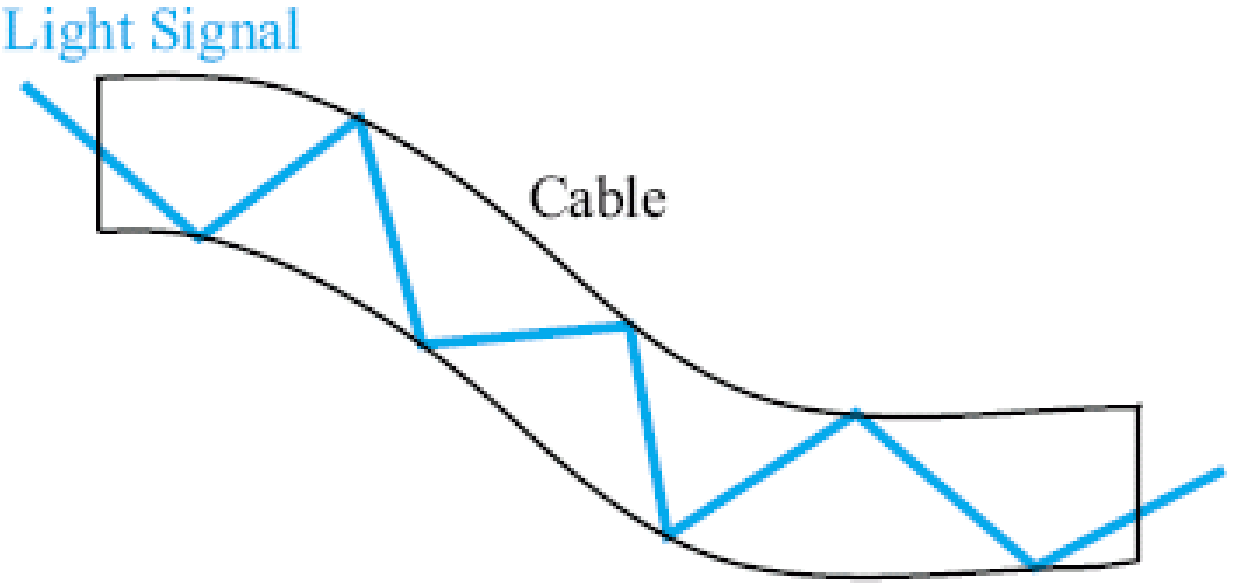
Examples of Diverging

- Telescopes – Work by using several Diverging lenses to focus light
- Near sightedness (Glasses)

- One type of telescope uses curved **mirrors** to form an image – this is called a **reflecting** telescope.
- Another type of telescope uses only **lenses** to form an image and is called a **refracting** telescope.

Total Internal Reflection

- Total Internal Reflection can occur when light moves along a path from a medium with a higher index of refraction to one with a lower index of refraction. (Demo)

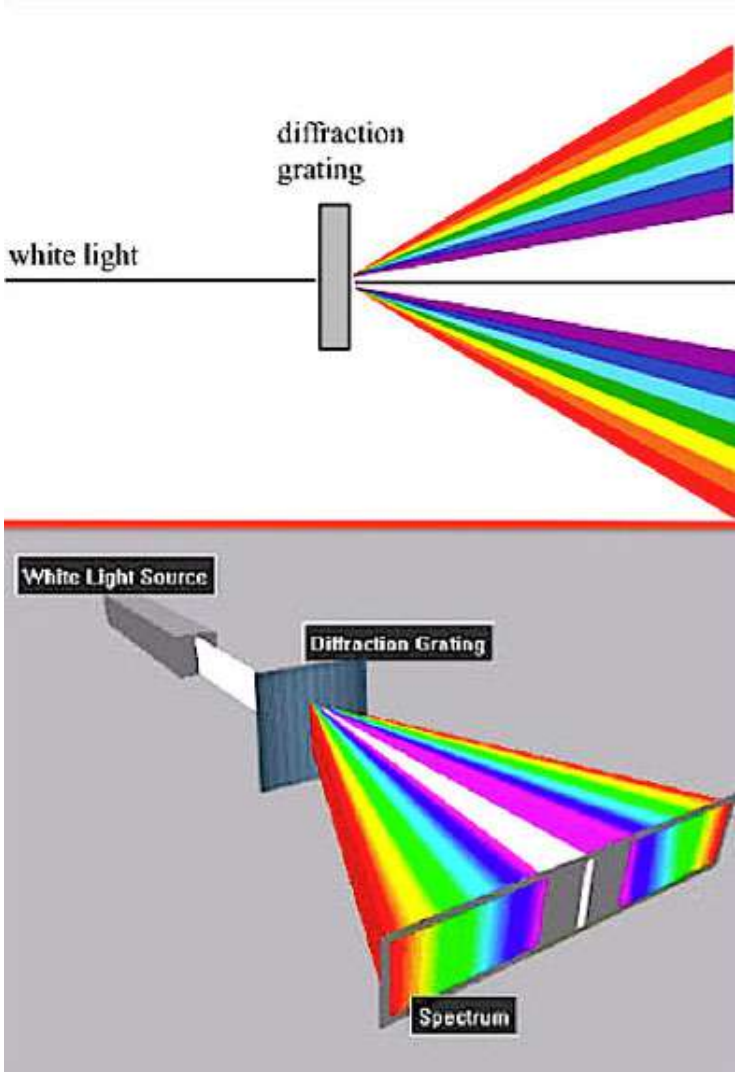


Critical Angle

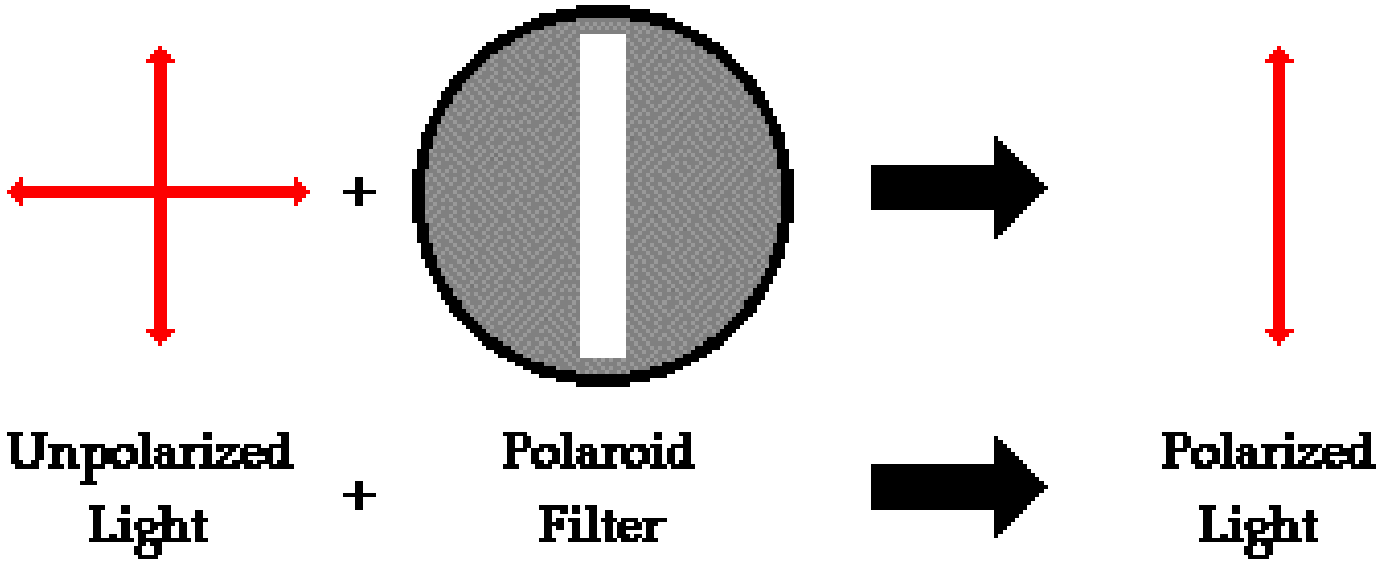
- Angle that bounces light or object back.

Diffraction

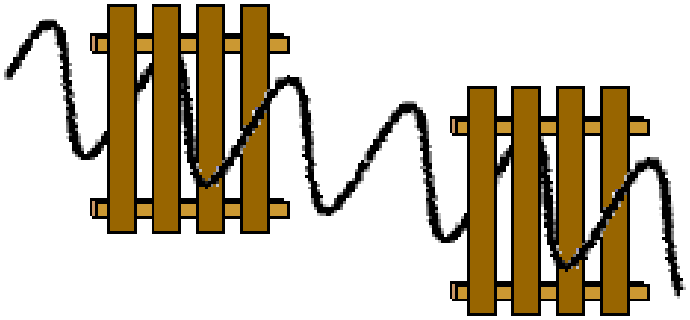
- The process by which a beam of light is spread out as a result of passing through a narrow opening.
- Diffraction Glasses/Sheet



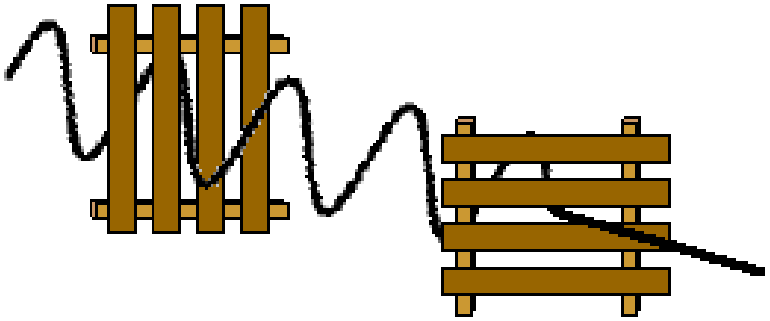
Polarization – *filtering* of light into a single plane



The Picket Fence Analogy



When the pickets of both fences are aligned in the vertical direction, a vertical vibration can make it through both fences.



When the pickets of the second fence are horizontal, vertical vibrations which make it through the first fence will be blocked.

Teacher

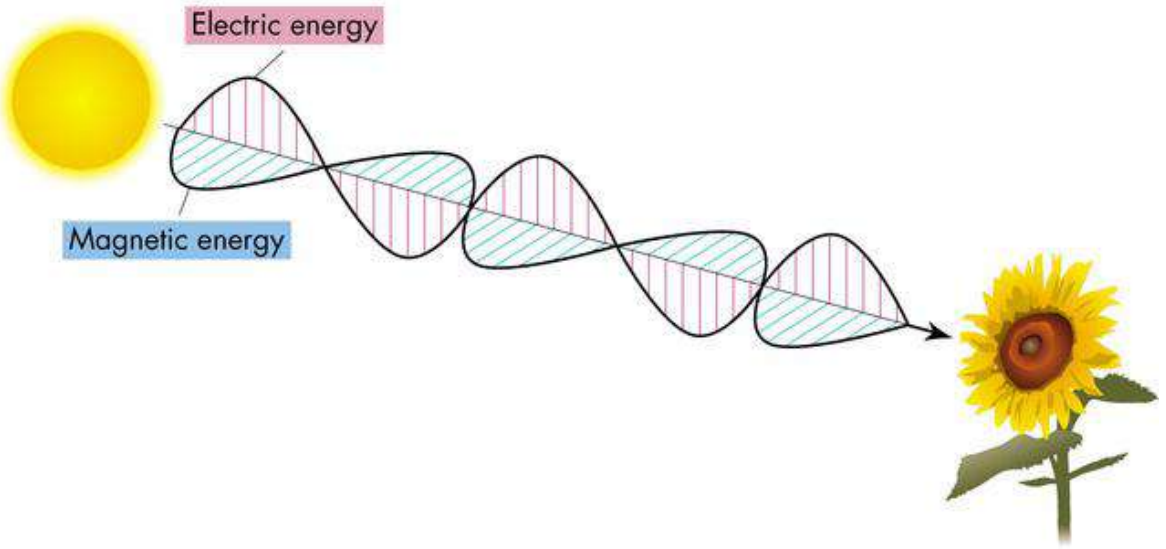
Teacher seen through two Polaroids

Axes aligned parallel to each other

Teacher seen through two Polaroids

Axes aligned perpendicular to each other

Light is made up of particles called photons.



Photons are packets of electromagnetic energy which travel as waves.

Light Theory

- Thomas Young
- Discovered that light is not a wave or a particle but instead both
- Young Double Slit Experiment

$E = mc^2$

- Einstein Theory
- Says that the energy is equal to a small amount of mass with a lot of energy created!
- Energy = mass * speed of light^2
- Atoms have less mass than their parts – supports theory

Lasers

- They have one uniform stream of light
- Quantum interference ensures the wavelengths are all uniform