

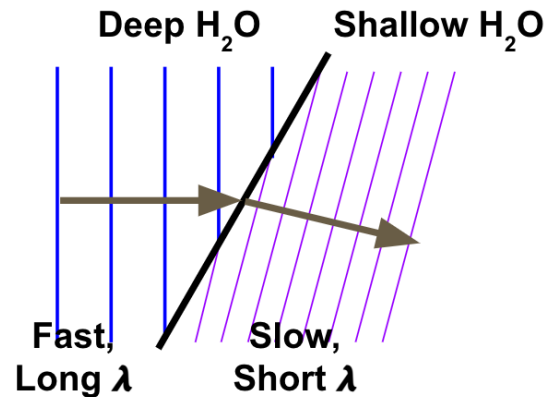
What is Refraction? Lesson Notes

Learning Outcomes

- What is refraction?

Boundary Behavior

- When a wave passes across the boundary between one material and another, there is a change in speed and wavelength.
- The energy carried by the **incident wave** to the boundary is *distributed* two ways - some to the **transmitted wave** and the rest to the **reflected wave**.
- Water waves traveling across the 2-dimensional surface display similar behavior - a **change in speed** and a **change in wavelength** - with the additional behavior of a **change in direction**.



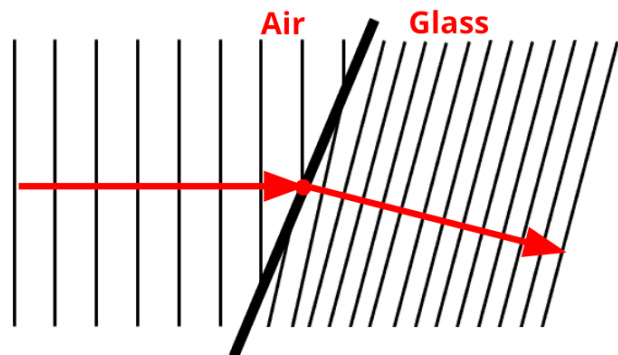
Refraction of Light Waves

An **incident wave** reaches the boundary; a **reflected wave** and a **transmitted wave** leaves the boundary.

As light crosses the boundary, there is ...

- a **change in speed**,
- a **change in wavelength**, and
- a **change in direction**.

Refraction is the change in direction of a wave that occurs when it crosses the boundary from one medium to another.



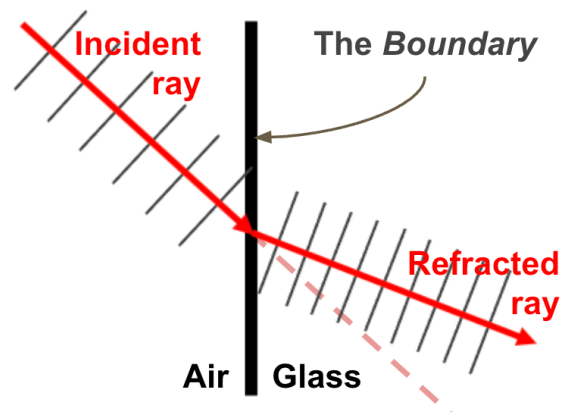
The Ray Model of Light

The **Ray Model of Light** utilizes **ray diagrams** consisting of rays drawn perpendicular to the wavefronts.

Incident Ray: approaching boundary

Refracted Ray: leaving boundary (in new medium)

Refraction occurs at the boundary. The light changes direction at the boundary.



Ray Diagrams for Refraction

Ray diagrams show quantitative information about the angles that the light ray makes with a **normal line**. Because of refraction (the change in direction of light), the angle of incidence is **not** equal to the angle of refraction.

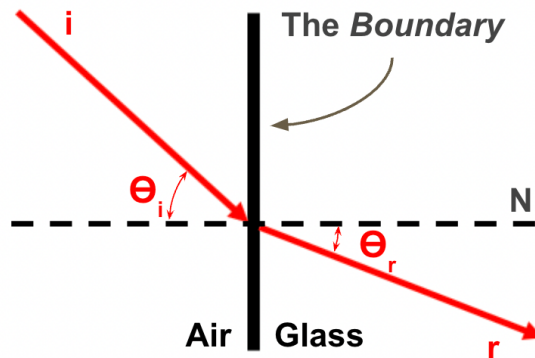
i = incident ray

r = refracted ray

N = normal line

θ_i = angle of incidence

θ_r = angle of refraction



Refraction and Visual Distortions

Refraction leads to interesting and commonly observed visual distortions ... like the broken pencil observation and the very full mug of root beer.

