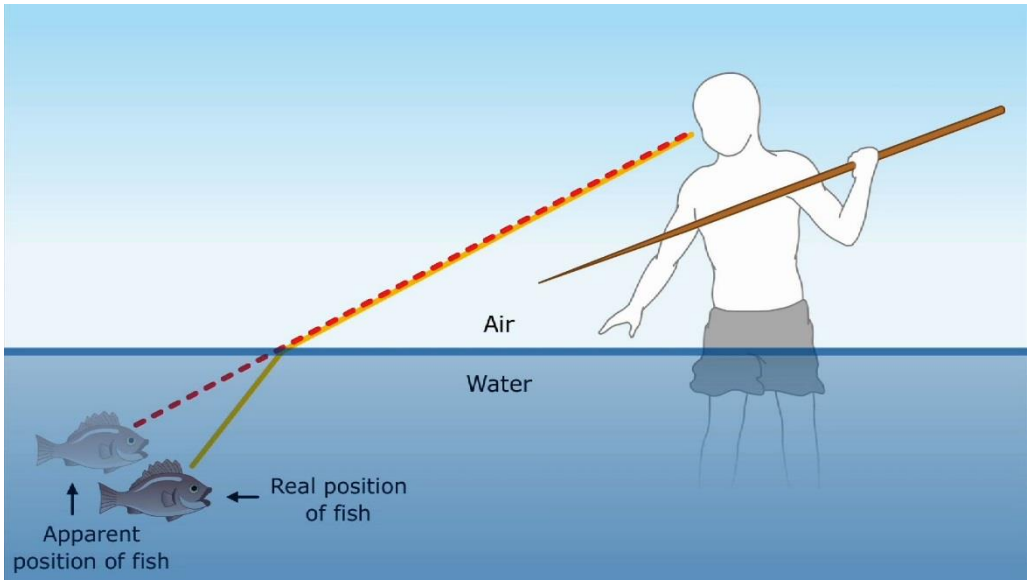
Refraction

When light waves hit a boundary (different medium) they are either absorbed, reflected, or transmitted. Sometimes light that is transmitted across a boundary will bend, or change direction. This is called refraction.



- The speed of light is constant within a medium, but changes from one medium to another.
- The change in speed of the light wave is what causes the change in direction, or bending, of the light.

Index of Refraction

A measurement of how much slower light travels through a given medium than it does through a vacuum.

index of refraction $\leftarrow n = \frac{c}{v}$ $c \rightarrow 3.0 \times 10^8$ m/s; $v \rightarrow$ speed of light in medium

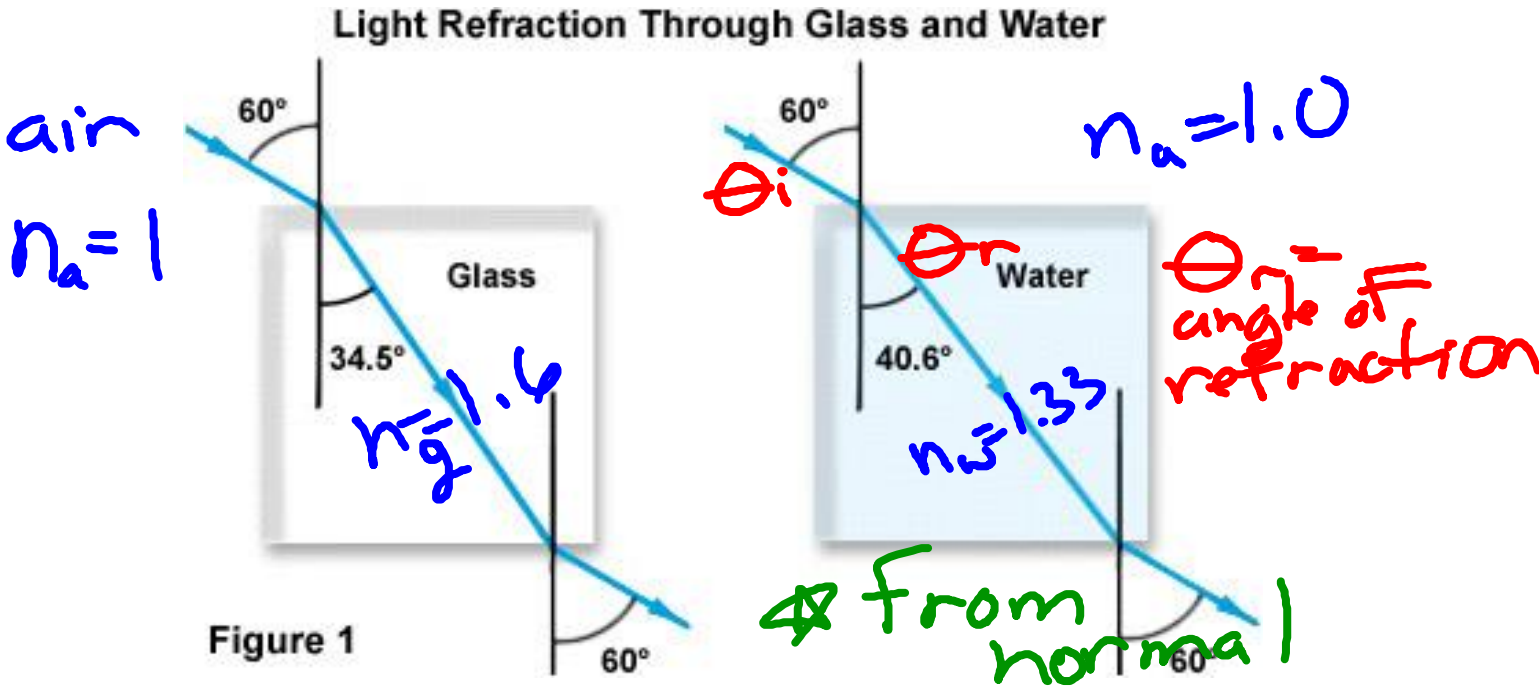
n always > 1

* no units

$n_{air} = 1.0003$ $\boxed{n_{air} = 1.0}$

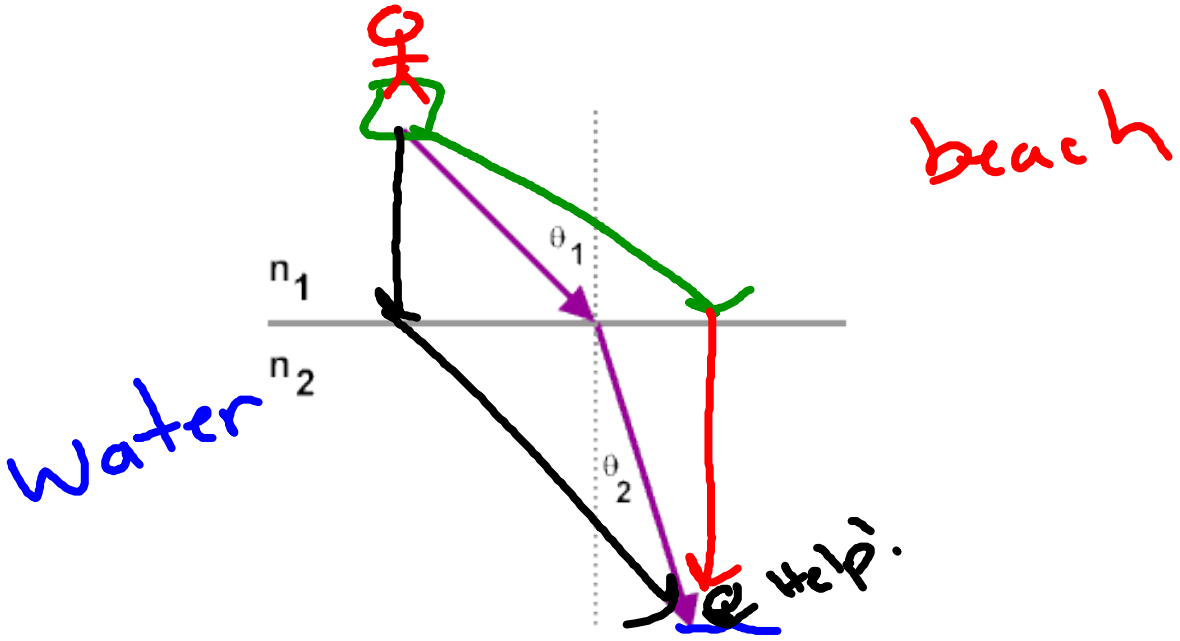
Which way will light bend?

- When light enters a slower medium, it bends *toward* the normal (angle decreases).
- When light enters a faster medium, it bends *away from* the normal (angle increases).



Principle of least time

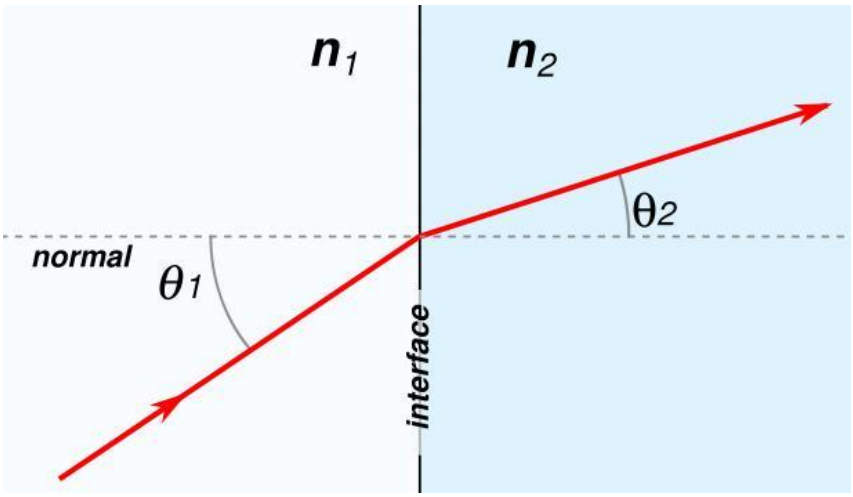
Light waves travel across the path of least resistance—they take the fastest possible path.



Snell's Law

$$n_1 sin\theta_1 = n_2 sin\theta_2$$

n = index of refraction



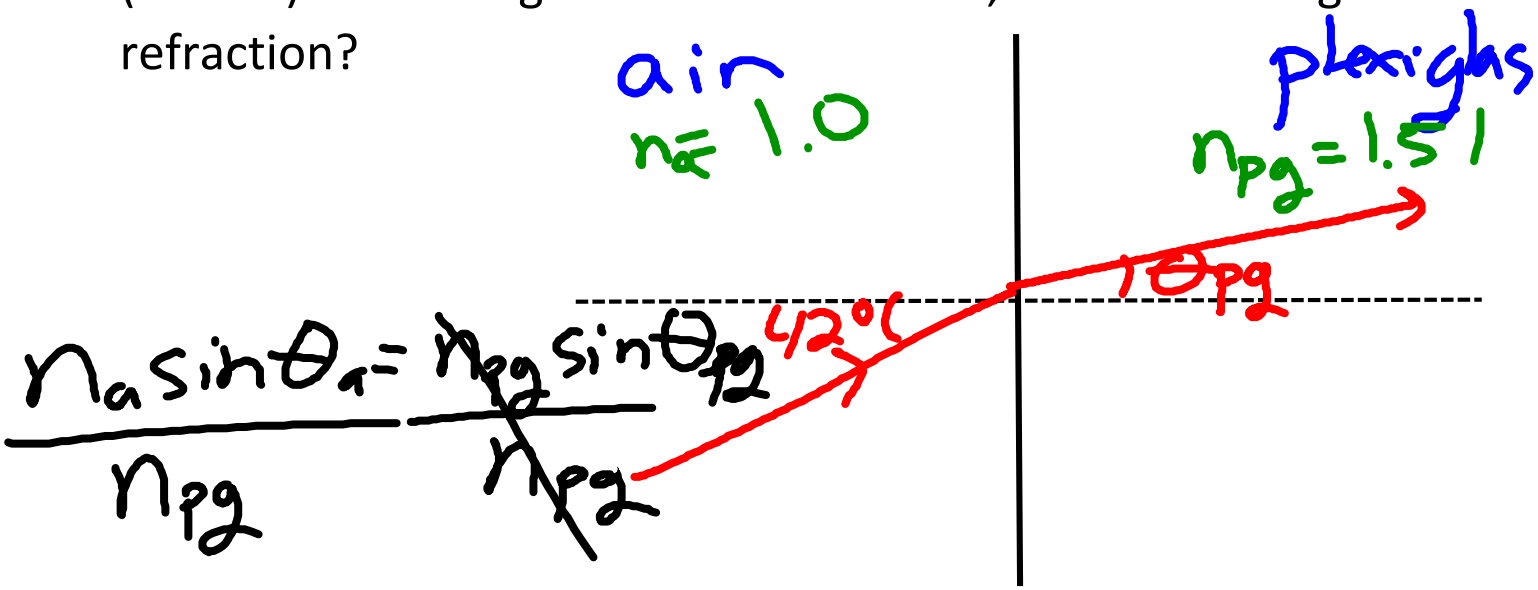
What if $\theta_1=0^o$?

$\sin 0^\circ = 0$

→ no refraction
→ no light bend

Example Problem

A beam of light passes from air into a layer of Plexiglas (n=1.51). If the angle of incidence is 42^0, what is the angle of refraction?



$$\frac{n_a \sin\theta_a = n_{pg} \sin\theta_{pg}}{n_{pg} \quad n_{pg}}$$

$$\sin\theta_{pg} = \frac{n_a \sin\theta_a}{n_{pg}}$$

$$\theta_{pg} = \sin^{-1}\left(\frac{(1.0)\sin 42^\circ}{1.51}\right)$$

$$\boxed{\theta_{pg} = 26.3^\circ}$$