Refractive Index

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Refractive Index is a measure of how much light slows down in a material when compared to its speed in a vacuum.
Absolute RI n is therefore a measure of optical density.

$$n = \frac{c}{c_s}$$

c – speed in vaccum

c_s ← speed in material

Relative RI between two materials: $_1n_2 = \frac{c_1}{c_2}$

c_1 ← speed in first

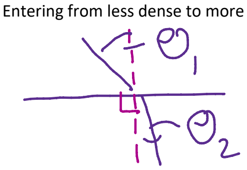
c_2 ← speed in second

combining gives

$$_1n_2 = \frac{n_2}{n_1}$$

Snell's Law

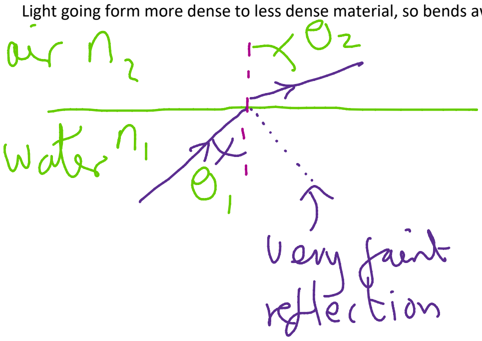
Entering from less dense to more dense bends towards the normal:



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

Critical Angle

Light going form more dense to less dense material, so bends away from the normal.

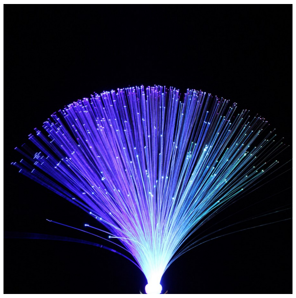


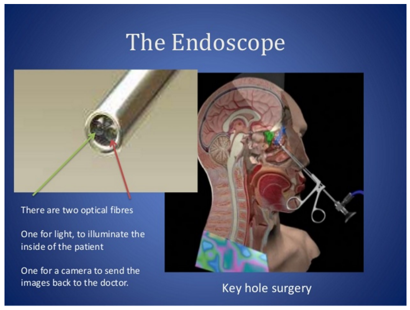
As you increase θ_1 so θ_2 increases.
Eventually $\theta_2 = 90°$ ... ray refracts along the surface of the water. This value of θ_1 is called the "Critical angle".
If θ_1 is increased no refraction, & the previously faint reflection becomes much brighter.

At θ_c snell's law changes:

$$n_1 \sin\theta_1 = n_2 \sin\theta_2 \quad \ldots \quad \sin 90 = 1$$

$$\text{so } n_1 \sin\theta_1 = n_2 = \frac{n_2}{n_1} \text{ or } {}_1n_2$$





Total Internal Reflection is Fab
You need to know about 'step-index' fibres. The fibres themselves have a high RI and are surrounded by material with a lower RI mean TIR happens and the inner fibre is protected from scratches.

These are used to send pulses of information (ie digital signals) great distances, and around corners very easily. Also they are used in medicine to help doctors see inside all those nasty bits of us that go wrong sometimes.... Light just shines down them, reflecting of the surfaces until it gets inside.

Lastly you need to know that the amplitude (think 'how bright') of a light pulse that travels down the fibre is reduced by **absorption**. **Dispersio**n means 'spreading out'. We find that pulses spread out because the different colours that make up the light have slightly different Ris and so travel at slightly different speeds. The effect is to broaden the pulse - this is called **material** dispersion. **Modal** dispersion happens because the light enters the fibre at slightly different angles and therefore the different rays travel slightly different distances therefore arriving at the other end at slightly different times.