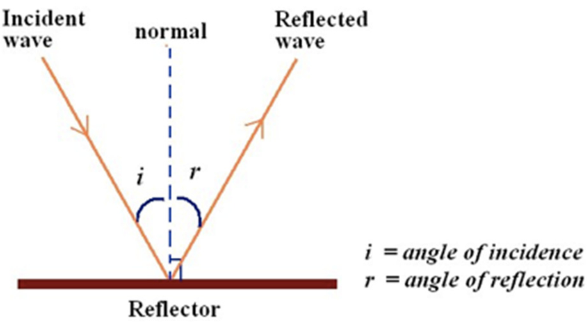
# TOPIC 2 – LIGHT: WAVE MODEL

**Inquiry question:** ***What evidence supports the classical wave model of light and what predictions can be made using this model?***

## PROPERTIES OF LIGHT

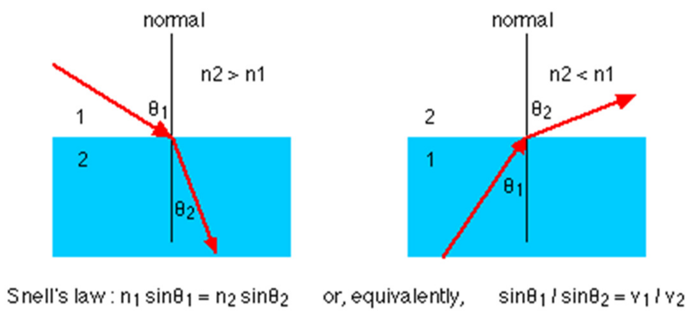
Light as a wave undergoes reflection, refraction, diffraction and interference.




**Reflection:**

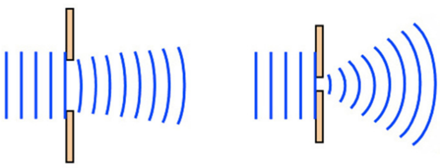
When waves meet a surface, they reflect so the angle of incidence is the same as the angle of reflection.

**Refraction:**




The bending and slowing of velocity of light when it passes into media of different optical densities. Snell's Law gives the mathematical relationship between the refractive index (n) of a medium and the angles through which light bends.

**Diffraction:**



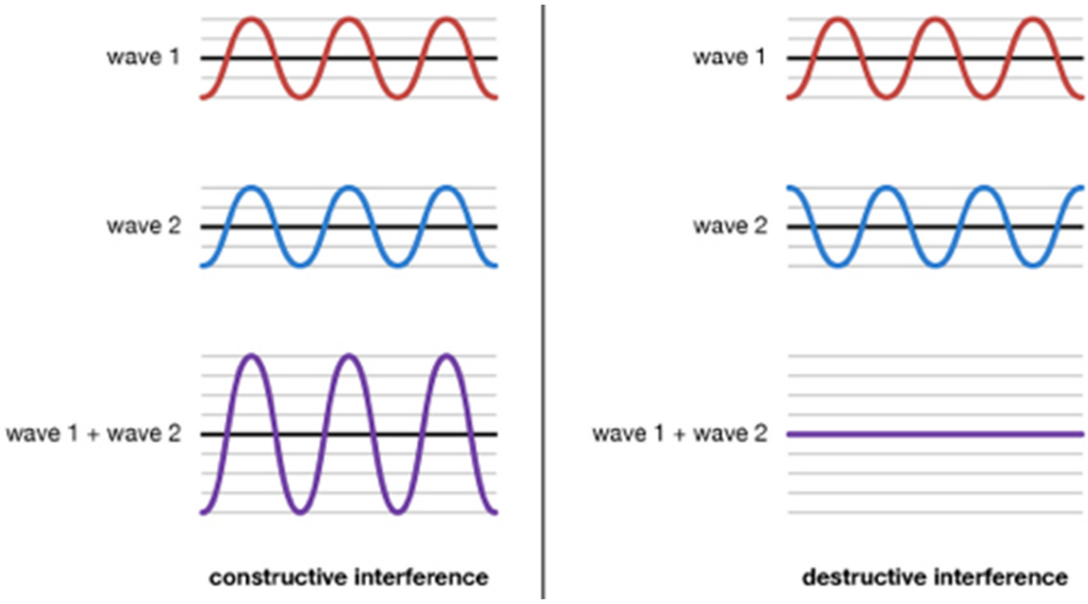
The bending of light as it passes through a gap, or travels around a corner.

Maximum diffraction results in circular waves.

Maximum diffraction occurs when the gap is equal to the wavelength of the light passing through it. To bend visible light, the gaps need to be very small as the wavelengths are in the $10^{-7}$ m magnitude.

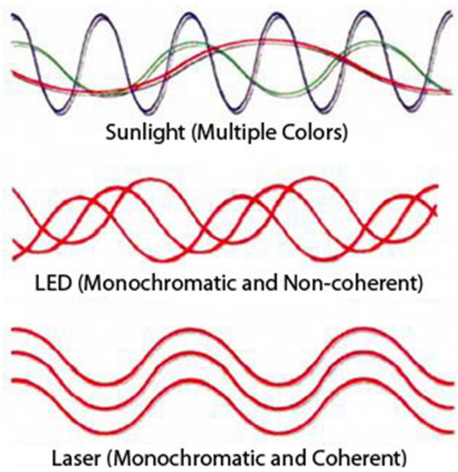
**Interference:**

When at least two (or many) light sources are in the same space, they will undergo constructive and destructive interference. When the waves strike a screen they form patterns based on this interference. Where light waves constructively interfere a bright band is seen. Where light waves destructively interfere a dark band is seen.




## DIFFRACTION AND INTERFERENCE OF LIGHT

Experiments that involve diffraction and interference of light are generally conducted with monochromatic, coherent sources of light like a laser.




Monochromatic – light of one wavelength only.

Coherent – light that is in phase (all the peaks of all the waves line up).

Light can be:

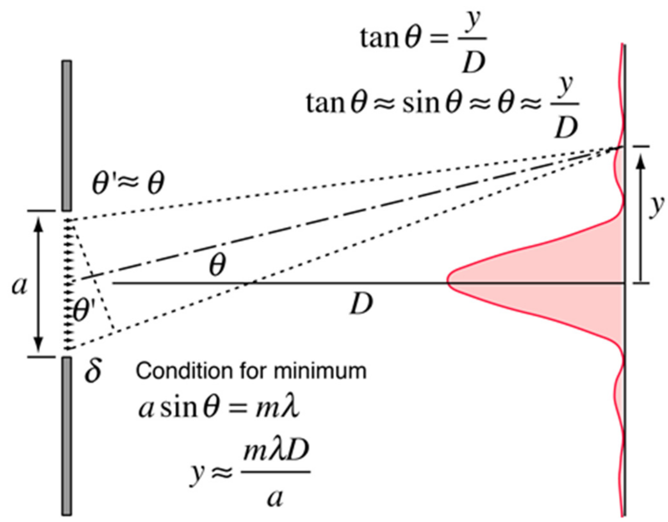
- Non-monochromatic and non-coherent (sunlight)
- Monochromatic and non-coherent (LED)
- Monochromatic and coherent (laser)

In diffraction and interference experiments we use double slits or diffraction gratings (millions of slits) and to get measurable and clear results it is important that when a light source hits the slits, it hits each one with the same part of the wave.

For example – peaks of the wave hit each slit at the same time, or troughs hit at the same time.

You would not get great results if you had a peak at one slit, a trough at another, then halfway up the wave at a third slit. Thus, light we use is generally monochromatic and coherent.

## SINGLE SLIT DIFFRACTION




**Note:** The syllabus requires only qualitative diffraction of light through a single slit.

As the wavelength of light is so small, even light through a single slit does not diffract perfectly.

As seen to the right even a narrow single slit gives an interference pattern determined by the width of the slit.

This is called Fraunhofer diffraction and is caused by side of the slit acting as another source of waves to cause interference.

The pattern observed has a very bright central peak that is twice the width of the surrounding bands.

Other bands are arranged symmetrically either side, decreasing in intensity as they move further from the centre.