Introduction to Optics

Optics

* Optics - how light behaves in the physical world

Is Light a Wave or a Particle?

Wave or Particle?

* Light is refracted in lenses:
  * Light must be a wave!
* Light can travel through a vacuum (space)
  * Light must be a particle!

Light is actually both a wave and a particle. Packets of light are called photons.

Optics

* Light is one of the forms of energy emitted from the sun.
* To reach us, this radiation must pass through space which is a vacuum.
* Light is unique in that it does not require a medium to travel, and is able to travel through outer space.

Optics

* **Medium** - any physical substance (air, water, dust) that acts as a carrier for the transmission of energy.
  * Sound travels through air particles
  * Water waves travel through water
  * A rope or slinky can be a medium for waves

Optics

* Energy travel through space as electromagnetic waves.
    * Electromagnetic Waves: A wave that has both electric and magnetic parts, travels at the speed of light.

Optics

* The term electromagnetic waves is used to describe light because light is made up of oscillating electric and magnetic fields.

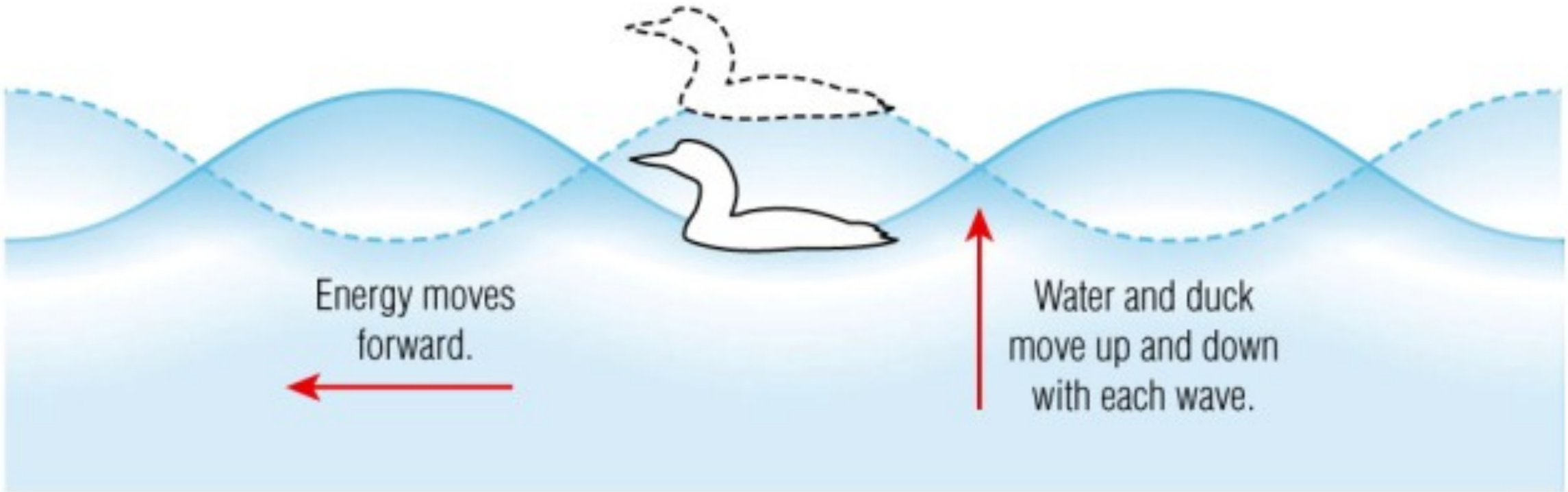

Figure 10.5 The duck moves up and down with the wave, but does not move forward or back as the wave passes beneath it.

* A wave is a disturbance that transfers energy from one point to another without transferring matter.

Optics

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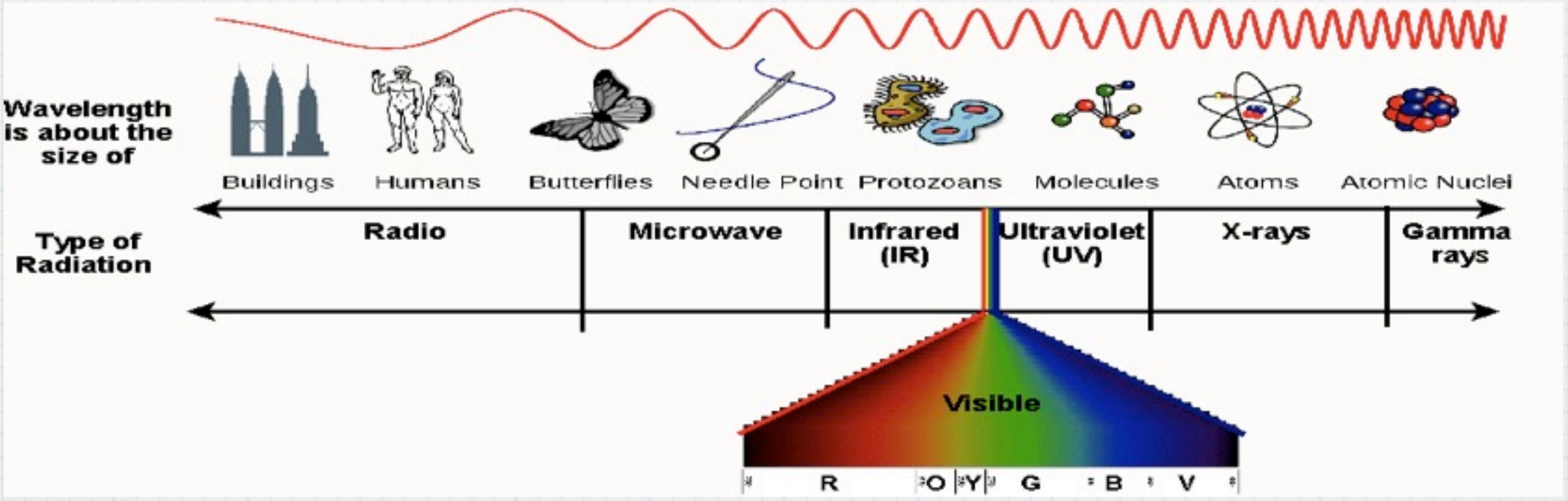

Optics

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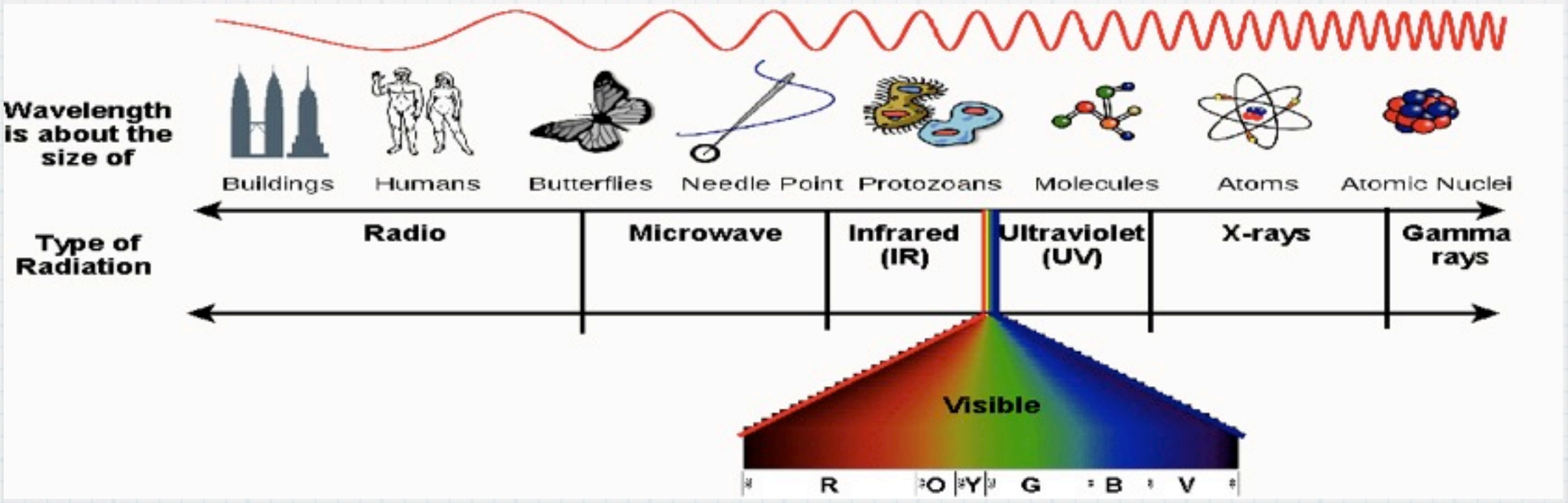


Speed of Light

* Lights travels extremely fast.
* The speed of light(c) is 3×10^8 m/s
* If you travelled this fast, you could run around the equator of the Earth 7.5 times.

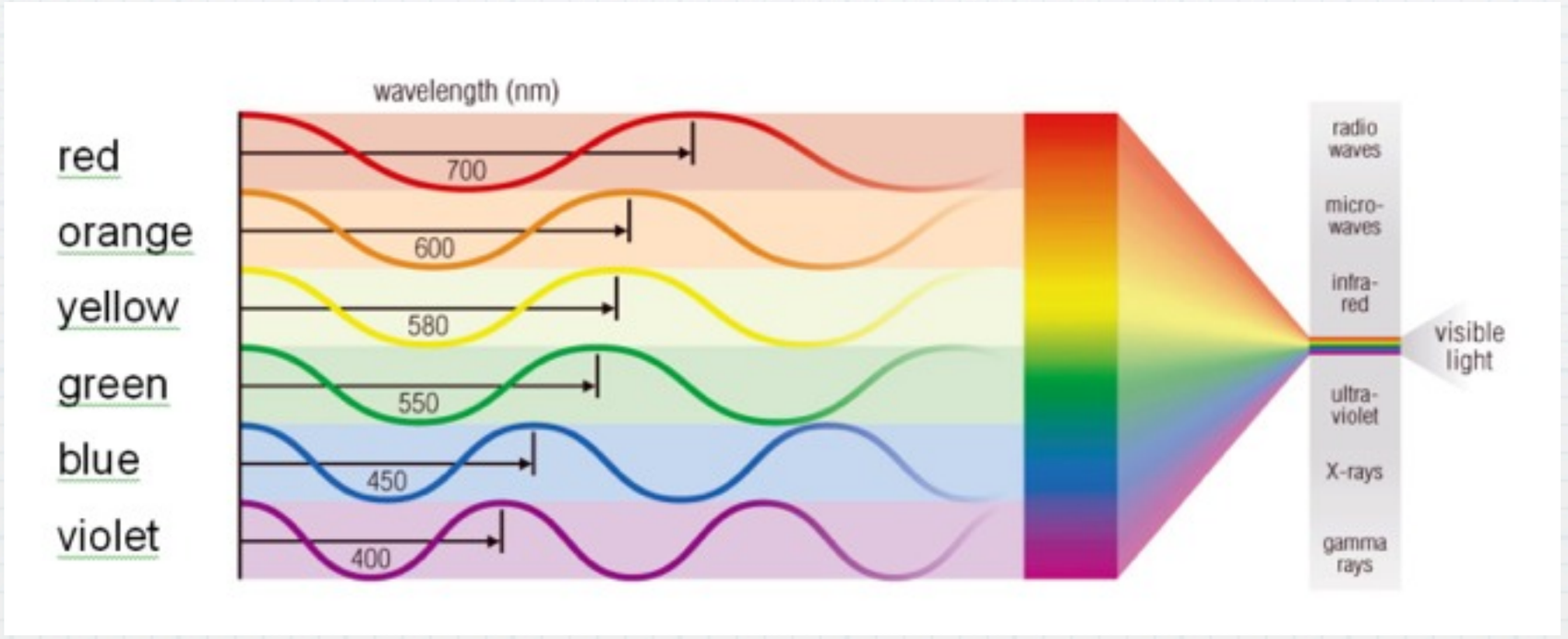
Colours

Colour

* White light is actually composed of a combination of many colours - all the colours of the rainbow.

Colours

* What distinguishes colours of light is the different wavelengths of light.



Colours

* These colours are called a SPECTRUM

* White light is made up of shades of Red, Orange, Yellow, Green, Blue, Indigo and Violet
* ROY G BIV is a mnemonic to help you remember the spectrum.

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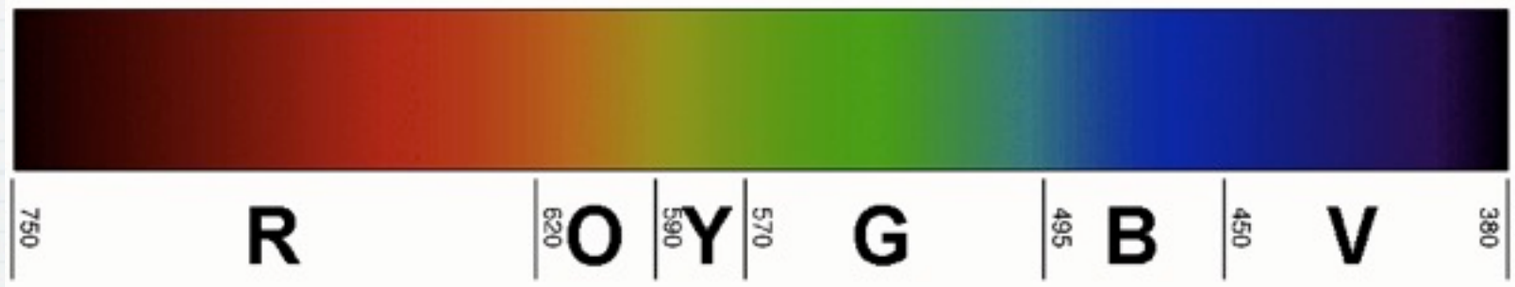

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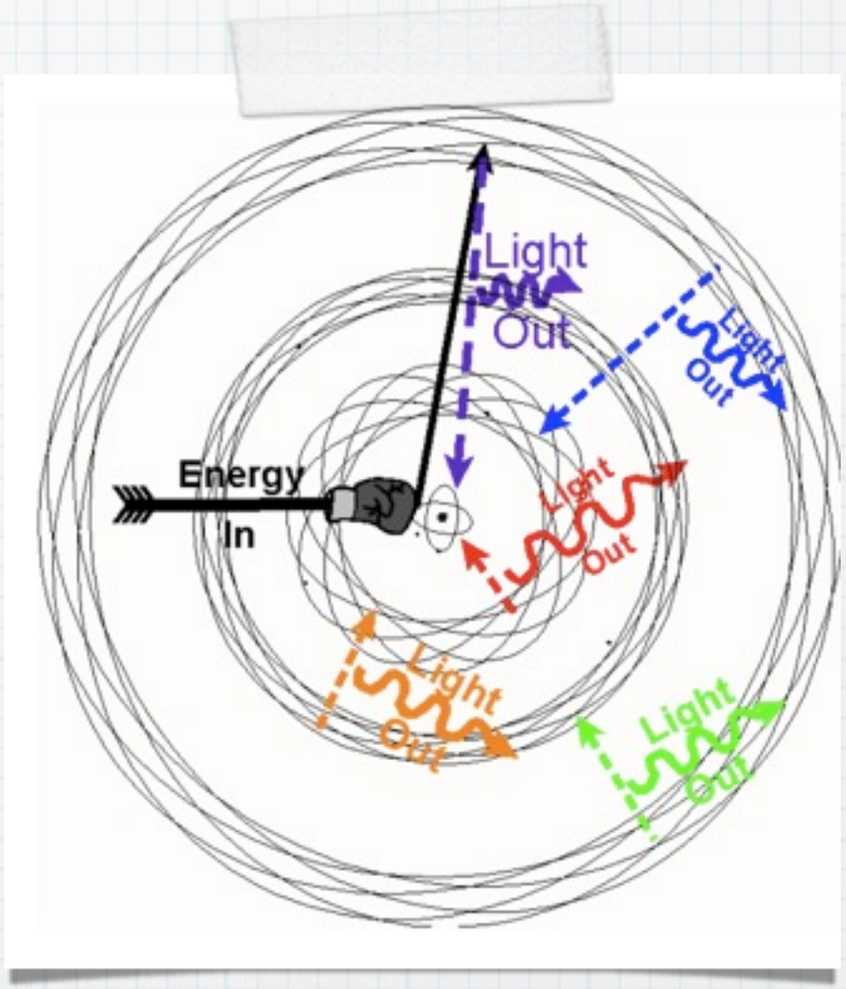
Colours

* Electrons in atoms can be excited to higher energy levels
* As these electrons fall back, they get rid of the excess energy they absorbed by emitting light.

Colours

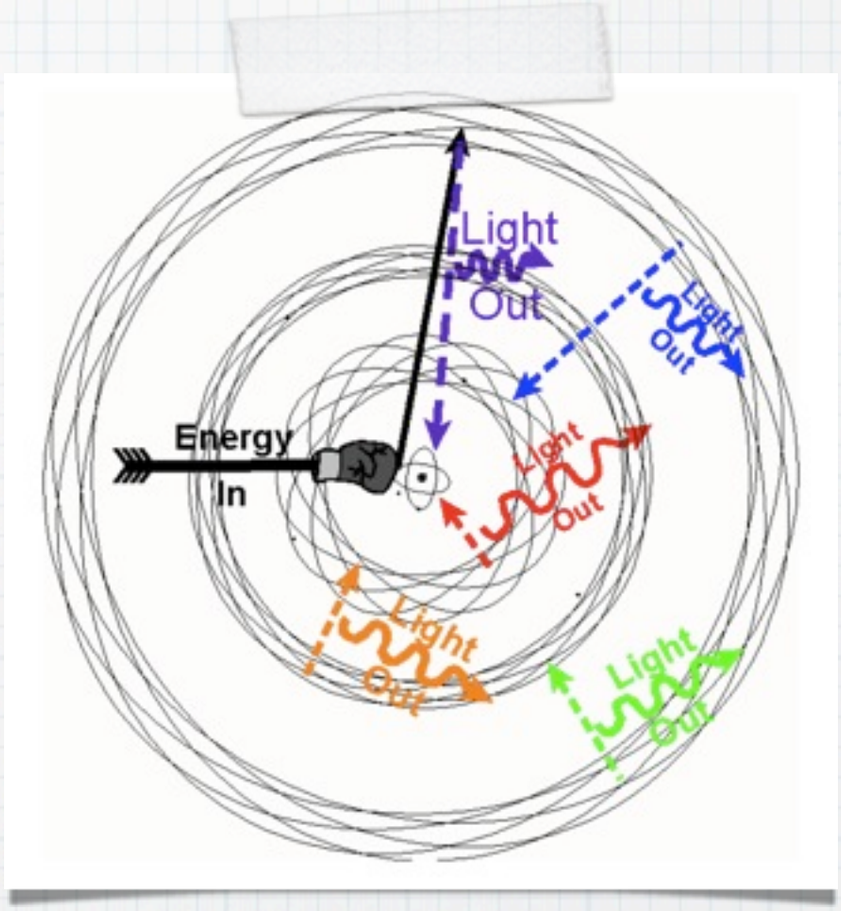
* There are a lot of different ways for electrons to fall back.

* Each way they can jump back down emits a different coloured line of light.



Colours

* Light is produced when electrons change energy levels.



Colours

* When a dog whistle is blown, can you hear it?

* Some sounds are at such a high frequency, we can't hear them.
* Our eyes can't "see" some of the electromagnetic spectrum

Colours

* Examples:
  * An iron emits Infared Radiation (which we can feel)
  * Microwave Radiation can be used to heat your food