



Captain Marvel and energy manipulation



How did Carol Danvers get her powers?

In her earliest comic book appearance, she is an officer in the United States Air Force and Security Chief of a restricted military base, where Danvers meets Dr. Walter Lawson, the human alias of alien Kree hero Mahr-Vel (known as Captain Marvel). In a later story, Danvers is caught in the explosion of a Kree device. Although, Captain Marvel manages to save her life, he transfers his powers to her in the process. She then adopts the mantle of Captain Marvel.

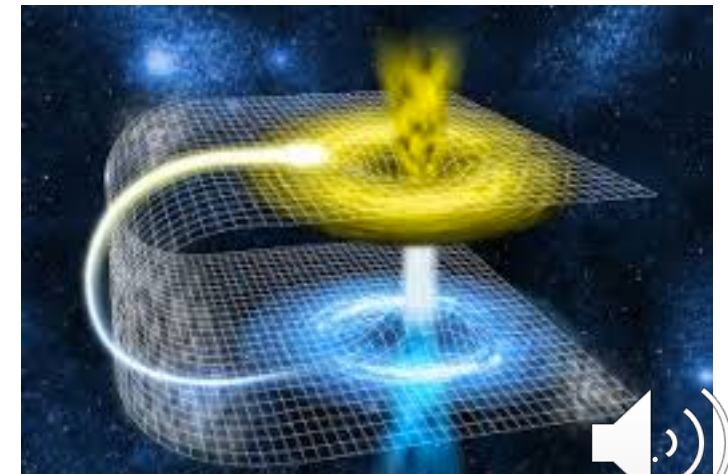
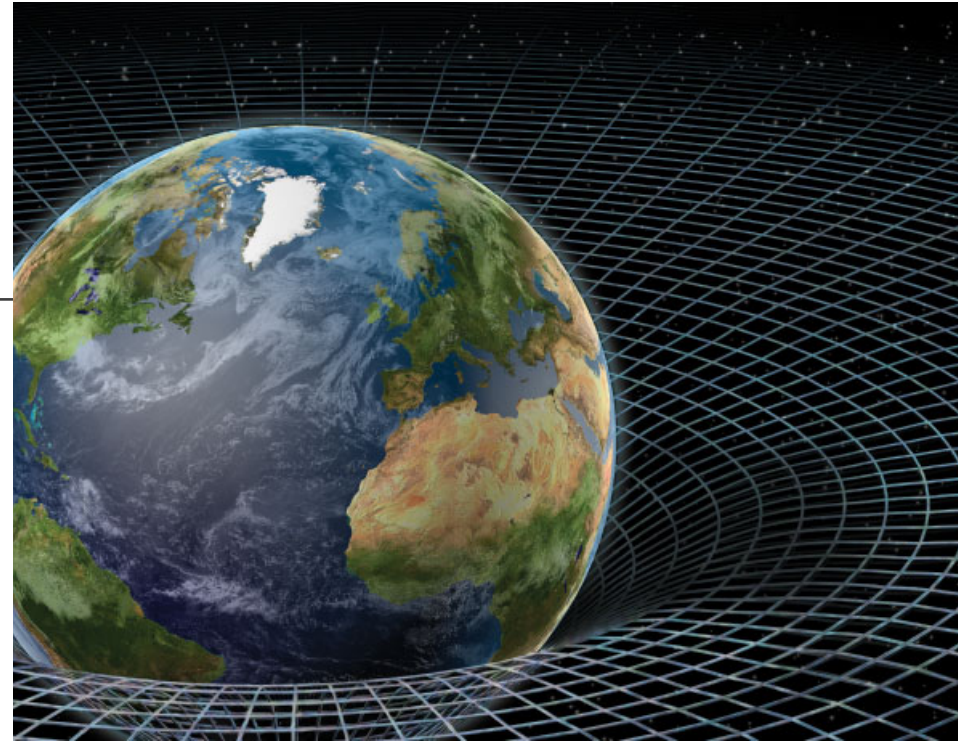


What are Captain Marvel's powers?

- Superhuman strength, agility and durability.
- The ability of supersonic flight.
- Power of energy manipulation and ability to generate heat, light and radiation.
- In some of the comics she has the power to control gravity and teleport. As well as the Power of Cosmic awareness.

Review: Gravitational Force

- The force that attracts a body towards the center of the earth, or towards any other physical body with mass.
- But gravity also can theoretically cause worm holes, allowing you to travel from one part of the universe to another.

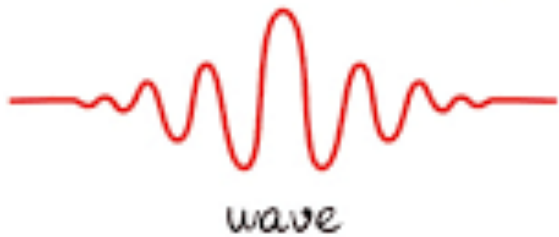




Energy Manipulation.

- What is energy?
- Energy, the capacity for a system to do work.
- Examples of energy are chemical energy from a battery, potential energy from gravity and kinetic energy from movement.
- But how is energy transferred?
- Most energy is transferred through light; this means if Captain Marvel can control light, she can control energy.

Wave-Particle Duality



$$c = 299\,792\,458 \text{ m/s}$$



particle

What is light?

- This is a problem that had puzzled scientists for years and years?
- Is it a particle or is it a wave?
- It turns out that you can think about light as being both, but we will start with waves!

Longitudinal propagation

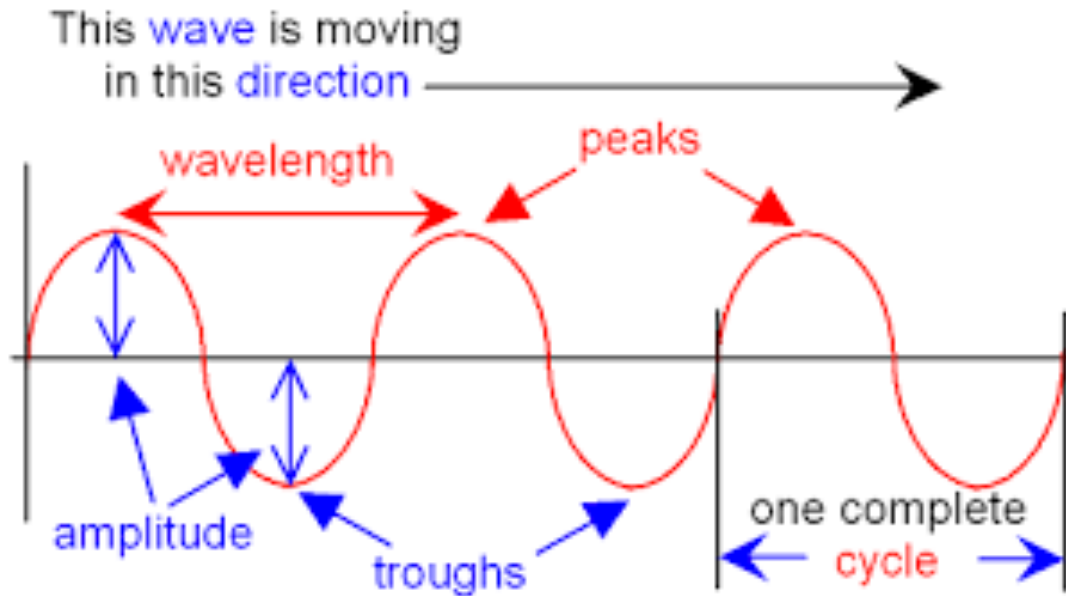


Transverse propagation

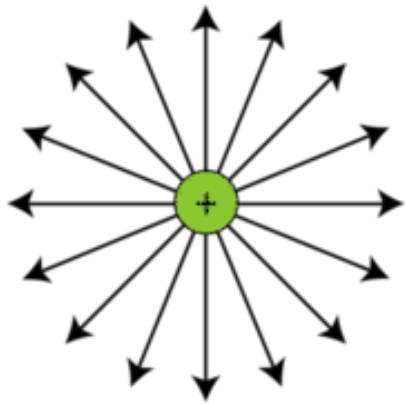
Waves

- Waves involve the transport of energy without the transport of matter.
- They come in two types, transverse and longitudinal.

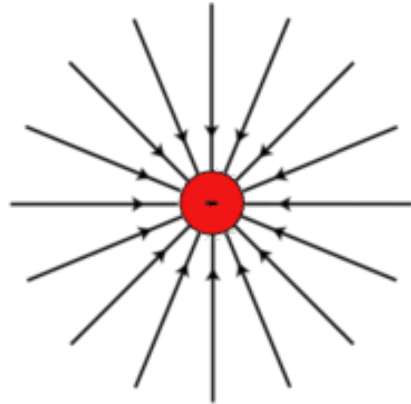
Properties of waves



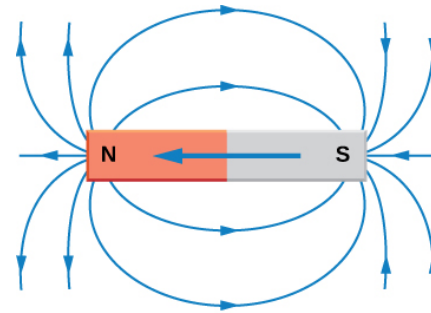
- Frequency is the number of complete waves passing a fixed point in a certain amount of time and it is measured in Hertz.
- The period is the amount of time it takes for a complete cycle, anything that repeats in cycles are called periodic. For example, the earth spins around, this is why we have daytime and nighttime. The period of the earth spinning is 24hrs.
- Wavelength is the distance between a point on a wave and the same point on the next wave.



Electric field lines of a positive point charge

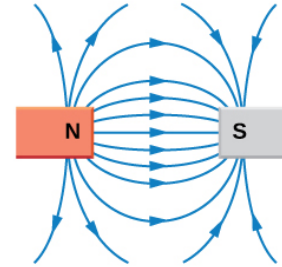


Electric field lines of a negative point charge



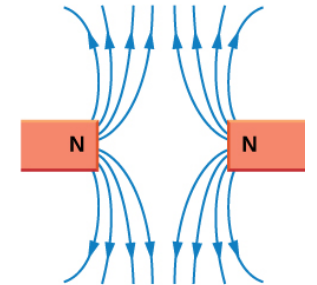
Magnetic field lines of a bar magnet

(a)



Magnetic field lines between unlike poles

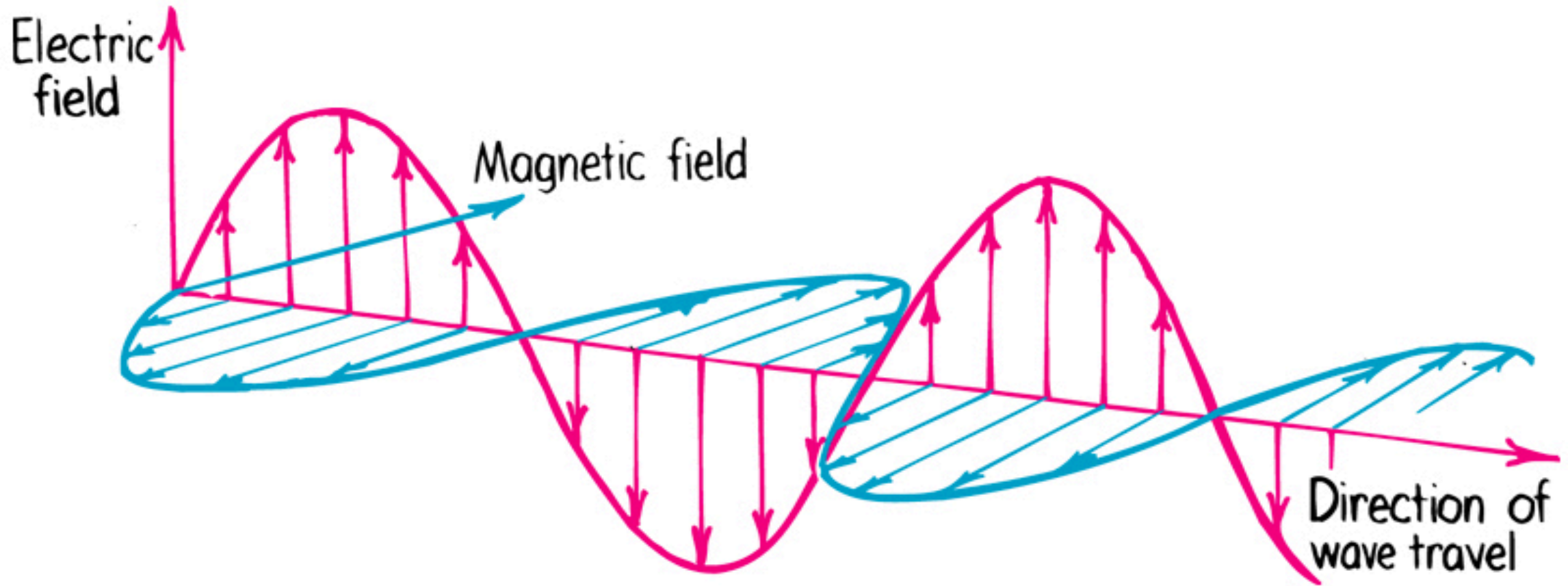
(b)



Magnetic field lines between like poles

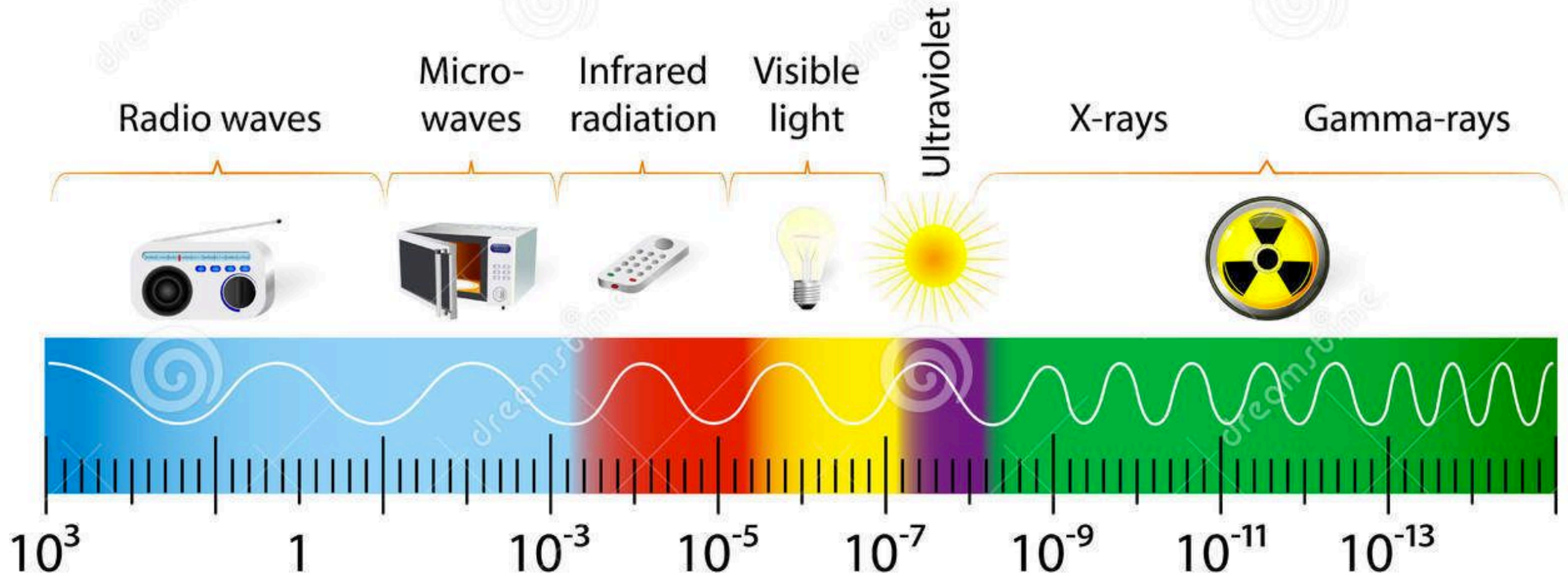
(c)

Recall that we have magnetic and electric fields.



Light as a wave is two transverse waves, one is an electric field and the other is a magnetic field

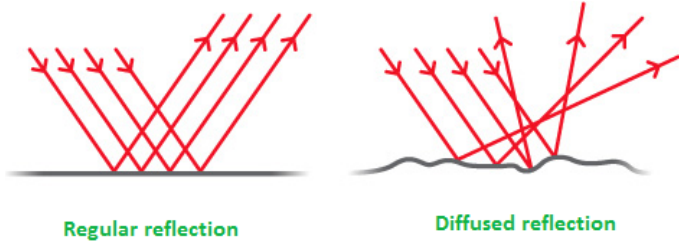
THE ELECTROMAGNETIC SPECTRUM



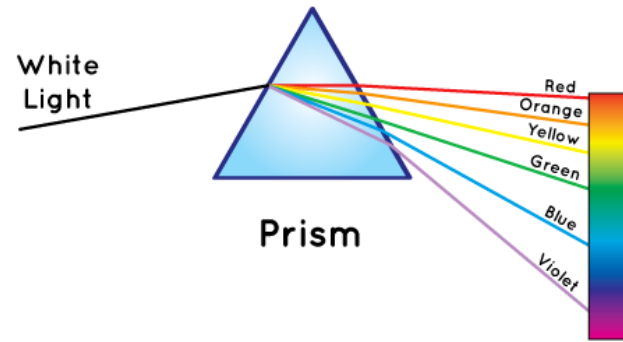
Electromagnetic radiation	Uses	
Radio waves	Broadcasting and communications – their longer wavelength means they travel further in the Earth's atmosphere, reflecting off hills and the upper atmosphere.	
Microwaves	Cooking food – microwaves are absorbed by water molecules causing them to vibrate (heat up). Satellite transmissions – their wavelength penetrates our atmosphere.	
Infrared	Heater and night vision equipment – all objects, including people, give out infrared rays which can be detected even at night. It's also used for television remote controls.	
Visible light	Human vision, photography and optical fibres – it's the only part of the spectrum we can see.	
Ultraviolet	Fluorescent lamps – they have chemicals inside them which absorb ultraviolet rays and convert the energy to visible light.	
X-rays	Medical equipment – they enable us to see the internal structure of objects and materials by passing through some substances (eg body tissue) but being absorbed by others (eg bone).	
Gamma rays	Sterilising food and medical equipment – they are highly penetrative and can kill.	

Uses of Electromagnetic Waves

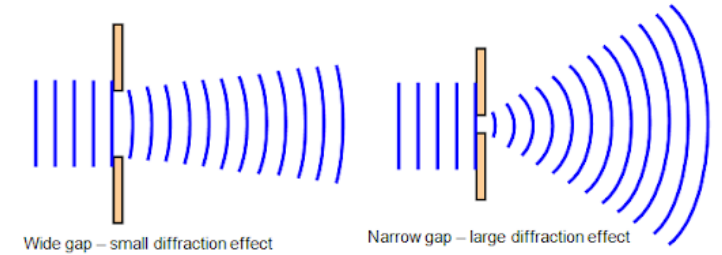
Reflection



Refraction

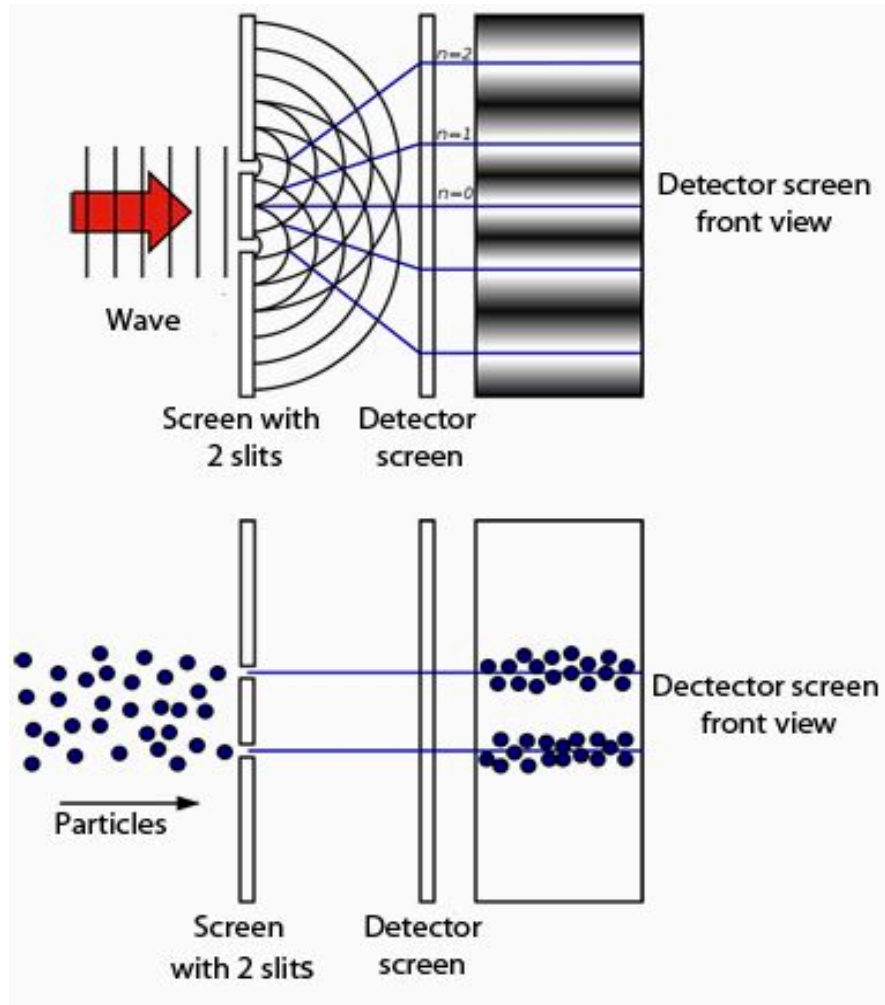


Diffraction



Properties of waves

The double slit experiment



So is light a wave or a particle?

The double slit experiment says it can be thought of as either, because depending on what way you measure it behaves like a particle or a wave.

Some videos to help

- Waves1: <https://www.youtube.com/watch?v=CVsdXKO9xlk>
- Waves 2: <https://www.youtube.com/watch?v=0Anh9HthWgQ>
- Light: <https://www.youtube.com/watch?v=IXxZRZxafEQ>
- Remember feel free to email me any questions.