

## P5: Light and the electromagnetic spectrum Knowledge Organiser

### Lesson sequence

1. Electromagnetic waves
2. Core practical - Investigating refraction (CP14)
3. The electromagnetic spectrum
4. Using the long wavelengths
5. Using the short wavelengths
6. Dangers of EM radiation

### 1. Electromagnetic waves

<b>*Electromagnetic waves</b>	Transverse waves that travel at the speed of light.
<b>*Speed of light</b>	300,000,000 m/s ( $3 \times 10^8$ m/s)
<b>*Frequency</b>	The number of waves that pass a point every second.
<b>*Wavelength</b>	The distance in m from the top of one wave to the top of the next.
<b>*EM wave similarities</b>	All are transverse, all travel at the speed of light.
<b>*EM wave differences</b>	Different frequencies, different wavelengths.
<b>*Visible light</b>	The only type of EM radiation that our eyes can detect.
<b>**Interface</b>	The boundary between two different materials.
<b>***Refraction and wave speed</b>	Light travels at different speeds in different materials causing it to refract when hitting the interface at an angle.
<b>***Prisms and the colour spectrum</b>	Different wavelengths slow down by different amounts when they hit glass causing each colour to refract differently.
<b>**Infrared discovery</b>	Light split into a spectrum. Thermometer placed on every colour plus next to red. Red was hot, next to red was hottest.

### 2. Core practical – Investigating refraction (CP14)

<b>**Angle of incidence</b>	Angle between the incident ray and the normal
<b>**Angle of refraction</b>	Angle between the refracted ray and the normal.
<b>*CP14 – Aim</b>	To explore how changing the angle of incidence changes the angle of refraction
<b>*CP14 - Setup</b>	Place a glass block on a sheet of paper, point a beam of light from a ray box at it, trace around the block and draw in the light ray.
<b>*CP14 - Measurement</b>	Use a protractor to draw a normal, then measure the angles of incidence and refraction.
<b>*CP14 - Variations</b>	Repeat 5 times, from 5 different angles, including head-on.
<b>*CP14 - Results</b>	The greater the angle of incidence, the greater the angle of refraction.

### 3. The electromagnetic spectrum

<b>*EM spectrum mnemonic</b>	<u>R</u> ubbish <u>M</u> emories <u>I</u> nclude <u>V</u> isiting <u>U</u> r <u>X</u> Girlfriend
<b>*EM spectrum – lowest to highest frequency or energy</b>	Radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, gamma rays
<b>*EM spectrum – lowest to highest wavelength</b>	Gamma rays, x-rays, ultraviolet, visible light, infrared, microwaves, radio waves
<b>*EM spectrum</b>	The full range of types of EM radiation.
<b>***EM Radiation and the atmosphere</b>	Some EM radiation (visible, radio) passes through the atmosphere, most is absorbed.
<b>***Space telescopes</b>	For radiation absorbed by the atmosphere, a telescope must be placed in space.

### 4. Using the long wavelengths

<b>*Visible light uses</b>	Illumination, photography
<b>*Infrared uses</b>	Short-range communications (TV remotes), fibre optics, cooking (grills and toasters), security cameras.
<b>*Microwave uses</b>	Microwave ovens, mobile phone and satellite communications.
<b>*Radio wave uses</b>	Radio and TV signals.
<b>***Producing radio waves</b>	Oscillating electricity in a metal rod produces radio waves.
<b>***Receiving radio waves</b>	Radio waves absorbed by a metal rod cause electrical oscillations.

### 5. Using the short wavelengths

<b>**Fluorescence</b>	Absorbing ultraviolet and re-emitting it as visible light.
<b>*Ultraviolet uses</b>	Fluorescent security inks, fluorescent light bulbs, sterilising water.
<b>*X-ray uses</b>	Hospital x-rays, baggage scanners.
<b>*Gamma ray uses</b>	Killing bacteria on food or surgical instruments, detecting and treating cancer.

### 6. EM radiation dangers

<b>**Infrared dangers</b>	Surface heating causing burns.
<b>**Microwave dangers</b>	Absorbed by water causing it to heat up → burns under the skin.
<b>**Ionisation</b>	High energy radiation causes ions to form in our cells, damaging DNA and causing cancer.
<b>*Ultraviolet dangers</b>	Skin cancer, snow blindness.
<b>*X-ray dangers</b>	Cancer
<b>*Gamma ray dangers</b>	Cancer