CHURCH STRETTON SCHOOL

# Combined Science - Physics

CP5 Knowledge organiser

## P5: Light and the electromagnetic spectrum

### 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 | |
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| ***Electromagnetic waves** | Transverse waves that travel at the speed of light. |
| ***Speed of light** | 300,000,000 m/s (3 x $10^8$ m/s) |
| ***Frequency** | The number of waves that pass a point every second. |
| ***Wavelength** | The distance in m from the top of one wave to the top of the next. |
| ***EM wave similarities** | All are transverse, all travel at the speed of light. |
| ***EM wave differences** | Different frequencies, different wavelengths. |
| ***Visible light** | The only type of EM radiation that our eyes can detect. |
| ****Interface** | The boundary between two different materials. |
| *****Refraction and wave speed** | Light travels at different speeds in different materials causing it to refract when hitting the interface at an angle. |
| *****Prisms and the colour spectrum** | Different wavelengths slow down by different amounts when they hit glass causing each colour to refract differently. |
| ****Infrared discovery** | 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) | |
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| ****Angle of incidence** | Angle between the incident ray and the normal |
| ****Angle of refraction** | Angle between the refracted ray and the normal. |
| ***CP14 – Aim** | To explore how changing the angle of incidence changes the angle of refraction |
| ***CP14 - Setup** | 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. |
| ***CP14 - Measurement** | Use a protractor to draw a normal, then measure the angles of incidence and refraction. |
| ***CP14 - Variations** | Repeat 5 times, from 5 different angles, including head-on. |
| ***CP14 - Results** | The greater the angle of incidence, the greater the angle of refraction. |

| 3. The electromagnetic spectrum | |
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| ***EM spectrum mnemonic** | **R**ubbish **M**emories **I**nclude **V**isiting **U**r **X** **G**irlfriend |
| ***EM spectrum – lowest to highest frequency or energy** | Radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, gamma rays |
| ***EM spectrum – lowest to highest wavelength** | Gamma rays, x-rays, ultraviolet, visible light, infrared, microwaves, radio waves |
| ***EM spectrum** | The full range of types of EM radiation. |

| *****EM Radiation and the atmosphere** | Some EM radiation (visible, radio) passes through the atmosphere, most is absorbed. |
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| *****Space telescopes** | For radiation absorbed by the atmosphere, a telescope must be placed in space. |

| 4. Using the long wavelengths | |
|---|---|
| ***Visible light uses** | Illumination, photography |
| ***Infrared uses** | Short-range communications (TV remotes), fibre optics, cooking (grills and toasters), security cameras. |
| ***Microwave uses** | Microwave ovens, mobile phone and satellite communications. |
| ***Radio wave uses** | Radio and TV signals. |
| *****Producing radio waves** | Oscillating electricity in a metal rod produces radio waves. |
| *****Receiving radio waves** | Radio waves absorbed by a metal rod cause electrical oscillations. |

| 5. Using the short wavelengths | |
|---|---|
| ****Fluorescence** | Absorbing ultraviolet and re-emitting it as visible light. |
| ***Ultraviolet uses** | Fluorescent security inks, fluorescent light bulbs, sterilising water. |
| ***X-ray uses** | Hospital x-rays, baggage scanners. |
| ***Gamma ray uses** | Killing bacteria on food or surgical instruments, detecting and treating cancer. |

| 6. EM radiation dangers | |
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| ****Infrared dangers** | Surface heating causing burns. |
| ****Microwave dangers** | Absorbed by water causing it to heat up → burns under the skin. |
| ****Ionisation** | High energy radiation causes ions to form in our cells, damaging DNA and causing cancer. |
| ***Ultraviolet dangers** | Skin cancer, snow blindness. |
| ***X-ray dangers** | Cancer |
| ***Gamma ray dangers** | Cancer |