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**Knowledge Rich Curriculum Plan**

Science – Physics

Year 12



| **Science****Year 12 Physics**  | **Unit: Electromagnetic Radiation and Quantum Phenomena** |  |  |
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| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Tiered Vocabulary**  | **Prior Knowledge:***In order to know this students, need to already know that…* |
| **Lesson:** **The Photoelectric Effect** | * Students will know that when light falls onto a metal plate it can release electrons from the surface
* Students will know that when the intensity of light falling onto the metal plate increases the number of electrons emitted increases.
* Students will know that the light has to be of sufficient frequency. If the frequency of light that falls on the metal plate is too low no electrons will be emitted
* Students will know that the photoelectric effect supports light travelling as photons.
* Students will know that the energy carried by a photon is given by the equations:

E = hf E = hc/lambda* Students will know that when a photon collides with an electorn in the metal it transfers energy to it, giving the electron enough energy to be removed from the metal and then fly off somewhere.
* Students will know how to apply the equation:

hf = (work function) + Ek* Students will know that the work function is the amount of energy required to just completely remove the electron from the surface of the metal
* Students will know that Ek represents kinetic energy
* Students will know that the threshold frequency \ (f0)is the minimum frequency that would release an electron from the surface of the metal
* Students will know that threshold frequency can be calculated using:

f0 = threshold frequency / h* Students will know that if kinetic energy of electrons against frequency is plotted as a graph (Ek y axis, f x axis):
* the gradient represents Planck's constant
* the y intercept represents the work function
 |  | * ***Students need to already know that photons are "packets" of electromagnetic waves***
* ***Students need to already know that ions are formed when electrons are lost or gained***
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| **Lesson:** **Collisions of Electrons with Atoms** | * Students will know that the Joule is too big to use on an atomic and nuclear scale, so the electronvolt (eV) is used instead
* Students will know that the electronvolt is defined as the energy gained by an electron of charge e, when it is accelerated through a potential difference of 1 volt.
* Students will know that 1 eV = 1.6 x 10^-19 J
* Students will know that electrons are found at distinct energy levels within an atom
* Students will know that for electrons can move up energy levels by gaining the exact amount of energy to make the transition. This energy can be from collisions with other electrons or absorbing a photon.
* Students will know that when electrons gain the exact amount of energy to move up an energy level this is referred to as "Excitation"
* Students will know that de-excitation is when an electron moves back down to its original energy level, releasing the exact amount of energy
* Students will know that ionisation refers to when electrons gain enough energy to be completely removed from the atom.
* Students will know that fluorescent tubes use excited electrons to produce light
* Students will know tthat fluorescent tubes work by:

1) they are filled with mercury vapour, across which a high voltage is applied. The high voltage accelerates fast moving free electrons that ionise some of the mercury atoms, producing more free electrons2) The flow of free electrons collide with electrons in other mercury atoms, exciting them to higher energy levels3) the excited electrons return to their ground state, emitting photons in the UV range4) The phosphor coating on the inside of the tube absorbs these photons, exciting its electrons to much higher orbits. These electrons then cascade down energy levels, emitting lower energy photons in the form of visible light | Electronvolt: energy gained by an electron of charge e, when its accelerated through a potential difference of 1 volt. | * ***Students need to already know that electrons orbit the nucleus of an atom***
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| **Lesson:** **Energy Levels and Photon Emission** | * Students will know that line spectra are evidence for discrete energy levels within atoms
* Students will know that light can be analysed by using a diffraction grating to split it into the colours that make it up.
* Students will know how to apply the following equation:

hf = E1 - E2* Students will know how to determine possible numbers of excitation/ de-excitation and related energies/ frequencies of photons that can be released during these transitions
 |  | * ***Students need to already know that 1 eV = 1.6 x 10^-19 J***
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| **Lesson:** **Wave-Particle Duality** | * Students will know that particles can display wave-like characteristics
* Students will know that electron diffraction suggests that particles possess wave properties and that the photoelectric effect suggests that electromagnetic waves have a particulate nature
* Students will know that the de Broglie wavelength is the wavelength a particle would have
* Students will know that de Broglie wavelength can be calculated using:

lambda = h / mv, where mv = momentum* Students will know that knowledge and understanding of the nature of matter changes over time
* Students will know that changes in understanding need to be evaluated through peer review and validated in the scientific community
 | de Broglie wavelength: the wavelength a particle would have when displaying wave characteristics | * ***Students need to already know that waves can behave as particles (photons)***
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