Meden School Curriculum Planning							
Subject	Physics	**Year Group**	12	**Sequence No.**	1	**Topic**	3.2 Particles and Radiation

Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
AQA GCSE Physics P4 atomic structure (protons, neutrons and electrons) Atomic symbols, mass number and atomic number. Isotopes, stable and unstable. Alpha, beta and gamma radiation. Atomic symbols Alpha and beta decay equations	**3.2.1.1 Constituent Parts of an Atom** Simple model of the atom, including the proton, neutron and electron. Charge and mass of the proton, neutron and electron in SI units and relative units. Specific charge of the proton and the electron, and of nuclei and ions. Proton number *Z*, nucleon number *A*, nuclide notation. Students should be familiar with the ^{A}X notation. Meaning of isotopes and the use of isotopic data. **3.2.1.2 Stable and Unstable Nuclei** The strong nuclear force; its role in keeping the nucleus stable; short-range attraction up to approximately 3 fm, very-short range repulsion closer than approximately 0.5 fm. Unstable nuclei; alpha and beta decay.	**Importance of Research** **Applications in daily life** Today, the tools of particle physics—the complex accelerators, the sensitive detectors, the grid computing, the high-volume data storage and analysis—are making a significant and lasting impact on quality of life for people around the globe.

	Equations for alpha decay, β^- decay including the need for the neutrino. The existence of the neutrino was hypothesised to account for conservation of energy in beta decay. **3.2.1.3 Particles, Antiparticles and photons** For every type of particle, there is a corresponding antiparticle. Comparison of particle and antiparticle masses, charge and rest energy in MeV. Students should know that the positron, antiproton, antineutron and antineutrino are the antiparticles of the electron, proton, neutron and neutrino respectively. Photon model of electromagnetic radiation, the Planck constant. $E=hf = \frac{hc}{\lambda}$ Knowledge of annihilation and pair production and the energies involved. The use of $E = mc^2$ is not required in calculations. **3.2.1.4 Particle Interactions** Four fundamental interactions: gravity, electromagnetic, weak nuclear, strong nuclear. (The strong nuclear force may be referred to as the strong interaction.) The concept of exchange particles to explain forces between elementary particles. Knowledge of the gluon, Z^0 and graviton will not be tested. The electromagnetic force; virtual photons as the exchange particle. The weak interaction limited to $\beta^-$and β^+ decay, electron capture and electron–proton collisions; W^+ and W^- as the exchange particles. Simple diagrams to represent the above reactions or interactions in terms of incoming	Over the decades, particle physics has developed the technologies needed to very accurately track particles as they collide and transform into hundreds of other particles. This same type of tracking is now essential for the computer tomography, MRIs and PET scans that allow a doctor to peer inside the human body to see what's wrong. **When promoting the value of their research or procuring funding, researchers often need to explain the significance of their work to the community — something that can be just as tricky as the research itself.** The hadron collider results show that **higher-energy collisions produce more particles per collision** and may reveal physics beyond the Standard Model The Large Hadron Collider has also discovered new subatomic particles, such as pentaquarks and tetraquarks, that are composed of

	and outgoing particles and exchange particles. **3.2.1.5 Classification of Particles** Hadrons are subject to the strong interaction. The two classes of hadrons: • baryons (proton, neutron) and antibaryons (antiproton and antineutron) • mesons (pion, kaon). Baryon number as a quantum number. Conservation of baryon number. Conservation of baryon number. The proton is the only stable baryon into which other baryons eventually decay. The pion as the exchange particle of the strong nuclear force. The kaon as a particle that can decay into pions. Leptons: electron, muon, neutrino (electron and muon types only) and their antiparticles. Lepton number as a quantum number; conservation of lepton number for muon leptons and for electron leptons. The muon as a particle that decays into an electron. Strange particles Strange particles as particles that are produced through the strong interaction and decay through the weak interaction (eg kaons). Strangeness (symbol s) as a quantum number to reflect the fact that strange particles are always created in pairs. Conservation of strangeness in strong interactions. Strangeness can change by 0, +1 or -1 in	five and four quarks respectively These findings help scientists understand the fundamental forces and matter in the universe.

	weak interactions. Appreciation that particle physics relies on the collaborative efforts of large teams of scientists and engineers to validate new knowledge. **3.2.1.6 Quarks and Antiquarks** Properties of quarks and antiquarks: charge, baryon number and strangeness. Combinations of quarks and antiquarks required for baryons (proton and neutron only), antibaryons (antiproton and antineutron only) and mesons (pion and kaon only). Only knowledge of up (u), down (d) and strange (s) quarks and their antiquarks will be tested. The decay of the neutron should be known. **3.2.1.7 Applications of Conservation Laws** Change of quark character in β^- and in β^+ decay. Application of the conservation laws for charge, baryon number, lepton number and strangeness to particle interactions. The necessary data will be provided in questions for particles outside those specified. Students should recognise that energy and momentum are conserved in interactions.	
