Meden School Curriculum Planning							
Subject	Physics	**Year Group**	10	**Sequence No.**	16	**Topic**	Atomic Structure

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!'
Y8: Atomic Structure Atoms can be sub divided into protons, neutrons and electrons. Protons have a charge of +1 and a mass of 1. Neutrons have a charge of 0 and a mass of 1. Electrons have a charge of -1 and a very small mass. Y8 Chemical tests Ions are atoms that have lost or gained an electron. Y9 History of the atom and periodic table The atomic number tells you the number of protons. The mass number tells you the number of protons + neutrons. JJ Thomson came up with the plum pudding model of the atom. The model of the atom that is accepted today is called the nuclear model. In this model	**L1: History of the Atom** New experimental evidence may lead to a scientific model being changed or replaced. Before the discovery of the **electron, atoms** were thought to be **tiny spheres** that could not be divided. The discovery of the electron led to the plum pudding model of the atom. The **plum pudding model** suggested that the atom is a **ball of positive charge** with **negative electrons** embedded in it. **L2: Alpha Scattering Experiment** The results from the **alpha particle scattering experiment** led to the conclusion that the mass of an atom was **concentrated at the centre (**nucleus) and that the nucleus was **charged**. This **nuclear model** replaced the plum pudding model. Niels Bohr adapted the nuclear model by suggesting that electrons o**rbit** the nucleus at specific distances. The theoretical calculations of Bohr agreed with experimental observations. Later experiments led to the idea that the positive charge of any nucleus could be subdivided into a whole number of smaller particles, each particle having the **same amount of positive charge**.The name **proton** was given to these particles. The experimental work of James Chadwick provided the evidence to show the existence of **neutrons** within the nucleus. This was about 20 years after the nucleus became an accepted scientific idea.	

most of the atom is empty space, with most of the mass concentrated in the centre in a positively charged nucleus.	**L3: Atomic Structure and Isotopes** Atoms are **very small**, having a radius of about **1×10^{-10} metres** The basic structure of an atom is a positively charged nucleus composed of both protons and neutrons surrounded by negatively charged electrons. The radius of a nucleus is less than 1/10 000 of the radius of an atom. Most of the mass of an atom is concentrated in the nucleus The electrons are arranged at different distances from the nucleus (different energy levels). The **electron arrangements** may change with the **absorption of electromagnetic radiation** (move further from the nucleus; a higher energy level) or by **the emission of electromagnetic radiation** (move closer to the nucleus; a lower energy level). In an atom the number of electrons is equal to the number of protons in the nucleus. Atoms have no overall electrical charge. All atoms of a particular element have the **same number of protons**. The number of protons in an atom of an element is called its **atomic number**. The total number of protons and neutrons in an atom is called its **mass number**. Atoms can be represented as shown in this example: (Mass number) (Atomic number) $^{23}_{11}\text{Na}$ Atoms of the same element can have **different numbers of neutrons**; these atoms are called **isotopes** of that element. Atoms turn into **positive ions** if they **lose** one or more outer electron(s). **L4**: Alpha, Beta and Gamma Radiation Some **atomic nuclei** are **unstable**. The nucleus gives out **radiation** as it changes to become more **stable**. This is a random process called **radioactive decay**. **Activity** is the rate at which a source of unstable nuclei decays. Activity is measured in **becquerel (Bq**)	Radiation has many real world applications. Alpha particles are used in smoke detectors. Beta particles can show doctors were a blood clot is forming, as well as detecting cracks in structures or piping. Gamma rays are used for sterilising medical equipment (there is another opportunity to emphasize this use in lesson 8)

	Count-rate is the number of decays recorded each second by a detector (eg Geiger-Muller tube). The nuclear radiation emitted may be: • an **alpha particle (α)** – this consists of two neutrons and two protons, it is the same as a helium nucleus • a **beta particle (β)** – a high speed electron ejected from the nucleus as a neutron turns into a proton • a **gamma ray (γ)** – electromagnetic radiation from the nucleus • a **neutron (n).** The properties of alpha particles, beta particles and gamma rays is limited to their **penetration** through materials, their **range** in air and **ionising power**. **L5: Activity and Half-life** Radioactive decay is **random.** The **half-life** of a radioactive isotope is the **time** it takes for the **number of nuclei** of the **isotope** in a sample **to halve**, or the time it takes for the **count rate** (or activity) from a sample containing the isotope to fall to **half its initial level**. Determine the half-life of a radioactive isotope from given information. Higher only: Calculate the net **decline**, expressed as a ratio, in a radioactive emission after a given number of half-lives. Calculations of half-lives from data and graphs Higher only: Use of **tangents** to half-life decay curves to find rate at given time **L6: Nuclear equations** In a nuclear equation an alpha particle may be represented by the symbol: $^{4}_{2}He$ and a beta particle by the symbol:	Misconception that radiation will eventually go away, however with always be there due to activity can only halve. Opportunity to link in Fukushima or Chernobyl and ask

	$^{0}_{-1}e$ The **emission** of the different types of nuclear radiation may cause a change in **the mass** and /or the **charge** of the nucleus. For example: $^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$ So alpha decay causes both the mass and charge of the nucleus to decrease. $^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$ So beta decay does not cause the mass of the nucleus to change but does cause the charge of the nucleus to increase. Use the names and symbols of common nuclei and particles to write balanced equations that show single alpha (α) and beta (β) decay. This is limited to balancing the atomic numbers and mass numbers. The identification of daughter elements from such decays is not required. The emission of a gamma ray **does not** cause the mass or the charge of the nucleus to change. **L7: Irradiation and Contamination** Radioactive **contamination** is the unwanted presence of materials containing radioactive atoms on other materials. **The hazard** from contamination is due to the decay of the **contaminating atoms**. Thetype of radiation emitted affects the level of hazard. **Irradiation** is the process of exposing an object to nuclear radiation.The **irradiated object** does not become radioactive. Compare the hazards associated with contamination and irradiation. Suitable precautions must be taken to protect against any hazard that the radioactive source used in the process of irradiation may present. It it is important for the findings of studies into the effects of radiation on humans to be published and shared with other scientists so that the findings can be checked by peer review.	will these areas ever be safe to inhabit again. Radiotherapy is an example of irradiation – you don't become contaminated after undergoing the treatment. Careers where you have to be mindful of irradiation and contamination include: radiographer, nuclear power station worker and physics teacher!!

	L8: Background Radiation **Background radiation** is around us all of the time. It comes from: • natural sources such as rocks and **cosmic rays** from space • man-made sources such as the fallout from nuclear weapons testing and nuclear accidents. The level of background radiation and **radiation dose** may be affected by occupation and/or location. Radiation dose is measured in **sieverts** (Sv) 1000 **millisieverts** (mSv) = 1 sievert (Sv) **L9: Risks and Uses** **Radioactive isotopes** have a very wide range of half-life values. Students should be able to explain why the hazards associated with radioactive material differ according to the half-life involved. Nuclear radiations are used in medicine for the: • exploration of internal organs • control or destruction of unwanted tissue. Students should be able to: describe and evaluate the uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue evaluate the perceived risks of using nuclear radiations in relation to given data and consequences. **L10 Nuclear Fission** **Nuclear fission** is the splitting of a large and unstable nucleus (eg uranium or plutonium). Spontaneous fission is rare. Usually, for fission to occur the unstable nucleus must first absorb a **neutron.** The nucleus undergoing fission splits into two **smaller nuclei**, roughly equal in size, and emits **two or three neutrons** plus **gamma rays**. Energy is released by the fission reaction. All of the fission products have **kinetic energy.** The neutrons may go on to start a **chain reaction.** The chain reaction is controlled in a **nuclear reactor** to control the energy released. The explosion caused by a nuclear weapon is caused by an uncontrolled chain reaction. **L11 Nuclear Fusion**	

	Nuclear fusion is the joining of **two light nuclei** to form a **heavier nucleus**. In this process some of the mass may be converted into the energy of radiation. **L12 Revision** **L13 EOTT** **L14 GPA and topic review**	