Meden School Curriculum Planning							
Subject	Chemistry	**Year Group**	10	**Sequence No.**	14	**Topic**	C1 Atomic structure and the Periodic table C8 Chemical analysis

Retrieval	Core Knowledge	Student Thinking
What do teachers need to **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!'
KS3 Year 7: Separating mixtures topic and Year 8 Atomic structure topic. Students learn the difference between an atom, molecule, element and a compound. They learn about what an atom consists of and how to read the nuclear symbol of an element on the periodic table.	**L1: Atoms.** (Recap) The smallest unit of matter, it makes up everything else. They have a radius of 0.1 nanometer. An element is a substance that only contains one type of atom. A compound is a substance with two or more elements chemically bonded together. A mixture is a substance with more than 1 type of element/compound. They are **not chemically joined**. The atom consists of three smaller particles (**sub-atomic particles**) called **protons, neutrons and electrons**. The electrons have a negative charge and can be found in shells around the edge of an atom. The **nucleus**, which is in the centre of the atom contains two types of sub-atomic particles, the **protons** which are positively charged and the **neutrons** which have no charge, they are neutral. Two important properties that we use to describe these sub-atomic particles are **mass and charge**. Protons have a charge of +1 and a mass of 1. Electrons have a charge of -1 and a mass which is described as 'very small' and neutrons which have a charge of 0 and a mass of 1. In an atom of a particular element, there are always the same number of protons, this never changes. The numbers of protons, neutron and electrons in an atom can be found on an elements nuclear symbol on the periodic table. The **atomic number** (bottom number) is the number of protons. The number of neutrons can be found from the **mass number** (top number) which tells us the number of protons and neutrons. To find the number of neutrons, mass number – atomic number. **L2: Balancing equations.** When chemical reactions occur, both symbol and word equations can be written. In a symbol equation, there must always be the same number of atoms of each element on both sides of an equation.	L1: It is thought that the concept of the atom was originally conceived by the Greek philosopher *Leucippus* during the early part of the fifth century BCE, although it is often accredited to his pupil *Democritus*. It would be hundreds of years, however, before these ideas could be backed up by experimental data.

	L3: Isotopes. Isotopes are different forms of the same element. They have the same number of protons (therefore the same atomic number) but a different number of neutrons (different mass number). When an element has more than one isotope, the term relative atomic mass, A_r, is used as it is an average mass taking into the account the different isotopes and their abundances. To calculate the relative atomic mass of an element, the following formula is used: Relative atomic mass (A_r) = $\frac{\text{sum of (isotope abundance x isotope mass number)}}{\text{Sum of abundances of all the isotopes}}$	
KS3 Year 9: History of the atom and periodic table topic. Students learn the different models of the atom and what we now understand the atom to consist of.	**L4: History of the atom.** What scientists believe an atom consists of has changed over time and there are a few notable scientists who had theories that were accepted for long periods of time. John Dalton stated that atoms were **solid spheres** and that different spheres made up the **different elements**. **JJ Thomson** came to the conclusion that the atom could no longer be a solid sphere from his experiments, the atom must also contain **small, negatively charged particles** and the positive charge is spread throughout. He called this model the **'Plum pudding model'**. **Ernest Rutherford and Ernest Marsden** came up with the **'Nuclear model'**, they fired positive alpha particles at a thin sheet of gold. They expected most of the particles to pass straight through, the majority did but some were deflected or reflected backwards. They came to the conclusion that an atom is **mostly empty space** with most of the **mass concentrated at the centre** in a **positively charged nucleus**. They said that electrons surrounded the nucleus in a **'cloud'**. **Niels Bohr** proposed a slightly modified version of the nuclear model, **'Bohr's nuclear model'** where he decided that if the electrons were in a 'cloud' around the nucleus then the atom would collapse because of the attraction to the positive nucleus. The electrons must be in **shells at fixed distances from the nucleus**. After further experiments, Rutherford concluded that the nucleus could be divided into smaller particles each of which had the same charge as a hydrogen nuclei, these were referred to as **protons.** James **Chadwick** later discovered neutrons.	L4: The first person in recorded history to discover a new element was Hennig Brand, a bankrupt German merchant. Brand tried to discover the philosopher's stone—a mythical object that was supposed to turn inexpensive base metals into gold.
KS3 Year 8: Periodic table topic. Students learn how to write electronic structures for the first 20 elements.	**L5: Electronic structure.** Electrons are arranged in shells in an atom. The maximum number of electrons that can be placed in the first shell (closest to the nucleus) is two, the maximum number of electrons that can be placed in both the second and third shell is eight. The first shell is always filled first, then the second and then the third. To show the electronic structure of an element, it can be drawn showing the position of the electrons and it can also be written numerically. For example, sodium has the electronic structure of 2,8,1. Two electrons in the first shell, eight in the second shell and one electron in the third shell.	
KS3 Year 9: History of the atom and periodic table topic. Students learn the history of the periodic table including the	**L6: The periodic table.** Our periodic table is based on the work of **Dmitri Mendeleev**, a Russian scientist who is known as **father of the periodic table**. Mendeleev left **gaps** in his table as he thought these were **undiscovered elements**. In his table, there were 8 groups ordered by atomic mass and similar properties.	L6: From a chemistry point of view, very little is mentioned about a few scientists who had a hand in what we now know as

contributions of Henry Moseley, Johann Dobereiner and Antoine Lavoisier, John Newland and Dmitri Mendeleev. Students also learn about how the modern periodic table is organised, in rows and columns. **KS3 Year 8: Periodic table topic.** Students learn how to relate group number with the number of outer electrons. **KS3 Year 8: Atomic structure topic.** Students learn the different names of groups 1, 7 and 0. **KS3 Year 8: Periodic table topic.** Students learn about the different groups and the properties they have.	He also had multiple elements in one box however he would swap elements in order for their properties to fit better in another group. For the gaps, he **predicted the properties** of these missing elements and these predictions made his table more widely accepted later when elements were discovered which had matching properties to his predictions. The discovery of isotopes in the early 20th century also confirmed that Mendeleev was correct not to place elements in a strict order of atomic mass but also consider their properties. In the modern periodic table, the two types of elements, **metals and non-metals** have been grouped in **vertical columns called groups**. These groups have **similar chemical properties**. The **horizontal rows** are called **periods**. The group number tells us how many electrons are in the outer shell and the period number tells us how many shells of electrons there are. **L7: Metals and non-metals.** Metals form positive ions when they react, they are found on the left-hand side of the periodic table. The elements in the centre of the periodic table are called the transition metals. Metals form positive ions when they lose the outer electrons, the electrons feel a weak attraction to the nucleus. Non-metals are found on the right-hand side of the periodic table. They either form negative ions in ionic compounds or bond covalently with other non-metals. Metals have similar physical properties to each other. They are strong but malleable (can be bent or hammered into different shapes). They are good conductors of heat and electricity and tend to be solids at room temperature as they have high melting and boiling points. Non-metals tend to be dull looking and brittle, have lower melting and boiling points than metals and don't generally conduct electricity. They also tend to have lower densities than metals. **L8: Group 1.** Group 1 metals are called the alkali metals. All group 1 elements have one electron in their outer shell. Group 1 elements are very reactive. This is because when they react with water, they produce alkaline solutions. The general formula for the reaction between alkali metals and water is: alkali metal + water → metal hydroxide + hydrogen. As you go down group 1, the elements get more reactive. This is because as you get further down the group, the outer electron gets further from the positive nucleus meaning a weaker attraction and is therefore more easily lost. Group 1 elements have similar properties, the first three are all less dense than water. As you go down the group, the melting and boiling points decrease and the relative atomic mass increases. When group 1 elements react with non-metals, they form ionic compounds which are usually white solids that dissolve in water to form colourless solutions. When group 1 elements are heated and react with chlorine gas, they react vigorously and produce a metal chloride. Alkali metal + chlorine → metal chloride. As you go down the group the reaction becomes more vigorous. Group 1 elements also react with oxygen to form a metal oxide. Lithium will form lithium oxide, sodium will form a mixture of sodium oxide and sodium peroxide and potassium will form a mixture of potassium peroxide and potassium superoxide.	the periodic table. A French geology professor, Alexandre Béguyer de Chancourtois, made a significant advance towards it, even though at the time few people were aware of it. He was the first to use a periodic arrangement of all the known elements, showing that similar elements appear at periodic atom weights. Henry Moseley provided a definitive way of identifying new elements based on measurements of X-ray frequencies. Mendeleev gets credit for 'discovering' the periodic table but the inspiration and data used came from Amedeo Avogadro, Johann Wolfgang Dobereiner and Stanislao Cannizzaro. Newland, another scientist who is credited with an earlier periodic table also predicted the existence of other elements but this does not get taught, more emphasis is placed on Mendeleev predicting the existence of other elements.

	L9: Group 7. Group 7 elements are called the halogens. They exist as diatomic molecules which means the atoms are in pairs. All group 7 elements have seven electrons in their outer shell. As you go down group 7, the elements get less reactive. This is because as you get further down the group, the outer electron gets further from the positive nucleus meaning a weaker attraction to attract an electron to the atom and it is therefore harder to gain an electron. As you go down the group, the melting and boiling points increase as well as the relative atomic mass. When group 7 elements react with other non-metals, they share electrons to form a full outer shell, these compounds all have simple molecular structures. When group 7 elements react with metals, they form ionic compounds and form halide ions. Group 7 elements also take part in displacement reactions. **L10: Group 0.** Group 0 elements are called the Noble gases. They are very unreactive due to the fact they all have a full outer shell. Helium, at the top of the group only has 2 electrons which fills the first shell where as the others below all have eight electrons in their outer shell. Noble gases are very stable elements, they don't need to give up or gain electrons to have the full outer shell. This leads them to being inert. As you go down the group, the relative atomic mass increase as well as the boiling points. As you go down the group, more energy is needed to overcome the intermolecular forces between the atoms leading to the increase in boiling points.	
KS2 Years 5/6: Separating mixtures. Different processes can be used to separate mixtures such as filtering, sieving, dissolving and evaporation. **KS3 Year 7: States of matter topic.** Evaporation, condensation, filtration and boiling points are covered in this topic. **KS3 Year 7: Separating mixtures topic.** Students learn about filtration, evaporation, distillation and chromatography.	**L11: Separation techniques.** A mixture can be separated using chromatography, filtration, crystallisation, simple distillation and fractional distillation. Chromatography (also covered later) can be used to separate mixtures made up of liquids of different colours. Filtration is used to separate an insoluble solid from a liquid reaction mixture. If the solid is soluble, evaporation and crystallisation are used. Evaporation can be used if the salt doesn't break down when it is heated. If it does break down, crystallisation is used instead. Distillation is used to separate mixtures that include a liquid. Simple distillation can be used to separate substances that have very different boiling points where as fractional distillation is used when the boiling points of the liquids are close together. **L12: Purity.** A pure substance in chemistry is one which only contains one compound or element throughout where as in everyday life, pure means that nothing has been added to it. To test for purity, a pure substance will melt or boil at a specific temperature. If a substance is impure, it could boil or melt over a range of temperatures. An impure substance will melt at a lower melting point or boil at an increased boiling point. **L13: Mixtures and formulations.** A mixture is a substance with more than 1 type of element/compound. They are **not chemically joined**. A mixture can be easily separated by physical methods. The properties of a mixture are a mixture of the properties of the separate parts. A formulation is a useful mixture with a	L11: Separation techniques are used all around us in various fields. They are used for such essential chores as removal of contaminants from raw materials, recovery and purification of primary products, and elimination of contaminants from effluent water and air streams. Mixtures are used in many processes, including steel manufacturing, the chemical industry and many others. Filtration is used in our cars (pollen filters), in our houses (filter dust and mites out of the air we breathe). We have all been wearing masks during the pandemic to filter out covid particles. Fractional distillation is used to separate out the different fractions from crude oil, this is

	precise purpose that is made by following a formula. Examples include paint, fuels, pharmaceutical drugs, fertilisers and food.	how we get petrol, diesel, kerosene for our cars, lorries and aeroplanes.
KS3 Year 7: Separating mixtures topic. Students are introduced to the basics of chromatography and key terms such as mobile and stationary phase. Students also learn that a pure substance will be represented by a single spot on a chromatogram.	**L14/L15: Chromatography (required practical).** In chromatography, there are two phases; a mobile phase and a stationary phase. During chromatography, the substances in the sample constantly move between the mobile phase and the stationary phase. They different components separate depending on their affinity for either the mobile phase or stationary phase. The amount of time each component spends in each phase depends on how soluble it is in the solvent and how attracted it is to the paper. A pure substance will only form one spot on the resulting chromatogram. Each substance on a chromatogram has an individual Rf value. This will change for each substance depending on the solvent it is in. To determine the identity of a substance, the R_f of an unknown sample needs to be compared to known reference substances. The formula needed to calculate R_f values is: $R_f \text{ value} = \frac{\text{Distance travelled by substance}}{\text{Distance travelled by solvent}}$	L14/L15: Chromatography is routinely used to identify and compare samples of drugs, explosives, inks and biological samples such as saliva, urine, blood and others.
KS3 Year 8: Chemical tests. Students learn the tests for oxygen, chlorine and hydrogen.	**L16: Gas tests.** To test for chlorine, damp litmus paper is bleached white. To test for hydrogen a lit splint will make a 'squeaky pop' at the end of a test tube containing hydrogen gas. To test for oxygen, a glowing splint will relight. If carbon dioxide is present, bubbling through limewater (calcium hydroxide) will turn the solution cloudy. This is due to the formation of solid calcium carbonate. **L17: Revision** **L18: EOTT** **L19: GPA**	