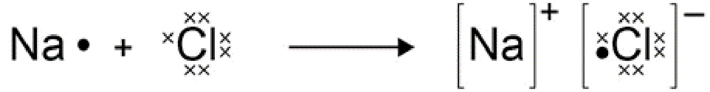
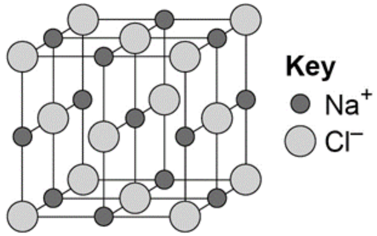
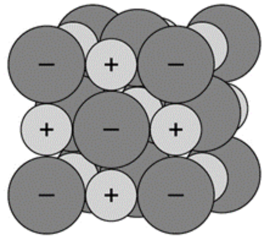
Meden School Curriculum Planning							
Subject	Chemistry	**Year Group**	10	**Sequence No.**	15	**Topic**	C2 Structure and Bonding

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!'
Y7 Physical and Chemical Change: Concept of chemical reactions re-arranging atoms. **Y8 Reactions of metals.** Metals reacting with non-metals to form compounds. **Y9 Periodic Table** introduced the electronic configuration of noble gases and the concept of a full outer-shell **Y8 Atomic structure** introduced electrons **Y8 Atomic Structure** introduced the concept of ions being charged particles. **Y9 History of the Atom and periodic table**, revisited atomic structure **Y9 History of the atom and periodic table,** where to find metals and non-metals on the periodic table **Y9 Trends on the periodic table**, introduced electronic configuration and the concept of shells. **Y9 Trends on the periodic tabl**e how ions are formed linked to electronic configuration and the loss or gain of electrons.	**L1 Chemical Bonds (5.2.1.1)** There are three types of strong **chemical bonds**: **ionic, covalent** and **metallic**. For ionic bonding the particles are **oppositely charged ions.** For covalent bonding the particles are atoms which **share pairs of electrons**. For metallic bonding the particles are atoms which share **delocalised electrons.** Ionic bonding occurs in compounds formed from metals combined with non-metals. Covalent bonding occurs in most non-metallic elements and in compounds of non-metals. Metallic bonding occurs in metallic elements and alloys. **L2 Ionic Bonding (5.2.1.2)** When a metal atom reacts with a non-metal atom electrons in the **outer shell** of the metal atom are transferred. Metal atoms lose electrons to become positively charged ions. Non-metal atoms gain electrons to become negatively charged ions. The ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 have the electronic structure of a **noble gas** (Group 0). The electron transfer during the formation of an ionic compound can be represented by a dot and cross diagram, eg for sodium chloride  (2,8,1) (2,8,7) (2,8) (2,8,8) Students should be able to draw dot and cross diagrams for ionic compounds formed by metals in Groups 1 and 2 with non-metals in Groups 6 and 7. The charge on the ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 relates to the group number of the element in the periodic table. Students should be able to work out the charge on the ions of metals and non-metals from the group number of the element, limited to the metals in Groups 1 and 2, and non-metals in Groups 6 and 7.	Chemists use theories of structure and bonding to explain the physical and chemical properties of materials. Analysis of structures shows that atoms can be arranged in a variety of ways, some of which are molecular while others are giant structures. Theories of bonding explain how atoms are held together in these structures. Scientists use this knowledge of structure and bonding to engineer new materials with desirable properties. The properties of these materials may offer new applications in a range of different technologies.

L3 Ionic Compounds (5.2.1.3) An ionic compound is a giant structure of ions. Ionic compounds are held together by strong **electrostatic forces** of attraction between oppositely charged ions. These forces act in all directions in the **lattice** and this is called ionic bonding.
The structure of sodium chloride can be represented in the following forms:



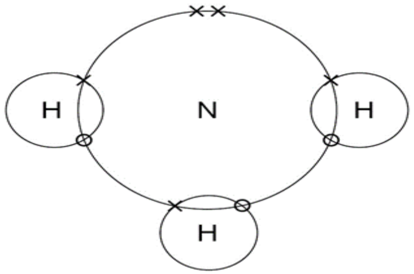
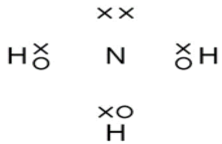
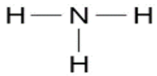
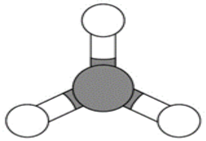
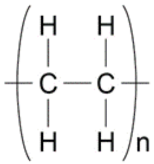


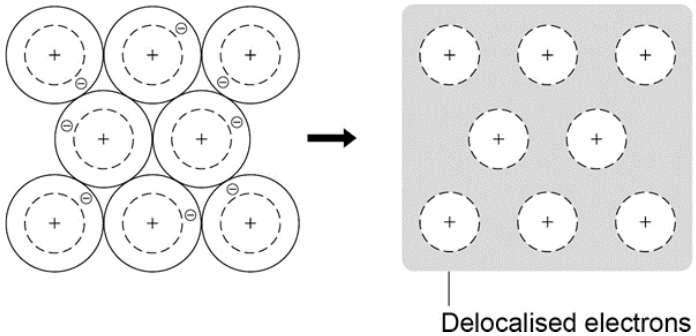
Students should be able to:

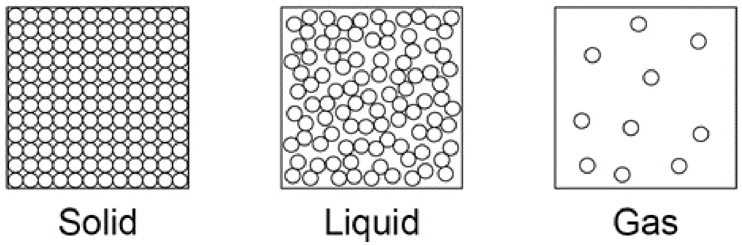
1. deduce that a compound is ionic from a diagram of its structure in one of the specified forms
2. describe the limitations of using **dot and cross, ball and stick**, two and three-dimensional diagrams to represent a giant ionic structure
3. work out the **empirical formula** of an ionic compound from a given model or diagram that shows the ions in the structure.

Students should be familiar with the structure of sodium chloride but do not need to know the structures of other ionic compounds.

L4 Covalent Bonding (5.2.1.4)
When atoms share pairs of electrons, they form **covalent bonds**. These bonds between atoms are strong. Covalently bonded substances may consist of small molecules.
Students should be able to recognise common substances that consist of small molecules from their chemical formula. Some covalently bonded substances have very large molecules, such as **polymers**.
Some covalently bonded substances have **giant covalent structures**, such as **diamond** and **silicon**

Y9 Using resources covered the properties of metals. The formation of alloys and why they have different properties	**dioxide**. The covalent bonds in molecules and giant structures can be represented in the following forms: **For ammonia (NH_3)**  and/or  and/or  and/or  Polymers can be represented in the form:  poly(ethene) where n is a large number. Students should be able to: **1.** draw dot and cross diagrams for the molecules of **hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane** 2. represent the covalent bonds in small molecules, in the repeating units of polymers and in part of giant covalent structures, using a line to represent a single bond 3. describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent molecules or giant structures deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule. **L5 Metallic Bonding (5.2.1.5)** Metals consist of **giant structures of atoms** arranged in a regular pattern.	

<table>
<tr>
<td>Y7 Physical and Chemical Change: states of matter and the particle model.</td>
<td>The electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure. The sharing of delocalised electrons gives rise to strong metallic bonds. The bonding in metals may be represented in the following form:


L6 The Three States of Matter(5.2.2.1 & 2)
The three states of matter are solid, liquid and gas. Melting and freezing take place at the melting point, boiling and condensing take place at the boiling point.
The three states of matter can be represented by a simple model. In this model, particles are represented by small solid spheres.
Particle theory can help to explain melting, boiling, freezing and condensing.


The amount of energy needed to change state from solid to liquid and from liquid to gas depends on the strength of the forces between the particles of the substance. The nature of the particles involved depends on the type of bonding and the structure of the substance. The stronger the forces between the particles the higher the melting point and boiling point of the substance.
(HT only) Limitations of the simple model above include that in the model there are no forces, that all particles are represented as spheres and that the spheres are solid.
Students should be able to:
1. predict the states of substances at different temperatures given appropriate data</td>
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Y9 Using resources covered the properties of metals. The formation of alloys and why they have different properties	2. explain the different temperatures at which changes of state occur in terms of energy transfers and types of bonding 3. recognise that atoms themselves do not have the bulk properties of materials (HT only) explain the limitations of the particle theory in relation to changes of state when particles are represented by solid inelastic spheres which have no forces between them. In chemical equations, the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions. Students should be able to include appropriate state symbols in chemical equations for the reactions in this specification. **L7 Properties of Ionic Compound (5.2.2.3)** Ionic compounds have regular structures **(giant ionic lattices**) in which there are **strong electrostatic forces** of attraction in all directions between oppositely charged ions. These compounds have high melting points and high boiling points because of the large amounts of energy needed to break the many strong bonds. When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and so charge can flow. **L8 Properties of Simple Covalent Molecules (5.2.2.4)** Substances that consist of small molecules are usually gases or liquids that have relatively low melting points and boiling points. These substances have only weak forces between the molecules **(intermolecular forces**). It is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils. The intermolecular forces increase with the size of the molecules, so larger molecules have higher melting and boiling points. These substances do not conduct electricity because the molecules do not have an overall electric charge. Students should be able to use the idea that intermolecular forces are weak compared with covalent bonds to explain the bulk properties of molecular substances. **L9 Giant Covalent Molecules and Polymers (5.2.2.5 & 6) Polymers** have very large molecules. The atoms in the polymer molecules are linked to other atoms by strong covalent bonds. The in**termolecular forces** between polymer molecules are relatively strong and so these substances are solids at room temperature. Students should be able to recognise polymers from diagrams showing their bonding and structure. Substances that consist of giant covalent structures are solids with very high melting points. All of the atoms in these structures are linked to other atoms by strong covalent bonds. These bonds must be overcome to melt or boil these substances. **Diamond and graphite** (forms of carbon) and **silicon dioxide (silica)** are examples of giant covalent structures.	Bronze the first alloy Around 3500 BC the first signs of bronze usage by the **ancient Sumerians** started to appear in the Tigris Euphrates valley in Western Asia.

	Students should be able to recognise giant covalent structures from diagrams showing their bonding and structure. **L10: Properties of Metals (5.2.2.7 & 8**) Metals have giant structures of atoms with strong metallic bonding. This means that most metals have high melting and boiling points. In pure metals, atoms are arranged in layers, which allows metals to be bent and shaped. Pure metals are too soft for many uses and so are mixed with other metals to make alloys which are harder. Students should be able to explain why alloys are harder than pure metals in terms of **distortion of the layers** of atoms in the structure of a pure metal. Metals are good conductors of electricity because the **delocalised electrons** in the metal carry electrical charge through the metal. Metals are good conductors of thermal energy because energy is transferred by the delocalised electrons **L11: Structure of Diamond and Graphite (5.2.3.1 & 2)** In diamond, each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure, so diamond is very hard, has a very high melting point and does not conduct electricity. Students should be able to explain the properties of diamond in terms of its structure and bonding. In graphite, each carbon atom forms three covalent bonds with three other carbon atoms, forming layers of **hexagonal rings** which have no covalent bonds between the layers. In graphite, one electron from each carbon atom is **delocalised.** Students should be able to explain the properties of graphite in terms of its structure and bonding. Students should know that graphite is similar to metals in that it has delocalised electrons. **L12: Graphene and Fullerenes (5.2.3.3) Graphene** is a single layer of graphite and has properties that make it useful in electronics and composites. Students should be able to explain the properties of graphene in terms of its structure and bonding. **Fullerenes** are molecules of carbon atoms with hollow shapes. The structure of fullerenes is based on hexagonal rings of carbon atoms but they may also contain rings with five or seven carbon atoms. The first fullerene to be discovered was Buckminsterfullerene (C_{60}) which has a spherical shape. **Carbon nanotubes** are cylindrical fullerenes with very high length to diameter ratios. Their properties make them useful for nanotechnology, electronics and materials. Students should be able to: 1. recognise graphene and fullerenes from diagrams and descriptions of their bonding and structure 2. give examples of the uses of fullerenes, including carbon nanotubes.	Diamond mining: inequalites for those who do the mining. The Catastrophic Effects Of Mining Diamonds | Ethica Diamonds UK Debate on the use of nanoparticles, Are they safe?