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**Knowledge Rich Curriculum Plan**

SCIENCE- Chemistry Year 10

Topic: Bonding

| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** |
| --- | --- | --- | --- | --- |
| **Lesson:** **States and State symbols** | * Students will know that intermolecular forces are forces that act between molecules
* Students will know that the changes of states are known as:

1) Melting (solid to liquid)2) Boiling (liquid to gas)3) Condensing (gas to liquid)4) Freezing (liquid to solid)5) subliming (solid to gas)6) Deposition (gas to solid)* Students will know that for changes of state to take place energy is needed to overcome intermolecular forces between the particles
* Students will know that the stronger the intermolecular forces, the more difficult it is to overcome them
* Students will know limitations of the particle model include that there are no forces represented, that all particles are represented with spheres and that the spheres are solid.
* Students will know that state symbols can be used to represent the states of different substances in a symbol equation
* Students will know that the state symbols are:

(s) - solid(l) - liquid(g) - gas(aq) - aqueous (dissolved in water)* Students will know how to use data to identify the state of substances in certain conditions
1. Students will know how to explain the limitations of the particle model
 | * ***Students need to already know that the three states of matter are solids, liquids and gases***

***Students need to already know how to draw particle models of solids, liquids and gases*** |  | Tier 2Tier 3Aqueous- An aqueous solution is a solution in which the solvent is water.Subliming- solid to gas Deposition- gas to solid |

| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** |
| --- | --- | --- | --- | --- |
| **Lesson:****Forming Ions** | * Students will know that atoms are more stable if they have a full outer shell of electrons
* Students will know that atoms can either gain or lose electrons to gain a full outer shell
* Students will know that metals lose their outer electrons to get a full outer shell
* Students will know that metals form positive ions
* Students will know that non-metals gain electrons to get a full outer shell

Students will know that non-metals form negative ions | ***Students need to already know that ions are charged atoms*** |  | Tier 2Tier 3Ion: A charged atom, formed by losing or gaining electrons |
| **Lesson:** **Ionic Bonds** | * Students will know that ionic bonds form between metals and non-metals
* Students will know that electrons are transferred from the outer shell of the metal atom
* Students will know that metals lose electrons from their outer shell to form positive ions
* Students will know that non-metal atoms gain electrons to form negative ions
* Students will know that ions formed from group 1 elements have a +1 charge
* Students will know that ions formed from group 2 elements have a +2 charge
* Students will know that ions formed from group 6 elements have a -2 charge
* Students will know that ions formed from group 7 elements have a -1 charge
* Students will know that ions formed by group 1, group 2, group 6 and group 7 elements have the same electronic structure as noble gases
* Students will know that an ionic bond is an electrostatic attraction between oppositely charged ions
* Students will know how to represent ionic compounds using dot and cross diagrams

Students will know how to determine the charge on an ion | * ***Students need to already know that ions are charged atoms***

***Students need to already know how to draw electronic structures*** |  | Tier 2Imbalance: A lack of balanceTier 3Electrostatic attraction: attraction between charged objectsIonic bond: The electrostatic attraction between two oppositely charged ions |
| **Lesson:** **Ionic Compounds** | * Students will know that an ionic compound is a giant structure made from ions
* Students will know that ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions
* Students will know that a lattice is a repeating 3D shape of ions
* Students will know that the electrostatic attractions in an ionic compound are felt in all directions
* Students will know that a limitation of dot and cross diagrams is that it shows electrons as being different in different atoms, whereas electrons are the same
* Students will know that ionic compounds have high melting and boiling points as the strong electrostatic forces of attraction require a lot of energy to overcome
* Students will know that solid ionic compounds are electrical insulators as there are no charged particles that are free to move
* Students will know that melted or dissolved ionic compounds are able to conduct electricity as the ions are free to move and carry a charge
* Students will know how to deduce the formula of an ionic compound based on the charges of the ions

Students will know how to deduce the formula of an ionic compound based on a diagram of the lattice | ***Students need to already know that ionic compounds form between metals and non-metals*** |  | Tier 2Tier 3Lattice: a regular repeated three-dimensional arrangement of atoms, ions, or molecules in a metal or other crystalline solid.Aqueous: Dissolved in water |
| **Lesson:****Covalent Bonds** | * Students will know that a covalent bond is between two non-metal atoms
* Students will know that a covalent bond occurs when a pair of electrons is shared between two atoms

Students will know how to represent the covalent bonds in water, hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, ammonia and methane using dot and cross diagrams | ***Students need to already know how to draw electronic configurations*** |  | Tier 2Limitation: WeaknessTier 3Covalent: chemical bond formed by the sharing of a pair of electrons between atoms |
| **Lesson:****Simple Covalent Molecules** | * Students will know that most substances that contain covalent bonds are simple covalent molecules
* Students will know that to melt or boil a simple covalent molecule enough energy is needed to overcome weak intermolecular forces
* Students will know that simple covalent molecules have low melting and boiling points as not a lot of energy is needed to overcome the intermolecular forces
* Students will know that simple covalent molecules are poor electrical conductors as they don't have any charged particles that are free to move

Students will know how to explain the properties of simple covalent substances | ***Students need to already know that intermolecular forces are forces that occur between molecules*** |  | Tier 2Tier 3Intermolecular forces: forces acting in between molecules |
| **Lesson:** **Giant Covalent Structures and Polymers** | * Students will know that some substances that contain covalent bonds are very large molecules called polymers
* Students will know that some covalently bonded substances have giant structures, such as silicon dioxide, diamond and graphite
* Students will know that since polymers are large molecules, the intermolecular forces between them are relatively large
* Students will know that polymers tend to be solids at room temperature
* Students will know that giant covalent structures have very high melting and boiling points
* Students will know that to melt a giant covalent structure a lot of energy is required to break strong covalent bonds

Students will know how to represent polymers | ***Students need to already know that the melting point is the temperature needed to reach to melt a substance*** |  | *Tier 2**Compare: estimate, measure, or note the similarity or dissimilarity between**Tier 3**Polymer: A long chain of repeating units**Polymerisation: is a process of reacting monomer molecules together in a chemical reaction to form polymer chains**Macromolecule: is defined as a molecule with a very large number of atoms**Allotropes: each of two or more different physical forms in which an element can exist* |
| **Lesson:** **Diamond and Graphite** | * Students will know that diamond and graphite are both forms of carbon
* Students will know that in diamond each carbon atom is covalently bonded to 4 other carbon atoms
* Students will know that diamond is very hard due to its repeating structure of each carbon atom being covalently bonded to 4 other carbon atoms
* Students will know that diamond has a very high melting point as a lot of energy is required to overcome the strong covalent bonds between the carbon atoms
* Students will know that in graphite each carbon atom is covalently bonded to 3 other carbon atoms, leaving one electron per carbon atom delocalised
* Students will know that the structure of graphite consists of layers of repeating hexagonal rings of carbon atoms

Students will know that graphite is able to conduct electricity as the delocalised electrons are free to move and carry charge | ***Students need to already know that delocalised electrons are electrons that are free to move*** |  |  |
| **Lesson:** **Graphene and Fullerenes** | * Students will know that graphene is a single layer of graphite
* Students will know that graphene consists of a single layer of carbon atoms, each covalently bonded to 3 other carbon atoms
* Students will know that graphene can conduct electricity due to having delocalised electrons
* Students will know that graphene is useful in electronics and composites
* Students will know that a composite is a material that is made up of at least 2 different parts
* Students will know that fullerenes are molecules of carbon atoms that have a hollow shape
* Students will know that the structure of fullerenes is based on rings of carbon atoms, where the rings can consist of either 5 or 7 carbon atoms
* Students will know that the first fullerene to be discovered was buckminsterfullerene, which consisted of 60 carbon atoms in a spherical shape
* Students will know that nanotubes are cylindrical fullerenes.

Students will know how to recognise graphene and fullerenes | ***Students need to already know that delocalised electrons are electrons that are free to move*** |  | Tier 2Tier 3Composite: A material that is made up of at least two different parts |
| **Lesson: Nanotechnology (Triple only)** | * Students will know that 1 nm is 1 x 10^-9 m
* Students will know that nanoscience refers to structures that are 1 - 100 nm in size
* Students will know that fine particles have diameters in the range of 100 - 250 nm
* Students will know that coarse particles have diameters between 1 x 10^-5 and 2.5 x 10^-6 m
* Students will know that coarse particles are often referred to as dust
* Students will know that as the side of a cube decreases by a factor of 10, the surface area : volume ratio increases by a factor of 10
* Students will know that nanoparticles have different properties to the same material in bulk due to their high surface area : volume ratio
* Students will know that only small amounts of nanoparticles are needed to be as effective as the same material in bulk
* Students will know that nanoparticles are used in medicine, electronics, cosmetics, deodorants, sun cream and as catalysts

Students will know how to evaluate the use of nanoparticles for a specific purpose |  | Estimations using relative sizes | Tier 2*Bulk: in large quantities**Tier 3**Nanoscience: the study of structures that are in the range of 1-100 nm**Fine particles: Particles with a diameter in the range of 100 – 250 nm**Coarse particles (also known as dust): Particles with a diameter in the range of 1 x 10-5 m to 2.5 x 10-6 m* |
| **Lesson:** **Metallic Bonding** | * Students will know that metals consist of giant structures of atoms arranged in a regular pattern
* Students will know that the outer shell electrons in a metal are delocalised, and are free to move around the structure

Students will know that metallic bonds are strong electrostatic forces of attraction between metal ions and delocalised electrons | ***Students need to already know that metal ions are positively charged*** |  | Tier 2*Property: an attribute, quality, or characteristic of something*Tier 3*Lattice: A series of particles arranged in a distinct pattern.**Delocalised: free moving**Malleable: able to bend into different shapes**Longevity: long existence or service* |
| **Lesson:** **Metal Properties** | * Students will know that in pure metals atoms are arranged in layers, and due to this they can be bent and shaped without damage (malleable).
* Students will know that pure metals tend to be too soft for many uses so are mixed with other metals to form alloys, which are harder
* Students will know that alloys are harder than pure metals as the layers of atoms are distorted, so are unable to slide over each other
* Students will know that metals are good conductors of electricity as the delocalised electrons are able to carry electrical charge

Students will know that metals are good thermal conductors as the delocalised electrons are able to transfer heat energy | ***Students need to already know that metals are sonorous, malleable, ductile, good conductors of electricity and good thermal conductors.*** |  |  |