NHSG Key Stage 3 Unit Overview for Y9 Chemistry: Bonding and the Properties of Materials

<table>
<tr><th>Scheme of Learning : Cell Structures</th><th colspan="2">Year 9 Chemistry: Bonding and the Properties of Materials</th></tr>
<tr><td rowspan="2">Learning Outcomes</td><td>Subject content:</td><td>Skill set:</td></tr>
<tr><td>Knowledge and understanding of ….

• How the simple electron energy level model can be used to explain the basic chemical properties of elements.
• The physical properties of elements and compounds and how the nature of their bonding is a factor in their properties.</td><td>• understand the power and limitations of science
• explain everyday and technological applications of science
• evaluate associated personal, social, economic and environmental implications
• evaluate risks both in practical science and the wider societal context
• recognise the importance of peer review of results and of communicating results to a range of audiences
• apply a knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to the experiment
• use scientific theories and explanations to develop hypotheses
• carrying out and representing mathematical and statistical analysis
• presenting reasoned explanations
• use SI units and IUPAC chemical nomenclature
• unless inappropriate
• use prefixes and powers of ten for orders of magnitude</td></tr>
<tr><td>Key Question</td><td colspan="2">How do atoms lose, gain or share electrons when they react? How does the nature of the bond between atoms affect the chemical or physical properties of elements and compounds?</td></tr>
<tr><td>Knowledge</td><td>Key concepts and skills</td><td>Key terminology</td></tr>
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	• describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties • explain how the atomic structure of metals and non-metals relates to their position in the periodic table • explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number • describe and compare the nature and • arrangement of chemical bonds in: • ionic compounds, simple molecules, giant covalent structures, polymers, and metals. • explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons • construct dot and cross diagrams for simple covalent and binary ionic substances • describe the limitations of particular representations and models • explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number • explain in terms of atomic number how Mendeleev's arrangement was refined into the modern periodic table • recall that carbon can form four covalent bonds • explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings	➢ metal ➢ non-metal ➢ physical properties ➢ chemical properties ➢ Periodic Table ➢ period ➢ group ➢ electronic structure ➢ outer shell ➢ ion ➢ ionic compound ➢ dot-and-cross diagram ➢ giant ionic lattice ➢ ionic bond ➢ Space-filling models ➢ covalent bond ➢ simple molecule ➢ intermolecular forces ➢ giant covalent structure ➢ polymers ➢ monomers ➢ repeating unit ➢ metallic lattice ➢ delocalised electrons ➢ metallic bonds ➢ allotropes ➢ diamond ➢ graphite ➢ graphene ➢ fullerenes ➢ condenses ➢ freezes ➢ melts

	• explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding • use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to explain the different temperatures at which changes of state occur • use data to predict states of substances under given conditions • explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged • compare 'nano' dimensions to typical dimensions of atoms and molecules • describe the surface area to volume relationship for different-sized particles and describe how this affects properties • describe how the properties of nanoparticulate materials are related to their uses • explain the possible risks associated with some nanoparticulate materials	➢ boils ➢ nanoparticle ➢ nanoparticulates
Ongoing Assessment	Retrieval questions at the start of every lesson. These questions refer to previous knowledge from Y7, Y8 and from earlier in the Y9 course which will help them develop further knowledge. Assessment in the form of questions and tasks in the topic book, including:	

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- Electron shells
- Forming ions
- Ionic bonding
- Ionic compounds
- Covalent bonding in compounds and elements
- Simple molecules
- Small molecules and intermolecular forces
- Properties of giant covalent structures
- Giant covalent structures and fullerenes
- Polymers
- Metals
- Metallic bonding
- Nanoparticles, properties and uses
- Development of the Periodic Table
- States, structure and bonding

Key misconceptions:

- Learners do not always appreciate that the nucleus of an atom does not change when an electron is lost, gained or shared.
- They also find it difficult to predict the numbers of atoms that must bond in order to achieve a stable outer level of electrons.
- Learners think that chemical bonds are physical things made of matter.
- They also think that pairs of ions such as Na+ and C*l* - are molecules.
- They do not have an awareness of the 3D nature of bonding and therefore the shape of molecules.
- Learners commonly have a limited understanding of what can happen during chemical reactions, for example substances may explode, burn, contract, expand or change state.

Homework:

- Drawing electron diagrams
- Ionic bonding exam questions
- Small molecules and intermolecular forces
- Giant covalent structures

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	➢ Polymers ➢ Nanoparticles (and risks) ➢ Exam style questions Revision checklist: At the front of topic booklet. Knowledge organisers review topic on one/two pages.
Final Assessment	Practical assessment: Class practicals to purify and separate mixtures, personalised feedback, including safe practice and accurate use of equipment. End of topic test. Closed book 30 marks in 30 minutes. Test will assess key skills and content from specification of this unit, using past GCSE style questions. The test includes multiple choice questions, practical knowledge question and mathematical application. A further multiple-choice assessment for Bonding is available just before the Y9 Exam to facilitate knowledge checking of this key skill prior to the end of year exam.
Clear sequencing of content	This is the third Chemistry topic in Y9. It recaps and builds upon some of the concepts in earlier Y9 topics and ideas covered at KS3 such as elements, compounds and chemical equations. The concepts from this topic will be built upon in all future GCSE topics and especially A-level Chemistry.
Links to Careers	• Opportunities to discuss new discoveries and their uses – graphene, which is expanded on further in Y10 during a workshop delivered by a chemistry researcher and member of the Nobel Prize winning team of Harry Kyoto. • Do you want to be an astrophysicist? Fullerenes have been found in the diffuse interstellar medium. Link to abstract and article in ppt. • Listen to Professor Dame Julia Higgins talk about her scientific life (6 minutes) – Professor at UCL researching Polymers.
Diversity and Inclusion	Women in Science: STEPHANIE KWOLEK, (1923-2014). Stephanie was a Polish-American chemist who contributed to the development of Kevlar, a strong and stiff polymer material best known for its use in bulletproof vests. Stephanie won numerous awards for her work in polymer chemistry. Discussion facilitated by test cover sheet.

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Intervention support	Every student receives topic booklets including specification. Knowledge Organiser shared. Retrieval questions available for the start of each lesson. Remote Learning Guide for each lesson is available on SharePoint with links to Bitesize videos. OUP GCSE Chemistry textbook on Kerboodle for all. Chemistry Drop-in club for support – voluntary and guided intervention.
Challenge	2 Zigzag Stretch and Challenge Articles, with questions, are provided at the back of the topic booklet: Silicon Lifeforms Seventeenth-century Nanoscience