# Sample Unit – Chemistry – Year 11

***Sample for implementation for Year 11 from 2018***

| **Module 1 – Properties and Structure of Matter** | | **Duration** 30 hours (including teacher determined hours for Depth Study) |
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| **Content focus**  Students analyse trends and patterns in relation to the properties of pure substances and use these to predict the properties of other pure substances. This knowledge is used to determine ways in which substances can be separated from each other or remain together.  Matter can be either pure substances with distinct measurable properties (eg melting and boiling points, reactivity, strength, density) or mixtures with properties that are dependent on the identity and relative amounts of the substances that constitute them. The analysis of these properties has led to the expansion of the periodic table of the elements and the advancement of atomic theory. This understanding has allowed for the development of complex models that have been subject to extensive peer review, and has contributed to advances in many disciplines over time.  Students use knowledge obtained from the study of the periodic table to examine trends and patterns that exist between chemical elements and atoms in order to discover that fundamental particles, and their role in the structure of an atom, give all chemicals their properties.  **Context of this Module**  As this unit addresses the first module in the Chemistry course, emphasis is placed on reviewing and developing student prior knowledge, particularly that gained in Stage 5. Skills in Working Scientifically will be enhanced, as students design and conduct investigations that further enables them to carry out a future **Depth Study** later in the Year 11 course. Students are given the opportunity to design their own investigations and practice efficient information and data collection strategies, as well as developing skills in communicating their findings using appropriate scientific language.  **Working Scientifically**  In this unit, students focus on: designing, evaluating and conducting investigations; obtaining and processing data in the most appropriate manner; and communicating ideas about the structural, physical and chemical aspects of matter. Students should be provided with opportunities to engage with all Working Scientifically skills. | | |
| **Outcomes**  A student:   * designs and evaluates investigations in order to obtain primary and secondary data and information **CH11/12-2** * conducts investigations to collect valid and reliable primary and secondary data and information **CH11/12-3** * selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media **CH11/12-4** * communicates scientific understanding using suitable language and terminology for a specific audience or purpose **CH11/12-7** * explores the properties and trends in the physical, structural and chemical aspects of matter **CH11-8** | | |
| **Course Requirements and Resources**  Risk assessments associated with each practical investigation  MSDS sheets  30 hours of scheduled coursework  Access to ICT  **Support Websites**   * <http://www.chemtutor.com/> * <http://www.chemguide.co.uk/> * <https://www.khanacademy.org/science/chemistry> * <http://www.sciencegeek.net/Chemistry/index.shtml> | **Formal assessment**  (*An example an assessment that could be used)*  **Chemical Structures (page 10)**  The assessment task associated with this unit requires students to present a series of models, either physical or digital, to show the main features of the major types of chemical structure, including:   * + ionic networks   + covalent lattices (including diamond and silicon dioxide)   + covalent molecular   + metallic structure   Students will also need to provide suitable annotations, labels or notes associated with each type of structure, as well as naming representative examples. | |
| **Topics**   1. Properties of Matter 2. Atomic Structure and Atomic mass 3. Periodicity 4. Bonding | **Inquiry Questions**   1. How do the properties of substances help us to classify and separate them? 2. Why are atoms of elements different from one another? 3. Are there patterns in the properties of elements? 4. What binds atoms together in elements and compounds? | |

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| **Module 1 – Properties and Structure of Matter** | **Duration** 30 hours  (including teacher determined hours for Depth Study) |
| **Working scientifically:**  **W/S – Conducting investigations – CH11/12-3**  **A student conducts investigations to collect valid and reliable primary and secondary data and information.**  Students:   * employ and evaluate safe work practices and manage risks (ACSCH031) * use appropriate technologies to ensure and evaluate accuracy * select and extract information from a wide range of reliable secondary sources and acknowledge them using an accepted referencing style  W/S - Processing Data and Information – CH11/12-4 **A student selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media**  Students:   * select qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media (ACSCH004, ACSCH007, ACSCH064, ACSCH101) * apply quantitative processes where appropriate * evaluate and improve the quality of data  W/S - Analysing Data and Information – CH11/12-5 **A student analyses and evaluates primary and secondary data and information**  Students:   * derive trends, patterns and relationships in data and information * assess error, uncertainty and limitations in data (ACSCH004, ACSCH005, ACSCH033, ACSCH099) * assess the relevance, accuracy, validity and reliability of primary and secondary data and suggest improvements to investigations (ACSCH005)  W/S – Problem Solving – CH11/12-6 **A student** solves scientific problems using primary and secondary data, critical thinking skills and scientific processes  Students:   * use modelling (including mathematical examples) to explain phenomena, make predictions and solve problems using evidence from primary and secondary sources (ACSCH006, ACSCH010) * use scientific evidence and critical thinking skills to solve problems  W/S – Communicating – CH11/12-6 **A student** communicates scientific understanding using suitable language and terminology for a specific audience or purpose  Students:   * select and use suitable forms of digital, visual, written and/or oral forms of communication * select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSCH008, ACSCH036, ACSCH067, ACSCH102) * construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion (ACSCH034, ACSCH036) | **Depth Study**  This module will provide students with the opportunity to plan and conduct investigations, as well as processing data and information. Focus should be placed on the development of skills related to planning and conducting investigations, as well as processing and communicating information. This Depth Study will not be formally assessed |

| **Topic : Properties of Matter** | |
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| **Inquiry Question**: **How do the properties of substances help us to classify and separate them?** | |
| **Content** | **Teaching, learning and assessment** |
| Review of Stage 5 | **1. Pre-test using crossword or Kahoot game:**  <https://getkahoot.com/how-it-works>  Brainstorm to check student knowledge and understanding from Stage 5. Students may develop their own Kahoot game, or be presented with one developed by the teacher. Major content areas students have encountered in Stage 4/5 include:   * the use of models to explain the arrangement of particles in matter * changes of state * density * properties and uses of elements * particle arrangement in elements, compounds and mixtures * methods of separating mixtures into their component elements and compounds * physical and chemical changes * atomic structure and the location of protons, electrons and neutrons within the atom * format of, and major trends within, the Periodic Table * radiation and radioactivity * chemical reactions – specifically combustion, corrosion, precipitation, neutralisation, decomposition, acids with metals and with carbonates * factors affecting the rates of chemical reactions |
|  | **2. Demonstration and investigation of the properties of matter:**  Refer to the following website:  <http://www.arborsci.com/cool/exploring-matter-chemistry-demonstrations>  and present students with the following demonstrations and/or investigations:   * polystyrene dissolving in acetone. Do not consider polarity at this stage. * density of regular Coca Cola and Diet Coke. * density column * mixtures smorgasbord * slime   Use these activities to ask students to develop questions and explanations about what is happening and why. Encourage students to consider ways in which they could further investigate their observations and what secondary data they would need to consider in order to make further explanations.  **W/S – Planning Investigations – CH11/12-2**  **W/S – Conducting investigations – CH11/12-3**  **W/S - Processing Data and Information – CH11/12-4** |
| Students:   * explore homogeneous mixtures and heterogeneous mixtures through practical investigations:   + using separation techniques based on physical properties (ACSCH026) | **3. Investigating and separating homogeneous and heterogeneous mixtures:**  Revise the distinction between homogeneous and heterogeneous mixtures and pure substances and generate a list of mixtures that can be found in the biosphere, lithosphere, hydrosphere and atmosphere.  Identify and describe procedures that can be used to separate naturally occurring mixtures of:  - solids with different sized particles  - solids and liquids  - dissolved solids in liquids  - liquids  - gases |
| * + calculating percentage composition by weight of component elements and/or compounds (ACSCH007) | Use a variety of processes, including filtration, distillation, separating funnel and chromatography, to separate the following mixtures, based on their physical properties:  - sand and calcium carbonate  - a suspension of calcium carbonate in water  - salt dissolved in water  - calcium sulphate, copper sulphate and water  - an oil and water mixture  - alcohol and water  - the colours in a felt-tipped pen  **W/S – Planning Investigations – CH11/12-2**  **W/S – Conducting investigations – CH11/12-3**  Design and conduct an investigation to separate the components of a mixture and carry out a gravimetric analysis to estimate its percentage composition.  **W/S – Planning Investigations – CH11/12-2**  **W/S – Conducting investigations – CH11/12-3**  **W/S – Processing Data and Information – CH11/12-4** |
| Students:   * investigate the nomenclature of inorganic substances using International Union of Pure and Applied Chemistry (IUPAC) naming conventions | **4. Investigating nomenclature of inorganic substances:**  Students should begin their knowledge of naming inorganic compounds by viewing the following video:  <https://scilearn.sydney.edu.au/fychemistry/iChem/inorganic_nomenclature.shtml>  It is important to provide students with practice worksheets and quizzes to reinforce these ideas. Students should also make a list of chemicals and their names as they are encountered within the course.  **W/S – Communication – CH11/12-7** |
| Students:   * classify the elements based on their properties and position in the periodic table through their:   + physical properties   + chemical properties | **5. Classification of elements and Review of the Periodic Table structure:**  Conduct an investigation to examine some physical properties and uses of a range of elements to present information about their classification as metals, non-metals and metalloids.  **W/S – Conducting investigations – CH11/12-3** W/S – Processing Data and Information – CH11/12-4 **W/S – Communication – CH11/12-7**  Use a given copy of the Periodic Table to summarise the following features:  - solids, liquids and gases  - metals  - non-metals  - metalloids  - groups and periods  - Group I, VII, VIII  - transition metals |

| **Topic : Atomic structure and atomic mass** | |
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| **Inquiry Question: Why are atoms of elements different from one another?** | |
| **Content** | **Teaching, learning and assessment** |
| Students:   * investigate the basic structure of stable and unstable isotopes by examining:   + their position in the periodic table   + the distribution of electrons, protons and neutrons in the atom   + representation of the symbol, atomic number and mass number (nucleon number) | **1. The basic structure of stable and unstable radioisotopes:**  Revision, research and class discussion of the following concepts:  - review of location and nature of protons, electrons and neutrons  - atomic number  - mass number  - what are isotopes, using some examples  - what is a radioisotope and briefly consider what causes instability in radioisotopes  <http://www.ansto.gov.au/NuclearFacts/AboutNuclearScience/Radioisotopes/>  <https://www.britannica.com/science/radioactive-isotope>  **W/S - Processing Data and Information – CH11/12-4**  A suitable review tool is Kahoot, or a phet simulation  <https://getkahoot.com/how-it-works>  <https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass>  Indicate the atomic number and deduce the mass number from the atomic mass given in a Periodic Table |
| Students:   * investigate the properties of unstable isotopes using natural and human-made radioisotopes as examples, including but not limited to:   + types of radiation   + types of balanced nuclear reactions | **2. Properties and uses of radioisotopes:**  Carry out research to identify some examples of natural and human-made radioisotopes, noting the properties of their examples. These could include half life; type of radiation emitted and the decay process described in a nuclear reaction equation. Note how the properties of the radioisotope may be related to their use.  **W/S - Processing Data and Information – CH11/12-4**  <http://www.ansto.gov.au/NuclearFacts/AboutNuclearScience/Radioisotopes/>  <https://www.britannica.com/science/radioactive-isotope> |
| Students:   * model the atom’s discrete energy levels, including electronic configuration and spdf notation (ACSCH017, ACSCH018, ACSCH020, ACSCH022) | **3. Electron configuration and orbitals:**  Model *s, p* and *d* orbitals using *Playdough* of different colours and wooden skewers to show the different sizes, shapes and orientation of the orbitals. Students should also experience the popular “diagonal filling order” diagram to help them understand the different energies and filling order of orbitals. Reference should be made to the appropriate blocks of the Periodic Table. This material is quite abstract, so students may need regular activity sheets, puzzles and games such as *Kahoot,* to reinforce these concepts.  **W/S - Processing Data and Information – CH11/12-4**  [*http://www.chemguide.co.uk/atoms/properties/atomorbs.html*](http://www.chemguide.co.uk/atoms/properties/atomorbs.html)  [*https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms/electron-configurations-jay-sal/v/orbitals*](https://www.khanacademy.org/science/chemistry/electronic-structure-of-atoms/electron-configurations-jay-sal/v/orbitals) |
| Students:   * calculate the relative atomic mass from isotopic composition (ACSCH024) | **4. Relative atomic mass:**  Calculate the relative atomic mass, (RAM), given the relative isotopic mass, (RIM), and abundance of each isotope.  **W/S – Communication – CH11/12-7**  <http://www.ausetute.com.au/atomicmass.html>  Youtube: How to calculate Relative Atomic Mass | The Chemistry Journey | The Fuse School |
| Students:   * investigate energy levels in atoms and ions through:   + collecting primary data from a flame test using different ionic solutions of metals (ACSCH019)   + examining spectral evidence for the Bohr model and introducing to the Schrödinger model | **5. Investigating energy levels in atoms:**  Conduct an investigation to examine the characteristic flame colours produced during vaporisation of salts containing the following ions: Na+; Ca2+; K+; Ba2+; Cu2+ and Sr2+ if available.  **W/S – Conducting investigations – CH11/12-3** W/S – Processing Data and Information – CH11/12-4 <http://www.chemguide.co.uk/inorganic/group1/flametests.html>  Youtube: Flame tests for metal cations - with spectroscope.  Research the Bohr and Quantum Mechanical models of the atom, and use these to explain their observations of spectra. The following animations are useful in providing visual representations of both types of atomic models.  **W/S - Processing Data and Information – CH11/12-4**  <https://www.youtube.com/watch?v=tuRnBEiQ4yA>  Youtube: Bohr Model Flame Test Explanation.mp4 |

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| **Topic : Periodicity** | |
| **Inquiry Question: Are there patterns in the properties of elements?** | |
| **Content** | **Teaching, learning and assessment** |
| Students:   * demonstrate, explain and predict the relationships in the observable trends in the physical and chemical properties of elements in periods and groups in the periodic table, including but not limited to:   + state of matter at room temperature   + electronic configurations and atomic radii   + first ionisation energy and electronegativity   + reactivity with water | **1. Patterns in the properties of elements:**  Conduct an investigation to examine some physical properties, including state, reactivity with water and electrical conductivity, to present information about the classification of elements in the Periodic Table. Consider samples of Mg, Zn, Na (teacher use only), I2, C, Pb, Cu and S.  Conduct research about the definitions and trends of first ionisation energies and electronegativities across periods and down groups within the Periodic Table, and present this information graphically.  Explain these trends in terms of electron configuration and orbitals, incorporating Hund’s Rule.  Groups of students may be given other specific properties to investigate, such as atomic radius, melting and boiling points and valency  **W/S – Conducting investigations – CH11/12-3** W/S – Processing Data and Information – CH11/12-4 **W/S – Communication – CH11/12-7**  <http://www.rsc.org/periodic-table/trends>  <https://prezi.com/cztujf5p9kg7/electronic-configurations-ionisation-energy/> |

| **Topic : Bonding** | |
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| **Inquiry Question: What binds atoms together in elements and compounds?** | |
| **Content** | **Teaching, learning and assessment** |
|  | **1. Different chemical structures:**  Conduct an investigation, process data and information and communicate their findings, to compare the physical properties of a range of substances. Properties investigated could include hardness, melting point, and electrical conductivity of both the solid/liquid and solution if applicable. Substances could include: salt, sugar, candle wax, tin, graphite, starch, glucose and silicon dioxide. Giant molecules/polymers may also be investigated by considering the properties of PE or PS.  Use student results to classify substances into five main groups; ionic, metallic, covalent molecular, covalent lattice and covalent network. Describe in general terms the main features of each type of structure.  Students use *Molymod kits/Playdough* to model the 5 main types of structure and hence, discuss the relationship between the type of structure and the physical properties observed.  **W/S – Conducting investigations – CH11/12-3** W/S – Processing Data and Information – CH11/12-4 **W/S – Communication – CH11/12-7**  ***This content area is intended to be formally assessed.*** |
| Students:   * investigate the different chemical structures of atoms and elements, including but not limited to:   + ionic networks   + covalent lattices (including diamond and silicon dioxide)   + covalent networks   + metallic structure | **2. Investigating chemical bonds:**  Think-Pair-Share activity about the nature of the 3 different types of chemical bonds:  - metal atoms combining with metal atoms to form metallic bonds, through the electrostatic attraction between a lattice of positive ions and delocalised electrons  - metal atoms combining with non-metal atoms to form ionic bonds, as a result of a metal atom donating its valance electron/s to a non-metal atom  - non-metal atoms combining with non-metal atoms to form covalent bonds, through the sharing of electrons.  In each case, note the requirements to achieve an inert gas configuration.  Analyse given values for electronegativity to deduce the nature of the bonding between 2 elements within the Periodic Table. This should consider the following:  - ionic bonds tend to form if the difference in electronegativity is equal to or greater than 1.8 (Pauling Scale)  - polar covalent bonds tend to form if the difference in electronegativity is 0.5 and 1.7 (Pauling Scale). Describe polar covalent bods as those in which electrons are shared unevenly.  - pure covalent bonds tend to form if the difference in electronegativity is less than 1.4 (Pauling Scale) W/S - Processing Data and Information – CH11/12-4 <https://www.khanacademy.org/science/chemistry/chemical-bonds/types-chemical-bonds/v/ionic-covalent-and-metallic-bonds> |
| Students:   * investigate the role of electronegativity in determining the ionic or covalent nature of bonds between atoms * investigate the differences between ionic and covalent compounds through:   + using nomenclature, valency and chemical formulae (including Lewis dot diagrams) (ACSCH029)   + examining the spectrum of bonds between atoms with varying degrees of polarity with respect to their constituent elements’ positions on the periodic table   + modelling the shapes of molecular substances (ACSCH056, ACSCH057) | **3. Representing ionic and covalent compounds:**  Review earlier work on nomenclature of inorganic substances, considering the importance of valency. Students progress to writing chemical formulae and drawing Lewis dot diagrams for ionic and covalent compounds.  **W/S – Communication – CH11/12-7**  <http://www.chemicalformula.org/basic-chemistry/chemical-formula>  <http://web.chem.ucla.edu/~harding/lewisdots.html>  Youtube: Drawing Lewis Dot Diagrams  Investigate and discuss, using molecular model kits or simulations, why certain covalent molecular substances have specific shapes. For example, consider the bent shape of the water molecule, the pyramidal shape of the ammonia molecule, the tetrahedral shape of the methane molecule and the linear shape of the carbon dioxide molecule. Use this as an introduction to VSEPR theory and the importance of bonding and non-bonding pairs in determining the shape of a molecule.  **W/S – Conducting investigations – CH11/12-3**  **W/S - Processing Data and Information – CH11/12-4**  <https://phet.colorado.edu/en/simulation/molecule-shapes>  Investigate the requirements for a molecule to be considered polar and some properties of polar substances.  **W/S – Conducting investigations – CH11/12-3**  **W/S - Processing Data and Information – CH11/12-4** |
| Students:   * explore the similarities and differences between the nature of intermolecular and intramolecular bonds and the strength of the forces associated with each, in order to explain the:   + physical properties of elements   + physical properties of compounds (ACSCH020, ACSCH055, ACSCH058) | **4. Investigating intermolecular and intramolecular bonds:**  Using secondary data, investigate the following physical properties - melting and boiling points, volatility, electrical conductivity and solubility – for elements and compounds that show the 3 main types of intermolecular bonds:  - dispersion forces  - dipole-dipole forces  - hydrogen bonding. Specific substances could include the halogen gases, the hydrogen halides, ammonia and water.  Relate the nature and strength of the intermolecular bonds to the physical properties observed.  **W/S – Conducting investigations – CH11/12-3**  **W/S - Processing Data and Information – CH11/12-4**  Relate the amount of energy needed to separate atoms and molecules in a molecular compound, to the nature of intermolecular and intramolecular bonds. Suitable examples include but are not limited to the boiling of water and the electrolysis of water.  **W/S - Processing Data and Information – CH11/12-4**  <https://www.khanacademy.org/test-prep/mcat/chemical-processes/covalent-bonds/a/intramolecular-and-intermolecular-forces>  Youtube: Intermolecular Forces and Boiling Points |
| Students:   * investigate elements that possess the physical property of allotropy | **5. Allotropes:**  Research the physical properties of the various allotropes of carbon (diamond, graphite and C60 fullerenes); oxygen (oxygen and ozone); phosphorus (red, white and black); sulphur (orthorhombic and rhombohedral) and tin (grey and white)  **W/S – Conducting investigations – CH11/12-3**  **W/S - Processing Data and Information – CH11/12-4**  <http://www.chemistryexplained.com/A-Ar/Allotropes.html> |

**Reflection and Evaluation**

# TEACHER: CLASS:

**DATE UNIT COMMENCED: DATE UNIT CONCLUDED:**

* **Variations to program:** (List additional resources and outline alternative strategies used.
* **The most effective teaching/ learning strategies and resources in this unit were:** (Please nominate 3 at least)
* **Less effective teaching strategies and resources for this unit were:** (Please nominate 2 at least)

**TEACHER’S SIGNATURE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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