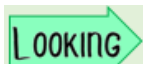
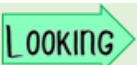


| Topic 8<br>Analysis                                                                                                                                                                                                                                                                                                                                                                                                     | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                       | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> <i>... how to (Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                                                                                                                                                 | Key Tier 3 vocabulary                                                                                                                     | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.8 Analysis</b><br>Chemists have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals. Forensic scientists and drug control scientists rely on such | <br><b>Year 8</b><br>Reaction types<br><br><br><b>Year 11</b><br>Chemical Analysis<br><br><b>Post 16</b><br>Analysis using a range of chromatography techniques.<br>Gas tests. | <b>Lesson 1 – Pure Substances and Formulations</b><br><i>...that</i> a formulation is a specific mixture that has been designed as a useful product. Pure substances have a specific boiling point. Mixtures boil over a range of temperatures.<br><i>...how to</i> distinguish between a pure substance and a mixture.<br><i>...how to</i> apply knowledge to past exam questions                                                               | Pure, substance, melting point, boiling point, impure, mixture, product, purpose, fertilisers,                                            | a) <b>Numeracy</b><br>Analysis and evaluation of data based questions using graphs and/or tables for analysis.<br><br>b) <b>Literacy</b><br>Scientific literacy on gas formulae<br><br>c) <b>Reading</b><br>Reading for learning on case studies.<br><br>d) <b>Cultural Capital/Careers</b><br>Forensic science<br><br>e) <b>Cross curricular knowledge links</b><br><br>f) <b>Misconceptions</b><br>A pure substance in chemistry means that it is only one type of particle, pure in general language means it hasn't had anything extra added to it such as pure orange juice. Orange juice isn't pure in chemistry as it contains |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                  | <b>Lesson 2, 3, 4 – Required Practical – Testing for Ions</b><br><i>...that</i> positive metal and negative non-metal ions can be distinguished using indicative tests<br><i>...how to</i> use indicative tests to identify common ions<br><i>...how to</i> safely complete an indicative tests practical<br><i>...how to</i> apply knowledge to past exam questions                                                                             | Flame tests, metals, ions, solutions, precipitates, carbonates, halide, sulphates                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                  | <b>Lesson 5 – Testing for Common Gases and Instrumental Analysis</b><br><i>...that</i> carbon dioxide, oxygen, hydrogen and chlorine have specific tests which can be used to identify them<br><i>...that</i> instrumental methods of analysis have advantages over traditional methods<br><i>...how to</i> analysis flame emission spectroscopy data to determine ions in a compound<br><i>...how to</i> apply knowledge to past exam questions | Identification, instrumental, accurate, sensitive, rapid, flame emission spectroscopy, spectroscope, spectrum, concentrations, metal ions |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                           |  |  |  |                                                            |
|-------------------------------------------|--|--|--|------------------------------------------------------------|
| instrumental<br>methods in<br>their work. |  |  |  | sugars, water, pulp, and lots of<br>other things.<br><br>. |
|-------------------------------------------|--|--|--|------------------------------------------------------------|

| Topic 7<br>Chemistry of the atmosphere.                                                                                                                                                                                                                                                                                                                                                                                       | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                                                                                                                                       | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> <i>.... how to (Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                                                                                                       | Key Tier 3 vocabulary                                                    | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The Earth's atmosphere is dynamic and forever changing. The causes of these changes are sometimes man-made and sometimes part of natural cycles. Scientists use software to predict weather and climate change as there are many variables that can influence this. The problems caused by increased levels of air pollutants require scientists and engineers to develop solutions that help mitigate human activity.</p> | <div>  <p><b>Linking</b></p> <p>KS3</p> <p><b>Year 7</b><br/>Materials</p> <p><b>Year 8</b><br/>Earth - climate</p> <p>KS4</p> <div>  <p><b>Looking</b></p> <p><b>Year 11</b><br/>Apply atmosphere knowledge to extended questions.</p> <p>Post 16<br/>Ozone layer and CFCs AS<br/>Chemistry</p> </div> </div> | <p><b><u>Lesson 1 – Composition of the Atmosphere</u></b><br/> <i>... that</i> the atmosphere is a mixture of gases<br/> <i>...that</i> theories about what was in the Earth's early atmosphere and how the atmosphere was formed have changed over time.<br/> <i>...how to</i> interpret graphs and charts which compare atmospheres.<br/> <i>...how to</i> apply knowledge to past exam questions</p> | Composition, atmosphere                                                  | <p><b>a) Numeracy</b><br/>Construct and interpret tables, graphs and charts on the composition of atmosphere of planets in the solar system.</p> <p><b>b) Literacy</b><br/>Scientific literacy – CO and CO<sub>2</sub></p> <p><b>c) Reading</b><br/>Reading and summarising accounts on the development of the atmosphere and the effects of climate change.</p> <p><b>d) Cultural Capital/Careers</b><br/>Climate scientist.<br/>COP 25. International government agreements on mitigating climate change.<br/>George Monbiot – political activist on climate change and the environment.</p> <p><b>e) Cross curricular knowledge links</b><br/>Geography – climate change</p> <p><b>(f) Misconceptions</b><br/>The gas we breath in for respiration isn't the largest part of our atmosphere<br/>The proportion of gases has stayed the same for around 200 million years, it has only started to change over the last 200 in a very small way<br/>Global warming and cooling are natural and have happened in cycles since Earth</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b><u>Lesson 2 – Evolution of the Atmosphere</u></b><br/> <i>...that</i> the Earth's atmosphere evolved from early Earth to modern Earth<br/> <i>...how to</i> interpret evidence and evaluate different theories about the Earth's early atmosphere.<br/> <i>...how to</i> apply knowledge to past exam questions</p>                                                                               | Evolution, dissolving, sedimentary photosynthesis                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b><u>Lesson 3 – Carbon Dioxide and the Greenhouse Effect</u></b><br/> <i>...that</i> climate change is impacted by the greenhouse effect,<br/> <i>....how to</i> describe and explain the greenhouse effect and its consequences.<br/> <i>...how to</i> apply knowledge to past exam questions</p>                                                                                                  | Carbon dioxide, methane, radiation, greenhouse gases, greenhouse effect. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b><u>Lesson 4 and 5 – Global Warming and Climate Change</u></b><br/> <i>...that</i> climate change is having a significant impact on the way we live, the weather and the habitats in our world.<br/> <i>.....how to</i> evaluate the impact climate change will have on agriculture, animals, ecosystems, coastal regions and water supplies.</p>                                                  | climate change, environment, impact, precipitation, ecosystem            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|  |  |                                                                                                                                                                                                                                                                                                                         |                                                                                                                 |                                                                                                                                                                                                                  |
|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | ... <i>how</i> to apply knowledge to past exam questions                                                                                                                                                                                                                                                                |                                                                                                                 | was a ball of molten rock, the argument is that humans have impacted on this cycle.                                                                                                                              |
|  |  | <b><u>Lesson 6 – Products of Combustion</u></b><br>... <i>that</i> combustion of fuels releases harmful products<br>... <i>how to</i> prove the products of complete combustion<br>.... <i>how to</i> link named emissions with the associated consequence.<br>... <i>how</i> to apply knowledge to past exam questions | Pollutants, emissions,<br>combustion, global dimming,<br>Sulphur dioxide<br>Nitrogen oxides, Carbon<br>monoxide | Climate change and global warming are different, climate change is changes to the weather that can have drastic consequences, and global warming is the average warming of the Earth that causes climate change. |

| Topic 1<br>CHEMISTRY<br>Atomic structure                                                                                                                                                                                                                                                                                                                                      | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                                                                    | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> .... <i>how to (Procedural)</i><br>L ADDERING                                                                                                                                                                                                                                                                                                                                                   | Key Tier 3 vocabulary                                                                                                      | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The periodic table provides chemists with a structured organisation of the known chemical elements from which they can make sense of their physical and chemical properties. The historical development of the periodic table and models of atomic structure provide good examples of how scientific ideas and explanations develop over time as new evidence emerges.</p> | <div>  <p>KS3</p> <p><b>Year 7</b></p> <p>Matter, separating mixtures.</p> <p><b>Year 8</b></p> <p>Elements, periodic table.</p> <p>KS4</p> <div>  </div> <p><b>Post 16</b></p> <p>Atomic structure</p> <p>Structure and bonding</p> </div> | <p><b><u>Lesson 1 – Compounds and Formulae</u></b></p> <p><i>...that</i> Elements are materials made up of one type of atom. Compounds contain two or more different types of atom, chemically bonded together</p> <p>.... <i>how to</i> distinguish between compounds and elements and write simple chemical formulae. Interpret particle diagrams.</p> <p><i>...how to</i> apply knowledge to past exam questions</p>                                                      | <p>Atom, element, compound</p>                                                                                             | <p><b>a) <u>Numeracy</u></b></p> <p>Electronic configuration</p> <p><b>b) <u>Literacy</u></b></p> <p>Learn significant number of subject specific vocabulary and use in correct context.</p> <p><b>c) <u>Reading</u></b></p> <p>Describe how scientific models develop over time. Reading in different formats e.g. timeline.</p> <p><b>d) <u>Cultural Capital/Careers</u></b></p> <p>Understand the historical significance and contributions of Dalton and Mendeleev to the development of the periodic Table.</p> <p><b>e) <u>Cross curricular knowledge links</u></b></p> <p>DT – materials</p> <p><b>f) <u>Misconceptions</u></b></p> <p>Chemicals are not bad for you, everything is made up of chemicals.</p> <p>We can't see atoms and haven't been able to until around 2018, scientists have used other practical techniques to be able to predict what we know about atoms.</p> <p>Theories of atoms have changed over time, a theory is not just an idea, and it has experimental evidence behind it.</p> |
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b><u>Lesson 2 – Separating Mixtures</u></b></p> <p><i>...that</i> a mixture is made up of two or more substances that are not chemically joined together. Mixtures can be separated according to their properties.</p> <p>.... <i>how to</i> select the best method for separation of a given mixture, including appropriate apparatus.</p> <p><i>...why</i> a particular method is most appropriate.</p> <p><i>...how to</i> apply knowledge to past exam questions</p> | <p>Mixture, purity, separation, evaporation, filtration, evaporation, chromatography</p> <p>Solute, solvent, solution.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b><u>Lesson 3 – Potable Water</u></b></p> <p><i>...that</i> potable water, is water which is safe to drink</p> <p>potable water can be obtained by distillation</p> <p>.... <i>how to</i> explain the process of simple distillation.</p> <p><i>...how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                 | <p>Potable, pure, boiling point, melting point</p>                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                               | <p><b><u>Lesson 4 – Structure of the Atom</u></b></p> <p><i>...that</i> the atom can be describes in terms of sub atomic particles. Isotopes are atoms of elements with the same number of protons but different numbers of neutrons.</p> <p><i>...how to</i> calculate the numbers of protons, electrons and neutrons in an atom.</p> <p><i>...how to</i> apply knowledge to past exam questions</p>                                                                        | <p>Protons, electrons, neutrons, isotopes, sub atomic particle, electronically neutral.</p>                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                       |                                                                                          |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------|
|  |  | <b><u>Lesson 5 – Developing the Atomic Model</u></b><br><i>...that</i> the model of the atom has changed over time, starting with Dalton’s idea of atoms being tiny solid balls to the plum pudding model to the Bohr model of the atom that is used today.<br><i>....how to</i> compare models of the atom over time.<br><i>...how to</i> apply knowledge to past exam questions                   | Plum pudding, Bohr, nuclear model, Rutherford.                        | There is not only one type of atom but 118 known types, these types are called elements. |
|  |  | <b><u>Lesson 6 – Electron Configuration</u></b><br><i>...that</i> electrons have a specific arrangement in the atom, occupying the lowest energy level first and filling up a shell before moving to the next.<br><i>....how to</i> arrange the electrons of the first 20 elements.<br><i>...how to</i> apply knowledge to past exam questions                                                      | Electrons, shells, energy levels<br>Electron configuration.<br>occupy |                                                                                          |
|  |  | <b><u>Lesson 7 – The Periodic Table</u></b><br><i>...that</i> the Periodic table is arranged in columns called groups and rows called periods. The structure of the Periodic table has changed over time.<br><i>....how to</i> the scientists John Newlands, and Dimitri Mendeleev contributed to the development of the Periodic table.<br><i>...how to</i> apply knowledge to past exam questions | Period, group                                                         |                                                                                          |
|  |  | <b><u>Lesson 8 – Group 1 Elements</u></b><br><i>...that</i> group 1 are known as the alkali metals and react in a similar way, but the reactivity increases down the group.<br><i>....how to</i> account for the increase in reactivity down group 1.<br><i>...how to</i> apply knowledge to past exam questions                                                                                    | Electron configuration, shielding, reactivity.                        |                                                                                          |
|  |  | <b><u>Lesson 9 and 10 – Group 7 Elements</u></b><br><i>...that</i> group 7 elements are known as the halogens and undergo displacement reactions. Group 7 elements react in a similar way, but the level of reactivity decreases down the group.                                                                                                                                                    | Reactivity, electrons, displacement.                                  |                                                                                          |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                          |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--|
|  |  | <p>...<i>how to</i> explain the trend in reactivity down group 7.</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                          |  |
|  |  | <p><b><u>Lesson 11 – Group 0 and Transition Metals</u></b></p> <p>...<i>that</i> transition metals are less reactive, denser, harder, and stronger than group 1 metals. Transition metals can be used as catalysts and have coloured compounds.</p> <p>...<i>that</i> Group 0 are known as the Noble gases, have full shells of electrons.</p> <p>...<i>how to</i> compare the reactivity of group 1 and the transition metals. Explain the unreactivity of group 0.</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | <p>Transition metal</p> <p>Noble gases</p> <p>Electron configuration</p> |  |

| Topic 3<br>Chemical Changes                                                                                                                                                                                                                                                                                                                                                                                            | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> .... <i>how to (Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                                                                            | Key Tier 3 vocabulary                                                                | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.4 Chemical Changes</b><br>Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organising their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes |  <b>LINKING</b><br><b>Year 7</b><br>Acids and alkalis<br>Metals and non- metals<br><b>Year 8</b><br>Types of reaction<br><b>Year 9</b><br>Chemical changes, reactions of metals, reactivity series and acids and alkalis<br><br> <b>LOOKING</b><br><b>Year 11</b><br>Chemical changes – paper 1<br><b>Post 16</b><br>Acid, alkali titrations.<br>Types of acid.<br>Neutralisation reactions. | <b><u>Lesson 1 – Reactivity Series and Displacement Reactions</u></b><br><i>...that</i> the reactivity series places metals in increasing order of reactivity and can be used to predict reactions.<br><i>....how to</i> use the reactivity series to predict whether or not a displacement reaction will happen.<br><i>...how to</i> apply knowledge to past exam questions | ionic compounds, reactivity series, displacement                                     | a) <b><u>Numeracy</u></b><br>Balancing ionic equations for more able students.<br><br>b) <b><u>Literacy</u></b><br>Etymology of words to describe metallic properties e.g. lustre.<br><br>c) <b><u>Reading</u></b><br>Methods, hazard warnings, extraction of aluminium reading to extract knowledge. Application of hydrogen homes. |
|                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b><u>Lesson 2 – The Process of Electrolysis</u></b><br><i>...that</i> electrolysis is a process which separates ionic compounds<br><i>.... how to</i> describe and explain the process of basic electrolysis<br><i>.... how to</i> represent the process at the electrodes using half equations<br><i>...how to</i> apply knowledge to past exam questions                  | Electrolysis, anode, cathode, anion, cation, electrolyte, electrodes, half equations | d) <b><u>Cultural Capital/Careers</u></b><br>Hydrogen extraction for fuels (hydrogen homes)<br><br>e) <b><u>Cross curricular knowledge links</u></b><br>Environmental impacts of large scale metal extraction – recycling metals and alternative metal extraction<br><br>f) <b><u>Misconceptions</u></b>                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b><u>Lesson 3 – The Extraction of Aluminium</u></b>                                                                                                                                                                                                                                                                                                                         | Bauxite, aluminium, electrodes, electrolysis, half equations                         | Not all metals are found as pure metal on Earth, most are found in                                                                                                                                                                                                                                                                   |

|  |  |                                                                                                                                                                                                                                                                                           |                                                                  |                                                                                                                                                                                                                                                                                                                                     |
|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>...<i>that</i> aluminium is a reactive metal that requires electrolysis to be separated from its ores</p> <p>.... <i>how</i> the extraction of aluminium is adjusted and has special conditions</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                     |                                                                  | <p>rocks as metal oxides or metal carbonates which are called ores.</p> <p>During electrolysis the metal is not always produced, if the metal is higher in reactivity than hydrogen then hydrogen is produced. A solution of the metal hydroxide would also be produced which is then later purified to produce the pure metal.</p> |
|  |  | <p><b><u>Lesson 4 – Aqueous Electrolysis</u></b></p> <p>...<i>that</i> aqueous solutions of ionic compounds can be separated using electrolysis</p> <p>.... <i>how to</i> predict the products of aqueous electrolysis</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Aqueous, prediction, products, reactivity series, halogens       |                                                                                                                                                                                                                                                                                                                                     |
|  |  | <p><b><u>Lesson 5 – Electrolysis Required Practical</u></b></p> <p>.... <i>how to</i> predict the products of electrolysis then test the predictions using the practical equipment</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                     | Aqueous, hazards, risks, electrolyte, anode, cathode             |                                                                                                                                                                                                                                                                                                                                     |
|  |  | <p><b><u>Lesson 6 – Neutralisation, pH and Indicators</u></b></p> <p>...<i>that</i> acids, alkalis and bases are chemicals which react in neutralisation reactions</p> <p>.... <i>how to</i> explain the differences between strong and weak acids</p>                                    | Acid, alkali, base, pH, neutralisation, indicators, strong, weak |                                                                                                                                                                                                                                                                                                                                     |

|  |  |                                                                                                                                                                                                                                                                                                         |                                                                                            |  |
|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--|
|  |  | ... <i>how to</i> apply knowledge to past exam questions                                                                                                                                                                                                                                                |                                                                                            |  |
|  |  | <b><u>Lesson 7 and 8 – Titration Required Practical</u></b><br>... <i>that</i> unknown concentrations can be determined using a titration reaction<br>... <i>how to</i> safely complete a titration practical to achieve concordant results<br>... <i>how to</i> apply knowledge to past exam questions | Titration, burette, pipette, indicator, end point, acid, alkali, concentration, concordant |  |

| Topic 5<br>Energy Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                              | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> .... <i>how to (Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                           | Key Tier 3 vocabulary                                              | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.5 Energy Changes</b><br>Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds.<br><br>Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. | <br><br><b>Year 8</b><br>Endothermic and exothermic reactions<br><br><br><br><b>Year 11</b><br>Apply energy change knowledge and detailed use of cells and batteries.<br><b>Post 16</b><br>Energetics | <b><u>Lesson 1 – Exothermic and Endothermic</u></b><br><i>...that</i> exothermic reactions release heat energy and endothermic absorb heat energy from their surroundings.<br><i>.... how to</i> draw reaction profiles for exothermic and endothermic reactions<br><i>...how to</i> apply knowledge to past exam questions | Exothermic, endothermic, profiles, activation energy, surroundings | <b>a) Numeracy</b><br>Analysis and evaluation of data based questions using graphs and/or tables for energy transfer<br>Carry out bond energy calculations<br><br><b>b) Literacy and reading</b><br>Reading methods in order to follow instructions.<br>Student safety sheets in order to evaluate risks in a practical.<br><br><b>c) Cultural Capital/Careers</b><br>Food hygienist and preparation – hot and cold cans.<br>Medics hot and cold packs.<br>DoFE – hand warmers |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                         | <b><u>Lesson 2 – Bond Enthalpy Calculations</u></b><br><i>...that</i> bonding breaking is endothermic and bond formation is exothermic<br><i>...how to</i> calculate bond enthalpy changes<br><i>...how to</i> apply knowledge to past exam questions                                                                       | Enthalpy, exothermic, endothermic, $\Delta H$ .                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                         | <b><u>Lesson 3 and 4 – Temperature Changes Practical</u></b><br><i>...how to</i> safely conduct a practical to investigate temperature changes in a reaction                                                                                                                                                                | Extrapolation, variables, hazard, risk, control                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                        |                                          |                                                                                                                                                                                                                                                                                                               |
|--|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>.... <i>how to</i> draw a graph from which data can be extrapolated</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                                                                                              |                                          |                                                                                                                                                                                                                                                                                                               |
|  |  | <p><b><u>Lesson 5 – Fuel Cells and Batteries</u></b></p> <p>...<i>that</i> cells and batteries use chemical reactions to produce an electrical current</p> <p>.... <i>how to</i> evaluate the use of hydrogen fuel cells</p> <p>...<i>how to</i> write half equations for the processes inside a hydrogen fuel cell</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Fuel cell, battery, ions, half equations | <p><b>e) Misconceptions</b></p> <p>It requires energy to break bonds and releases energy when bonds are made. The enthalpy change is a balance between energy used from bond breaking and bond making.</p> <p>Endothermic reactions are cold as they take in thermal (heat) energy from the surroundings.</p> |

| Topic 7<br>Organic Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                                                                    | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> <i>... how to (Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                                                                                                                | Key Tier 3 vocabulary                                                                                                                       | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.7 Organic Chemistry</b><br>The chemistry of carbon compounds is so important that it forms a separate branch of chemistry. A great variety of carbon compounds is possible because carbon atoms can form chains and rings linked by C-C bonds. The main sources of organic compounds are living, or once-living materials from plants and animals. These sources include fossil fuels, a major source of feedstock for the petrochemical industry. Chemists take organic molecules and modify to make new, useful materials such as polymers, pharmaceuticals, perfumes and flavourings, dyes and detergents. | <br><b>Year 8</b><br>Elements, compounds, mixtures<br><br><b>Year 9</b><br>Atomic structure, separating mixtures<br><br><br><br><b>Year 11</b><br>Apply organic knowledge to extended questions.<br><br><b>Post 16</b><br>Organic chemistry | <b><u>Lesson 1 – Alkanes and Alkenes Review</u></b><br><i>...that</i> hydrocarbons can be classified as alkenes and alkanes<br><i>...how to</i> differentiate between alkenes and alkanes<br><i>...how to</i> apply knowledge to past exam questions                                                                                                                                                            | Alkanes, alkenes, double bond, unsaturated, saturated, functional group, homologous series                                                  | a) <b><u>Numeracy</u></b><br>Interpreting charts and graphs on data linking crude oil and its uses. Using general formulae to predict formulae of alkanes and alkenes.<br><br>b) <b><u>Literacy</u></b><br>Systematic naming of molecules in homologous series: meth-, eth-, prop-, etc. Key words in terms of properties of hydrocarbons and the etymology of these words.<br><br>c) <b><u>Reading</u></b><br>Reading for information retrieval. Literacy homework - Comparison and evaluation of the environmental impacts of production of ethanol from steam hydration of ethane and fermentation of glucose with yeast.<br><br>d) <b><u>Cultural Capital/Careers</u></b><br>Organic chemistry can help you get into careers in forensics, pharmaceuticals, making perfumes |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                               | <b><u>Lesson 2 – Alkenes and their Reactions</u></b><br><i>...that</i> alkenes undergo reactions in which atoms are added to the carbons in the double bond<br><i>...how to</i> test for the presence of the alkene functional group<br><i>...how to</i> represent the polymerisation of alkenes and predict the products of addition polymerisation<br><i>...how to</i> apply knowledge to past exam questions | Alkanes, alkenes, double bond, unsaturated, addition reactions, functional group, polymer                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                               | <b><u>Lesson 3 – Alcohols, Carboxylic Acids and Esters</u></b><br><i>...that</i> alcohols, carboxylic acids and esters are homologous series with differing functional groups which affects their chemical reactivity<br><i>... how to</i> test for the different functional groups and write equations for their reactions                                                                                     | Functional group, carboxylic acid, ester, ethyl ethanoate, strong and weak acids, Combustion, oxidising agent, fermentation, glucose, yeast |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|  |  |                                                                                                                                                                                                                                                                                   |                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | ... <i>how</i> to apply knowledge to past exam questions                                                                                                                                                                                                                          |                                                                                                                          | and flavours (Christmas dinner flavoured crisps!)<br>How synthetic polymers have had an impact on everyday life.<br>History of the discovery of DNA as a polymer chain.                                                                                                                                                                                                                                                  |
|  |  | <b><u>Lesson 4 – Condensation Polymers</u></b><br>... <i>that</i> condensation polymers are formed from two different monomers to give a polymer and water<br>... <i>how to</i> represent condensation polymers<br>... <i>how</i> to apply knowledge to past exam questions       | Condensation polymerisation, monomers, repeat units                                                                      | (e) <b><u>Cross curricular knowledge links</u></b><br>DT: polymers as design materials.<br>Geography – crude oil as a finite resources<br>Biology – biochemistry, amino acids, proteins and DNA                                                                                                                                                                                                                          |
|  |  | <b><u>Lesson 5 – Biochemistry</u></b><br>... <i>that</i> polymers exist naturally, for example proteins and DNA<br>... <i>how</i> natural polymers form<br>... <i>how to</i> describe the structure of DNA in detail.<br>... <i>how</i> to apply knowledge to past exam questions | Amino acids, polypeptides, proteins, cellulose, starch, deoxyribonucleic acid, polymer chains, nucleotides, double helix | (f) <b><u>Misconceptions</u></b><br>Organic does not mean natural – it chemistry it refers to carbon chemistry.<br>The “hydro” in hydrocarbons does not mean water – it means hydrogen.<br>Saturated means no double bonds present – not a “saturated solution”<br>Fractions themselves are a mixture of compounds with similar properties.<br>Fractional distillation is separation, cracking is thermal decomposition. |

## Year 11 Practical Review

| Topic            | Rationale<br>(layering, Why this<br>why now?)                                                                                                                                                                                                                                                                                  | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> .... <i>how to</i><br><i>(Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                                                                                                                             | Key Tier 3 vocabulary                                                                                                 | Core skills and<br>enrichment<br>opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Practical Review | <br><br>KS3 and GCSE Key<br>Practical Skills<br><br>Required Practical<br>Knowledge<br><br><br><br>Application to GCSE<br>exam questions<br><br>Post 16 CPAC | <i>...that</i> a mixture is made up of two or<br>more substances that are not chemically<br>joined together.<br>Mixtures can be separated according to<br>their properties.<br>.... <i>how to</i> select the best method for<br>separation of a given mixture, including<br>appropriate apparatus.<br>... <i>why</i> a particular method is most<br>appropriate.<br>.... <i>how to</i> apply knowledge to past<br>examination questions | Mixture, purity, separation,<br>evaporation, filtration, evaporation,<br>chromatography<br>Solute, solvent, solution. | <u><b>Numeracy</b></u><br>Analysis and<br>evaluation of data<br>based questions<br>using graphs and/or<br>tables for rates and<br>chemical changes.<br><br>Learners need to<br>employ the use of<br>suitable units when<br>measuring and<br>collecting data.<br><br>There is a need for<br>learners to develop<br>their mathematical<br>mastery to<br>determine the<br>gradient of a straight<br>line.<br><br>Learners will also<br>need to be able to<br>determine the<br>intercept on a linear<br>graph.<br><br><u><b>Literacy and reading</b></u> |
|                  |                                                                                                                                                                                                                                                                                                                                | <u><b>Making a soluble salt RP</b></u><br>... <i>how to</i> prepare a pure, dry sample of<br>a soluble salt from an insoluble oxide or<br>carbonate.<br>... <i>how to</i> apply knowledge to past exam<br>questions.                                                                                                                                                                                                                    | evaporation, crystallisation, base,<br>neutralisation, excess                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  |                                                                                                                                                                                                                                                                                                                                | <u><b>Lesson 6 – Neutralisation, pH and Indicators</b></u><br>... <i>that</i> acids, alkalis and bases are<br>chemicals which react in neutralisation<br>reactions<br>.... <i>how to</i> explain the differences<br>between strong and weak acids                                                                                                                                                                                       | Acid, alkali, base, pH, neutralisation,<br>indicators, strong, weak                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                  |                                                                                                                                                                                                                                                                                                                                | <u><b>Lesson 7 and 8 – Titration Required Practical</b></u><br>... <i>that</i> unknown concentrations can be<br>determined using a titration reaction                                                                                                                                                                                                                                                                                   |                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                        |                                                         |
|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
|  |  | .... <i>how to</i> safely complete a titration practical to achieve concordant results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                        | <u><a href="#">Cultural Capital/Careers</a></u>         |
|  |  | <b><u>Lesson 2 – The Process of Electrolysis</u></b><br>... <i>that</i> electrolysis is a process which separates ionic compounds<br>.... <i>how to</i> describe and explain the process of basic electrolysis<br>.... <i>how to</i> represent the process at the electrodes using half equations<br>... <i>that</i> aqueous solutions of ionic compounds can be separated using electrolysis<br>.... <i>how to</i> predict the products of aqueous electrolysis<br>.... <i>how to</i> predict the products of electrolysis then test the predictions using the practical equipment | Electrolysis, anode, cathode, anion, cation, electrolyte, electrodes, half equations<br><br>Aqueous, prediction, products, reactivity series, halogens | <u><a href="#">Cross curricular knowledge links</a></u> |
|  |  | <b><u>Lesson 1 – Exothermic and Endothermic</u></b><br>... <i>that</i> exothermic reactions release heat energy and endothermic absorb heat energy from their surroundings.<br>.... <i>how to</i> draw reaction profiles for exothermic and endothermic reactions<br>... <i>how to</i> safely conduct a practical to investigate temperature changes in a reaction<br>.... <i>how to</i> draw a graph from which data can be extrapolated                                                                                                                                           | Exothermic, endothermic, profiles, activation energy, surroundings, extrapolation, variables, hazard, risk, control                                    |                                                         |
|  |  | <b><u>Lesson 1 – Measuring Rate of Reaction</u></b><br>... <i>that</i> mean rate of reaction can be determined by measuring quantity of mass used or product released<br>... <i>how to</i> determine the rate of a chemical reaction by interpreting data<br>... <i>that</i> the rate of reaction can be changed by altering conditions                                                                                                                                                                                                                                             | Product, reactant, rate, mean, gradient<br><br>Dependent, independent, control, variable, surface area, delivery tube                                  |                                                         |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|  |  | <p>...<i>how to</i> use collision theory to explain the effect of changing conditions on the rate of reaction</p> <p>...<i>how to</i> measure the rate of reaction during a practical for production of gaseous products</p> <p>...<i>how to</i> represent data using graphs</p> <p>...<i>how to</i> measure the rate of reaction during a practical which produces solid</p> <p>...<i>how to</i> represent data using graphs</p> <p>...<i>how to</i> describe and explain the shape of a graph</p> |  |  |
|  |  | <p><b><u>Lesson 5 – Testing for Common Gases and Instrumental Analysis</u></b></p> <p>...<i>that</i> carbon dioxide, oxygen, hydrogen and chlorine have specific tests which can be used to identify them</p> <p>...<i>that</i> instrumental methods of analysis have advantages over traditional methods</p> <p>...<i>how to</i> analysis flame emission spectroscopy data to determine ions in a compound</p>                                                                                     |  |  |
|  |  | <p><b><u>Lesson 3 and 4 - Chromatography</u></b></p> <p>...<i>that</i> chromatography can be used to separate mixtures and can give information to help identify substances.</p> <p>....<i>how to</i> calculate R<sub>f</sub> values</p> <p>...<i>how to</i> set up an investigation to find the content/ solubility of a dye and to calculate the R<sub>f</sub> value.</p> <p>....<i>how to</i> apply knowledge to past exam questions</p>                                                         |  |  |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|  |  | <u>Lesson 2, 3, 4 – Required Practical – Testing for Ions</u><br><i>...that</i> positive metal and negative non-metal ions can be distinguished using indicative tests<br><i>....how to</i> use indicative tests to identify common ions<br><i>....how to</i> safely complete an indicative tests practical                                                                                                     |  |  |
|  |  | <u>Lesson 2 – Potable Water</u><br><i>...that</i> potable water is different to pure water.<br><i>... how to</i> test the purity of water.<br><i>... how to</i> describe the differences between the treatment of ground water and freshwater<br><i>... how to</i> purify salt water by simple distillation.<br><i>... how to</i> test the purity of the water produced by determining mass of dissolved solids |  |  |

| Topic 3<br>Quantitative Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rationale<br>(Layering, Why this why now?)                                                                                                                                                                                                                                                                                                                                                                                                               | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> <i>... how to (Procedural)</i><br>LADDERING                                                                                                                                                                                                                      | Key Tier 3 vocabulary                                             | Core skills and enrichment opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions. Identifying different types of chemical reactions allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas. |  <p><b>Year 8</b><br/>Periodic table</p> <p><b>Year 9</b><br/>Atomic structure and periodic table, chemical changes, acids and alkalis</p>  <p><b>Year 11</b><br/>Apply quantitative knowledge across a broad range of questions.</p> <p><b>Post 16</b><br/>Quantitative chemistry</p> | <b><u>Lesson 1 – Relative Atomic and Relative Formula Mass</u></b><br><i>...that</i> relative atomic masses are found on the periodic table<br><i>...how to</i> calculate relative atomic and relative formula mass<br><i>...how to</i> calculate percentage element in a compound<br><i>...how to</i> apply knowledge to past exam questions | Mass number, formula mass, formula, equation, reactants, products | <p><b>a) <u>Numeracy</u></b><br/>A wide range of calculation on moles, RFM, reacting masses, limiting factors, concentration of solutions.<br/>Analysis and evaluation of data based questions using graphs and/or tables for quantitative questions.</p> <p><b>b) <u>Literacy and reading</u></b></p> <p><b>c) <u>Cultural Capital/Careers</u></b><br/>Chemical engineers, pharmaceuticals, toxicology, river water analysis</p> <p><b>d) <u>Cross curricular knowledge links</u></b><br/>Rearranging equations, converting units, percentages all linked with maths skills</p> <p><b>e) <u>Misconceptions</u></b><br/>When balancing equations you can't change how the compounds are made up – this means you can't add</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b><u>Lesson 2 Conservation of Mass</u></b><br><i>...that</i> mass is conserved in a reaction<br><i>...how to</i> use chemical equations to evaluate conservation of mass<br><i>...how to</i> apply knowledge to past exam questions                                                                                                          | Conservation, mass, balanced                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b><u>Lesson 3 – Conservation of Mass Practical</u></b><br><i>...that</i> mass does not always appear to be conserved in a reaction                                                                                                                                                                                                           | Safety, crucible, balance, weighing boat                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|  |  |                                                                                                                                                                                                                                                                                                                  |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>...<i>how to</i> complete a practical to investigate conservation of mass safely</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                           |                                                                         | <p>or take away any of the 'small numbers'.</p> <p>Some reactions look like mass is lost however it is normally a product that is a gas escaping from wherever the reaction is happening.</p> <p>HT ONLY. A mole is just a number. As atoms are so small it is impossible to talk about 1 atom of a substance, we can only really talk about them in very large amounts. So, a mole was created as a standard, it stands for <math>6.02 \times 10^{23}</math> particles.</p> <p>Understanding the correct units and their conversions.</p> <p>Appreciation of standard form and manipulation of standard form within calculations.</p> <p>Scale of what a decimetre is.</p> <p>Use of non-integers in balancing equations.</p> |
|  |  | <p><b><u>Lesson 4 - Introduction to Moles</u></b></p> <p>...<i>that</i> a mole is a chemical quantity</p> <p>...<i>how to</i> calculate moles using the correct equation</p> <p>...<i>how to</i> rearrange the moles equation</p> <p>...<i>how to</i> apply your knowledge to questions</p>                      | Mole, quantity, mass, relative atomic/formula mass, Avogadro's constant |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|  |  | <p><b><u>Lesson 5 – Reacting Masses</u></b></p> <p>...<i>that</i> moles can be used to calculate required masses of reagents and predicted masses of products</p> <p>...<i>how to</i> apply the moles equation to calculating reacting masses</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Moles, reacting masses, balanced equation, conservation                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|  |  | <p><b><u>Lesson 6 – Using Moles to Balance Equations</u></b></p> <p>...<i>that</i> moles can be used to calculate required masses of</p>                                                                                                                                                                         | Balancing, stoichiometry, moles                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|  |  |                                                                                                                                                                                                                                                                                                                                               |                                                                             |  |
|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--|
|  |  | <p>reagents and predicted masses of products</p> <p>...<i>how to</i> apply the moles equation to find stoichiometry to balance equations</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                   |                                                                             |  |
|  |  | <p><b><u>Lesson 7 – Limiting Reactants</u></b></p> <p>...<i>that</i> quantity of product is limited by the quantity of reactant</p> <p>...<i>how to</i> apply the moles equation to find the limiting reactant in a reaction</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                               | Stoichiometry, limiting reactant, excess                                    |  |
|  |  | <p><b><u>Lesson 8 – Percentage Yield and Atom Economy</u></b></p> <p>...<i>that</i> reactions do not always produce a 100% yield</p> <p>...<i>how to</i> calculate percentage yield for given reactions</p> <p>...<i>how to</i> calculate atom economy for given reactions</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Completion, reversible, yield, reactant, product, theoretical, atom economy |  |
|  |  | <p><b><u>Lesson 9 – Concentration of Solutions</u></b></p> <p>...<i>that</i> cubic decimetres are a unit of concentration</p>                                                                                                                                                                                                                 | Solutions, concentration, volume, solute, decimetre, cubic centimetre, mass |  |

|  |  |                                                                                                                                                                                                                                                                                                                                       |                                                                              |  |
|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--|
|  |  | <p>...<i>how to</i> convert between units</p> <p>...<i>how to</i> calculate the concentration of solutions.</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                        |                                                                              |  |
|  |  | <p><b><u>Lesson 10 – Titration Calculations</u></b></p> <p>...<i>that</i> the concentration of an unknown acid or alkali can be found via a titration reaction</p> <p>...<i>how to</i> calculate the concentration of an unknown using the concentration equations</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Solutions, concentration, volume, solute, decimetre, cubic centimetre, mass, |  |
|  |  | <p><b><u>Lesson 11 – Volume of Gases</u></b></p> <p>...<i>that</i> one mole of gas occupies a set volume</p> <p>...<i>how to</i> calculate the volume of gas using the moles equation</p>                                                                                                                                             | Volume, temperature, pressure, volumes, gaseous                              |  |

| Topic 6<br>Rate and Extent of<br>Chemical Change                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Rationale<br>(Layering, Why this<br>why now?)                                                                                                                                                                                                                                                                                                                 | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative)</i> <i>... how to</i><br><i>(Procedural)</i><br><b>L ADDERING</b>                                                                                                                                                                                        | Key Tier 3 vocabulary                                                                                                                   | Core skills and enrichment<br>opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.6 Rate and extent of<br/>chemical change</b><br>Chemical reactions can<br>occur at vastly<br>different rates. Whilst<br>the reactivity of<br>chemicals is a<br>significant factor in<br>how fast chemical<br>reactions proceed,<br>there are many<br>variables that can be<br>manipulated in order<br>to speed them up or<br>slow them down.<br>Chemical reactions<br>may also be reversible<br>and therefore the<br>effect of different<br>variables needs to be<br>established in order to<br>identify how to<br>maximise the yield of<br>desired product. In<br>industry, chemists and<br>chemical engineers<br>determine the effect of<br>different variables on<br>reaction rate and yield | <br><b>Year 8</b><br>Rates of reaction<br><br><br><b>Year 11</b><br>Apply rate and<br>extent of chemical<br>change knowledge<br>to extended<br>questions.<br><br><b>Post 16</b><br>kinetics | <b><u>Lesson 1 – Measuring Rate of Reaction</u></b><br><i>...that</i> mean rate of reaction can be<br>determined by measuring quantity of<br>mass used or product released<br><i>...how to</i> determine the rate of a<br>chemical reaction by interpreting data<br><i>...how to</i> apply knowledge to past exam<br>questions    | Product, reactant, rate, mean,<br>gradient                                                                                              | <b>a) <u>Numeracy</u></b><br>Analysis and evaluation of data<br>based questions using graphs<br>and/or tables for rates and<br>chemical changes.<br><br>Learners need to employ the<br>use of suitable units when<br>measuring and collecting data.<br><br>There is a need for learners to<br>develop their mathematical<br>mastery to determine the<br>gradient of a straight line.<br><br>Learners will also need to be<br>able to determine the intercept<br>on a linear graph.<br><br><b>b) <u>Literacy and reading</u></b><br>Analysis and evaluation of data<br>based questions using extended<br>text for use of changing<br>conditions on the Haber<br>process.<br><br><b>c) <u>Cultural Capital/Careers</u></b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                               | <b><u>Lesson 2 – Factors affecting rate of<br/>reaction</u></b><br><i>...that</i> the rate of reaction can be<br>changed by altering conditions<br><i>...how to</i> use collision theory to explain<br>the effect of changing conditions on the<br>rate of reaction<br><i>...how to</i> apply knowledge to past exam<br>questions | Collision, particle, energy, activation,<br>rate, concentration, pressure,<br>sufficient, catalyst, temperature,<br>surface area, state |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                               | <b><u>Lesson 3 and 4 – Changing Surface Area</u></b><br><i>...how to</i> measure the rate of reaction<br>during a practical for production of<br>gaseous products<br><i>...how to</i> represent data using graphs<br><i>...how to</i> apply knowledge to past exam<br>questions                                                   | Dependent, independent, control,<br>variable, surface area, delivery tube                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                               | <b><u>Lesson 5, 6 and 7 – Changing<br/>Concentration</u></b>                                                                                                                                                                                                                                                                      | Dependent, independent, control,<br>variable, rate, concentration,<br>hydrochloric, thiosulphate.                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                |                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>of product. Whilst there may be compromises to be made, they carry out optimisation processes to ensure that enough product is produced within a sufficient time, and in an energy-efficient way.</p> | <p>...<i>how to</i> measure the rate of reaction during a practical which produces solid<br/>         ...<i>how to</i> represent data using graphs<br/>         ...<i>how to</i> describe and explain the shape of a graph<br/>         ...<i>how to</i> apply knowledge to past exam questions</p>            | <p>Erlenmeyer, obscure, hypothesis, conclusion</p>                                              | <p>How the Haber Process has had an impact on the global economy.</p>                                                                                                                                                                                                                                                                                                                                              |
|                                                                                                                                                                                                          | <p><b><u>Lesson 8 – Reversible Reactions</u></b><br/>         ... <i>that</i> some chemical reactions are reversible<br/>         ...<i>how to</i> represent reversible reactions<br/>         ...<i>how to</i> apply knowledge to past exam questions</p>                                                     | <p>Reactant, product, forward, backward, reversible, equilibrium, rate, anhydrous, hydrated</p> | <p><b>d) <u>Cross curricular knowledge links</u></b><br/>         Opportunities for learners to demonstrate their research skills</p>                                                                                                                                                                                                                                                                              |
|                                                                                                                                                                                                          | <p><b><u>Lesson 9 and 10 – Equilibria and Le Chateliers</u></b><br/>         ... <i>that</i> chemical reactions reach a state of equilibria<br/>         ...<i>how to</i> apply the three steps to success to Le Chateliers principle<br/>         ...<i>how to</i> apply knowledge to past exam questions</p> | <p>Reactant, product, forward, backward, reversible, equilibrium, Le Chatelier.</p>             | <p><b>e) <u>Misconceptions</u></b><br/>         Not all reactions happen quickly, some take millions of years to happen!</p> <p>Mass and energy are never lost or created; however, it might look like the mass goes down during a reaction. But this is because a gas will be given off and has escaped.</p> <p>Catalysts are not part of the reaction; they just interact with the atoms to help them react.</p> |
|                                                                                                                                                                                                          | <p><b><u>Lesson 11 – Haber Process</u></b><br/>         ... <i>that</i> the Haber process is a major industrial reaction<br/>         ...<i>how to</i> explain the compromise conditions required in the Haber process<br/>         ...<i>how to</i> apply knowledge to past exam questions</p>                | <p>Haber process, ammonia, reactor, fertilisers</p>                                             | <p>Particles collide all the time however not all collisions cause a reaction, this is because they don't have enough energy for the reaction to occur.</p>                                                                                                                                                                                                                                                        |



| Topic 10<br>Earth's Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Rationale<br>(Layering, why<br>this why now?)                                                                                                                                                                                                                                                                                                              | Knowledge goals: <i>You need to know....</i><br><i>...that (Declarative) ... how to (Procedural)</i><br>L ADDERING                                                                                                                                                                                                                                                                                                                         | Key Tier 3 vocabulary                                                                                                                                                                                           | Core skills and enrichment<br>opportunities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.10 Earths resources and using resources.</b><br>Industries use the Earth's natural resources to manufacture useful products.<br>To operate sustainability, chemists seek to minimise the use of limited resources, use of energy, waste, and environmental impact in the manufacture of these products.<br>Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised.<br>Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists' study how human activity has affected the Earth's | <br><b>Year 7</b><br>Fossil fuels<br><b>Year 9</b><br>Organic chemistry<br><br><br><b>Year 11</b><br>Apply Earths resources and using resources knowledge.<br><b>Post 16</b><br>Polymers | <b><u>Lesson 1 – The Earths Resources</u></b><br><i>...that</i> the Earth provides all the resources needed for human survival.<br><i>... how to</i> distinguish between finite and renewable sources.<br><i>...how to</i> apply knowledge to past exam questions                                                                                                                                                                          | Resources, warmth, shelter, food, transport, natural, agriculture, fuels, finite, renewable.                                                                                                                    | <b>a) <u>Numeracy</u></b><br>Extract and interpret information about resources from charts, graphs, and tables.<br><br>Use orders of magnitude to evaluate significance of data.<br><br><b>b) <u>Literacy and reading</u></b><br>Analysis and evaluation of data-based questions using extended text for LCAs and metal extraction methods.<br>Methods to produce potable water, comparison, and evaluation.<br>Reading for information retrieval.<br><br><b>c) <u>Cultural Capital/Careers</u></b><br>How composites have had an impact on everyday life.<br>The Haber process, its place in history and the modern impacts of fertiliser development.<br>Access to potable water and purification of water sources in different locations around the global – the challenges and |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                            | <b><u>Lesson 2– Alternative Extraction of Metals</u></b><br><i>...that</i> the Earth's resources of metal ores is limited.<br><i>... how to</i> use alternative extraction methods to access low grade ores.<br><i>...how to</i> apply knowledge to past exam questions                                                                                                                                                                    | Metal ores, phytomining, bioleaching, bacteria, leachate, electrolysis, metal extraction.                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                            | <b><u>Lesson 3 – Reduce, Reuse and Recycle and Life Cycle Assessments</u></b><br><i>...that</i> reducing, reusing, and recycling help to conserve resources.<br><i>... how to</i> evaluate ways of reducing the use of materials.<br><i>...that</i> life cycle assessments are carried out to assess environmental impact of products.<br><i>... how to</i> carry out a life cycle assessment for shopping bags made of paper and plastic. | Life cycle assessment, manufacturing, packaging, lifetime, quantified, processing.<br><br>Metals, glass, building materials, ceramics, quarrying, mining, recycled, melting, recasting, scrap, ore, extraction. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                                                             |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| natural cycles and how damaging effects can be minimalised. |  | ... <i>how</i> to apply knowledge to past exam questions                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                          | implications of water safe for everyone to drink.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                             |  | <b><u>Lesson 4 – Materials</u></b><br>... <i>that</i> most everyday metals we use are alloys and they have specific uses.<br>... <i>how to</i> interpret and evaluate the composition and uses of alloys.<br>... <i>that</i> the properties of materials are related to their uses.<br>... <i>how to</i> compare the physical properties of glass and clay ceramics, polymers, and composites.<br>... <i>how</i> to apply knowledge to past exam questions | Alloys, jewellery, proportion, carats, shaped, malleable, ductile, corrosion, resistant, density.<br><br>Limestone, borosilicate, temperature, clay, pottery, conditions, density, thermosoftening, polymers, thermosetting, composites. | <b>d) <u>Cross curricular knowledge links</u></b><br>The Haber process, its place in history and the modern impacts of fertiliser development – links to History and Geography.<br>Design Technology – materials and their uses.<br><br><b>e) <u>Misconceptions</u></b><br>Water has been cycled through the water cycle millions of times; it can be purified easily.<br><br>The reduction of energy use in cleaning water and recycling materials will reduce the amount of carbon dioxide produced.<br><br>Fossil fuels will run out as it is a non-renewable resource, it can be made still however it takes longer to make it than the time we use it in. |
|                                                             |  | <b><u>Lesson 5 – Corrosion and its Prevention</u></b><br>... <i>that</i> rusting is an example of corrosion.<br>... <i>how to</i> prevent rusting.<br>... <i>how</i> to apply knowledge to past exam questions                                                                                                                                                                                                                                             | Corrosion, environment, rusting, air, water, coating, barrier, electroplating, greasing, painting, reactive, galvanise, sacrificial protection.                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                             |  | <b><u>Lesson 6 – The Haber Process</u></b><br>... <i>that</i> the Haber process is used to manufacture ammonia, which is used to produce nitrogen-based fertilisers.<br>... <i>how to</i> apply the principles of dynamic equilibrium to the Haber process.<br>... <i>how to</i> explain the compromise conditions used in the Haber process.<br>... <i>how</i> to apply knowledge to past exam questions                                                  | Manufacture, fertiliser, Haber process, catalyst, pressure, reversible reaction, equilibrium                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                            |  |
|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--|
|  |  | <b><u>Lesson 7 – Production and Uses of NPK Fertilisers</u></b><br><i>...that</i> NPK fertilisers are used to improve agricultural productivity.<br><i>...that</i> phosphate rock must be treated and cannot be directly used as a fertiliser.<br><i>... how to</i> compare the industrial production of fertilisers with laboratory preparations.<br><i>...how to</i> apply knowledge to past exam questions | Industrial, production, processes, fertilisers, formulations, preparation, laboratory      |  |
|  |  | <b><u>Lesson 8 – Potable Water</u></b><br><i>...that</i> potable water is different to pure water.<br><i>... how to</i> test the purity of water.<br><i>... how to</i> describe the differences between the treatment of ground water and freshwater.<br><i>...how to</i> apply knowledge to past exam questions                                                                                              | Potable, pure, sterilising, desalination, reverse osmosis, filter.                         |  |
|  |  | <b><u>Lesson 9 – Wastewater Treatment</u></b><br><i>...that</i> sewage can be treated to make it safe to drink.<br><i>... how to</i> purify wastewater.<br><i>...how to</i> apply knowledge to past exam questions                                                                                                                                                                                            | Sewage, grit, sedimentation, anaerobic digestion, aerobic, effluent, sludge, agricultural. |  |
|  |  | <b><u>Lesson 10 – Water RP</u></b><br><i>... how to</i> purify salt water by simple distillation.                                                                                                                                                                                                                                                                                                             | Distillation, Liebig condenser, evaporation, condensing, boiling point                     |  |

|  |  |                                                                                                                                |  |  |
|--|--|--------------------------------------------------------------------------------------------------------------------------------|--|--|
|  |  | <p>... <i>how to</i> test the purity of the water produced.</p> <p>...<i>how</i> to apply knowledge to past exam questions</p> |  |  |
|--|--|--------------------------------------------------------------------------------------------------------------------------------|--|--|

| <b>Topic 2</b><br><b>CHEMISTRY</b><br><b>Structure and Bonding</b>                                                                                                                                                                                                                                                                                                                                                                           | <b>Rationale</b><br><b>(Layering, Why this</b><br><b>why now?)</b>                                                                                                                                                                                                                              | <b>Knowledge goals: You need to know....</b><br><i>...that (Declarative) ... how to (Procedural)</i><br><div>L ADDERING</div>                                                                                                                                            | <b>Key Tier 3 vocabulary</b>                                                      | <b>Core skills and enrichment opportunities.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>4.2 Bonding, Structures and Properties</b><br>Chemical bonds are the glue that hold substances together. The attraction of one atom to another determines a substances chemical reactivity and its physical properties. Understanding how these can be determined by considering the atoms involved within the substance can be used to advance our understanding of materials science and where research may go in the immediate future. | <div>← Linking</div><br><b>Year 7</b><br>Properties of metals and non-metals<br><b>Year 8</b><br>Periodic table<br><b>Year 9</b><br>Atomic structure<br><div>→ Looking</div><br><b>Year 11</b><br>Apply bonding knowledge and detailed use of nanoparticle<br><b>Post 16</b><br>AS Bonding unit | <b>Lesson 1 – Forming Ions</b><br><i>...that</i> ions are formed from the loss and gain of electrons into electron shells<br><i>...how to</i> represent ions using dot and cross diagrams<br><i>...how to</i> apply knowledge to past exam questions                     | Ion, positive, negative, cation, anion, transfer, noble gas, configuration, ionic | <b>a) Numeracy</b><br>Analysis and evaluation of data based questions using graphs and/or tables for bonding properties.<br><br><b>b) Literacy and reading</b><br>Analysis and evaluation of data based questions using extended text for use of polymers and nanoparticles.<br><br><b>c) Cultural Capital/Careers</b><br>The development of new and diverse nanoparticles for use in everyday life.<br><br><b>d) Cross curricular knowledge links</b><br>Opportunities for learners to demonstrate their research skills<br><br><b>e) Misconceptions</b><br>When a substance dissolves or changes state no bonds are broken, this is often confused as FORCES between molecules are overcome when a change of state happens. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                 | <b>Lesson 2 – Ionic Compounds</b><br><i>...that</i> ionic compounds can be represented in different ways.<br><i>...how to</i> describe and explain ionic bond formation using dot and cross diagrams.<br><i>...how to</i> apply knowledge to past exam questions         | Giant, lattice, 3D, ions                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                 | <b>Lesson 3 – Properties of Ionic Compounds</b><br><i>...that</i> the specific bonding in ionic compounds leads to different properties.<br><i>...how to</i> construct the formula of common ionic compounds.<br><i>...how to</i> apply knowledge to past exam questions | Conductivity, brittle, soluble, electrostatic                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                 | <b>Lesson 3 and 4 – Covalent Bonding</b><br><i>...that</i> covalent bonds are formed from the sharing of electrons<br><i>...how to</i> draw dot and cross diagrams to represent simple covalent molecules                                                                | Covalent, dot and cross, sharing, valence, intermolecular forces                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                        |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  | <p>...<i>how to</i> explain the properties of simple covalent compounds in terms of structure and bonding</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                                                                                                       |                                                                                                                                       | <p>Non metals do-not conduct electricity however graphite, graphene and fullerenes made purely from carbon (a non-metal) can conduct electricity.</p>                                                                                                                                                                                                                                                  |
|  |  | <p><b><u>Lesson 5 – Polymers</u></b></p> <p>...<i>that</i> simple covalent molecules can form polymers</p> <p>...<i>how to</i> draw the structure of polymers and repeat units</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                                  | <p>Polymer, manufactured, covalent, molecule, monomer, repeat unit polymerisation, thermosetting, thermosoftening, intermolecular</p> | <p>To be stable each atom wants a full outer shell of electrons, hydrogen and helium need 2 electrons, however every other atom wants 8. You only need to know the first 20 elements as this rule works for them.</p>                                                                                                                                                                                  |
|  |  | <p><b><u>Lesson 6 – Giant Covalent Molecules</u></b></p> <p>...<i>that</i> carbon can exist in three different forms called allotropes</p> <p>...<i>that</i> the different bonding in these allotropes leads to the different properties of the allotropes</p> <p>...<i>how to</i> explain the properties of these allotropes in terms of structure and bonding</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | <p>Brilliant, strong, hard, lubricant,</p>                                                                                            | <p>In ionic bonding electrons are not shared, they are given and taken. It is then those differently charged ions that are attracted to each other forming the bond.</p> <p>Ionic compounds are not just two or three ions (NaCl is not 1 sodium ion and 1 chlorine ion), there are millions of ions that make up the compounds, the formula shown is the simplest way to write the ratio of ions.</p> |
|  |  | <p><b><u>Lesson 7 – Nanoparticles</u></b></p> <p>...<i>that</i> nanoscience is the study of nano-sized particles</p> <p>...<i>how to</i> explain the properties of nanoparticles in terms of structure and bonding</p>                                                                                                                                                                                                             | <p>Nanoparticle, surface area to volume ratio</p>                                                                                     | <p>An ionic bond is the attraction between positive and negative ions (multiples of</p>                                                                                                                                                                                                                                                                                                                |

|  |  |                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                 |                                                                          |
|--|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
|  |  | <p>...<i>how to</i> calculate surface area to volume ratio</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                                                                                                                                                                |                                                                                                                                 | each) however electrons must be transferred for those charges to appear. |
|  |  | <p><b><u>Lesson 8 – Metallic Bonding</u></b></p> <p>...<i>that</i> metallic bonding occurs in metals</p> <p>...<i>how to</i> explain the properties of metals in terms of structure and bonding</p> <p>...<i>how to</i> apply knowledge to past exam questions</p>                                                                                                           | Delocalised, electrostatic, electron, conduction                                                                                |                                                                          |
|  |  | <p><b><u>Lesson 9 – Alloys and Transition Metals</u></b></p> <p>...<i>that</i> alloys are mixture of metals and either metals or non-metals</p> <p>...<i>how to</i> explain the properties of alloys in terms of structure and bonding</p> <p>...<i>that</i> transition metals have a range of properties</p> <p>...<i>how to</i> apply knowledge to past exam questions</p> | Mixtures, properties, malleable, proportion, stainless, sonorous, malleable, ductile, reflective, conductor, catalyst, compound |                                                                          |