

## Chemistry – St Joseph's College

### Subject vision statement

In line with the National Curriculum, Science looks to support students in their understanding and exploration of the world around them. Students develop skills that enable them to explain how and why things happen while being analytical and curious. Students are encouraged to think big and apply key ideas to everyday phenomenon. Each discipline (Biology, Chemistry and Physics) is taught through distinct topics, while links in understanding across the Sciences is constantly referenced. There is a large focus on practical work to support the understanding of concepts and to give students the opportunity to develop skills that are beyond learned content.

### Intent statement

**What:** Key elements across all three sciences (e.g. particle behaviour, energy, living organisms, forces) are taught and developed across all key stages; each one drawing on fundamental concepts from previous learning and providing opportunity to develop and broaden students' understanding of the key themes that underpin scientific theory. Students revisit practical work regularly; developing skills linked to identifying variables, writing methods, analysing data and evaluating equipment and techniques, which enable them to become curious and independent scientists. Alongside developing scientific understanding, there is a core focus on the use of numeracy and literacy skills across all key stages, which enable students to successfully access all parts of the subject.

**How:** The structure of the Science curriculum provides varied opportunity for students to feel success and develop their interest in such a dynamic subject. Practical work, with key aspects such as planning, actioning, analysing and evaluating, is built in at every opportunity and given distinct focus. Students are encouraged to think like scientists and to develop their skill set beyond the acquisition of knowledge. The inclusion of a Reading Week in Key Stage 3 supports students in their developing of key literacy skills, including analysing and evaluating sources of information and considering their validity. There is a high level of focus on the acquisition of new language to enable students to access the curriculum, thinking about the etymology and morphology of key terms. Numerical skills are woven throughout the Science curriculum, providing opportunity to model and develop these frequently.

At KS3 students are assessed using exam-style question during assessment points, focusing on the core skills to be a successful scientist: Knowledge recall, Mathematical skills, Graphical skills and Practical skills. Students have the option to select Triple Science as part of their GCSE choices. At KS4 students are assessed using GCSE exam questions, with final external assessments taking place at the end of the Year 11. At KS5 students can choose between the pure A Level subjects (Biology, Chemistry and Physics) or the

more contextual BTEC Applied Science course (offered as both a single and double option). A Levels are assessed at the end of the two-year course while the BTEC offers a blended approach of assessments throughout alongside high demand coursework tasks.

**Why:** Science enables us to explain what is happening around us; it encourages students to be curious and to ask questions. There is the opportunity to provide transferable skills, including numerical skills, analytical skills and high-quality oracy skills. Boosting science capital is of particular importance as the world develops new and exciting technology, and a rigorous but exciting curriculum is important for students to consider STEM subjects and careers in their future, where they will be at the centre of change and innovation.

| Year 10                                                |                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                  |                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                            |                                                                                                                              |
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|                                                        | Autumn 1                                                                                                                                                                                                                                                                                                           | Autumn 2                                                                                                                                                                                         | Spring 1                                                                                                                                                                                                                 | Spring 2                                                                                                                                                                                                                                                                                                           | Summer 1                                                                                                                                                                                                                                                                   | Summer 2                                                                                                                     |
| <b>Topic</b>                                           | <b>Atomic structure and Periodic Table</b><br>Describe the structure of atoms that make up elements, including how the model has been developed as new information was discovered. Describe how the Periodic Table has been developed over time and explain how it can be used to give information about elements. | <b>Bonding and structure – Metals</b><br>Explain how the three types of chemical bonds form metallic, ionic and covalent. Explain the key properties of metallic, ionic and covalent substances. | <b>Metals and Energy changes</b><br>Describing the common reactions of metals, using the energy change of a reaction to define it as exothermic or endothermic, explaining how to measure this energy change accurately. | <b>Acids, bases and salts and Electrolysis</b><br>Define acids and alkalis, describe common reactions of acids and be able to plan the stages required to make crystals of a soluble salt. Describe how to extract metals that are more reactive than carbon through electrolysis, giving aluminium as an example. | <b>Quantitative chemistry and Energy changes</b><br>Using chemical calculations to show how quantities of chemicals in reactions can change, while overall mass in chemical reactions is conserved.                                                                        | <b>Chemical Analysis</b><br>Describe how to test substances, including the four common gases produced in chemical reactions. |
| <b>Building on</b><br>(knowledge, concepts and skills) | Elements vs compounds defining the key terms and being able to identify properties as well naming substances.                                                                                                                                                                                                      | Atoms and Elements and The Periodic table as well as its structure.                                                                                                                              | Chemical reactions, types of reactions, drawing graphs. Bonding and balancing chemical equations.                                                                                                                        | Naming ionic compounds, writing formulae, chemical reactions. Concentration. Ionic compounds, ions and charges, electricity. Reactivity series, Testing for gases. Extraction of metals, writing half equations.                                                                                                   | Structure of an atom, writing chemical formula, identifying isotopes, using Periodic Table. Being able to construct both word and symbol chemical equations as well as balancing. Taking measurements during reactions and calculating Mr and using Units of measurements. | Separating mixtures. Covalent molecules, bonding and properties.                                                             |

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| <b>Building towards</b><br>(knowledge, concepts and skills)            | Maths skills- Using the term 'relative' in relation to charges, charges and mass of subatomic particles.                                                                                                                                                                                                                                                                       | Maths links – using the 2,8,8 model. Constructing a chronological timeline of discoveries and developments relating to the periodic table specifically. Use of maths to balance chemical equations. Using Ar to determine electronic configurations. Using percentage to determine quantities within alloys. | Writing ionic formulae and drawing dot and cross diagrams. Comparing melting point data. Using math skills to calculate SA to Vol. Ratios. Writing formula and charges on ions. | Calculating changes in mass. Using pH scale and numeracy. Links to logarithmic scale of pH – change by factor of 10 between numbers. Being able to construct half equations. | Developing key numerical skills in relation to amount of substance which underpins all aspects of Chemistry, developing graphical skills to enable students to draw sketches of patterns without values, beginning to understand the energetic consequence of chemical reactions ready for further development at A Level. | Gaining concrete understanding of simple chromatography to be built upon with more complex ideas at A Level. |
| <b>Independent enrichment</b> (wider reading and learning suggestions) | CGP revision guide/ workbook/ knowledge organisers/ flashcards<br>Focus magazine (sciencefocus.com)<br>Popsci.com<br>GCSE revision buddy<br>The Science book: Big Ideas Simply Explained<br><a href="https://www.youtube.com/@MattGreenJGM">https://www.youtube.com/@MattGreenJGM</a><br><a href="https://www.youtube.com/@Cognitoedu">https://www.youtube.com/@Cognitoedu</a> |                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                 |                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                            |                                                                                                              |
| <b>SMSC</b>                                                            |                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                 | Discussions around the extraction of materials (particularly finite materials) and how they are processed.                                                                   |                                                                                                                                                                                                                                                                                                                            |                                                                                                              |
| <b>Careers</b>                                                         |                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                 | Materials scientists                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                            |                                                                                                              |

| Year 11                                                |                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                |          |          |          |
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|                                                        | Autumn 1                                                                                                                                                                                                                                                                                              | Autumn 2                                                                                                                                                                                                                                                                                                                       | Spring 1                                                                                                                                                                                                                                       | Spring 2 | Summer 1 | Summer 2 |
| <b>Topic</b>                                           | <b>Rate of Reaction and Equilibrium</b><br>Explaining how to speed up the rate of chemical reactions, describing how to measure this change, calculating the rate of a reaction, describing examples of reversible reactions, writing their equations and giving the observations that would be made. | <b>Hydrocarbons and Chemistry of the atmosphere</b><br>Describing the types of compounds found in crude oil, including their properties, and explaining how we process them to make them more useful, understanding how the Earth's atmosphere has developed and explaining how human activity has resulted in Global Warming. | <b>Using resources and Chemical Analysis</b><br>Explaining how to evaluate the products we use in everyday life in terms of their sustainability and environmental impact and describing how to test substances.                               | Revision | Revision | Exams    |
| <b>Building on</b><br>(knowledge, concepts and skills) | Developing understanding of how chemical reactions occur and scientific measurements we can take to determine this, building on understanding of energy in reactions and applying this to make predictions.                                                                                           | Extending knowledge of bonding, specifically about covalent molecules and applying this to real life concepts, identifying properties of substances and using these to separate mixtures, drawing from the Waves topic in Physics to support explanations of Global Warming.                                                   | Building on knowledge about properties of substances related to bonding, general ideas about what happens to waste including links to decomposition in Biology, deepening knowledge about separating mixtures from KS3 using their properties. |          |          |          |

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| <b>Building towards</b><br>(knowledge, concepts and skills)            | Developing ideas about how chemical reactions can be manipulated and gaining confidence in the effect of conditions so that further quantitative analysis and explanation can be built in at A Level.                                                                                                                                                                                                                                                                                    | Developing basic understanding of organic chemistry and associated simple reactions ready for further exploration across the entire A Level course, starting to understand how infrared radiation interacts with covalent bonds to underpin some analytic aspects at A level. | Developing ideas to support students in personal choices around being a positive part of the community, gaining concrete understanding of simple chromatography to be built upon with more complex ideas at A Level. |  |                                       |  |
| <b>Independent enrichment</b> (wider reading and learning suggestions) | CGP revision guide/ workbook/ knowledge organisers/ flashcards<br>Catalyst magazine ( <a href="http://www.nationalstemcentre.org.uk/catalyst">www.nationalstemcentre.org.uk/catalyst</a> )<br>Focus magazine ( <a href="http://sciencefocus.com">sciencefocus.com</a> )<br>Newscientists.com<br><a href="https://www.youtube.com/@MattGreenJGM">https://www.youtube.com/@MattGreenJGM</a><br><a href="https://www.youtube.com/@ScienceShorts">https://www.youtube.com/@ScienceShorts</a> |                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                      |  | CGP – Head start to A Level Chemistry |  |
| <b>SMSC</b>                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Discussions around climate change and the use of finite resources and the measures humans can take to limit this.                                                                                                                                                             | Discussions around the use of finite resources, debates around products and measuring their environmental impact.                                                                                                    |  |                                       |  |
| <b>Careers</b>                                                         | Chemical engineer                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                               | Environmental scientist                                                                                                                                                                                              |  |                                       |  |

| Year 12                                                |                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                      |
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|                                                        | Autumn 1                                                                                                                                                                                                               | Autumn 2                                                                                                                                                                                                                                               | Spring 1                                                                                                                                                                                                                                            | Spring 2                                                                                                                                                                                                                                           | Summer 1                                                                                                                                                                                                                                                                                                                                   | Summer 2                                                                                                                                                                             |
| <b>Topic</b>                                           | <b>Atomic structure, Bonding and Amount of substance:</b><br>Understanding the basics of how atoms bond to form elements and compounds, how these properties behave and how we can measure them in a chemical sense.   | <b>Periodic trends, the Halogens, Group 2 elements, REDOX reactions and Acids:</b><br>Looking at how the Periodic Table is structure, key groups and how elements and compounds interact specifically focussing on REDOX reactions and neutralisation. | <b>Basics of Organic Chemistry, Alkanes and Enthalpy:</b><br>Beginning to understand key concepts about carbon chemistry, measuring and applying changes in energy in chemical reactions.                                                           | <b>Alkenes, Alcohols and Equilibrium:</b><br>Developing understanding of double bonds and the presence of oxygen in carbon chemistry, understanding how conditions affect the yield of a reversible reaction both in applied and numerical senses. | <b>Haloalkanes, Organic synthesis, Organic analysis, Rates of reaction:</b><br>Developing understanding of the presence of halogens in carbon chemistry, linking all reactions, analysing carbon compounds using multiple techniques, understanding how to increase the rate of a chemical reaction both qualitatively and quantitatively. | <b>Carbonyls and carboxylic acid:</b><br>Further development of understanding of the presence of oxygen in carbon chemistry alongside overall recap of key topics covered this year. |
| <b>Building on</b><br>(knowledge, concepts and skills) | Building on GCSE topics such as Atomic structure and Bonding and function; using the concept of conservation of mass and developing the skilful use of mathematics within chemistry and science and thinking about how | Building on GCSE topics such as Periodic table and Acids, bases and salts; developing the concept of why chemical reactions happen and the transfer of electrons and developing skills around measuring and calculating concentration.                 | Building on GCSE topics such as Hydrocarbons, Organic Chemistry (Triple) and energy changes; using the concepts of drawing covalent molecules and scientific graphical representations and developing practical skills including considering error. | Continuing to build on GCSE topics such as Hydrocarbons, also building on the GCSE topic Equilibrium; using the concept of chemical reactions and conditions that affect it and developing the skilful the use of mathematics in chemistry.        | Building on GCSE topics such as Chemistry of the Atmosphere and Rates of reaction while summarising the organic topics in Y12; using the concepts of mass and functional groups to distinguish between molecules and developing the skilful the use of                                                                                     | Building on the carbon chemistry in the rest Year 12, continuing to develop the models used to show mechanisms, developing revision skills that can be used to summarise learning.   |

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|                                                                        | concepts can be modelled.                                                                                                                                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                       | mathematics in chemistry.                                                                                                                                                                                                                   |                                                                                                                                                                              |
| <b>Building towards</b><br>(knowledge, concepts and skills)            | Developing confidence in the use of mathematics in chemistry to be used in all future topics alongside the writing of chemical formula and balanced symbol equations.                                                                                                                                                  | Developing key phrases to be used to explain patterns of behaviour in elements and concepts, understanding basic neutralisation before increasing challenge in Year 13. | Developing skills to be able to use and identify elements IUPAC naming of organic compounds in preparation of all future topics, starting to develop understanding of the use of mechanisms to show the stages of a chemical reaction, gaining confidence in how enthalpy can be measured and calculated for different reactions ready for Y13 Enthalpy lessons. | Understanding the link between Alcohols, Carbonyls and Carboxylic acids while gaining breadth in the use of mechanisms to be able to apply ideas to unseen examples. Moving from a qualitative understanding of reactions to quantitative values to allow clearer comparison, used in both Rates and Acids, bases and buffers topics. | Making concrete links between the homologous series studied this year, ready to introduce further groups next year, while starting to process information used to identify them before adding more techniques in Year 13.                   | Continuing to add further reactions to the organic overview, ready to complete this in Y13.                                                                                  |
| <b>Independent enrichment</b> (wider reading and learning suggestions) | Further understanding of the mass of spec – research of CERN<br><a href="https://home.cern/">https://home.cern/</a><br><br><a href="https://ed.ted.com/lessons/daniel-dulek-how-big-is-a-mole-not-the-animal-the-other-one">https://ed.ted.com/lessons/daniel-dulek-how-big-is-a-mole-not-the-animal-the-other-one</a> | The Disappearing Spoon by Sam Kean<br><br>Reactions: The private life of atom by Peter Atkins<br><br>The Periodic Tales by Hugh Alderley-Williams                       | The Manda Guide to Biochemistry by Masaharu Takemura                                                                                                                                                                                                                                                                                                             | Maths Skills for A Level Chemistry by Dan McGowan<br><br>Why Chemical reactions happen by James Keeler                                                                                                                                                                                                                                | <a href="https://www.ted.com/talks/rachel_pike_the_science_behind_a_climate_headline">https://www.ted.com/talks/rachel_pike_the_science_behind_a_climate_headline</a><br><br>Organic Chemistry, a very short introduction by Graham Patrick | Napoleon's Buttons: How 17 Molecules Changed History by Penny Le Couteur and Jay Burreson<br><br><a href="http://www.periodicvideos.com/">http://www.periodicvideos.com/</a> |



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|                | <p>A Short History of Chemistry by Isaac Asimov</p> <p>Subscription to Chemistry Review, Catalyst or ChemNet Society (check online for access)</p> |                                                               |                                  |                                                                                               |                                                                                            |                          |
| <b>SMSC</b>    |                                                                                                                                                    | Discussion of the risks of using chlorine in water treatment. |                                  | Opinions around the use of plastics and their disposal, including alternative options to use. | Links between using IR for analysis and how this links to the occurrence of Global warming |                          |
| <b>Careers</b> | Pharmacological sciences, medical sciences, material sciences                                                                                      | Chemical analyst, water analyst, chemical engineer            | Chemical engineer, fuel sciences | Material sciences, environmentalist, chemical engineer                                        | Chemical analyst, environmentalist, chemical engineer                                      | Pharmacological sciences |

| Year 13                                                |                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                               |                                                                                                                                           |                   |          |
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|                                                        | Autumn 1                                                                                                                                                                                         | Autumn 2                                                                                                                                                                                                                                                                                                                                                                            | Spring 1                                                                                                                                                                                                                                                                                      | Spring 2                                                                                                                                  | Summer 1          | Summer 2 |
| <b>Topic</b>                                           | <b>Aromatic chemistry and Acids, Bases and Buffers:</b><br>Developing understanding of ring structures in carbon chemistry, understanding acids, bases and neutralisation from a numerical view. | <b>Amines, amides and amino acids, Organic analysis and Enthalpy and entropy:</b><br>Developing understanding of the presence of nitrogen in carbon chemistry, additional methods to analysis carbon compounds, linking energy with disorder to predict the spontaneity of chemical reactions.                                                                                      | <b>Organic synthesis, Electrochemical cells, Transition metals and REDOX titrations:</b><br>Assimilating all carbon chemistry knowledge to form links, understanding the use of REDOX to generate potential difference, use of REDOX reactions to measure the progress of chemical reactions. | Targeted revision and completion of Practical Endorsement.                                                                                | Targeted revision | Exams    |
| <b>Building on</b><br>(knowledge, concepts and skills) | Building on the AS topics of alkenes and continuing to develop skills used to represent mechanisms of reactions; further development of AS reactions of acids.                                   | Building on the AS topics of ester looking at a different type of condensation polymer; continuing to broaden ideas around types of isomerism; drawing on GCSE Biology knowledge (or A Level) about amino acids and how they are built up to make proteins from DNA; introducing further techniques used to identify organic molecules; building on ideas around energy from Y12 to | Summarising all organic topics covered over the A Level course; building on ideas of REDOX from Y12 and applying this explain chemical reactions; building on ideas around bonding and isomerism in AS chemistry and applying this to transition elements.                                    | Using experiences of practical activities across the whole course to develop confidence in all key elements of the Practical Endorsement. |                   |          |

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|                                                                        |                                                                                                                                                                                                                                                                                                                   | understand why reactions happen spontaneously.                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                         |                                                                                |  |  |
| <b>Building towards</b><br>(knowledge, concepts and skills)            | Further development of the use of mechanisms to show how reactions occur in stages, explanation of how models are developed in molecules we cannot see, increasing the numerical demand for mathematical calculations around the concepts of acid, base and buffers, before applying these to real life examples. | Understanding the similarities and differences between esters and amides, further understanding of the 3D structure of proteins, complex analysis of multiple sources of information to identify a chemical compound, understanding the underpinning numerical rationale behind why some reactions will occur spontaneously and others will not. | Assimilation of reactions in organic chemistry to develop skills to tackle unknown mechanisms, understanding of how a battery works from a chemical sense, understanding real life applications of transition metal complexes and their impact, further development of mathematical skills to calculate unknowns in chemical reactions. | Confidence in completing more complex practical work in a university setting.  |  |  |
| <b>Independent enrichment</b> (wider reading and learning suggestions) | Elegant Solutions: Ten beautiful experiments in Chemistry by Philip Ball<br><br>Elephants on Acid by Alex Boese<br><br>Subscription to Chemistry Review, Catalyst or ChemNet Society (check online for access)                                                                                                    | Statistical thermodynamics by A Moczek and A Meijar<br><br>Seven Brief Lessons on Physics by Carlo Rovelli<br><br>Organic Chemistry, a very short introduction by Graham Patrick<br><br>Why Chemical reactions happen by James Keeler                                                                                                            | Stuff Matters, Exploring the Marvelous Materials that Shape our ManMade World by Mark Miadownik<br><br>Four Laws that Drive the Universe by Peter Atkins                                                                                                                                                                                | Advice to a young scientist by P.D. Medawar<br><br>Bad Science by Ben Goldacre |  |  |

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| <b>SMSC</b>    |                                                                                 | Comparison of addition polymers to condensation polymers and their impact on the environment, discussion around DNA and the possible mutation of its structure and following consequences. | Discussions about use of electric powered vehicles vs. combustion engines and fuel cells. |  |  |  |
| <b>Careers</b> | Chemical analyst, medical sciences, pharmacological sciences, material sciences | Chemical analyst, chemical engineer, geneticist                                                                                                                                            | Chemical analyst, forensic scientists, toxicologist, environment sciences                 |  |  |  |