Curriculum overview: Chemistry

Content studied in Key Stage 2

Properties and changes of materials:

- Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity and response to magnets.
- Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
- Use knowledge of solids, liquids and gases to decide how mixtures might be separated
- Explain and demonstrate reversible and irreversible changes

Key skills/content requirements at GCSE

Chemistry content and understanding

Topics students need to have a good understand of

1. States of matter and the structure of the atom
2. Organisation of the periodic table
3. Chemical changes
4. Calculations in chemistry
5. Energy changes in chemical reactions
6. Rates of chemical reactions
7. Chemical tests to identify different chemicals
8. Chemistry of resources
9. Chemistry of the atmosphere
10. Organic chemistry

Students will need to know appropriate key terminology in order to describe and explain the chemical concepts within each topic and how they interrelate with appropriate academic depth.

Students will need to know a range of required practical's. These require a high level of applied practical knowledge.

Chemistry is split into two broad aspects, the fundamentals of chemistry in the 21st century – which includes our current understanding of the structure of the atom and periodic table, complex ideas of chemical reactions including thermodynamics and the reactivity series. Students will also need to know the calculations required to complete chemistry to a high degree. The second aspect of chemistry at King Charles is the application of chemistry in society, including the chemistry of the atmosphere and how humans can have an impact on the environment. Also how the rate of chemical reactions can be used in different applications and the production of chemicals fundamental to modern society, including the agrochemical and petrochemical industries.

Scientific skills

Development of scientific thinking

- Understand how scientific methods and theories develop over time.
- Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.
- Appreciate the power and limitations of science and consider any ethical issues which may arise.
- Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.
- Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences.
- Recognise the importance of peer review of results and of communicating results to a range of audiences.

Experimental skills and strategies

- Use scientific theories and explanations to develop hypotheses.
- Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
- Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.
- Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.
- Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative
- Make and record observations and measurements using a range of apparatus and methods.
- Evaluate methods and suggest possible improvements and further investigations.

Analysis and Evaluation

- Presenting observations and other data using appropriate methods.
- Translating data from one form to another.
- Carrying out and represent mathematical and statistical analysis.
- Representing distributions of results and make estimations of uncertainty.
- Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.
- Presenting reasoned explanations including relating data to hypotheses.
- Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.
- Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms.

	Maths skills ▪ Use scientific vocabulary, terminology and definitions. ▪ Recognise the importance of scientific quantities and understand how they are determined. ▪ Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate. ▪ Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). ▪ Interconvert units. ▪ Use an appropriate number of significant figures in calculation. ▪ Standard form ▪ Estimates and significant figures ▪ Averages ▪ Simple probability ▪ Algebra skills ▪ Graph skills The knowledge and skills in this section apply across the specification, including the required practicals.

Curriculum Overview

Chemitsry content and understanding: Each year students will learn about a range of fundamental particle, chemical reaction and application of chemistry topics to help develop their chemical understanding of key content. This portable knowledge is what students are entitled to know if they are to be a well rounded scientist.
Scientific skills: *For each year group specific skills are delivered within topics. Each year skill development will embed and build upon what was learnt in the previous year. Across all year groups, lessons with a practical focus have been integrated into schemes of work to guide students though the process of; selecting apparatus, writing a methodology, working in a systematic manner, analysing data to draw conclusions, making evaluations and improvements.*
Red italics is triple science knowledge only

	Term 1	Term 2	Term 3	Portable knowledge	Key terms	
Year 7	**Particle theory** ▪ Particles ▪ States of matter ▪ Changes of states ▪ Heating and cooling curves ▪ Diffusion ▪ Sublimation	**Elements** ▪ Elements & compounds ▪ Compounds ▪ Chemical formulae and reactions ▪ Mixtures ▪ Separating soluble solids from insoluble ▪ Separating liquids based on boiling point ▪ Chromatography ▪ Discovery of the noble gases	**Earth Science** ▪ Changing atmosphere ▪ Greenhouse gases ▪ Carbon cycle ▪ Climate change – causes ▪ Climate change – preventing change ▪ Atmospheric pollutants	▪ Structure of matter – how physical changes can impact the organisation of matter. ▪ Separation – How different materials can be categorised and isolated using chemical properties ▪ How humans are having an impact on the planet through complex interactions.	Element Compound Mixture Atom Particle Pure Solid Liquid Gas Vacuum Melting Condensing Freezing Boiling Evaporating Sublimation Deposition Melting point Boiling point Diffusion	Solvent Solute Solution Chromatography Distillation Separation Acid Alkali Base Concentrated Corrosive Dilute Indicator Litmus Neutral Neutralisation pH scale Salt Universal indicator

Year 8	**Atoms** ▪ Atomic structure ▪ Atomic number ▪ Atomic mass ▪ Isotopes ▪ Electronic structure ▪ Electronic structure and the periodic table ▪ Metals and non-metals ▪ Periodic table patterns – reactions of group 1 ▪ Reactions of group 7 ▪ Development of periodic table	**Chemical reactions** ▪ Word equations and molecular masses ▪ Symbol equations and masses ▪ Conservation of mass ▪ Mass changes in thermal decomposition ▪ Burning fuels – calorimetry ▪ Thermal decomposition ▪ Exothermic and endothermic reactions ▪ Metals and acids ▪ Metals and ▪ Metals and water ▪ Displacement ▪ Extracting metals ▪ Catalysts	**Acids and alkalis** ▪ Everyday acids and alkalis ▪ Indicators and pH ▪ Making indicators ▪ History of acids ▪ Neutralisation ▪ Making salts	As Yr 7 plus: ▪ The fundermental particles of matter and the arrangement of the periodic table. ▪ How chemical reactions rearrange chemicals but do not create or destroy any other matter ▪ Acidity and pH – behaviour of chemicals is dependent on their solubility and interactions which other dissolved chemicals.	Atom Proton Neutron Electron Electronic structure Atomic nucleus Atomic number Mass number Isotope Group 0 Group 1 Group 7 Periodic table Carbon cycle Atmosphere Photosynthesis Respiration Emissions Carbon footprint Greenhouse effect Carbon monoxide Acid rain Climate change Combustion Complete combustion	Deforestation Activation energy Chemical reaction Combustion Complete combustion Conservation of mass Decomposition Endothermic change Exothermic change Fuel Incomplete combustion Oxidation Physical change Product Reactant. Thermal decomposition Catalyst Displacement reaction Metal Ore Reactivity series Thermite reaction
Year 9	**Atomic Structure** ▪ The atom ▪ Equations and formulae ▪ Separation techniques ▪ Distillation and chromatography ▪ Changing ideas about the atom ▪ Sub-atomic particles ▪ Mass and isotopes ▪ Electronic configuration ▪ Origins of the periodic table ▪ Organisation of the periodic table	**Bonding, Structure & properties of matter** ▪ States of matter ▪ Ionic bonding ▪ Giant ionic structures ▪ Covalent bonding ▪ Structure of simple covalent molecules ▪ Structure of giant covalent structures ▪ Graphene and fullerenes ▪ Bonding and properties of metals ▪ *Properties and uses of*	**Chemical analysis** ▪ Pure substances and formulations ▪ Chromatography required practical – calculating Rf values ▪ Testing for chlorine, oxygen, hydrogen and carbon dioxide ▪ *Spectroscopic testing* ▪ *Identification of ions as hydroxides, halides and sulfate.* **Chemistry of the atmosphere** ▪ The Earth's atmosphere	▪ How chemical reactions show change of arrangement of atoms, but no overall change in the number of atoms. ▪ How the periodic table was devised and it can be interpreted to explain the behaviour of atoms. ▪ How the structure of the atom will affect the bonding of the atom and the properties of any material.	Alkali metals Atomic number Chromatography Crystallisation Distillation Element Group Halogen Mass number Noble gases Periodic table Isotope Group 0 Group 1	Molecule Boiling point Melting point Conductivity Malleable Ductile Nano Endothermic Exothermic Activation energy Reduction Oxidation Waste product

	▪ Group 1 ▪ Group 7 ▪ Group trends ▪ *The transition elements*	*nanotechnology* **Energy Changes** ▪ Exothermic and endothermic reactions ▪ Required practical – investigating temperature changes ▪ Energy level diagrams ▪ *Electrical cells* ▪ *Hydrogen fuel cells*	▪ The greenhouse effect ▪ Carbon footprint and atmospheric pollutants	▪ All chemical reactions result in a change of energy, often a measurable temperature change. ▪ Pure substances in chemistry are a substance made of only one type of element or compound. ▪ Chemical reactions can be used to identify the presence of specific chemicals. ▪ Humans are having an impact on the environment. ▪ Chemistry can be used to solve many issues relating to climate change.	Group 7 Ionic Covalent Metallic Ion Electrostatic Giant lattice Graphene Graphite Diamond Intermolecular force	Pure Rf value Halide Sulfate Hydroxide Spectroscopy Litmus Climate change Greenhouse effect Global dimming Acid rain
Year 10	**Chemical changes** ▪ Metal oxides ▪ Reactivity series ▪ Extraction of metals ▪ Oxidation and reduction ▪ Metals and acids ▪ Required practical – neutralisation and production of salts ▪ Soluble salts ▪ pH scale and neutralisation ▪ strong and weak acids ▪ Titration ▪ electrolysis of molten compounds ▪ electrolysis of aqueous solutions ▪ using electrolysis to extract metals ▪ half equations at the electrodes. **Rate & Extent of Chemical Change** ▪ Rate of reaction ▪ Collison theory and surface area ▪ The effect of temperature ▪ Required practical - the effect of concentration	**Using resources** ▪ Using the Earth's resources and Potable Water ▪ Waste water treatment ▪ Bioleaching and phytomining ▪ The life cycle and recycling ▪ *Corrosion and its prevention* ▪ *Uses of ceramics, polymers and composites* ▪ *The Haber process*	**Organic chemistry** ▪ Hydrocarbons, alkanes and fractional distillation ▪ Combustion ▪ Cracking and alkenes ▪ *Reactions of alkenes and alcohols* ▪ *Carboxylic acids* ▪ *Polymerisation* ▪ *Biological polymers*	▪ Extraction of metals ▪ Redox reactions ▪ Solubility and production of soluble salts and from insoluble bases ▪ General reactions of metal compounds and acids. ▪ Process of electrolysis and how reactive metals can be extracted using the process. ▪ Factors that affect rates of reaction. ▪ What is a reversible reaction? ▪ How is waste water treated? ▪ Modern alternatives to extract metals. ▪ Where oil comes from and how it is modified to become a useful product.	Oxidation Reduction Reactivity Acid Base Alkali pH Neutralisation Strong acid Weak acid Extraction Ore Redox Concentration Surface area Reversible Equilibrium Catalyst Rate of reaction Potable Sedimentation Screening	Sterilisation Polymer Composite Corrosion Haber process Ammonia Compromise conditions Yield Hydrocarbon Fractional distillation Combustion Cracking Alkane Alkene Alcohol Carboxylic acid Addition Combustion Polymerisation Addition polymer Condensation polymer

	▪ The effect of a catalyst ▪ Reversible reactions ▪ Energy changes in reversible reactions ▪ Dynamic equilibrium ▪ Altering conditions at equilibrium					
Year 11	**<u>Quantitative chemistry</u>** ▪ Calculating relative atomic mass and moles ▪ Avogadro's constant ▪ Calculating mass and moles from an equation ▪ Balance equations to calculate mass ▪ *Yield and atom economy* ▪ Use concentration to calculate the mass of a solute ▪ *Concentrations in mol/dm^3* ▪ *The amount of substance in relation to volume of gases*			▪ What is a mole? ▪ How mass is calculated based on the subatomic particles in a compound. ▪ Concentration is the measure of an amount of solute dissolved in a volume of solvent. ▪ Concentration and mass can be used to predict the amounts of materials produced in a chemical reaction – stoichiometry.	Mole Avogadro constant Relative atomic mass Relative formula mass Relative molecular mass Concentration Yield Atom economy Gas volume	

GCSE External assessment:

Combined science is assessed by six written examinations, each exam lasting 1 hour and 15 minutes. All examinations are taken at the end of Year 11. Two grades are awarded as described in the table.

	Weighting	
Biology paper 1	16.7%	The qualification will be graded on a 17-point scale: 1 – 1 to 9 – 9, where 9 – 9 is the best grade. This counts as two GCSE grades**.**
Biology paper 2	16.7%	
Chemistry paper 1	16.7%	
Chemistry paper 2	16.7%	
Physics paper 1	16.7%	
Physics paper 2	16.7%	

Students studying the separate sciences will achieve three science GCSEs at the end of Year 11. These will be in the following subjects

- GCSE biology
- GCSE chemistry
- GCSE physics

All content is examined at the end of Year 11. All of the GCSE science courses are split into two units:

	Weighting	
Biology Paper 1	50%	A GCSE grade in Biology from grade 9 to grade 1
Biology Paper 2	50%	
Chemistry Paper 1	50%	A GCSE grade in Chemistry from grade 9 to grade 1
Chemistry Paper 2	50%	

Physics Paper 1	50%	A GCSE grade in Physics from grade 9 to grade 1
Physics Paper 2	50%	

Each examination is available at two tiers. Teachers will use internal class assessments to decide which tier is most appropriate for you.

Tier	Available Grades
Higher	4-9 if studying the separate sciences 4-4 to 9-9 if studying combined science
Foundation	4- 5 if studying the separate sciences 1-1 to 5-5 if studying combined science

In addition to acquiring knowledge and understanding, students learn a range of practical and investigative skills that are assessed in each of the 6 examinations.

SMSC in science:

Spiritual development in science

In the science department we look to maintain a neutral approach as we study issues and ideas which are sometimes a source of tension in our society today. The modern world is full of potential areas for conflict, when scientific and spiritual ideas come together. Students will study topics such as evolution and the universe's origins using an evidence-based approach. This means scientific theories can be introduced then evaluated from an unbiased perspective. From this students often see how it is possible for spiritual and scientific theories to exist alongside each other, and how this may lead to more tolerance of different viewpoints.

Moral development in science

Rapid advances in science have given us the opportunity to influence and change the world in which we live, often with positive outcomes. However, the new powers given to society by science have also led to moral issues arising, and in lots of cases vigorous debate surrounds these ideas, for example with genetically modified organisms. We give students the opportunity to engage with some of the most significant scientific developments and to weigh up the evidence to form their own conclusions on some moral issues facing society today. This is not only a key exam skill, but a vital skill for all students as they develop as young adults.

Social development in science

The impact of science on society is extremely significant. Medical advances in particular are changing the way we live, with a continued increase in global population and longer life expectancy. Students will study the scientific advances that have led to this, the problems caused and possible solutions to them, whilst being encouraged to deepen their own understanding and form and support views using scientific fact. Through this approach students will gain a wider perspective on the changing society that surrounds them.

Cultural development in science

Achievement in the field of science is truly global, and promoting cultural awareness is an intrinsic part of the science curriculum. From the Russian origins of the periodic table to the discovery of radioactivity by the French physicist Henri Becquerel, progress in all areas of scientific study is a consequence of a worldwide commitment to continuing discovery.