**The Nottingham Emmanuel School – *Subject* Curriculum Map (2022-2023)**

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| Intent statement | The science curriculum at Emmanuel will provide students with the new knowledge needed to navigate the modern world. This will allow our students to develop their scientific literacy which will enable them to make informed decisions. This will empower and equip our students to be good role models, who are mindful of the word around them and give them the skills to make meaningful contributions to society. We aim to remove barriers to learning through raising aspirations via an inclusive and diverse curriculum for all students. |
| Diversity across the curriculum | Our curriculum represents the diversity of our students by promoting science as accessible to all. We will use inclusive language, images and texts and promote scientific role models that represent the diversity of our school community. We will deliver the science curriculum with an awareness of the different religious beliefs of our students whilst being mindful of any unconscious bias. |
|  |  | AUT 1 | AUT 2 | SPR 1 | SPR 2 | SUM 1 | SUM 2 |
| Year 10 | Title and objectives | **Atomic structure and bonding review &****Chemical changes** | **Chemical changes & Energy changes** | **Extraction of metals & Electrolysis** | **Quantitative chemistry** | **Revision** | **Chemical analysis** |
| Core knowledge | * Review atomic structure, periodic table bonding and structures
* Transition metals and nanoparticles
* Metal oxides
* The reactivity series
* Displacement reactions
* Reactions of acids
* Salts from metals
* Salts from insoluble bases
* Making salts
* **Required practical 1:** preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.
 | * Neutralisation and the pH scale
* Strong and weak acids (HT)
* Titration
* **Required practical 2:** (Chemistry only) determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.
* Exothermic and endothermic reactions
* Reaction profiles
* The energy change of reactions (HT)
* Chemical cells and batteries
* Fuel cells
* **Required practical 4:** investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals.
 | * Extraction of metals and reduction
* Oxidation and reduction in terms of electrons (HT)
* The process of electrolysis
* Electrolysis of molten ionic compounds
* Using electrolysis to extract metals
* Electrolysis of aqueous solutions
* Representation of reactions at electrodes as half equations (HT)
* **Required practical 3:** Investigate what happens when aqueous solutions are electrolysed using inert electrodes.
 | * Relative formula mass
* Conservation of mass
* The mole
* Empirical formula
* The mole and equations
* Limiting reactants
* Atom economy
* Percentage yield
* Titration Concentrations calculations
* Volumes of gases
 | * Atomic structure and the periodic table
* Bonding and structures
* Chemical changes
* Energy changes
* Extraction of metals and electrolysis
* Quantitative chemistry
 | * Purity and formulations
* Paper chromatography
* *Tests for gases*
* *Tests for anions*
* *Tests for cations*
* *Flame emission spectroscopy*
* **Required practical 6:** Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values.
* **Required practical 7:** Use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections
 |
| Skills | * Writing formula
* Writing word and symbol equations
* Writing formulae from formulae of common ions
* Predict products from given reactions
* Measuring pH
* Practical skills (Filtration and crystallisation).
 | * pH calculations (HT)
* Writing word and symbol equations
* Writing formulae
* Practical skills (Using a burette, pipette, and titration technique).
* Mean titre calculations
* Bond energy calculations
* Manipulating graphs
* Drawing diagrams
* Writing half equations
 | * Writing word and balanced symbol equations
* Writing half equations
* Writing ionic equations
* Practical skills (Electrolysis apparatus).
* Developing hypothesis
* Manipulating graphs
 | * Calculating relative formula mass
* Percentage mass calculations
* Estimations of uncertainty
* Mole calculations
* Using molar ratios
* Reacting mass calculations
* Unit conversion (mass and volume)
* Use standard form and appropriate number of significant figures
 | * Practice papers
 | * Using melting point apparatus
* Practical skills (setting up paper chromatography apparatus)
* Analysing chromatograms
* Testing for gases
* Testing for ions
* Writing half equations
* Writing equations
 |
| Covid recovery | Focus on practical skills and retrieval. |
| Careers |  | Thunder and Lightning Demonstration Lecture (UON) |  |  |  |  |
| Year 11 | Title and objectives | **The rate and extent of chemical exchange** | **Chemistry of the atmosphere & Using resources** | **Using resources & Organic chemistry** | **Organic chemistry**  | **Revision** |
| Core knowledge | * Calculating rates of reactions
* Factors affecting the rates of chemical reactions
* Collision theory and activation energy
* Catalysts
* Reversible reactions
* Energy changes during reversible reactions
* Equilibrium
* Le Chatelier’s principle (HT)
* **Required practical 5: I**nvestigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced **and** a method involving a change in colour or turbidity.
 | * Evolution of the atmosphere
* Greenhouse gases
* Climate change
* Air pollution
* Finite and renewable resources
* Reduce, reuse and recycle
* Resources and sustainability
* Life cycle assessments
* Extracting metals from ores
* Potable water
* Waste water treatment
* **Required practical 8:** Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.
 | * Corrosion (rusting)
* Alloys
* Properties and Uses of materials
* The Haber process
* NPK fertilis4ers
* Crude oil, hydrocarbons, and alkanes
* Fractional distillation and petrochemicals
* Properties of hydrocarbons
* Cracking and alkenes
 | * Structure and formulae of alkenes
* Reactions of alkenes
* Alcohols
* Carboxylic acids
* Esters
* Addition polymers
* Condensation polymers (HT)
* Naturally occurring polymers, amino acids and DNA (HT)
 | * Paper 1 revision focusing on required practicals and key skills.
* Revision of paper 1 topics: Atomic structure, the periodic table, bonding and structures, quantitative chemistry, chemical changes, energy changes
 | * Paper 2 revision focusing on required practicals and key skills.
* Revision of paper 2 topics: Rates of reaction, organic chemistry, chemical analysis, chemistry of the atmosphere and using resources.
 |
| Skills | * Gradient of a straight line
* Tangents (HT)
* Lines of bets fit
* Mean calculations
* Writing equations
* Drawing and interpreting appropriate graphs from data to determine rate of reaction.
* Practical skills (measuring rates)
 | * Drawing pie charts
* Analysing and describing patterns in data
* Word and balanced symbol equations
* Practical skills (testing pH, distillation)
* Evaluating LCA of different products
 | * Applying LCP to industrial processes to maximise yield and talk about compromises between rate and equilibria.
* Making models of alkanes and determine molecular formula.
* Describe and explain trends in data for alkanes.
 | * Drawing displayed formula
* Writing displayed formula equations
* Practical skills (Reactions of alkenes and alcohols).
* Modelling polymerisation
 | * Re-visit each required practical.
* Practice papers
 | * Re-visit each required practical.
* Practice papers
 |
| Covid recovery | Focus on practical skills and retrieval. |
| Careers |  |  | Severn Trent – Using resources (guest speaker) |  |  |  |
| Year 12 | Title and objectives | **Skills, Atomic structure and bonding and structures** | **Amount of substance and introduction to organic chemistry**  | **Energetics, Kinetics and Alkanes and Halogenoalkanes** | **Equilibria and redox reactions and Alkenes and Alcohols** | **Periodicity, group 2 and group 7 elements and Organic analysis** | **Revision and Spectroscopy**  |
| Core knowledge | * Practical and mathematical skills
* Atomic structure
* Fundamental particles
* Protons, neutrons and electrons
* Mass number and isotopes
* Relative atomic mass and relative molecular mass
* The Mass spectrometer
* Electron arrangement
* Ionisation energies
* Ionic bonding
* Covalent bonding
* Charge clouds
* Shapes of molecules
* Polarisation
* Intermolecular forces
* Metallic bonding
* Properties of metals
 | * The Mole
* Limiting and excess reactants
* Concentration calculations
* Gases and the Mole
* Chemical equations
* Titrations
* Molecular and empirical formula
* Water of crystallisation
* Atom economy
* Percentage yield
* **Required practical 1** - Make up a volumetric solution and carry out a simple acid–base titration
* Formulas
* Functional groups
* Nomenclature
* Isomers
* E/Z isomers
 | * Enthalpy
* Bond enthalpies
* Measuring enthalpy changes
* Hess’s Law
* **Required practical 2 –** Measurement of an enthalpy change
* Reaction rates
* Maxwell-Boltzmann distribution curves
* Catalysts
* Measuring rates
* **Required practical 3 –** Investigation of how the rate of a reaction changes with temperature
* Alkanes and petroleum
* Alkanes as fuels
* Synthesis of chloroalkanes
* Halogenoalkanes
* Nucleophilic substitution
* Elimination reactions
 | * Reversible reactions
* Le Chatelier’s principle
* Industrial processes
* The equilibrium constant
* Factors affecting the equilibrium constant
* Redox reactions
* Oxidation states
* Redox equations
* Alkenes
* Electrophilic addition
* Reactions of alkenes
* Addition polymers
* Alcohols
* Dehydrating alcohols
* Ethanol production
* Oxidising alcohols
* **Required practical 5 –** Distillation of a product from a reaction
 | * The periodic table
* Electronic configurations
* Periodicity (atomic radius, melting points and 1st IE)
* Group 2 – the alkaline earth metals
* Group 2 compounds
* Group 7 – The halogens
* Halide ions
* Test for ions
* **Required practical 4 –** Carry out simple test-tube reactions to identify cations and anions
* Tests for functional groups
* Mass spectrometry
* Infrared spectroscopy
* **Required practical 6 –** Tests for alcohol, aldehyde, alkene and carboxylic acid
 | * Revision of AS Physical, Inorganic and Organic chemistry.
* NMR spectroscopy intro
* 13C NMR Spectroscopy
* 1H NMR Spectroscopy
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| Skills | * Measuring mass and volume accurately
* Weighing by difference
* Drawing tables
* Plotting data
* Writing formulae
* Unit conversions
* Writing balanced symbol equations
* Writing ionic equations
* TOF calculations
* Writing half equations
* Drawing dot and cross diagrams
* Explaining properties
* Drawing 3D shapes
* Drawing hydrogen bonding
 | * S.I Units
* Unit conversions
* Standard form
* Rounding to an appropriate number of significant figures
* Molar ratios (stoichiometry)
* Rearranging equations
* Writing balanced symbol equations
* Writing ionic equations
* Make a standard solution
* Carry out a titration
* Drawing formulas
* Identifying functional groups
* Naming compounds
* Drawing isomers
 | * Measure temperature accurately
* Calculate enthalpy
* Calculate bond enthalpies
* Measuring enthalpy changes
* Extrapolating lines
* Calculating temp change from a graph
* Drawing cycles
* Drawing Maxwell-Boltzmann distribution curves
* Measuring volume of gas, time taken for cross to disappear
* Writing equations
* Free-radical substitution equations
* Naming and drawing mechanisms
 | * Applying Le Chatelier’s principle
* Writing expressions
* Naming and drawing mechanisms
* Writing equations
* Drawing polymers
* Practical skills – distillation and using a separating funnel
 | * Writing equations
* Writing electronic configurations
* Plotting trends in IE
* Test-tube reactions for cations and anions
* Test-tube reactions for organic functional groups
* Analysing spectrums
 | * Analysing spectrums
* Structure determination
 |
| Covid recovery | Focus on practical skills and retrieval. |
| Careers | Experience chemistry at NTU |  |  |  |  |  |
| Year 13 | Title and objectives | **Thermodynamics and isomerism and carbonyl compounds** | **Rate equations and Kp and Aromatic compounds and amines and polymers** | **Electrode potentials and Amino acids, proteins and DNA and Chromatography** | **Acids, Bases and pH and Transition metals** | **Period 3 elements and Reactions of ions in aqueous solution** | **Revision** |
| Core knowledge | * Enthalpy changes
* Born-Haber cycles
* Enthalpies of solution
* Entropy
* Free-Energy changes
* Optical isomerism
* Aldehydes and ketones
* Hydroxynitriles
* Carboxylic Acids and Esters
* Reactions and Uses of Esters
* Acyl Chlorides
* Acid Anhydrides
* Purifying organic compounds
* **Required practical 10 –** Preparation of a pure organic solid and test of its purity and a pure organic liquid
 | * Monitoring reactions
* Reaction rates and graphs
* Rate equations
* The initial rates method
* Clock reactions
* Rate-concentration graphs
* The rate-determining step
* The Arrhenius equation
* Gas equilibria
* Change gas equilibria
* **Required practical 7 –** Measuring the rate of reaction by an initial rate method and by a continuous monitoring method
* Aromatic compounds
* Reactions of Aromatics
* Amines and Amides
* Reactions of Amines
* Condensation polymerisation
* Monomers and repeating units
* Disposing of polymers
 | * Electrode potentials
* Standard electrode potentials
* Electrochemical series
* Electrochemical cells
* **Required practical 8 -**  Measuring the EMF of an electrochemical cell
* Amino acids
* Proteins
* Enzymes
* DNA
* Cisplatin
* Chromatography
* Gas chromatography
* **Required practical 12 –** Separation of species by thin-layer chromatography
 | * Acids, Bases and Kw
* pH calculations
* The Acid dissociation constant
* Titrations and pH curves
* Titration Calculations
* Buffer Action
* Calculating pH of buffers
* **Required practical 9 –** investigating how pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base
* Transition metals – the basics
* Complex ions
* Isomerism in complex ions
* Formation of coloured ions
* Ligand substitution
* Variable oxidation states
* Transition metal titrations
 | * Period 3 elements
* Period 3 oxides
* Transition metal catalysts
* Metal-aqua ions
* **Required practical 11 –** Carry out simple test-tube reactions to identify transition metal ions in aqueous solution
 |  |
| Skills | * Drawing Born-Haber cycles
* Drawing Cycles
* Calculating the gradient of a line
* Manipulating equations
* Drawing optical isomers
* Writing equations
* Naming and drawing mechanisms
* Synthesis of Aspirin
* Purifying organic compounds
* Testing for purity
 | * Measuring rate (gas volume, changes in pH, colour change and loss of mass)
* Plotting data
* Drawing lines of best fit
* Calculating the gradient of a line (Tangents)
* Writing expressions
* Naming and drawing mechanisms
* Writing equations
* Drawing repeating units of polymers
* Identifying monomers from repeating units of polymers
 | * Drawing cell diagrams
* Writing conventional cell representations
* Writing half equations
* Manipulating equations
* Setting up a cell
* Drawing primary, secondary and tertiary protein structures
* Drawing the different components of a nucleotide.
* Setting up a chromatography practical
 | * Writing expressions
* Writing equations
* Writing half equations
* Manipulating equations
* Titration practical (measuring volume)
* Plotting pH curves
* Drawing shapes of isomers
* Manipulating equations
* Plotting calibration curves
* Writing equations
 | * Writing equations
* Carry out a titration
* Manipulating equations
* Writing half equations
* Test tube reactions
 |  |
| Covid recovery | Focus on practical skills and retrieval. |
| Careers | Spectroscopy trip to the University of Nottingham | Aspirin synthesis and analysis at NTU |  |  |  |  |