VCE Chemistry

EP Curriculum Map

Unit 1: How can the diversity of materials be explained?

Area of Study 1: How can knowledge of elements explain the properties of matter?

Elements and the periodic table

Content Descriptor	Lesson Names
The relative and absolute sizes of particles that are visible and invisible to the unaided eye: small and giant molecules and lattices; atoms and sub-atomic particles; nanoparticles and nanostructures.	• The Structure of an Atom • What are Atoms, Elements and Compounds? • Introduction to Bonding
The definition of an element with reference to atomic number; mass number; isotopic forms of an element using appropriate notation.	• What are Atoms, Elements and Compounds? • Atomic Number
Spectral evidence for the Bohr model and for its refinement as the Schrödinger model; electronic configurations of elements 1 to 36 using the Schrödinger model of the atom, including s, p, d and f notations (with copper and chromium exceptions).	• History of the Atomic Model • Rutherford-Bohr Model • Electron Configuration of Atoms • Electron Configuration of Ions
The periodic table as an organisational tool to identify patterns and trends in, and relationships between, the structures (including electronic configurations and atomic radii) and properties (including electronegativity, first ionisation energy, metallic/non-metallic character and reactivity) of elements.	• Trends in the Periodic Table • Periodic Trends: Electronegativity • Periodic Trends: Ionisation Energy • Periodic Trends: Metallic Character • Periodic Trends: Atomic Radius

Metals

Content Descriptor	Lesson Names
The common properties of metals (lustre, malleability, ductility, heat and electrical conductivity) with reference to the nature of metallic bonding and the structure of metallic crystals, including limitations of representations; general differences between properties of main group and transition group metals.	• Metals in the Periodic Table • Metals, Non-Metals and Metalloids • Physical Properties of Metallic Substances • Metallic Substances • Periodic Trends: Metallic Character

Experimental determination of the relative reactivity of metals with water, acids and oxygen.	• Periodic Trends: Metallic Character • Acid-Metal Reactions
The extraction of a selected metal from its ore/s including relevant environmental, economic and social issues associated with its extraction and use.	• Mining • Minerals and Rocks as Resources • Mining and Mineral Exploration
Experimental modification of a selected metal related to the use of coatings or heat treatment or alloy production.	*Further development planned*
Properties and uses of metallic nanomaterials and their different nanoforms including comparison with the properties of their corresponding bulk materials.	*Further development planned*

Ionic compounds

Content Descriptor	**Lesson Names**
Common properties of ionic compounds (brittleness, hardness, high melting point, difference in electrical conductivity in solid and liquid states) with reference to their formation, nature of ionic bonding and crystal structure including limitations of representations.	• What are Ions? • Physical Properties of Ionic Substances • Ionic Substances
Experimental determination of the factors affecting crystal formation of ionic compounds.	• Ions in Solution
The uses of common ionic compounds.	• Naming Ionic Compounds

Quantifying atoms and compounds

Content Descriptor	**Lesson Names**
The relative isotopic masses of elements and their representation on the relative mass scale using the carbon-12 isotope as the standard; reason for the selection of carbon-12 as the standard.	• What are Isotopes? • Isotope Properties
Determination of the relative atomic mass of an element using mass spectrometry (details of instrument not required).	• Mass Spectrometry
The mole concept; Avogadro constant; determination of the number of moles of atoms in a sample of known mass; calculation of the molar mass of ionic compounds.	• Moles and Molar Mass • Moles and Balanced Equations (Stoichiometry)
Experimental determination of the empirical formula of an ionic compound.	• Molecular and Empirical Formulae

Area of Study 2: How can the versatility of non-metals be explained?

Materials from molecules

Content Descriptor	Lesson Names
Representations of molecular substances (electron dot formulas, structural formulas, valence structures, ball-and-stick models, space-filling models) including limitations of representations.	• Electron Dot Diagrams of Atoms • Lewis Structures of Molecules and Ions • Development of the VSEPR Theory
Shapes of molecules and an explanation of their polar or non-polar character with reference to the electronegativities of their atoms and electron-pair repulsion theory.	• Introduction to Shapes of Molecules • Trigonal-Based Shapes • Tetrahedral-Based Shapes • Bipyramidal-Based Shapes • Octahedral-Based Shapes • Review of Molecule Shapes • Polarity of Molecules
Explanation of properties of molecular substances (including low melting point and boiling point, softness, and non-conduction of electricity) with reference to their structure, intramolecular bonding and intermolecular forces.	• Types of Intermolecular Forces • Physical Properties of Molecular Substances
The relative strengths of bonds (covalent bonding, dispersion forces, dipole-dipole attraction and hydrogen bonding) and evidence and factors that determine bond strength including explanations for the floating of ice and expansion of water at higher temperatures.	• The Ionic-Covalent Continuum • Covalent Bonding • Covalent Network Substances • Physical Properties of Covalent Network Substances

Carbon lattices and carbon nanomaterials

Content Descriptor	Lesson Names
The structure and bonding of diamond and graphite that explain their properties (including heat and electrical conductivity and hardness) and their suitability for diverse applications.	• Carbon Chemistry • Allotropes of Carbon
The structures, properties and applications of carbon nanomaterials including graphene and fullerenes.	• Nanomaterials

Organic compounds

Content Descriptor	Lesson Names
The origin of crude oil and its use as a source of	*Further development planned*

hydrocarbon raw materials.	
The grouping of hydrocarbon compounds into families (alkanes, alkenes, alkynes, alcohols, carboxylic acids and non-branched esters) based upon similarities in their physical and chemical properties including general formulas, their representations (structural formulas, condensed formulas, Lewis structures), naming according to IUPAC systematic nomenclature (limited to non-cyclic compounds up to C10, and structural isomers up to C7) and uses based upon properties.	• Introduction to Organic Chemistry • Naming Esters • Naming Alkanes • Chemical and Structural Formula of Alkanes • Naming Alkenes • Naming Alkynes • Naming Alcohols • Naming Carboxylic Acids • Physical Properties of Haloalkanes • Physical Properties of Amides • Physical Properties of Amines • Physical Properties of Carboxylic Acids • Physical Properties of Alcohols
Determination of empirical and molecular formulas of organic compounds from percentage composition by mass and molar mass.	• Chemical Formulae • Empirical and Molecular Formulae • Moles and Equations

Polymers

Content Descriptor	**Lesson Names**
The formation of polymers from monomers including addition polymerisation of alkenes.	• Introduction to Polymers • Addition Polymer Structure, Properties and Uses • Condensation Polymer Structure, Properties & Uses
The distinction between linear (thermoplastic) and cross-linked (thermosetting) polymers with reference to structure, bonding and properties including capacity to be recycled. The features of linear polymers designed for a particular purpose including the selection of a suitable monomer (structure and properties), chain length, degree of branching, percentage crystalline areas and addition of plasticisers. The advantages and disadvantages of the use of polymer materials.	• Plastics • Addition Polymer Structure, Properties and Uses • Condensation Polymer Structure, Properties & Uses • Comparing Addition and Condensation Polymerisation

Unit 2: What makes water such a unique molecule?

Area of Study 1: How do substances interact with water?

Properties of water

Content Descriptor	Lesson Names
Trends in the melting and boiling points of Group 16 hydrides, with reference to the nature and relative strengths of their intermolecular forces and to account for the exceptional values for water.	• Properties of Water • Phase Changes
Specific heat capacity and latent heat including units and symbols, with reference to hydrogen bonding to account for the relatively high specific heat capacity of liquid water, and significance for organisms and water supplies of the relatively high latent heat of vaporisation of water.	• Specific Latent Heat • Specific Heat Capacity

Water as a solvent

Content Descriptor	Lesson Names
The comparison of solution processes in water for molecular substances and ionic compounds.	• Solute, Solvent and Solution • Concentration • Solubility in Water • Effect of Temperature on Solubility
Precipitation reactions represented by balanced full and ionic equations, including states.	• Precipitation Reactions • Precipitation Equations and Descriptions
The importance of the solvent properties of water in selected biological, domestic or industrial contexts.	*Further development planned*

Acid-base (proton transfer) reactions in water

Content Descriptor	Lesson Names
The Brønsted-Lowry theory of acids and bases including polyprotic acids and amphiprotic species, and writing of balanced ionic equations for their reactions with water including states.	• Acids • Acids and Bases • Reactions of Acids • Bases • Neutralisation

The ionic product of water, the pH scale and the use of pH in the measurement and calculations of strengths of acids and bases and dilutions of solutions (calculations involving acidity constants are not required).	• pH • Kw and pOH
The distinction between strong and weak acids and bases, and between concentrated and dilute acids and bases, including common examples.	• Acids and Bases
The reactions of acids with metals, carbonates and hydroxides including balanced full and ionic equations, with states indicated.	• Reactions of Acids • Metal Oxides and Hydroxides • Metal Carbonates and Hydrogen Carbonates
The causes and effects of a selected issue related to acid-base chemistry.	• Neutralisation

Redox (electron transfer) reactions in water

Content Descriptor	**Lesson Names**
Oxidising and reducing agents, conjugate redox pairs and redox reactions including writing of balanced half and overall redox equations with states indicated.	• Introduction to Oxidation-Reduction • Introduction to Oxidation-Reduction Reactions
The reactivity series of metals and metal displacement reactions including balanced redox equations with states indicated.	• Explaining Reactivity • Balancing Redox Half-Equations • Balancing Overall Redox Equations
The causes and effects of a selected issue related to redox chemistry.	• Displacement Reactions • Combustion and Corrosion

Area of Study 2: How are substances in water measured and analysed?

Water sample analysis

Content Descriptor	**Lesson Names**
Existence of water in all three states at Earth's surface including the distribution and proportion of available drinking water.	• Water on Earth • Water Cycle • States of Water
Sampling protocols including equipment and sterile techniques for the analysis of water quality at various depths and locations. The definition of a chemical contaminant and an example relevant to a selected water supply.	*Further development planned*

Measurement of solubility and concentration

Content Descriptor	Lesson Names
The use of solubility tables and experimental measurement of solubility in gram per 100 g of water.	• Solubility in Water • Solubility Product Expressions • Solutions and Concentration • Other Measures of Concentration
The quantitative relationship between temperature and solubility of a given solid, liquid or gas in water.	• Effect of Temperature on Solubility
The use of solubility curves as a quantitative and predictive tool in selected biological, domestic or industrial contexts.	• Solutions and Concentration • Other Measures of Concentration • Effect of Temperature on Solubility
The concept of solution concentration measured with reference to moles (mol L-1) or with reference to mass or volume (g L-1, mg L-1, %(m/m), %(m/v), %(v/v), ppm, ppb) in selected domestic, environmental, commercial or industrial applications, including unit conversions.	• Solutions and Concentration • Other Measures of Concentration • Calculating Solubility • Saturated Solution Calculations • Calculating Solubility Products

Analysis for salts in water

Content Descriptor	Lesson Names
Sources of salts found in water (may include minerals, heavy metals, organo-metallic substances) and the use of electrical conductivity to determine the salinity of water samples.	• Relative Concentrations, pH and Conductivity
The application of mass-mass stoichiometry to gravimetric analysis to determine the mass of a salt in a water sample.	• Moles and Molar Mass
The application of colorimetry and/or UV-visible spectroscopy, including the use of a calibration curve, to determine the concentration of coloured species (ions or complexes) in a water sample.	*Further development planned*
The application of atomic absorption spectroscopy (AAS), including the use a calibration curve, to determine the concentration of metals or metal ions in a water sample (excluding details of instrument).	• Atomic Absorption Spectroscopy

Analysis for organic compounds in water

Content Descriptor	Lesson Names
Sources of organic contaminants found in water (may include dioxins, insecticides, pesticides, oil spills). The application of high performance liquid chromatography (HPLC) including the use of a calibration curve and retention time to determine the concentration of a soluble organic compound in a water sample (excluding details of instrument).	*Further development planned*

Analysis for acids and bases in water

Content Descriptor	Lesson Names
Sources of acids and bases found in water (may include dissolved carbon dioxide, mining activity and industrial wastes).	*Further development planned*
Volume-volume stoichiometry (solutions only) and application of volumetric analysis including the use of indicators, calculations related to preparation of standard solutions, dilution of solutions and use of acid-base titrations to determine the concentration of an acid or a base in a water sample.	• Introduction to Titrations • Titration Calculations (NEW) • Titration Curves • Titration Curve Calculations: Before Equivalence • Titration Curve Calculations: To Equivalence and Beyond • Buffer Solutions • Dilutions (NEW) • Buffer Calculations • Standard Solutions (NEW) • Performing a Titration (NEW)

Unit 3: How can chemical processes be designed to optimise efficiency?

Area of Study 1: What are the options for energy production?

Obtaining energy from fuels

Content Descriptor	Lesson Names
The definition of a fuel, including the distinction between fossil fuels and biofuels with reference to origin and renewability (ability of a resource to be replaced by natural processes within a relatively short period of time).	• Fuels
Combustion of fuels as exothermic reactions with reference to the use of the joule as the SI unit of energy, energy transformations and their efficiencies and measurement of enthalpy change including symbol (ΔH) and common units (kJ mol-1, kJ g-1, MJ/tonne).	• Exothermic and Endothermic Processes • Enthalpy and Heat • State Changes • Standard Enthalpy Changes: Part 1 • Hess's Law • Standard Enthalpy Changes: Part 2 • Calculating Enthalpy Changes • Bond Enthalpies of Molecules • Entropy • Bond Enthalpies of Reactions • Spontaneity of Reactions
The writing of balanced thermochemical equations, including states, for the complete and incomplete combustion of hydrocarbons, methanol and ethanol, using experimental data and data tables.	• Thermochemical Equations • Energy Level Diagrams
The definition of gas pressure including units, the universal gas equation and standard laboratory conditions (SLC) at 25 °C and 100 kPa.	• Ideal Gas Law: PV=nRT • Kinetic Theory and Gas Laws • Pressure and Equilibrium
Calculations related to the combustion of fuels including use of mass-mass, mass-volume and volume-volume stoichiometry in calculations of enthalpy change (excluding solution stoichiometry) to determine heat energy released, reactant and product amounts and net volume of greenhouse gases at a given temperature and pressure (or net mass) released per MJ of energy obtained.	• Mole Ratios • Stoichiometry and Energy Calculations
The use of specific heat capacity of water to determine the approximate amount of heat energy released in the combustion of a fuel.	• Specific Heat Capacity • Calorimetry

Fuel choices

Content Descriptor	Lesson Names
The comparison of fossil fuels (coal, crude oil, petroleum gas, coal seam gas) and biofuels (biogas, bioethanol, biodiesel) with reference to energy content, renewability and environmental impacts related to sourcing and combustion.	• Fuels • Oil Pollution and Industrial Waste • The Palm Oil Predicament • Use of Fuels in Society
The comparison of the suitability of petrodiesel and biodiesel as transport fuels with reference to sources, chemical structures, combustion products, flow along fuel lines (implications of hygroscopic properties and impact of outside temperature on viscosity) and the environmental impacts associated with their extraction and production.	• Fuels • Oil Pollution and Industrial Waste • The Palm Oil Predicament • Use of Fuels in Society

Galvanic cells as a source of energy

Content Descriptor	Lesson Names
Redox reactions with reference to electron transfer, reduction and oxidation reactions, reducing and oxidising agents, and use of oxidation numbers to identify conjugate reducing and oxidising agents.	• Introduction to Oxidation-Reduction • Introduction to Oxidation-Reduction Reactions • Explaining Reactivity • Displacement Reactions • Combustion and Corrosion
The writing of balanced half-equations for oxidation and reduction reactions and balanced ionic equations, including states, for overall redox reactions.	• Balancing Redox Half-Equations • Balancing Overall Redox Equations
Galvanic cells as primary cells and as portable or fixed chemical energy storage devices that can produce electricity (details of specific cells not required) including common design features (anode, cathode, electrolytes, salt bridge and separation of half-cells) and chemical processes (electron and ion flows, half-equations and overall equations).	• Introduction to Galvanic Cells • Standard Reduction Potentials of Half-Cells • Batteries
The comparison of the energy transformations occurring in spontaneous exothermic redox reactions involving direct contact between reactants (transformation of chemical energy to heat energy) compared with those occurring when the reactants are	• Introduction to Galvanic Cells • Standard Reduction Potentials of Half-Cells • Batteries

separated in galvanic cells (transformation of chemical energy to electrical energy).	
The use of the electrochemical series in designing and constructing galvanic cells and as a tool for predicting the products of redox reactions, deducing overall equations from redox half-equations and determining maximum cell voltage under standard conditions.	• Calculating Cell Potentials for Galvanic Cells

Fuel cells as a source of energy

Content Descriptor	Lesson Names
The common design features of fuel cells including use of porous electrodes for gaseous reactants to increase cell efficiency (details of specific cells not required). The comparison of the use of fuel cells and combustion of fuels to supply energy with reference to their energy efficiencies (qualitative), safety, fuel supply (including the storage of hydrogen), production of greenhouse gases and applications. The comparison of fuel cells and galvanic cells with reference to their definitions, functions, design features, energy transformations, energy efficiencies (qualitative) and applications.	*Further development planned*

Area of Study 2: How can the yield of a chemical product be optimised?

Rate of chemical reactions

Content Descriptor	Lesson Names
Chemical reactions with reference to collision theory, including qualitative interpretation of Maxwell-Boltzmann distribution curves.	• Rate of Reaction • Collision Theory and Rate of Reaction • Rate of Reaction Equations • Maxwell-Boltzmann Distribution Curves
The comparison of exothermic and endothermic reactions including their enthalpy changes and representations in energy profile diagrams.	• Activation Energy and Energy Profiles
Factors affecting the rate of a chemical reaction including temperature, surface area concentration of	• Factors Affecting Reaction Rates

solutions, gas pressures and presence of a catalyst.	
The role of catalysts in changing the rate of chemical reactions with reference to alternative reaction pathways and their representation in energy profile diagrams.	• Catalysts

Extent of chemical reactions

Content Descriptor	Lesson Names
The distinction between reversible and irreversible reactions, and between rate and extent of a reaction.	• Chemical Systems • Reversible Changes • Equilibrium • Energetics of Reversible Reactions
Homogenous equilibria involving aqueous solutions or gases with reference to collision theory and representation by balanced chemical or thermochemical equations (including states) and by concentration-time graphs.	• Temperature and Equilibrium • Concentration and Equilibrium • Pressure and Equilibrium
Calculations involving equilibrium expressions and equilibrium constants (Kc only) for a closed homogeneous equilibrium system including dependence of value of equilibrium constant, and its units, on the equation used to represent the reaction and on the temperature.	• The Equilibrium Constant • Calculating Equilibrium Constants
Le Chatelier's principle: identification of factors that favour the yield of a chemical reaction, representation of equilibrium system changes using concentration-time graphs and applications, including competing equilibria involved in the occurrence and treatment of carbon monoxide poisoning resulting from incomplete combustion of fuels.	• Le Chatelier's Principle

Production of chemicals by electrolysis

Content Descriptor	Lesson Names
Electrolysis of molten liquids and aqueous solutions using different electrodes.	• Introduction to Electrolytic Cells and Electrolysis
The general operating principles of commercial electrolytic cells, including basic structural features and selection of suitable electrolyte (molten or aqueous) and electrode (inert or reactive) materials to obtain desired	• Introduction to Electrolytic Cells and Electrolysis

products (no specific cell is required).	
The use of the electrochemical series to explain or predict the products of an electrolysis, including identification of species that are preferentially discharged, balanced half-equations, a balanced ionic equation for the overall cell reaction, and states.	• Predicting Products of Electrolysis
The comparison of an electrolytic cell with a galvanic cell with reference to the energy transformations involved and basic structural features and processes. The application of stoichiometry and Faraday's Laws to determine amounts of product, current or time for a particular electrolytic process.	*Further development planned*

Rechargeable batteries

Content Descriptor	**Lesson Names**
The operation of rechargeable batteries (secondary cells) with reference to discharging as a galvanic cell and recharging as an electrolytic cell, including the redox principles (redox reactions and polarity of electrodes) and the factors affecting battery life with reference to components and temperature (no specific battery is required).	• Batteries

Unit 4: How are organic compounds categorised, analysed and used?

Area of Study 1: How can diversity of carbon compounds be explained and categorised?

Structure and nomenclature of organic compounds

Content Descriptor	Lesson Names
The carbon atom with reference to valence number, bond strength, stability of carbon bonds with other elements and the formation of isomers (structural and stereoisomers) to explain carbon compound diversity, including identification of chiral centres in optical isomers of simple organic compounds and distinction between cis- and trans- isomers in simple geometric isomers.	• Introduction to Organic Chemistry • Structural Isomers • Geometric Isomers • Optical Isomers • Alcohol Isomerism • Alkene Isomerism • Haloalkane Classification and Isomerism • Primary Amine Isomerism • Alkane Isomers
Structures including molecular, structural and semi-structural formulas of alkanes (including cyclohexane), alkenes, alkynes, benzene, haloalkanes, primary amines, primary amides, alcohols (primary, secondary, tertiary), aldehydes, ketones, carboxylic acids and non-branched esters.	• Properties of Amides • Properties of Esters • Properties of Alcohols • Properties of Alkenes • Properties of Carbonyl Compounds • Properties of Haloalkanes • Properties of Primary Amines • Properties of Alkanes • Physical Properties of Amino Acids • Properties of Alkynes • Properties of Carboxylic Acids
IUPAC systematic naming of organic compounds up to C8 with no more than two functional groups for a molecule, limited to non-cyclic hydrocarbons, haloalkanes, primary amines, alcohols (primary, secondary, tertiary), carboxylic acids and non-branched esters.	• Naming Alcohols • Naming Alkanes • Naming Alkenes • Naming Amides • Naming Amines • Naming Esters • Naming Haloalkanes • Naming Aldehydes • Molecular and Structural Formulas of Alkanes • Naming Ketones • Naming Alkynes • Naming Carboxylic Acids

Categories, properties and reactions of organic compounds

Content Descriptor	Lesson Names
An explanation of trends in physical properties (boiling point, viscosity) and flashpoint with reference to structure and bonding.	• Properties of Amides • Properties of Esters • Properties of Alcohols • Properties of Alkenes • Properties of Carbonyl Compounds • Properties of Haloalkanes • Properties of Primary Amines • Properties of Alkanes • Physical Properties of Amino Acids • Properties of Alkynes • Properties of Carboxylic Acids
Organic reactions, including appropriate equations and reagents, for the oxidation of primary and secondary alcohols, substitution reactions of haloalkanes, addition reactions of alkenes, hydrolysis reactions of esters, the condensation reaction between an amine and a carboxylic acid, and the esterification reaction between an alcohol and a carboxylic acid.	• Formation of Esters • Alkene Reactions • Reactions of Carbonyl Compounds • Reactions of Primary Amines • Substitution Reactions of Alcohols • Substitution Reactions of Haloalkanes • Elimination Reactions of Alcohols • Substitution Reactions of Alkanes • Oxidation Reactions of Alcohols • Fermentation and Ethanol Production
The pathways used to synthesise primary haloalkanes, primary alcohols, primary amines, carboxylic acids and esters, including calculations of atom economy and percentage yield of single-step or overall pathway reactions.	• Designing Chemical Synthesis Processes • Limiting Reagents and Theoretical Yield • Percentage Yield • Overall Reaction Efficiency • Green Chemistry Principles

Analysis of organic compounds

Content Descriptor	Lesson Names
The principles and applications of mass spectroscopy (excluding features of instrumentation and operation) and interpretation of qualitative and quantitative data, including identification of molecular ion peak, determination of molecular mass and identification of simple fragments.	• Mass Spectrometry of Compounds
The principles and applications of infrared spectroscopy (IR) (excluding features of instrumentation and	• Infrared Spectroscopy

operation) and interpretation of qualitative and quantitative data including use of characteristic absorption bands to identify bonds.	
The principles (including spin energy levels) and applications of proton and carbon-13 nuclear magnetic resonance spectroscopy (NMR) (excluding features of instrumentation and operation); analysis of carbon-13 NMR spectra and use of chemical shifts to determine number and nature of different carbon environments in a simple organic compound; and analysis of high resolution proton NMR spectra to determine the structure of a simple organic compound using chemical shifts, areas under peak and peak splitting patterns (excluding coupling constants) and application of the n+1 rule.	• Principles of NMR Spectroscopy • Carbon-13 spectroscopy • Proton NMR Spectroscopy
Determination of the structures of simple organic compounds using a combination of mass spectrometry (MS), infrared spectroscopy (IR) and proton and carbon-13 nuclear magnetic resonance spectroscopy (NMR) (limited to data analysis).	• Mass Spectrometry of Compounds • Infrared Spectroscopy • Principles of NMR Spectroscopy • Carbon-13 spectroscopy • Proton NMR Spectroscopy • Structural Determination
The principles of chromatography including use of high performance liquid chromatography (HPLC) and construction and use of a calibration curve to determine the concentration of an organic compound in a solution.	• Chromatography Techniques
Determination of the concentration of an organic compound by volumetric analysis, including the principles of direct acid-base and redox titrations (excluding back titrations).	*Further development planned*

Area of Study 2: What is the chemistry of food?

Key food molecules

Content Descriptor	**Lesson Names**
Proteins: formation of dipeptides and polypeptides as condensation polymers of 2-amino acids; primary (including peptide links), secondary, tertiary and quaternary structure and bonding; distinction between essential and non-essential amino acids as dietary components.	• Protein Structure and Sequencing • Amino Acids • Amino Acid Reactions • Formation and Hydrolysis of Amides
Carbohydrates: formation of disaccharides from	• Monosaccharides

monosaccharides, and of complex carbohydrates (specifically starch and cellulose) as condensation polymers of monosaccharides; glycosidic links; storage of excess glucose in the body as glycogen; comparison of glucose, fructose, sucrose and the artificial sweetener aspartame with reference to their structures and energy content.	• Condensation Reactions of Carbohydrates
Fats and oils (triglycerides): common structural features including ester links; distinction between fats and oils with reference to melting points; explanation of different melting points of triglycerides with reference to the structures of their fatty acid tails and the strength of intermolecular forces; chemical structures of saturated and unsaturated (monounsaturated and polyunsaturated) fatty acids; distinction between essential and nonessential fatty acids; and structural differences between omega-3 fatty acids and omega-6 fatty acids. Vitamins: inability of humans to synthesise most vitamins (except Vitamin D) making them essential dietary requirements; comparison of structural features of Vitamin C (illustrative of a water-soluble vitamin) and Vitamin D (illustrative of a fat-soluble vitamin) that determine their solubility in water or oil.	• Structure, Properties and Functions of Lipids

Metabolism of food in the human body

Content Descriptor	Lesson Names
Metabolism of food as a source of energy and raw materials: general principles of metabolism of food involving enzyme-catalysed chemical reactions with reference to the breakdown of large biomolecules in food by hydrolytic reactions to produce smaller molecules, and the subsequent synthesis of large biologically important molecules by condensation reactions of smaller molecules.	• Metabolic Requirements • Biochemical Processes
Enzymes as protein catalysts: active site; modelling of process by which enzymes control specific biochemical reactions (lock-and-key and induced fit models); consequences of variation in enzyme-substrate interaction (lock-and-key mechanism) due to the behaviour of a particular optical isomer; explanation of effects of changes in pH (formation of zwitterions and denaturation), increased temperature (denaturation) and decreased temperature (reduction in activity) on	• Introducing Enzymes • Enzyme structure • Factors Affecting Enzymes • Examples of Enzyme Reactions • Digestive Enzymes

enzyme activity with reference to structure and bonding; action of enzymes in narrow pH ranges; and use of reaction rates to measure enzyme activity.	
The distinction between denaturation of a protein and hydrolysis of its primary structure.	• Amino Acid Reactions • Protein Structure and Sequencing
Hydrolysis of starch in the body: explanation of the ability of all humans to hydrolyse starch but not cellulose, and of differential ability in humans to hydrolyse lactose; glycaemic index (GI) of foods as a ranking of carbohydrates based on the hydrolysis of starches (varying proportions of amylose and amylopectin) to produce glucose in the body.	• Hydrolysis of Carbohydrates • Food as an Energy Source
Hydrolysis of fats and oils from foods to produce glycerol and fatty acids; oxidative rancidity with reference to chemical reactions and processes, and the role of antioxidants in slowing rate of oxidative rancidity. The principles of the action of coenzymes (often derived from vitamins) as organic molecules that bind to the active site of an enzyme during catalysis, thereby changing the surface shape and hence the binding properties of the active site to enable function as intermediate carriers of electrons and/or groups of atoms (no specific cases required).	*Further development planned*

Energy content of food

Content Descriptor	**Lesson Names**
The comparison of energy values of carbohydrates, proteins and fats and oils.	• Food as an Energy Source
Glucose as the primary energy source, including a balanced thermochemical equation for cellular respiration.	• Aerobic Respiration • Food as an Energy Source
The principles of calorimetry; solution and bomb calorimetry, including determination of calibration factor and consideration of the effects of heat loss; and analysis of temperature-time graphs obtained from solution calorimetry.	• Food as an Energy Source