

Curriculum overview for CHEMISTRY, SL&HL, DP1, 3mn, 2026/2027

Teacher: Z. Topličan

Unit Title & Timing	IB Syllabus Alignment	Key Concept(s)	Content	Learning Outcomes	Assessment Tasks	ATL Skills	Links to Other Subjects	TOK Links
Unit 0: Measurement & Data Processing September	Skills in the study of chemistry (Tools 1–3, Inquiry 1–3)	Quantification & Uncertainties: Quantitative measurements inherently involve uncertainties, requiring systematic modelling and data processing.	Measurement uncertainties & errors Error propagation Graphical analysis & best-fit lines Lab safety & apparatus usage HL: Quadratic sum error propagation, data linearization using logs/exponentials.	Distinguish random vs. systematic errors. Calculate absolute/percentage uncertainties & propagate errors. Interpret linear graphs, slopes, and intercepts. HL: Linearize non-linear experimental data and evaluate confidence intervals.	Data processing exercise Safety test	Thinking (critical) Research (data management)	Physics: Error analysis & measurement uncertainties	How do error propagation and uncertainties affect our degree of certainty in scientific knowledge?
Unit 1: Stoichiometric Relationships September-October	Structure 1.1 & 1.4 (Particulate nature & The mole)	Models & Quantification: Matter consists of discrete particles; counting particles by mass enables precise quantitative stoichiometry.	Particulate nature of matter The mole concept & Avogadro's constant Chemical formulas & equations Solutions & molar concentration Ideal gas laws & gas calculations HL: Real gas deviations (Van der Waals equation), back titrations.	Calculate moles, molar masses, and particle Determine empirical/molecular formulas. Calculate concentrations, limiting reagents, and theoretical vs. % yield. Apply ideal gas equations HL: Solve complex back-titration calculations and explain real gas deviations.	Hydrated salt formula lab Acid-base titration lab End of unit test	Thinking (analysis) Self-management	Economics: Yield of processes Physics: Ideal gas laws, density	Does the ideal gas model represent reality, or is it merely a convenient scientific fiction?

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Unit 2: Atomic Structure November	Structure 1.2 & 1.3 (Nuclear atom & Electron configurations)	Atomic Models & Energy Sublevels: Subatomic interactions dictate atomic identity and emission spectra, revealing subatomic organization.	Subatomic particles & isotopes Mass spectrometry & relative atomic mass Electromagnetic spectrum Line emission spectra of hydrogen Electron configurations HL: Orbital shapes, successive ionization energies, anomalous configurations (Cr,Cu).	Describe atomic structure using mass and atomic numbers. Calculate relative atomic mass using mass spec data. Explain emission spectra in terms of electron energy transitions. Deduce electron arrangements for species up to $Z = 36$ HL: Interpret successive IE graphs for shell evidence; deduce transition metal ion configurations.	Molar mass determination lab Data-based lab report End of unit test	Thinking Communication	Biology: Isotope diagnostics Physics: Radioactivity, spectra	How can we claim knowledge of subatomic structures that cannot be observed directly with human senses?
Unit 3: Periodicity December	Structure 3.1 (Periodic table & trends)	Periodic Classification & Trends: Periodic variation in physical and chemical properties is governed by recurring valence electron patterns.	Periodic table structure (groups/periods) Trends in physical properties (atomic/ionic radius, IE, EN) Trends in chemical properties (Group 1, 17, Period 3 oxides) Transition metals & complex ions HL: d-block transition elements, ligand splitting, complex ions, magnetism, catalysis.	Explain periodic trends across periods and down groups. Deduce oxidation states and periodic chemical behavior. Describe transition metal characteristics: variable oxidation HL: Explain d-orbital crystal field splitting, complex ion colour ($\Delta E = hf$), and magnetism	Melting point lab End of unit test	Research Social (collaboration)	Biology: Biological roles of Na/K/Ca Physics: Conductors & semiconductors	Is the periodic table a human invention to organize data, or a discovery of fundamental natural order?

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Unit 4: Chemical Bonding & Structure January-February	Structure 2.1–2.4 (Ionic, covalent, metallic, & materials)	Structural Models & Intermolecular Forces: Material properties are determined by ionic, covalent, or metallic bonding and intermolecular interactions.	Ionic bonding & crystal lattices Covalent bonding, Lewis structures, & VSEPR geometry Intermolecular forces (dispersion, dipole-dipole, H-bonding) Metallic bonding & alloys Hybridization & resonance Giant covalent structures & materials HL: Expanded octets, formal charge, resonance, hybridization (sp, sp ² , sp ³), σ/π bonds.	Predict bonding type via electronegativity differences and state lattice properties. Deduce Lewis structures, VSEPR shapes, polarities, and formal charges. Distinguish London dispersion, dipole-dipole, and hydrogen bonding. HL: Apply formal charge to deduce stable Lewis structures; evaluate 5/6-domain VSEPR shapes and hybridization.	3D Molecular modelling report End of unit test	Thinking (spatial reasoning) Communication	Mathematics: 3D Geometry Physics: Conductors, electrostatics Biology: H-bonds in DNA	What are the strengths and limitations of using visual 2D/3D models to represent invisible subatomic interactions?
Unit 5: Energetics March	Reactivity 1.1–1.4 (Enthalpy, energy cycles, fuels, entropy/spontaneity)	Energy, Enthalpy & Spontaneity: Chemical transformations are accompanied by energy changes dictated by enthalpy, entropy, and spontaneity.	Exothermic & endothermic reactions Enthalpy change & calorimetry Hess's Law & Born-Haber cycles Bond enthalpies Entropy & Gibbs free energy HL: Born-Haber cycles, enthalpy of solution/hydration, lattice enthalpy, entropy (ΔS), Gibbs free energy (ΔG).	Calculate ΔH from calorimetry data Apply Hess's Law cycles and standard enthalpy changes Calculate enthalpy changes using bond enthalpies. HL: Calculate lattice enthalpy via Born-Haber cycles; evaluate spontaneity using $\Delta G = \Delta H - T\Delta S$.	Decomposition of CaCO ₃ Determination of an enthalpy change of reaction End of unit test	Self-management Thinking	Physics: Energy conservation & thermodynamics Economics: Cost-effectiveness of fuels	How do the laws of thermodynamics constrain human technological progress and energy utilization?

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Unit 6: Chemical Kinetics April	Reactivity 2.2 (Rate of chemical change)	Rates of Change & Activation Energy: Reaction speed depends on molecular collision frequency, energy, spatial orientation, and catalysts.	Reaction rate measurement techniques Collision theory & activation energy Rate laws, rate constants & orders of reaction Maxwell-Boltzmann distribution curves Catalysis & multi-step reaction mechanisms HL: Rate laws, reaction orders (0, 1, 2), Arrhenius equation ($k=Ae^{-E_a/RT}$), rate-determining step mechanisms.	Analyse factors affecting rate via collision theory. Sketch Maxwell-Boltzmann distributions and reaction energy profiles. Evaluate multi-step reaction mechanisms and the rate-determining step. HL: Deduce rate expressions, calculate E_a using Arrhenius plots, and deduce mechanisms from rate laws	Measuring the rate of reaction between marble and HCl (lab. ex.) Rate of a chemical reaction (laboratory experiment) End of the unit test	Research (data capture) Thinking	Biology: Enzyme catalysis, kinetics in metabolic systems	How does the application of Occam's razor guide chemists in choosing between competing reaction mechanisms?
Unit 7: Equilibrium May	Reactivity 2.3 (Extent of chemical change)	Dynamic Balance & Equilibrium: Reversible reactions achieve dynamic equilibrium where rates balance, dictated by physical conditions.	Dynamic equilibrium characteristics Equilibrium constant expressions & calculations Le Chatelier's principle Relationships between Q , K_c , and ΔG HL: ICE table calculations, non-equilibrium quotient (Q), thermodynamic link ($\Delta G^\ominus = -RT \ln K$). Industrial equilibrium processes (Haber/Contact)	Write K_c expressions and solve equilibrium concentration values. Apply Le Chatelier's principle to concentration, pressure, and temperature changes. Explain relationships between reaction quotient Q , K_c , and ΔG HL: Calculate equilibrium concentrations using ICE tables; link K_c to Gibbs free energy.	Equilibrium shifts lab End of unit test	Thinking (systems) Self-management	Economics: Haber & Contact process efficiency	To what extent do mathematical equilibrium expressions simplify real-world chemical systems?

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Unit 8: Acids and Bases May–June	Reactivity 3.1 (Proton transfer reactions)	Proton Transfer & Acid-Base Models: Acid-base behavior involves proton transfer explained through historical, evolving scientific models.	Brønsted-Lowry & Lewis acid-base theories Conjugate acid-base pairs The pH/pOH scale & ionic product of water Strong vs. weak acids/bases (K_a , K_b , pK_a , pK_b) Acid-base titrations, pH curves, & indicators Buffer solutions HL: Lewis theory, K_a , K_b , pK_a , pK_b , salt hydrolysis, buffer calculations, titration curves, indicators.	Identify acids/bases using Brønsted-Lowry and Lewis models. Calculate pH, pOH, K_w , K_a , K_b , pK_a , pK_b Distinguish strong vs. weak acids/bases via properties and K_a / K_b Plot titration curves, select indicators, and explain buffer action. HL: Calculate pH of weak acids, weak bases, and buffers; analyse hydrolysis and titration curve half-equivalence points.	Determination of acidity of different solutions by using pH meter and different indicators Acid – base titration-pH curve End of the unit test	Communication Research	Biology: Biological buffer systems Environmental/CAS: Acid rain in Zagreb	How does the evolution from Arrhenius to Brønsted-Lowry and Lewis models demonstrate the provisional nature of science?

Curriculum overview for CHEMISTRY, SL&HL, DP2, 4mn, 2026/2027

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Unit 9: Redox Processes <i>September-October</i>	Reactivity 3.2 (Electron transfer reactions)	Electron Transfer & Energy Conversion: Electron transfer drives chemical oxidation-reduction, generating electrical energy and electroplating.	Oxidation states & redox balancing Voltaic cells & standard cell potentials Electrolytic cells & electrolysis of molten/aqueous salts Quantitative electrochemistry Electroplating & industrial extraction HL: Standard electrode potentials (E), $\Delta G = -nFE$, quantitative electrolysis ($Q = I \cdot t$), electroplating.	Balance redox equations in acidic/alkaline conditions. Analyse voltaic cells, calculate E and deduce spontaneity. HL: Calculate cell potentials (E), predict reaction spontaneity using ΔG , and solve electroplating stoichiometry.	Electrochemistry lab Determination of $\text{Ar}\{\text{Cu}\}$ lab End of unit test	Thinking Self-management	Physics: Direct current, potential difference, cell storage	What ethical considerations arise when selecting electrochemical materials for renewable energy storage?
Individual Scientific Investigation <i>October-December</i>	Internal Assessment (Inquiry 1–3)	Scientific Inquiry & Methodology: Scientific knowledge is constructed through ethical, rigorous, independent experimental design.	Independent research design & question formulation Safe experimental techniques & variable control Data collection, processing, & uncertainty analysis Scientific conclusion & evaluation	Formulate an original, focused scientific research question. Execute a safe, ethically controlled experimental methodology. Process quantitative data, propagate uncertainties, and evaluate errors. Draw evidence-based conclusions linked to scientific literature.	Internal Assessment Scientific Investigation Report (20%)	Research Self-management Thinking	Cross-disciplinary experimental methodologies	What constitutes sufficient evidence when evaluating scientific claims in an independent investigation?

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Unit 10: Organic Chemistry <i>December-April</i>	Structure 3.2 & Reactivity 3.3–3.4 (Organic structures & mechanisms)	Functional Groups & Organic Pathways: Carbon's structural versatility enables functional group diversity and reaction pathways via mechanism types.	IUPAC nomenclature & functional groups Structural, E/Z, cis-trans, & optical isomerism Reactions of alkanes, alkenes, alcohols, halogenoalkanes, & benzene Reaction mechanisms (SN1, SN2, electrophilic addition/substitution) Structural determination (IR, MS, HNMR spectroscopy) HL: SN1/SN2, electrophilic addition/substitution mechanisms, stereoisomerism (chiral centres, optical activity), 1H-NMR spectral elucidation, multi-step synthesis.	Draw and name organic molecules across homologous series. Analyse structural, E/Z, cis-trans, and optical isomerism. Outline reaction pathways for main organic functional groups. Describe SN1, SN2, electrophilic addition, and substitution mechanisms. Elucidate structures using Mass Spec, IR, and HNMR spectra. HL: Draw curly-arrow mechanisms, elucidate complex structures using high-resolution spectra, and map multi-step reaction pathways.	Organic functional groups lab Electrophilic substitution lab Progress test End of unit test	Thinking Skills: Analyse reaction mechanisms and predict products. Identify patterns in organic reactions. Research Skills: Interpret spectroscopic evidence. Communication Skills: Communicate organic structures and mechanisms using accepted chemical conventions.	Biology: Biomolecules and metabolism Medicine: Pharmaceuticals and drug development Environmental systems: Organic pollutants	To what extent do models and representations help or hinder our understanding of molecular structures? How reliable are indirect methods of observation in constructing scientific knowledge?

Chemistry, ATL Skills, TOK, Academic Integrity and International-Mindedness

Through the study of chemistry, students develop critical thinking, research, communication and self-management skills through inquiry, experimentation and analysis of evidence. The course promotes international-mindedness by exploring scientific discoveries and technological developments from diverse cultural and historical contexts, as well as global challenges related to energy, health, sustainability and the environment. Connections with TOK encourage students to reflect on the nature of scientific knowledge, the role of models, the interpretation of evidence and the provisional character of scientific theories. Academic integrity underpins all learning through ethical scientific practice, responsible use of data, accurate citation of sources and honest reporting of experimental findings. The course supports the development of IB Learner Profile attributes including Inquirers, Thinkers, Knowledgeable, Principled, Reflective and Open-minded learners.