Marietta City Schools

2024–2025 District Unit Planner

Teacher(s)	IB Chemistry PLC	**Subject Group and Course**	Group 4 - Chemistry		
Course Part and Topic	**UNIT 2 - KINETICS AND EQUILIBRIUM** Reactivity 2.2 - How Fast? The Rate of Chemical Change Reactivity 2.3 - How Far? The Extent of Chemical Change Reactivity 3.1 - Proton Transfer Reactions	**SL or HL / Year 1 or 2**	SL Year 2	**Dates**	Semester 1 (9 weeks)
Unit Description and Texts		**DP Assessment(s) for Unit**			
Resources for 2025 "New" Syllabus ● Brown et al. *Pearson Baccalaureate Standard Level Chemistry*, 3rd edition ● Bylikin et al. *Oxford IB Diploma Programme: Chemistry Course Companion*, 2023 edition. ● Talbot et al. *Chemistry for the IB Diploma Programme*, 3rd edition. ● IB Chemistry Guide First Assessment 2025 ● InThinking IB subject site for Chemistry ● IB Chemistry Schoology Course Resources for 2016 "Old" Syllabus ● Murphy et al. *Oxford IB Diploma Programme: Chemistry Course Companion*, 2014 edition. ● Brown and Ford. *Pearson Baccalaureate Standard Level Chemistry*, 2nd edition. ● Hodder Study and Revision Guide for the IB Diploma ● Hodder IA Internal Assessment for Chemistry		● Unit 02 Summative Assessment - *Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)*			

INQUIRY: establishing the purpose of the unit

Transfer Goals *List here one to three big, overarching, long-term goals for this unit. Transfer goals are the major goals that ask students to "transfer" or apply their knowledge, skills, and concepts at the end of the unit under new/different circumstances, and on their own without scaffolding from the teacher.*
Phenomenon: Strong acids such as sulfuric acid react with bases such as hydroxides or carbonates faster than weak acids such as carbonic acid do. Statement of Inquiry: Chemical kinetics and equilibrium allow us to answer the questions "how fast" and "how far?" in a chemical reaction. 1. **Students can** explain how the rate of a reaction can be controlled. 2. **Students can** explain how the extent of a reversible reaction can be influenced. 3. **Students can** explain what happens when protons are transferred in a chemical reaction.

ACTION: teaching and learning through inquiry

Content / Skills / Concepts - Essential Understandings	**Learning Process** *Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.*

<u>Reactivity 2.2.1</u> **The rate of reaction is expressed as the change in concentration of a particular reactant/product per unit time.** *Determine rates of reaction.* ● Calculation of reaction rates from tangents of graphs of concentration, volume or mass against time should be covered. **<u>Reactivity 2.2.2</u>** **Species react as a result of collisions of sufficient energy and proper orientation.** *Explain the relationship between the kinetic energy of the particles and the temperature in kelvin, and the role of collision geometry.* **<u>Reactivity 2.2.3</u>** **Factors that influence the rate of a reaction include pressure, concentration, surface area, temperature and the presence of a catalyst.** *Predict and explain the effects of changing conditions on the rate of a reaction.* **<u>Reactivity 2.2.4</u>** **Activation energy, Ea, is the minimum energy that colliding particles need for a successful collision leading to a reaction.** *Construct Maxwell–Boltzmann energy distribution curves to explain the effect of temperature on the probability of successful collisions.* **<u>Reactivity 2.2.5</u>** **Catalysts increase the rate of reaction by providing an alternative reaction pathway with lower Ea.** *Sketch and explain energy profiles with and without catalysts for endothermic and exothermic reactions.* *Construct Maxwell–Boltzmann energy distribution curves to explain the effect of different values for Ea on the probability of successful collisions.* ● Biological catalysts are called enzymes. ● The different mechanisms of homogeneous and heterogeneous catalysts will not be assessed. **<u>Reactivity 2.3.1</u>** **A state of dynamic equilibrium is reached in a closed system when the rates of forward and backward reactions are equal.** *Describe the characteristics of a physical and chemical system at equilibrium.* **<u>Reactivity 2.3.2</u>** **The equilibrium law describes how the equilibrium constant, K, can be determined from the stoichiometry of a reaction.** *Deduce the equilibrium constant expression from an equation for a homogeneous reaction.* **<u>Reactivity 2.3.3</u>**	Learning experiences and strategies/planning for self-supporting learning: ☒ Lecture ☐ Socratic seminar ☒ Small group/pair work ☒ PowerPoint lecture/notes ☒ Individual presentations ☒ Group presentations ☒ Student lecture/leading ☐ Interdisciplinary learning Details: *Students will learn through a combination of presentations, small group work, practice problems, and lab work.* ☒ Other(s): *practice problems, lab work*
	Formative assessment(s): *Short closer quizzes for each lesson* *Practice with Tools and Inquiries* *Daily formative checks*
	Summative assessments: Unit Exam - *Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)* Laboratory Assignment - *assessing Tools and Inquiries practiced in*

The magnitude of the equilibrium constant indicates the extent of a reaction at equilibrium and is temperature dependent. *Determine the relationships between K values for reactions that are the reverse of each other at the same temperature.* ● Include the extent of reaction for: K << 1, K < 1, K = 1, K > 1, K >> 1. **<u>Reactivity 2.3.4</u>** **Le Châtelier's principle enables the prediction of the qualitative effects of changes in concentration, temperature and pressure to a system at equilibrium.** *Apply Le Châtelier's principle to predict and explain responses to changes of systems at equilibrium.* ● Include the effects on the value of K and on the equilibrium composition. ● Le Châtelier's principle can be applied to heterogeneous equilibria such as: X(g) ⇌ X(aq) **<u>Reactivity 3.1.1</u>** **Brønsted–Lowry acid is a proton donor and a Brønsted–Lowry base is a proton acceptor.** *Deduce the Brønsted–Lowry acid and base in a reaction.* ● A proton in aqueous solution can be represented as both H^+ (aq) and H_3O^+ (aq). ● The distinction between the terms "base" and "alkali" should be understood. **<u>Reactivity 3.1.2</u>** **A pair of species differing by a single proton is called a conjugate acid–base pair.** *Deduce the formula of the conjugate acid or base of any Brønsted–Lowry base or acid.* **<u>Reactivity 3.1.3</u>** **Some species can act as both Brønsted–Lowry acids and bases** *Interpret and formulate equations to show acid–base reactions of these species.* **<u>Reactivity 3.1.4</u>** **The pH scale can be used to describe the $[H^+]$ of a solution: $pH = -\log_{10}[H^+]$; $[H^+] = 10^{-pH}$.** *Perform calculations involving the logarithmic relationship between pH and $[H^+]$* ● Include the estimation of pH using universal indicator, and the precise measurement of pH using a pH meter/probe. ● The equations for pH are given in the data booklet. **<u>Reactivity 3.1.5</u>** **The ion product constant of water, K_W, shows an inverse relationship between $[H^+]$ and $[OH^-]$. $K_W = [H^+][OH^-]$** *Recognize solutions as acidic, neutral and basic from the relative values of $[H^+]$ and $[OH^-]$* ● The equation for K_W and its value at 298 K are given in the data booklet. **<u>Reactivity 3.1.6</u>** **Strong and weak acids and bases differ in the extent of ionization.** *Recognize that acid–base equilibria lie in the direction of the weaker conjugate.*	*the Unit* **Differentiation:** ☒ Affirm identity - build self-esteem ☒ Value prior knowledge ☒ Scaffold learning ☒ Extend learning Details: ● *SWD/504 – Accommodations Provided* ● *ELL – Reading & Vocabulary Support* ● *Intervention Support* ● *Extensions – Enrichment Tasks and Project* **Tools and Inquiries:** **<u>Reactivity 2.2.1</u>** ● Tool 1, 3, Inquiry 2—Concentration changes in reactions are not usually measured directly. What methods are used to provide data to determine the rate of reactions? ● Tool 1—What experiments measuring reaction rates might use time as i) a dependent variable ii) an independent variable? **<u>Reactivity 2.2.3</u>** ● Tool 1—What variables must be controlled in studying the effect of a factor on the rate of a reaction? ● Nature of science, Tool 3, Inquiry 3—How can graphs provide evidence of systematic and random error? **<u>Reactivity 3.1.4</u>** ● Tools 1, 2, 3—What is the shape of a sketch graph of pH against [H+]? ● Nature of science, Tool 2—When are digital sensors (e.g.

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• HCl, HBr, HI, HNO_3, and H_2SO_4 are strong acids, and group 1 hydroxides are strong bases. • The distinction between strong and weak acids or bases and concentrated and dilute reagents should be covered. **Reactivity 3.1.7** **Acids react with bases in neutralization reactions.** *Formulate equations for the reactions between acids and metal oxides, metal hydroxides, hydrogencarbonates and carbonates.* • Identify the parent acid and base of different salts. • Bases should include ammonia, amines, soluble carbonates and hydrogencarbonates; acids should include organic acids. **Reactivity 3.1.8** **pH curves for neutralization reactions involving strong acids and bases have characteristic shapes and features.** *Sketch and interpret the general shape of the pH curve.* • Interpretation should include the intercept with the pH axis and equivalence point. • Only monoprotic neutralization reactions will be assessed.	pH probes) more suitable than analogue methods (e.g. pH paper/solution)? **Reactivity 3.1.6** • Tool 1, Inquiry 2—What physical and chemical properties can be observed to distinguish between weak and strong acids or bases of the same concentration? **Reactivity 3.1.7** • Tool 1, Structure 1.1—How can the salts formed in neutralization reactions be separated? **Reactivity 3.1.8** • Tool 1, Structure 1.1—How can the salts formed in neutralization reactions be separated?

Approaches to Learning (ATL)

Check the boxes for any explicit approaches to learning connections made during the unit. For more information on ATL, please see the guide.

☒ Thinking

☒ Social

☒ Communication

☒ Self-management

☒ Research

Details:

Students will be continuously challenged to develop higher-order thinking skills as they take prior knowledge, combine it with new content, and synthesize new understandings and connections.

Students will build social groups through group work and intentional reflection activities.

Language and Learning *Check the boxes for any explicit language and learning connections made during the unit. For more information on the IB's approach to language and learning, please see [the guide.]()*	**TOK Connections** *Check the boxes for any explicit TOK connections made during the unit*	**CAS Connections** *Check the boxes for any explicit CAS connections. If you check any of the boxes, provide a brief note in the "details" section explaining how students engaged in CAS for this unit.*
☒ Activating background knowledge ☒ Scaffolding for new learning ☒ Acquisition of new learning through practice ☒ Demonstrating proficiency Details: *Content and vocabulary introduced in previous science courses will be used in this unit.* *Students will use many of the concepts from this unit in future units throughout the two-year course.* *Students will acquire new vocabulary.* *Students will continually demonstrate proficiency with chemistry vocabulary in class discussions and group work.*	☐ Personal and shared knowledge ☒ Ways of knowing ☐ Areas of knowledge ☐ The knowledge framework Details: *TOK knowledge questions will be included as discussion options for each lesson.*	☒ Creativity ☐ Activity ☐ Service Details: *Students will be encouraged to consider the creativity involved in scientific experimentation. Students can explore alternative ways (visual, for example) to express and explain this creativity to others.*
Resources		

List and attach (if applicable) any resources used in this unit
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REFLECTION: considering the planning, process, and impact of the inquiry

What worked well *List the portions of the unit (content, assessment, planning) that were successful*	**What didn't work well** *List the portions of the unit (content, assessment, planning) that were not as successful as hoped*	**Notes / Changes / Suggestions** *List any notes, suggestions, or considerations for the future teaching of this unit*