International Baccalaureate
Baccalauréat International
Bachillerato Internacional

Marietta City Schools

2024–2025 District Unit Planner

IB Chemistry PLC		**Subject Group and Course**	Group 4 - Chemistry		
Course Part and Topic	**UNIT 3 - REACTION STOICHIOMETRY** Structure 1.1 - Introduction to the particulate nature of matter Structure 1.4 - Counting particles by mass: The mole Structure 1.5 - Ideal gases Reactivity 2.1 - How much? The amount of chemical change	**SL or HL / Year 1 or 2**	HL Year 1	**Dates**	Semester 2 - Weeks 1 to 8
Unit Description and Texts		**DP Assessment(s) for Unit**			
● Chemistry for the IB Diploma Third Edition, Hodder Education		● Unit 03 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: Precise control over reactant quantities dictates the size, shape, and properties of nanoparticles, contributing to advancements for applications ranging from drug delivery to catalysis.

Statement of Inquiry: The quantitative aspects of chemical transformations enable scientists to design and optimize chemical processes across a multitude of applications.

Goals:

1. **Students can** model the particulate nature of matter.
2. **Students can** quantify matter on the atomic scale.
3. **Students can** use the model of ideal gas behaviour to predict the behaviour of real gases.
4. **Students can** use chemical equations to calculate reacting ratios.

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>Structure 1.1.1</u> **Elements are the primary constituents of matter, which cannot be chemically broken down into simpler substances. Compounds consist of atoms of different elements chemically bonded together in a fixed ratio. Mixtures contain more than one element or compound in no fixed ratio, which are not chemically bonded and so can be separated by physical methods.** *Distinguish between the properties of elements, compounds, and mixtures.* ● Solvation, filtration, recrystallization, evaporation, distillation, and paper chromatography should be covered. The differences between homogeneous and heterogeneous mixtures should be understood. **<u>Structure 1.1.2</u>** **The kinetic molecular theory is a model to explain physical properties of matter (solids, liquids, and gases) and changes of state.** *Distinguish the different states of matter.* *Use state symbols (s, l, g, and aq) in chemical equations.* ● Names of changes of state should be covered: melting, freezing, vaporization (evaporation and boiling), condensation, sublimation, and deposition. **<u>Structure 1.1.3</u>** **The temperature, T, in Kelvin (K) is a measure of average kinetic energy (E_k) of particles.** *Interpret observable changes in physical properties and temperature during changes of state.* *Convert between values in Celsius and Kelvin scales.* ● The kelvin (K) is the SI unit of temperature and has the same incremental value as the Celsius degree (°C). **<u>Structure 1.4.1</u>** **The mole (mol) is the SI unit of amount of substance. One mole contains exactly the number of elementary entities given by the Avogadro constant.** *Convert the amount of substance, n, to the number of specified elementary entities.* ● An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or a specified group of particles. ● The Avogadro constant (N_A) is given in the data booklet. It has the units mol^{-1}. **<u>Structure 1.4.2</u>** **Masses of atoms are compared on a scale relative to ^{12}C and are expressed as relative atomic mass (A_r) and relative formula mass (M_r) .** *Determine relative formula masses (M_r) from relative atomic masses (A_r) .* ● Relative atomic mass and relative formula mass have no units. ● The values of relative atomic masses given to two decimal places in the data booklet should be used in	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*

calculations.

Structure 1.4.3
Molar mass (*M*) has the units g mol^{-1}.
Solve problems involving the relationships between the number of particles, the amount of substance in moles and the mass in grams.
- The relationship $n = m/M$ is given in the data booklet.

Structure 1.4.4
The empirical formula of a compound gives the simplest ratio of atoms of each element present in that compound. The molecular formula gives the actual number of atoms of each element present in a molecule.
Interconvert the percentage composition by mass and the empirical formula.
Determine the molecular formula of a compound from its empirical formula and molar mass.

Structure 1.4.5
The molar concentration is determined by the amount of solute and the volume of solution.
Solve problems involving the molar concentration, amount of solute and volume of solution.
- The use of square brackets to represent molar concentration is required.
- Units of concentration should include g dm^{-3} and mol dm^{-3} and conversion between these.
- The relationship $n = CV$ is given in the data booklet.

Structure 1.4.6
Avogadro's law states that equal volumes of all gases measured under the same conditions of temperature and pressure contain equal numbers of molecules.
Solve problems involving the mole ratio of reactants and/or products and the volume of gases.

Structure 1.5.1
An ideal gas consists of moving particles with negligible volume and no intermolecular forces. All collisions between particles are considered elastic.
Recognize the key assumptions in the ideal gas model.

Structure 1.5.2
Real gases deviate from the ideal gas model, particularly at low temperature and high pressure.
Explain the limitations of the ideal gas model.
- No mathematical coverage is required.

Structure 1.5.3
The molar volume of an ideal gas is a constant at a specific temperature and pressure.
Investigate the relationship between temperature, pressure and volume for a fixed mass of an ideal gas and analyse graphs relating these variables.
- The names of specific gas laws will not be assessed.
- The value for the molar volume of an ideal gas under standard temperature and pressure (STP) is given in the data booklet.

Structure 1.5.4

Summative assessments:

Content Exam - *Items to gauge content mastery*

DP Assessment - *Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)*

Laboratory Assignment - *assessing Tools and Inquiries practiced in 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:

Structure 1.1.1
- Tool 1—What factors are considered in choosing a method to separate the components of a mixture?
- Tool 1—How can the products of a reaction be purified?

Structure 1.4.4
- Tool 1—How can experimental data on mass changes in combustion reactions be used to derive empirical formulas?

The relationship between the pressure, volume, temperature and amount of an ideal gas is shown in the ideal gas equation $PV = nRT$ and the combined gas law $P_1V_1 / T_1 = P_2V_2 / T_2$. *Solve problems relating to the ideal gas equation.* ● Units of volume and pressure should be SI only. The value of the gas constant *R*, the ideal gas equation, and the combined gas law, are given in the data booklet. **Reactivity 2.1.1** **Chemical equations show the ratio of reactants and products in a reaction.** *Deduce chemical equations when reactants and products are specified.* ● Include the use of state symbols in chemical equations. **Reactivity 2.1.2** **The mole ratio of an equation can be used to determine the masses and/or volumes of reactants and products; the concentrations of reactants and products for reactions occurring in solution.** *Calculate reacting masses and/or volumes and concentrations of reactants and products.* ● Avogadro's law and definitions of molar concentration are covered in Structure 1.4. ● The values for Ar given in the data booklet to two decimal places should be used in calculations. **Reactivity 2.1.3** **The limiting reactant determines the theoretical yield.** *Identify the limiting and excess reactants from given data.* ● Distinguish between the theoretical yield and the experimental yield. **Reactivity 2.1.4** **Solve problems involving reacting quantities, limiting and excess reactants, theoretical, experimental and percentage yields.** **Reactivity 2.1.5** **The atom economy is a measure of efficiency in green chemistry.** *Calculate the atom economy from the stoichiometry of a reaction.* ● Include discussion of the inverse relationship between atom economy and wastage in industrial processes. ● The equation for calculation of the atom economy is given in the data booklet.	● Tool 3 —What is the importance of approximation in the determination of an empirical formula? **Structure 1.4.5** ● Tool 1—What are the considerations in the choice of glassware used in preparing a standard solution and a serial dilution? ● Tool 1, Inquiry 2—How can a calibration curve be used to determine the concentration of a solution? **Structure 1.5.3** ● Tools 2 and 3— Graphs can be presented as sketches or as accurately plotted data points. What are the advantages and limitations of each representation? **Structure 1.5.4** ● Tool 1, Inquiry 2—How can the ideal gas law be used to calculate the molar mass of a gas from experimental data? **Reactivity 2.1.3** ● Tool 1, Inquiry 1, 2, 3—What errors may cause the experimental yield to be i) higher and ii) lower than the theoretical yield?

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.* *Students will communicate their findings to their peers in the form of small-group presentations.* *Students will continue to work on self-management and organization skills.* *Students will complete background research to develop and extend their learning.*

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	☐ Personal and shared knowledge ☒ Ways of knowing ☐ Areas of knowledge	☒ Creativity ☐ Activity ☐ Service

☒ 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.*	☐ The knowledge framework Details: *TOK knowledge questions will be included as discussion options for each lesson.*	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*		
Resources for 2025 Syllabus: ● Chemistry for the IB Diploma Third Edition, Hodder Education ● IB Chemistry Guide First Assessment 2025 ● InThinking IB subject site for Chemistry ● IB Chemistry Schoology Course		

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*