IB CHEMISTRY YEAR 1 - Unit 2

IB Chemistry PLC		**Subject Group and Course**	Group 4 - Chemistry		
Course Part and Topic	4.1 - Ionic Bonding and Structure 4.2 - Covalent Bonding 4.3 - Covalent Structure (partial) 4.5 - Metallic Bonding 5.1 - Measuring Energy Changes 5.2 - Hess's Law 5.3 - Bond Enthalpies	**SL or HL / Year 1 or 2**	SL Year 1	**Dates**	October to December 2022
Unit Description and Texts		**DP Assessment(s) for Unit**			
• Murphy et al. *Oxford IB Diploma Programme: Chemistry Course Companion*, 2014 edition. • Brown and Ford. *Pearson Baccalaureate Standard Level Chemistry*, 2nd edition.		• Unit 02 Summative Assessment - *Paper 1, 2, and 3 questions from old IB Papers*			

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: The energy released or gained by a chemical reaction is dependent on bonds breaking and forming.
Statement of Inquiry: The world is in constant motion; motion is the mode of existence of matter.

1. **Students can** compare and contrast ionic bonding, covalent bonding, and metallic bonding in terms of type of electrostatic attraction, strength, and effect on properties and types of compounds formed.
2. **Students can** deduce the formula and name of an ionic or covalent compound, and draw the Lewis structure for a covalent compound.
3. **Students can** differentiate between exothermic and endothermic processes in terms of enthalpy change and stability.
4. **Students can** calculate enthalpy change (ΔH) for a reaction or process using the problem-appropriate method: from temperature change ($Q=mc\Delta T$), using Hess's Law, from enthalpy changes of formation, or from bond enthalpies.

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.*
Students will UNDERSTAND the following CONTENT: • **Positive ions (cations) form by metals losing valence electrons, and negative ions (anions) form by non-metals gaining electrons** • **The number of electrons lost or gained is determined by the electron configuration of the atom** • **The ionic bond is due to electrostatic attraction between oppositely charged ions** • **Under normal conditions, ionic compounds are usually solids with lattice structures** • **A covalent bond is formed by the electrostatic attraction between a shared pair of electrons and the positively charged nuclei** • **Single, double and triple covalent bonds involve one, two and three shared pairs of electrons respectively** • **Bond length decreases and bond strength increases as the number of shared electrons increases** • **Bond polarity results from the difference in electronegativities of the bonded atoms** • **A metallic bond is the electrostatic attraction between a lattice of positive ions and delocalized electrons** • **The strength of a metallic bond depends on the charge of the ions and the radius of the metal ion** • **Alloys usually contain more than one metal and have enhanced properties** • **Lewis (electron dot) structures show all the valence electrons in a covalently bonded species** • **The "octet rule" refers to the tendency of atoms to gain a valence shell with a total of 8 electrons** • **Some atoms, like Be and B, might form stable compounds with incomplete octets of electrons** • **Heat is a form of energy, and temperature is a measure of the average kinetic energy of the particles; total energy is conserved in chemical reactions** • **Chemical reactions that involve transfer of heat between the system and the surroundings are described as endothermic or exothermic** • **The enthalpy change (ΔH) for chemical reactions is indicated in kJ mol^{-1} and usually expressed under standard conditions, given by ΔH°, including standard states** • **The enthalpy change for a reaction that is carried out in a series of steps is equal to the sum of the enthalpy changes for the individual steps** • **Bond-forming releases energy and bond-breaking requires energy** • **Average bond enthalpy is the energy needed to break one mol of a bond in a gaseous molecule averaged over similar compounds** Students will DEVELOP the following SKILLS: • **Deduce the formula and name of an ionic compound from its component ions, including polyatomic ions (NH_4^+, OH^-, NO_3^-, HCO_3^-, CO_3^{2-}, SO_4^{2-}, and PO_4^{3-})**	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* *Daily formative checks*

- **Explain volatility, electrical conductivity, and solubility in terms of ionic structure**
- **Deduce the formula and name of a covalently bonded compound**
- **Deduce the polar nature of a covalent bond from electronegativity values**
- **Explain properties of metals (electrical conductivity, malleability, trends in melting points)**
- **Explain properties of alloys in terms of non-directional bonding**
- **Deduce the Lewis (electron dot) structure of molecules or ions showing all valence electrons for up to four electron pairs per atom**
- **Understand and give examples of coordinate covalent bonds**
- **Calculate heat change when temperature of a pure substance is changed using $q = mc\Delta T$**
- **Perform calculations involving ΔH_c° and ΔH_f°**
- **Understand the effect of heat losses to the environment and the heat capacity of the calorimeter in calorimetry experiments**
- **Lab: Determine the enthalpy of a reaction in a calorimetry experiment**
- **Calculate enthalpy changes with Hess's Law and using the equation: ΔH reaction = $\sum$ (ΔH_f° products) - $\sum$ (ΔH_f° reactants)**
- **Determine the enthalpy change of a reaction that is the sum of multiple reactions with known enthalpy changes**
- **Calculate enthalpy changes from known bond enthalpy values**
- **Compare calculated enthalpy change with experimentally measured values**
- **Sketch and evaluate potential energy profiles in determining whether reactants or products are more stable and if the reaction is exothermic or endothermic**
- **Discuss the bond strength in ozone relative to oxygen in its importance to the atmosphere**

Summative assessments:

Exam consisting of Paper 1, Paper 2, and Paper 3 questions

Analysis Project involving Combustion of Alcohols

Lab Report: Measuring Enthalpy Change for a Reaction

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*

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 a lab report.

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 for their lab report.

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.*	□ 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 may apply creativity in their lab work.*

Students will acquire new vocabulary. *Students will continually demonstrate proficiency with chemistry vocabulary in class discussions and group work.*		
Resources *List and attach (if applicable) any resources used in this unit*		
● Textbooks (Oxford and Pearson - see page 1) ● Laboratory resources ● Online notes and videos (Schoology)		

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*