Marietta City Schools

2024–2025 District Unit Planner

IB Chemistry HL Year 1		**Subject Group and Course**	Group 4 - Chemistry		
Course Part and Topic	**UNIT 1 - ATOMS AND PERIODICITY** Structure 1.2 - The nuclear atom Structure 1.3 - Electron configurations Structure 3.1 - The periodic table: Classification of elements	**SL or HL / Year 1 or 2**	HL / Year 1	**Dates**	08/01 - 09/11
Text(s)		**DP Assessment(s) for Unit**			
● Chemistry for the IB Diploma Third Edition, Hodder Education		● Unit 01 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: Isotopes are used in medical imaging to diagnose and monitor a wide variety of conditions through the interactions that they have with electrons in the human body.

Statement of Inquiry: The fundamental principles that shape the behavior and properties of elements enable scientists to develop and use predictive models across scientific disciplines.

Goals:

1. **Students can** explain how the nuclei of atoms differ.
2. **Students can** model the energy states of electrons in atoms.
3. **Students can** use the periodic table to predict patterns and trends in the properties of elements.

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 1.2.1</u> **Atoms contain a positively charged, dense nucleus composed of protons and neutrons (nucleons). Negatively charged electrons occupy the space outside the nucleus.** *Use the nuclear symbol $^{A}_{Z}X$ to deduce the number of protons, neutrons and electrons in atoms and ions.* ● Relative masses and charges of the subatomic particles should be known; actual values are given in the data booklet. The mass of the electron can be considered negligible. **<u>Structure 1.2.2</u>** **Isotopes are atoms of the same element with different numbers of neutrons.** *Perform calculations involving non-integer relative atomic masses and abundance of isotopes from given data.* ● Differences in the physical properties of isotopes should be understood. ● Specific examples of isotopes need not be learned. **<u>Structure 1.2.3</u>** **Mass spectra are used to determine the relative atomic masses of elements from their isotopic composition.** *Interpret mass spectra in terms of identity and relative abundance of isotopes.* ● The operational details of the mass spectrometer will not be assessed. **<u>Structure 1.3.1</u>** **Emission spectra are produced by atoms emitting photons when electrons in excited states return to lower energy levels.** *Qualitatively describe the relationship between colour, wavelength, frequency and energy across the electromagnetic spectrum.* *Distinguish between a continuous and a line spectrum.* ● Details of the electromagnetic spectrum are given in the data booklet. **<u>Structure 1.3.2</u>** **The line emission spectrum of hydrogen provides evidence for the existence of electrons in discrete energy levels, which converge at higher energies.** *Describe the emission spectrum of the hydrogen atom, including the relationships between the lines and energy transitions to the first, second and third energy levels.*	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:**

- The names of the different series in the hydrogen emission spectrum will not be assessed.

Structure 1.3.3
The main energy level is given an integer number, n, and can hold a maximum of $2n^2$ electrons.
Deduce the maximum number of electrons that can occupy each energy level.

Structure 1.3.4
A more detailed model of the atom describes the division of the main energy level into s, p, d and f sublevels of successively higher energies.
Recognize the shape and orientation of an s atomic orbital and the three p atomic orbitals.

Structure 1.3.5
Each orbital has a defined energy state for a given electron configuration and chemical environment, and can hold two electrons of opposite spin.
Sublevels contain a fixed number of orbitals, regions of space where there is a high probability of finding an electron.
Apply the Aufbau principle, Hund's rule and the Pauli exclusion principle to deduce electron configurations for atoms and ions up to Z = 36.
- Full electron configurations and condensed electron configurations using the noble gas core should be covered.
- Orbital diagrams, i.e. arrow-in-box diagrams, should be used to represent the filling and relative energy of orbitals.
- The electron configurations of Cr and Cu as exceptions should be covered.

Structure 1.3.6
In an emission spectrum, the limit of convergence at higher frequency corresponds to ionization.
Explain the trends and discontinuities in first ionization energy (IE) across a period and down a group.
Calculate the value of the first IE from spectral data that gives the wavelength or frequency of the convergence limit.
- The value of the Planck constant (h) and the equations $E = hf$ and $c = \lambda f$ are given in the data booklet.

Structure 1.3.7
Successive ionization energy (IE) data for an element give information about its electron configuration.
Deduce the group of an element from its successive ionization data.
- Databases are useful for compiling graphs of trends in IEs.

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 1.3.2
- Inquiry 2—In the study of emission spectra from gaseous elements and of light, what qualitative and quantitative data can be collected from instruments such as gas discharge tubes and prisms?

Structure 1.3.6
- Tool 3 - Why are log scales useful when discussing IEs?

Structure 3.1.4

Structure 3.1.1 **The periodic table consists of periods, groups, and blocks.** *Identify the positions of metals, metalloids, and non-metals in the periodic table.* ● The four blocks associated with the sublevels s, p, d, f should be recognized. ● A copy of the periodic table is available in the data booklet. **Structure 3.1.2** **The period number shows the outer energy level that is occupied by electrons. Elements in a group have a common number of valence electrons.** *Deduce the electron configuration of an atom up to Z = 36 from the element's position in the periodic table and vice versa.* ● Groups are numbers from 1 to 18. ● The classifications "alkali metals", "halogens", "transition elements", and "noble gases" should be known. **Structure 3.1.3** **Periodicity refers to trends in properties of elements across a period and down a group.** *Explain the periodicity of atomic radius, ionic radius, ionization energy, electron affinity, and electronegativity.* **Structure 3.1.4** **Trends in properties of elements down a group include the increasing metallic character of group 1 elements and decreasing non-metallic character of group 17 elements.** *Describe and explain the reactions of group 1 metals with water, and of group 17 elements with halide ions.* **Structure 3.1.5** **Metallic and non-metallic properties show a continuum. This includes the trend from basic metal oxides through amphoteric to acidic non-metal oxides.** *Deduce equations from the reactions with water of the oxides of group 1 and group 2 metals, carbon and sulfur.* ● Include acid rain caused by gaseous non-metal oxides, and ocean acidification caused by increasing CO_2 levels. **Structure 3.1.6** **The oxidation state is a number assigned to an atom to show the number of electrons transferred in forming a bond. It is the charge that atom would have if the compound were composed of**	● Inquiry 2, Tool 2 - Why are simulations often used in exploring the trends in chemical reactivity of group 1 and group 17 elements? **Structure 3.1.10** ● Tool 1, Inquiry 2 - How can colorimetry or spectrophotometry be used to calculate the concentration of a solution of coloured ions?

ions. *Deduce the oxidation states of an atom in an ion or a compound.* *Explain why the oxidation state of an element is zero.* ● Oxidation states are shown with a + or - sign followed by the Arabic symbol for the number, e.g. +2,-1. Examples should include hydrogen in metal hydrides (-1) and oxygen in peroxides (-1). ● The terms “oxidation number” and “oxidation state” are often used interchangeably, and either term is acceptable in assessment. ● Naming conventions for oxyanions use oxidation numbers shown with Roman numerals, but generic names persist and are acceptable. Examples include NO_3^- nitrate, NO_2^- nitrite, SO_4^{2-} sulfate, SO_3^{2-} sulfite. **Structure 3.1.7** **Discontinuities occur in the trend of increasing first ionization energy across a period.** *Explain how these discontinuities provide evidence for the existence of energy sublevels.* ● Explanations should be based on the energy of the electron removed, rather than on the “special stability” of filled and half-filled sublevels. **Structure 3.1.8** **Transition elements have incomplete d-sublevels that give them characteristic properties.** *Recognize properties, including: variable oxidation state, high melting points, magnetic properties, catalytic properties, formation of coloured compounds and formation of complex ions with ligands.* ● Knowledge of different types of magnetism will not be assessed. **Structure 3.1.9** **The formation of variable oxidation states in transition elements can be explained by the fact that their successive ionization energies are close in value.** *Deduce the electron configurations of ions of the first-row transition elements.* **Structure 3.1.10** **Transition element complexes are coloured due to the absorption of light when an electron is promoted between the orbitals in the split d-sublevels. The colour absorbed is complementary to the colour observed.** *Apply the colour wheel to deduce the wavelengths and frequencies of light absorbed and/or observed.* ● Students are not expected to know the different splitting patterns and their relation to the coordination number. ● The colour wheel and the equation $c = \lambda f$ are given in the data booklet.	

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	**TOK Connections**	**CAS Connections**
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.]()	*Check the boxes for any explicit TOK connections made during the unit*	*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*
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*
