Marietta City Schools

2025–2026 District Unit Planner

<table>
<tr><td colspan="2">IB Chemistry HL Year 1</td><td>Subject Group and Course</td><td colspan="3">Group 4 - Chemistry</td></tr>
<tr><td>Course Part and Topic</td><td>UNIT 2 - FROM MODELS TO MATERIALS
Structure 2.1 - The ionic model
Structure 2.2 - The covalent model
Structure 2.3 - The metallic model
Structure 2.4 - From models to materials
Structure 3.2 - Functional groups: Classification of organic compounds</td><td>SL or HL / Year 1 or 2</td><td>HL / Year 1</td><td>Dates</td><td>09/12 - 12/18</td></tr>
<tr><td colspan="2">Text(s)</td><td colspan="4">DP Assessment(s) for Unit</td></tr>
<tr><td colspan="2">● Chemistry for the IB Diploma Third Edition, Hodder Education</td><td colspan="4">● Unit 02 Summative Assessment - Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)</td></tr>
</table>

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: Shape memory polymers and alloys can “remember” and return to their original shape after being deformed through the use of external stimuli such as heat and pressure. Statement of Inquiry: The underlying principles governing the structure, behavior, and applications of diverse substances foster innovations in material science and engineering. Goals: **1.** **Students can** use scientific evidence to determine the ionic nature and properties of a compound. **2.** **Students can** use scientific evidence to determine the metallic nature and properties of an element. **3.** **Students can** use scientific evidence to determine the covalent nature and properties of a substance. 4. **Students can** explain the role that bonding and structure have in the design of materials. **5.** **Students can** explain how the classification of organic molecules helps us to predict their properties.

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 2.1.1</u> **When metal atoms lose electrons, they form positive ions called cations. When non-metal atoms gain electrons, they form negative ions called anions.** *Predict the charge of an ion from the electron configuration of the atom.* ● The formation of ions with different charges from a transition element should be included. **<u>Structure 2.1.2</u>** **The ionic bond is formed by electrostatic attractions between oppositely charged ions.** *Deduce the formula and name of an ionic compound from its component ions, including polyatomic ions.* **Binary ionic compounds are named with the cation first, followed by the anion. The anion adopts the suffix "ide".** *Interconvert names and formulas of binary ionic compounds.* ● The following polyatomic ions should be known by name and formula: ammonium NH4 +, hydroxide OH^-, nitrate NO_3^-, hydrogencarbonate HCO_3^-, carbonate CO_3^{2-}, sulfate SO_4^{2-}, phosphate PO_4^{3-}. **<u>Structure 2.1.3</u>** **Ionic compounds exist as three-dimensional lattice structures, represented by empirical formulas.** *Explain the physical properties of ionic compounds to include volatility, electrical conductivity and solubility.* ● Include lattice enthalpy as a measure of the strength of the ionic bond in different compounds, influenced by ion radius and charge. **<u>Structure 2.2.1</u>** **A covalent bond is formed by the electrostatic attraction between a shared pair of electrons and the positively charged nuclei.** **The octet rule refers to the tendency of atoms to gain a valence shell with a total of 8 electrons.** *Deduce the Lewis formula of molecules and ions for up to four electron pairs on each atom.* *Distinguish between a continuous and a line spectrum.*	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, building bonding models* **Formative assessment(s):** *Structure quizzes, in class informal assessment working through practice IB problems, in class warm ups*

● Lewis formulas (also known as electron dot or Lewis structures) show all the valence electrons (bonding and non-bonding pairs) in a covalently bonded species. ● Electron pairs in a Lewis formula can be shown as dots, crosses or dashes. ● Molecules containing atoms with fewer than an octet of electrons should be covered. ● Organic and inorganic examples should be used. **<u>Structure 2.2.2</u>** **Single, double and triple bonds involve one, two and three shared pairs of electrons respectively.** *Explain the relationship between the number of bonds, bond length and bond strength.* **<u>Structure 2.2.3</u>** **A coordination bond is a covalent bond in which both the electrons of the shared pair originate from the same atom.** *Identify coordination bonds in compounds.* ● AHL - Include coverage of transition element complexes. **<u>Structure 2.2.4</u>** **The valence shell electron pair repulsion (VSEPR) model enables the shapes of molecules to be predicted from the repulsion of electron domains around a central atom.** *Predict the electron domain geometry and the molecular geometry for species with up to four electron domains.* ● Include predicting how non-bonding pairs and multiple bonds affect bond angles. **<u>Structure 2.2.5</u>** **Bond polarity results from the difference in electronegativities of the bonded atoms.** *Deduce the polar nature of a covalent bond from electronegativity values.* ● Bond dipoles can be shown either with partial charges or vectors. ● Electronegativity values are given in the data booklet. **<u>Structure 2.2.6</u>** **Molecular polarity depends on both bond polarity and molecular geometry.** *Deduce the net dipole moment of a molecule or ion by considering bond polarity and molecular geometry.* ● Examples should include species in which bond dipoles do and do not cancel each other. **<u>Structure 2.2.7</u>** **Carbon and silicon form covalent network structures.**	**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)* **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>Structure 2.1.3</u>** ● Tool 1, Inquiry 2—What experimental data demonstrate the physical properties of ionic compounds? **<u>Structure 2.2.9</u>** ● Tool 1, Inquiry 2—What experimental data demonstrate the physical properties of covalent substances? **<u>Structure 2.2.10</u>** ● Tool 1—How can a mixture be separated using

Describe the structures and explain the properties of silicon, silicon dioxide and carbon's allotropes: diamond, graphite, fullerenes and graphene. ● Allotropes of the same element have different bonding and structural patterns, and so have different chemical and physical properties. **<u>Structure 2.2.8</u>** **The nature of the force that exists between molecules is determined by the size and polarity of the molecules. Intermolecular forces include London (dispersion), dipole-induced dipole, dipole–dipole and hydrogen bonding.** *Deduce the types of intermolecular force present from the structural features of covalent molecules.* ● The term "van der Waals forces" should be used as an inclusive term to include dipole–dipole, dipoleinduced dipole, and London (dispersion) forces. ● Hydrogen bonds occur when hydrogen, being covalently bonded to an electronegative atom, has an attractive interaction on a neighbouring electronegative atom. **<u>Structure 2.2.9</u>** **Given comparable molar mass, the relative strengths of intermolecular forces are generally: London (dispersion) forces < dipole–dipole forces < hydrogen bonding.** *Explain the physical properties of covalent substances to include volatility, electrical conductivity and solubility in terms of their structure.* **<u>Structure 2.2.10</u>** **Chromatography is a technique used to separate the components of a mixture based on their relative attractions involving intermolecular forces to mobile and stationary phases.** *Explain, calculate and interpret the retardation factor values, R_F.* ● Knowledge of the use of locating agents in chromatography is not required. ● The technical and operational details of a gas chromatograph or high-performance liquid chromatograph will not be assessed. **<u>Structure 2.2.11</u>** **Resonance structures occur when there is more than one possible position for a double bond in a molecule.** *Deduce resonance structures of molecules and ions.* ● Include the term "delocalization". **<u>Structure 2.2.12</u>** **Benzene, C_6H_6 , is an important example of a molecule that has resonance.**	paper chromatography or thin layer chromatography (TLC)? **<u>Structure 2.3.1</u>** ● Tool 1, Inquiry 2, Structure 3.1—What experimental data demonstrate the physical properties of metals, and trends in these properties, in the periodic table?

Discuss the structure of benzene from physical and chemical evidence. **<u>Structure 2.2.13</u>** **Some atoms can form molecules in which they have an expanded octet of electrons.** *Visually represent Lewis formulas for species with five and six electron domains around the central atom.* *Deduce the electron domain geometry and the molecular geometry for these species using the VSEPR model.* **<u>Structure 2.2.14</u>** **Formal charge values can be calculated for each atom in a species and used to determine which of several possible Lewis formulas is preferred.** *Apply formal charge to determine a preferred Lewis formula from different Lewis formulas for a species.* **<u>Structure 2.2.15</u>** **Sigma bonds σ form by the head-on combination of atomic orbitals where the electron density is concentrated along the bond axis.** **Pi bonds π form by the lateral combination of p-orbitals where the electron density is concentrated on opposite sides of the bond axis.** *Deduce the presence of sigma bonds and pi bonds in molecules and ions.* ● Include both organic and inorganic examples. **<u>Structure 2.2.16</u>** **Hybridization is the concept of mixing atomic orbitals to form new hybrid orbitals for bonding.** *Analyse the hybridization and bond formation in molecules and ions.* *Identify the relationships between Lewis formulas, electron domains, molecular geometry and type of hybridization.* *Predict the geometry around an atom from its hybridization, and vice versa.* ● Include both organic and inorganic examples. ● Only sp, sp^2 and sp^3 hybridization need to be covered. **<u>Structure 2.3.1</u>** **A metallic bond is the electrostatic attraction between a lattice of cations and delocalized electrons.** *Explain the electrical conductivity, thermal conductivity and malleability of metals.* ● Relate characteristic properties of metals to their uses.	

<u>Structure 2.3.2</u> **The strength of a metallic bond depends on the charge of the ions and the radius of the metal ion.** *Explain trends in melting points of s and p block metals.* ● A simple treatment in terms of charge of cations and electron density is required. **<u>Structure 2.3.3</u>** **Transition elements have delocalized d-electrons.** *Explain the high melting point and electrical conductivity of transition elements.* ● Chemical properties of transition elements are covered in Reactivity 3.4. **<u>Structure 2.4.1</u>** **Bonding is best described as a continuum between the ionic, covalent and metallic models, and can be represented by a bonding triangle.** *Use bonding models to explain the properties of a material.* ● A triangular bonding diagram is provided in the data booklet. **<u>Structure 2.4.2</u>** **The position of a compound in the bonding triangle is determined by the relative contributions of the three bonding types to the overall bond.** *Determine the position of a compound in the bonding triangle from electronegativity data.* *Predict the properties of a compound based on its position in the bonding triangle.* ● To illustrate the relationship between bonding type and properties, include example materials of varying percentage bonding character. Only binary compounds need to be considered. ● Calculations of percentage ionic character are not required. ● Electronegativity data are given in the data booklet. **<u>Structure 2.4.3</u>** **Alloys are mixtures of a metal and other metals or non-metals. They have enhanced properties.** *Explain the properties of alloys in terms of non-directional bonding.* ● Illustrate with common examples such as bronze, brass and stainless steel. Specific examples of alloys do not have to be learned. **<u>Structure 2.4.4</u>** **Polymers are large molecules, or macromolecules, made from repeating subunits called**	

monomers. *Describe the common properties of plastics in terms of their structure.* ● Examples of natural and synthetic polymers should be discussed. **Structure 2.4.5** **Addition polymers form by the breaking of a double bond in each monomer.** *Represent the repeating unit of an addition polymer from given monomer structures.* ● Examples should include polymerization reactions of alkenes. ● Structures of monomers do not have to be learned but will be provided or will need to be deduced from the polymer. **Structure 2.4.6** **Condensation polymers form by the reaction between functional groups in each monomer with the release of a small molecule.** *Represent the repeating unit of polyamides and polyesters from given monomer structures.* ● All biological macromolecules form by condensation reactions and break down by hydrolysis. **Structure 3.2.1** **Organic compounds can be represented by different types of formulas. These include empirical, molecular, structural (full and condensed), stereochemical and skeletal.** *Identify different formulas and interconvert molecular, skeletal and structural formulas.* *Construct 3D models (real or virtual) of organic molecules.* ● Stereochemical formulas are not expected to be drawn, except where specifically indicated. **Structure 3.2.2** **Functional groups give characteristic physical and chemical properties to a compound. Organic compounds are divided into classes according to the functional groups present in their molecules.** *Identify the following functional groups by name and structure: halogeno, hydroxyl, carbonyl, carboxyl, alkoxy, amino, amido, ester, phenyl.* ● The terms “saturated” and “unsaturated” should be included. **Structure 3.2.3** **A homologous series is a family of compounds in which successive members differ by a common structural unit, typically CH_2 . Each homologous series can be described by a general formula.**	

Identify the following homologous series: alkanes, alkenes, alkynes, halogenoalkanes, alcohols, aldehydes, ketones, carboxylic acids, ethers, amines, amides and esters. **<u>Structure 3.2.4</u>** **Successive members of a homologous series show a trend in physical properties.** *Describe and explain the trend in melting and boiling points of members of a homologous series.* **<u>Structure 3.2.5</u>** **"IUPAC nomenclature" refers to a set of rules used by the International Union of Pure and Applied Chemistry to apply systematic names to organic and inorganic compounds.** *Apply IUPAC nomenclature to saturated or mono-unsaturated compounds that have up to six carbon atoms in the parent chain and contain one type of the following functional groups: halogeno, hydroxyl, carbonyl, carboxyl.* ● Include straight-chain and branched-chain isomers. **<u>Structure 3.2.6</u>** **Structural isomers are molecules that have the same molecular formula but different connectivities.** *Recognize isomers, including branched, straight-chain, position and functional group isomers.* ● Primary, secondary and tertiary alcohols, halogenoalkanes and amines should be included. **<u>Structure 3.2.7</u>** **Stereoisomers have the same constitution (atom identities, connectivities and bond multiplicities) but different spatial arrangements of atoms.** *Describe and explain the features that give rise to cis-trans isomerism; recognize it in non-cyclic alkenes and C3 and C4 cycloalkanes.* *Draw stereochemical formulas showing the tetrahedral arrangement around a chiral carbon.* *Describe and explain a chiral carbon atom giving rise to stereoisomers with different optical properties.* *Recognize a pair of enantiomers as non-superimposable mirror images from 3D modelling (real or virtual).* ● Nomenclature using the E-Z system will not be assessed. ● The terms "chiral", "optical activity", "enantiomer" and "racemic" mixture should be understood. ● Knowledge of the different chemical properties of enantiomers can be limited to the fact that they behave differently in chiral environments. ● Wedge-dash type representations involving tapered bonds should be used for the	

representation of enantiomers. **<u>Structure 3.2.8</u>** **Mass spectrometry (MS) of organic compounds can cause fragmentation of molecules.** *Deduce information about the structural features of a compound from specific MS fragmentation patterns.* ● Include reference to the molecular ion. ● Data on specific MS fragments are provided in the data booklet. **<u>Structure 3.2.9</u>** **Infrared (IR) spectra can be used to identify the type of bond present in a molecule.** *Interpret the functional group region of an IR spectrum, using a table of characteristic frequencies (wavenumber/cm–1).* ● Include reference to the absorption of IR radiation by greenhouse gases. ● Data for interpretation of IR spectra are given in the data booklet.. **<u>Structure 3.2.10</u>** **Proton nuclear magnetic resonance spectroscopy (1H NMR) gives information on the different chemical environments of hydrogen atoms in a molecule.** *Interpret 1H NMR spectra to deduce the structures of organic molecules from the number of signals, the chemical shifts, and the relative areas under signals (integration traces).* **<u>Structure 3.2.11</u>** **Individual signals can be split into clusters of peaks.** *Interpret 1H NMR spectra from splitting patterns showing singlets, doublets, triplets and quartets to deduce greater structural detail.* ● Data for interpretation of 1H NMR spectra are given in the data booklet. **<u>Structure 3.2.12</u>** **Data from different techniques are often combined in structural analysis.** *Interpret a variety of data, including analytical spectra, to determine the structure of a molecule.*	
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 ☒ 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*