

**Marietta City Schools**  
**2025-2026 District Unit Planner**

<b>Teacher(s)</b>	Audrey Wakeley	<b>Subject Group and Course</b>	Group 4 - Chemistry		
<b>Course Part and Topic</b>	<b>UNIT 5 - Electron Sharing Reactions</b> R3.3 Electron Sharing Reactions R3.4 Electron-Pair Sharing Reactions	<b>SL or HL / Year 1 or 2</b>	HL / Year 2	<b>Dates</b>	02/12 - 03/12 (3 weeks)
<b>Unit Description and Texts</b>		<b>DP Assessment(s) for Unit</b>			
<ul style="list-style-type: none"> <li>Chemistry for the IB Diploma Third Edition, Hodder Education</li> </ul>		<ul style="list-style-type: none"> <li>Unit 05 Summative Assessment - <i>Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)</i></li> </ul>			
<b>NOTE: HL Extensions are highlighted in yellow throughout this document.</b>					

***INQUIRY: establishing the purpose of the unit***

<p><b>Transfer Goals</b></p> <p><i>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.</i></p>
<p><u>Phenomenon</u>: When making medicines or fragrances, chemists often use nucleophilic substitution reactions to modify molecules. For example, converting a compound containing a chlorine atom into an alcohol can happen very quickly or slowly depending on the molecular structure. This is because the rate at which the nucleophile donates electrons to the carbon and replaces the halide depends on whether the carbon is attached to primary, secondary, or tertiary groups. Investigating this reveals how electron sharing during bond forming, steric effects, and reaction conditions influence the mechanisms and speeds of these important reactions in industry.</p> <p><u>Statement of Inquiry</u>: Electron sharing reactions shape the structure and properties of molecules, enabling the development of materials, medicines, and biological systems essential to modern life and technological advancement.</p> <ol style="list-style-type: none"> <li><b>Students can</b> identify and represent radicals, e.g. <math>\bullet\text{CH}_3</math> and <math>\text{Cl}\bullet</math>.</li> <li><b>Students can</b> explain, including with equations, the homolytic fission of halogens, known as the initiation step in a chain reaction.</li> </ol>

3. **Students can** explain, using equations, the propagation and termination steps in the reactions between alkanes and halogens.
4. **Students can** recognize nucleophiles in chemical reactions.
5. **Students can** deduce equations with descriptions and explanations of the movement of electron pairs in nucleophilic substitution reactions.
6. **Students can** explain, with equations, the formation of ions by heterolytic fission.
7. **Students can** recognize electrophiles in chemical reactions.
8. **Students can** deduce equations for the reactions of alkenes with water, halogens, and hydrogen halides.
9. **Students can** apply Lewis acid-base theory to inorganic and organic chemistry to identify the role of the reacting species.
10. **Students can** draw and interpret Lewis formulas of reactants and products to show coordination bond formation in Lewis acid-base reactions.
11. **Students can** deduce the charge on a complex ion, given the formula of the ion and ligands present.
12. **Students can** describe and explain the mechanisms of the reactions of primary and tertiary halogenoalkanes with nucleophiles.
13. **Students can** predict and explain the relative rates of the substitution reactions for different halogenoalkanes.
14. **Students can** explain the mechanisms of the reactions between symmetrical alkenes and halogens, water, and hydrogen halides.
15. **Students can** predict and explain the major product of a reaction between an unsymmetrical alkene and a hydrogen halide or water.
16. **Students can** describe and explain the mechanism of the reaction between benzene and a charged electrophile,  $E^+$ .

### ***ACTION: teaching and learning through inquiry***

Content / Skills / Concepts - Essential Understandings	Learning Process
<p><i>Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.</i></p>	
<p><b>Reactivity 3.3.1</b>  <b>A radical is a molecular entity that has an unpaired electron. Radicals are highly reactive.</b>  <i>Identify and represent radicals, e.g. <math>\bullet CH_3</math> and <math>Cl\bullet</math>.</i></p> <p><b>Reactivity 3.3.2</b>  <b>Radicals are produced by homolytic fission, e.g. of halogens, in the presence of ultraviolet (UV) light or heat.</b>  <i>Explain, including with equations, the homolytic fission of halogens, known as the initiation step in a chain reaction.</i></p> <ul style="list-style-type: none"> <li>• The use of a single-barbed arrow (fish hook) to show the movement of a single electron should be covered.</li> </ul>	<p>Learning experiences and strategies/planning for self-supporting learning:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Lecture</li> <li><input type="checkbox"/> Socratic seminar</li> <li><input checked="" type="checkbox"/> Small group/pair work</li> <li><input checked="" type="checkbox"/> PowerPoint lecture/notes</li> <li><input checked="" type="checkbox"/> Individual presentations</li> </ul>

<p><b>Reactivity 3.3.3</b>  <b>Radicals take part in substitution reactions with alkanes, producing a mixture of products.</b>  <i>Explain, using equations, the propagation and termination steps in the reactions between alkanes and halogens.</i></p> <ul style="list-style-type: none"> <li>Reference should be made to the stability of alkanes due to the strengths of the C-C and C-H bonds and their essentially non-polar nature.</li> </ul> <p><b>Reactivity 3.4.1</b>  <b>A nucleophile is a reactant that forms a bond to its reaction partner (the electrophile) by donating both bonding electrons.</b>  <i>Recognize nucleophiles in chemical reactions.</i></p> <ul style="list-style-type: none"> <li>Both neutral and negatively charged species should be included.</li> </ul> <p><b>Reactivity 3.4.2</b>  <b>In a nucleophilic substitution reaction, a nucleophile donates an electron pair to form a new bond, as another bond breaks producing a leaving group.</b>  <i>Deduce equations with descriptions and explanations of the movement of electron pairs in nucleophilic substitution reactions.</i></p> $\text{Nu:}^- + \text{R}-\ddot{\text{X}} \rightarrow \text{R}-\text{Nu} + \text{:}\ddot{\text{X}}\text{:}^-$ <p style="text-align: center;">substrate</p> <p style="margin-left: 200px;">Nu = nucleophile        R = electrophile        X = leaving group</p> <p><b>Reactivity 3.4.3</b>  <b>Heterolytic fission is the breakage of a covalent bond when both bonding electrons remain with one of the two fragments formed.</b>  <i>Explain, with equations, the formation of ions by heterolytic fission.</i></p> <ul style="list-style-type: none"> <li>Curly arrows should be used to show the movement of electron pairs during reactions.</li> </ul> <p><b>Reactivity 3.4.4</b>  <b>An electrophile is a reactant that forms a bond to its reaction partner (the nucleophile) by accepting both bonding electrons from that reaction partner.</b>  <i>Recognize electrophiles in chemical reactions.</i></p> <ul style="list-style-type: none"> <li>Both neutral and positively-charged species should be included.</li> </ul>	<p><input checked="" type="checkbox"/> Group presentations</p> <p><input checked="" type="checkbox"/> Student lecture/leading</p> <p><input type="checkbox"/> Interdisciplinary learning</p> <p>Details:</p> <p><i>Students will learn through a combination of presentations, small group work, practice problems, and lab work.</i></p> <p><input checked="" type="checkbox"/> Other(s): <i>practice problems, lab work</i></p> <hr/> <p><b>Formative assessment(s):</b></p> <p><i>Short closer quizzes for each lesson</i>  <i>Practice with Tools and Inquiries</i>  <i>Daily formative checks</i></p> <hr/> <p><b>Summative assessments:</b></p> <p><i>Unit Exam - Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)</i></p> <p><i>Laboratory Assignment - assessing Tools and Inquiries practices in the Unit</i></p> <hr/> <p><b>Differentiation:</b></p> <p><input checked="" type="checkbox"/> Affirm identity - build self-esteem</p> <p><input checked="" type="checkbox"/> Value prior knowledge</p> <p><input checked="" type="checkbox"/> Scaffold learning</p>
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#### Reactivity 3.4.5

Alkenes are susceptible to electrophilic attack because of the high electron density of the carbon-carbon double bond. These reactions lead to electrophilic addition.

*Deduce equations for the reactions of alkenes with water, halogens, and hydrogen halides.*

#### Reactivity 3.4.6

A Lewis acid is an electron-pair acceptor and a Lewis base is an electron-pair donor.

*Apply Lewis acid-base theory to inorganic and organic chemistry to identify the role of the reacting species.*

#### Reactivity 3.4.7

When a Lewis base reacts with a Lewis acid, a coordination bond is formed. Nucleophiles are Lewis bases and electrophiles are Lewis acids.

*Draw and interpret Lewis formulas of reactants and products to show coordination bond formation in Lewis acid-base reactions.*

#### Reactivity 3.4.8

Coordination bonds are formed when ligands donate an electron pair to transition element cations, forming complex ions.

*Deduce the charge on a complex ion, given the formula of the ion and ligands present.*

#### Reactivity 3.4.9

Nucleophilic substitution reactions include the reactions between halogenoalkanes and nucleophiles.

*Describe and explain the mechanisms of the reactions of primary and tertiary halogenoalkanes with nucleophiles.*

- Distinguish between the concerted one-step  $S_N2$  reaction of primary halogenoalkanes and the two-step  $S_N1$  reaction of tertiary halogenoalkanes. Both mechanisms occur for secondary halogenoalkanes. The stereospecific nature of  $S_N2$  reactions should be covered.

#### Reactivity 3.4.10

The rate of substitution reactions is influenced by the identity of the leaving group.

*Predict and explain the relative rates of the substitution reactions for different halogenoalkanes.*

- Different halogenoalkanes should include RCl, RBr, and RI.
- The roles of the solvent and the reaction mechanism on the rate will not be assessed.

Extend learning

Details:

1. SWD/504 – Accommodations Provided
2. ELL – Reading & Vocabulary Support
3. Intervention Support
4. Extensions – Enrichment Tasks and Project

**Reactivity 3.4.11**

Alkenes undergo electrophilic addition reactions.

Describe and explain the mechanisms of the reactions between symmetrical alkenes and halogens, water, and halogen halides.

**Reactivity 3.4.12**

The relative stability of carbocations in the addition reactions between hydrogen halides and unsymmetrical alkenes can be used to explain the reaction mechanism.

Predict and explain the major product of a reaction between an unsymmetrical alkene and a hydrogen halide or water.

**Reactivity 3.4.13**

Electrophilic substitution reactions include the reactions of benzene with electrophiles.

Describe and explain the mechanism of the reaction between benzene and a charged electrophile,  $E^+$ .

- The formation of the electrophile will not be assessed.

**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
<p><i>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 <a href="#">the guide</a>.</i></p>	<p><i>Check the boxes for any explicit TOK connections made during the unit</i></p>	<p><i>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.</i></p>
<p><input checked="" type="checkbox"/> Activating background knowledge</p> <p><input checked="" type="checkbox"/> Scaffolding for new learning</p> <p><input checked="" type="checkbox"/> Acquisition of new learning through practice</p> <p><input checked="" type="checkbox"/> Demonstrating proficiency</p> <p>Details:</p> <p><i>Content and vocabulary introduced in previous science courses will be used in this unit.</i></p> <p><i>Students will acquire new vocabulary.</i></p> <p><i>Students will continually demonstrate proficiency with chemistry vocabulary in class discussions and group work.</i></p>	<p><input type="checkbox"/> Personal and shared knowledge</p> <p><input checked="" type="checkbox"/> Ways of knowing</p> <p><input type="checkbox"/> Areas of knowledge</p> <p><input type="checkbox"/> The knowledge framework</p> <p>Details:</p> <p><i>TOK knowledge questions will be included as discussion options for each lesson.</i></p>	<p><input type="checkbox"/> Creativity</p> <p><input type="checkbox"/> Activity</p> <p><input type="checkbox"/> Service</p> <p>Details:</p> <p>N/A</p>

<b>Resources</b> <i>List and attach (if applicable) any resources used in this unit</i>		
<ul style="list-style-type: none"> <li>● Chemistry for the IB Diploma, Third Edition, Hodder Education</li> <li>● IB Chemistry Guide First Assessment 2025</li> <li>● InThinking IB subject site for Chemistry</li> <li>● IB Chemistry Schoology Course</li> </ul>		

***REFLECTION: considering the planning, process, and impact of the inquiry***

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