**Marietta City Schools**

**2025–2026 District Unit Planner**

| **Teacher(s)** | Audrey Wakeley | **Subject Group and Course** | Group 4 - Chemistry | | |
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| **Course Part and Topic** | **UNIT 4 - Electron Transfer Reactions**<br>Reactivity 3.2 - Electron Transfer Reactions | **SL or HL / Year 1 or 2** | HL / Year 2 | **Dates** | 01/07 - 02/11<br>(5 weeks) |

| **Unit Description and Texts** | **DP Assessment(s) for Unit** |
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| • Chemistry for the IB Diploma Third Edition, Hodder Education | 1. Unit 04 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.*

<u>Phenomenon</u>: When iron and copper are exposed to the same humid environment, iron rusts rapidly while copper remains largely untarnished. This difference arises from distinct electron transfer reactions involved in the corrosion processes of each metal and their varying electrode potentials. Exploring this phenomenon uncovers how redox reactions, protective oxide layers, and electrochemical series explain the varying corrosion rates and their impact on material durability.

<u>Statement of Inquiry</u>: Electron transfer reactions drive essential processes in both natural systems and technological application, from cellular respiration and corrosion to energy storage in batteries and the development of sustainable energy solutions.

1. **Students can** deduce oxidation states of an atom in a compound or an ion.
2. **Students can** identify the oxidized and reduced species and the oxidizing and reducing agents in a chemical reaction.
3. **Students can** deduce redox half-equations and equations in acidic or neutral solutions.
4. **Students can** predict the relative ease of oxidation of metals.
5. **Students can** predict the relative ease of reduction of halogens.
6. **Students can** interpret data regarding metal and metal ion reactions.

7. **Students can** deduce equations for reactions of reactive metals with dilute HCl and $H_2SO_4$.
8. **Students can** identify electrodes as anode and cathode and identify their signs/polarities in voltaic cells and electrolytic cells based on the type of reaction occurring at the electrode.
9. **Students can** explain the direction of electron flow from anode to cathode in the external circuit and ion movement across the salt bridge.
10. **Students can** deduce the reactions of the charging process from given electrode reactions for discharge and vice versa.
11. **Students can** explain how current is conducted in an electrolytic cell.
12. **Students can** deduce the products of the electrolysis of a molten.
13. **Students can** deduce equations to show changes in the functional groups during oxidation of primary and secondary alcohols, including the two-step reaction in the oxidation of primary alcohols.
14. **Students can** deduce equations to show reduction of carboxylic acids to primary alcohols via the aldehyde and reduction of ketones to secondary alcohols.
15. **Students can** deduce the products of the reactions of hydrogen with alkenes and alkynes.
16. **Students can** interpret standard electrode potential data in terms of ease of oxidation/reduction.
17. **Students can** predict whether a reaction is spontaneous in the forward or reverse direction from $E^\ominus$ data.
18. **Students can** determine the value for $\Delta G^\ominus$ from $E^\ominus$ data.
19. **Students can** deduce from standard electrode potentials the products of the electrolysis of aqueous solutions.
20. **Students can** deduce equations for the electrode reactions during electroplating.

## *ACTION: teaching and learning through inquiry*

| Content / Skills / Concepts - Essential Understandings | Learning Process |
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| **Reactivity 3.2.1**<br>**Oxidation and reduction can be described in terms of electron transfer, change in oxidation state, oxygen gain/loss or hydrogen loss/gain.A radical is a molecular entity that has an unpaired electron. Radicals are highly reactive.**<br>*Deduce oxidation states of an atom in a compound or an ion.*<br>*Identify the oxidized and reduced species and the oxidizing and reducing agents in a chemical reaction.*<br>● Include examples to illustrate the variable oxidation states of transition element ions and of most main group non-metals.<br>● Include the use of oxidation numbers in the naming of compounds. | Learning experiences and strategies/planning for self-supporting learning:<br>☒ Lecture<br>☐ Socratic seminar<br>☒ Small group/pair work<br>☒ PowerPoint lecture/notes |

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| **<u>Reactivity 3.2.2</u>**<br>**Half-equations separate the processes of oxidation and reduction, showing the loss or gain of electrons.**<br>*Deduce redox half-equations and equations in acidic or neutral solutions.*<br><br>**<u>Reactivity 3.2.3</u>**<br>**The relative ease of oxidation and reduction of an element in a group can be predicted from its position in the periodic table.**<br>**The reactions between metals and aqueous metal ions demonstrate the relative ease of oxidation of different metals.**<br>*Predict the relative ease of oxidation of metals.*<br>*Predict the relative ease of reduction of halogens.*<br>*Interpret data regarding metal and metal ion reactions.*<br>● The relative reactivity of metals observed in metal/metal ion displacement reactions does not need to be learned; appropriate data will be supplied in examination questions.<br><br>**<u>Reactivity 3.2.4</u>**<br>**Acids react with reactive metals to release hydrogen.**<br>*Deduce equations for reactive metals with dilute HCl and* $H_2SO_4$.<br><br>**<u>Reactivity 3.2.5</u>**<br>**Oxidation occurs at the anode and reduction occurs at the cathode in electrochemical cells.**<br>*Identify electrodes as anode and cathode and identify their signs/polarities in voltaic cells and electrolytic cells based on the type of reaction occurring at the electrode.* | ☒ Individual presentations<br><br>☒ Group presentations<br><br>☒ Student lecture/leading<br><br>☐ Interdisciplinary learning<br><br>Details:<br><br>*Students will learn through a combination of presentations, small group work, practice problems, and lab work.*<br><br>☒ Other(s): *practice problems, lab work* |
| | **Formative assessment(s):**<br><br>*Short closer quizzes for each lesson*<br>*Practice with Tools and Inquiries*<br>*Daily formative checks* |
| | **Summative assessments:**<br><br>Unit Exam - *Paper 1 and 2 questions modeled after the real IB Exam Papers (2025 syllabus)*<br><br>Laboratory Assignment - *assessing Tools and Inquiries practiced in the Unit* |

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| **<u>Reactivity 3.2.6</u>**<br>**A primary (voltaic) cell is an electrochemical cell that converts energy from spontaneous redox reactions to electrical energy.**<br>*Explain the direction of electron flow from anode to cathode in the external circuit and ion movement across the salt bridge.*<br>● Construction of primary cells should include: half-cells containing metal/metal ion, anode, cathode, electric circuit, salt bridge.<br><br>**<u>Reactivity 3.2.7</u>**<br>**Secondary (rechargeable) cells involve redox reactions that can be reversed using electrical energy.**<br>*Deduce the reactions of the charging process from given electrode reactions for discharge and vice versa.*<br>● Include discussion of advantages and disadvantages of fuel cells, primary cells, and secondary cells.<br><br>**<u>Reactivity 3.2.8</u>**<br>**An electrolytic cell is an electrochemical cell that converts electrical energy to chemical energy by bringing about non-spontaneous reactions.**<br>*Explain how current is conducted in an electrolytic cell.*<br>*Deduce the products of the electrolysis of a molten salt.*<br>● Construction of electrolytic cells should include: DC power source connected to anode and cathode, electrolyte.<br><br>**<u>Reactivity 3.2.9</u>**<br>**Functional groups in organic compounds may undergo oxidation.**<br>*Deduce equations to show changes in the functional groups during oxidation of primary and secondary alcohols, including the two-step reaction in the oxidation of primary alcohols.*<br>● Include explanation of the experimental set-up for distillation and reflux.<br>● Include the fact that tertiary alcohols are not oxidized under similar conditions.<br>● Names and formulas of specific oxidizing agents and the mechanisms of oxidation will not be assessed. | **Differentiation:**<br><br>☒ Affirm identity - build self-esteem<br><br>☒ Value prior knowledge<br><br>☒ Scaffold learning<br><br>☒ Extend learning<br><br>Details:<br><br>● *SWD/504 – Accommodations Provided*<br>● *ELL – Reading & Vocabulary Support*<br>● *Intervention Support*<br>● *Extensions – Enrichment Tasks and Project*<br><br>**Tools and Inquiries:**<br><br>**<u>Reactivity 3.2.2</u>**<br>Tool 1, Inquiry 2 - Why are some redox titrations described as “self-indicating”?<br><br>**<u>Reactivity 3.2.3</u>**<br>Tool 1, Inquiry 2 - What observations can be made when metals are mixed with aqueous metal ions and solutions of halogens are mixed with aqueous halide ions?<br><br>**<u>Reactivity 3.2.16</u>**<br>Tool 1 - How is an electrolytic cell used for electroplating? |

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| **<u>Reactivity 3.2.10</u>**<br>**Functional groups in organic compounds may undergo reduction.**<br>*Deduce equations to show reduction of carboxylic acids to primary alcohols via the aldehyde and reduction of ketones to secondary alcohols.*<br>● Include the role of hydride ions in the reduction reaction.<br>● Names and formulas of specific reducing agents and the mechanisms of reduction will not be assessed.<br><br>**<u>Reactivity 3.2.11</u>**<br>**Reduction of unsaturated compounds by the addition of hydrogen lowers the degree of unsaturation.**<br>*Deduce the products of the reactions of hydrogen with alkenes and alkynes.*<br><br>**<u>Reactivity 3.2.12</u>**<br>**The hydrogen half-cell $H^+$ (aq) + $e^-$ ⇄ ½ $H_2$ (g) is assigned a standard electrode potential of zero by convention. It is used in the measurement of standard electrode potential, $E^{\ominus}$.**<br>*Interpret standard electrode potential data in terms of ease of oxidation/reduction.*<br>● Standard reduction potentials are given in the data booklet.<br><br>**<u>Reactivity 3.2.13</u>**<br>**Standard cell potential, $E^{\ominus}_{cell}$ , can be calculated from standard electrode potentials. $E^{\ominus}_{cell}$ has a positive value for a spontaneous reaction.**<br>*Predict whether a reaction is spontaneous in the forward or reverse direction from $E^{\ominus}$ data.*<br><br>**<u>Reactivity 3.2.14</u>**<br>**The equation $\Delta G^{\ominus} = -nFE^{\ominus}_{cell}$ shows the relationship between standard change in Gibbs energy and standard cell potential for a reaction.**<br>*Determine the value for $\Delta G^{\ominus}$ from $E^{\ominus}$ data.*<br>● The equation and the value of *F* in C $mol^{-1}$ are given in the data booklet. | |

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| **<u>Reactivity 3.2.15</u>**<br>**During electrolysis of aqueous solutions, competing reactions can occur at the anode and cathode, including the oxidation and reduction of water.**<br>*Deduce from standard electrode potentials the products of the electrolysis of aqueous solutions.*<br>● Electrolytic processes should include the electrolysis of water and of aqueous solutions.<br>● The effects of concentration and the nature of the electrode are limited to the electrolysis of NaCl (aq) and $CuSO_4$ (aq).<br><br>**<u>Reactivity 3.2.16</u>**<br>**Electroplating involves the electrolytic coating of an object with a metallic thin layer.**<br>*Deduce equations for the electrode reactions during electroplating.* | |

**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.*

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

| **Language and Learning**<br><br>*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**<br><br>*Check the boxes for any explicit TOK connections made during the unit* | **CAS Connections**<br><br>*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.* |
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| ☒ Activating background knowledge<br><br>☒ Scaffolding for new learning<br><br>☒ Acquisition of new learning through practice<br><br>☒ Demonstrating proficiency<br><br>Details:<br><br>*Content and vocabulary introduced in previous science courses will be used in this unit.*<br><br>*Students will use many of the concepts from this unit in future units throughout the course.*<br><br>*Students will acquire new vocabulary.*<br><br>*Students will continually demonstrate proficiency with chemistry vocabulary in class* | ☐ Personal and shared knowledge<br><br>☒ Ways of knowing<br><br>☐ Areas of knowledge<br><br>☐ The knowledge framework<br><br>Details:<br><br>*TOK knowledge questions will be included as discussion options for each lesson.* | ☒ Creativity<br><br>☐ Activity<br><br>☐ Service<br><br>Details:<br><br>*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.* |

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| *discussions and group work.* | | |

| **Resources**<br><br>*List and attach (if applicable) any resources used in this unit* |
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| ● Chemistry for the IB Diploma Third Edition, Hodder Education<br>● IB Chemistry Guide First Assessment 2025<br>● InThinking IB subject site for Chemistry<br>● IB Chemistry Schoology Course |

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

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