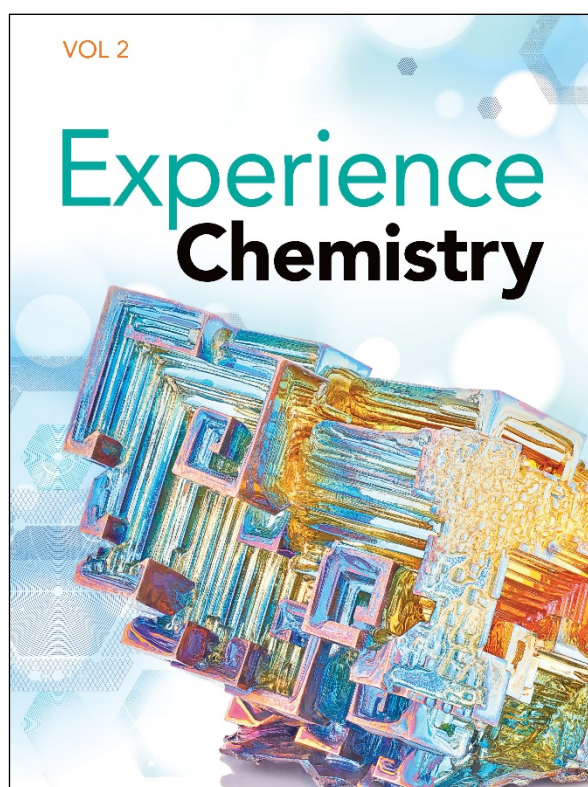
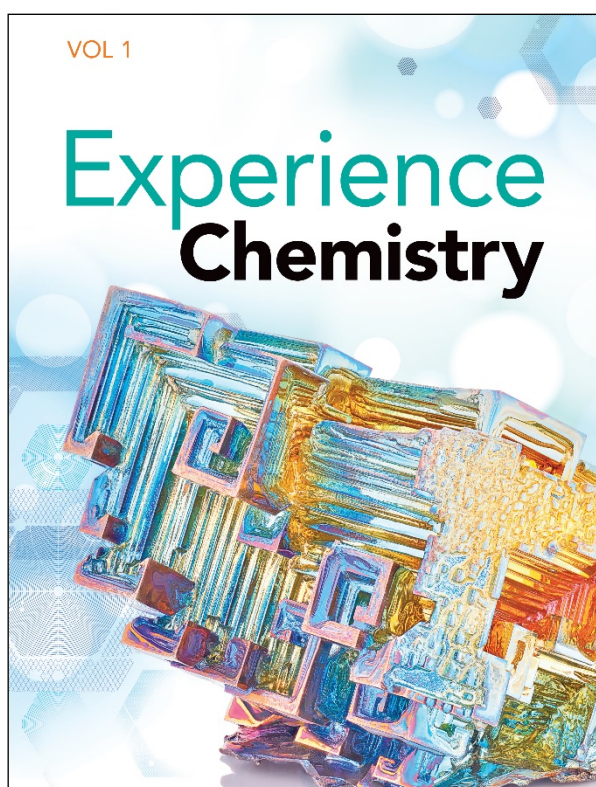


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To the
Ohio
2018 Learning Standards for Science
High School Chemistry

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Introduction

This document demonstrates how **Experience Chemistry ©2021** supports Ohio's 2018 Learning Standards for Science: High School Chemistry. Correlation references include the Experience Notebook (Volume 1 and 2), Teacher Guide, and online digital assets.

Savvas Learning Company is excited to introduce **Experience Chemistry!** From climate change, water quality, and the newest energy sources, to the foods we grow and eat, your students will experience chemistry like never before. The program uses cool, weird, and amazing phenomena to engage students in 3-D science. Give students an up-close, first-hand experience they'll never forget.

Be the first to *Experience It!*

Storylines are organized around a real-world Anchoring Phenomena that sparks student curiosity, gives a purpose to learning and connects chemistry concepts through a unifying unique occurrence. Students encounter everyday phenomena through Claims-Evidence Reasoning Exercises, Authentic Readings, STEM Projects, and Engineering Performance Tasks.

Explore Phenomena with Flinn Scientific!

Experience Chemistry and Flinn Scientific partner to deliver high-quality inquiry opportunities to chemistry classrooms. Lab Experiments, Engineering Challenges, Performance Tasks, Virtual Reality Simulations, and Lab Videos by Flinn Scientific immerse students in hands-on chemistry.

Hands-On Labs

- Assign student-friendly labs focused on real-world phenomena in every learning experience.
- Customize your lessons with four versions of every lab including Open-Ended, Guided, Shortened, and Advanced.

Lab Videos

- Background videos, demo videos and summary videos engage and connect students to the phenomena, prepare students and instructors for set-up and revisit concepts before assessments.

Design Challenges and Performance Tasks

- Students mimic the real-world activities of engineers as they define and solve problems and design, test and evaluate solutions.
- Students demonstrate mastery of three-dimensional learning at the end of every Investigation with a Performance-Based assessment.

Lab Kits

- Simplify lab set-up and solution preparation with time-saving lab kits.

Virtual Reality

- Immerse your students in 360° simulations that bring chemistry to life.

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Table of Contents

(C.PM.1) Atomic structure.....	4
(C.PM.2) Periodic Table.....	5
(C.PM.3) Chemical bonding.....	6
(C.PM.4) Representing compounds.....	8
(C.PM.6) Intermolecular forces of attraction	10
(C.IM.1) Chemical reactions	12
(C.IM.2) Gas laws	16
(C.IM.3) Stoichiometry.....	17

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM) Structure and Properties of Matter	
(C.PM.1) Atomic structure	
(C.PM.1.a) Evolution of atomic models/theory	<p>Experience Notebook, Volume 1: Visualizing the Atom, 12 Atomic Emission Spectra, 22-23 The Bohr Model, 24-25 Bohr Model Representations of Atoms, 26 Revisit Investigative Phenomenon, 27 Revisiting the Atomic Model, 28-29 Atomic Orbitals, 30-31 Revisit Investigative Phenomenon, 32</p> <p>Teacher Guide: Inquiry Labs: Evaluate Atomic Spectra; Evaluate the Bohr Model of the Atom Digital Activities: The Quantum Mechanical Model and Atomic Orbitals; Evaluate Atomic Models; The History of Atomic Models</p>
(C.PM.1.b) Electrons	<p>Experience Notebook, Volume 1: Visualizing the Atom, 12 Types of Atoms, 13-14 Mass Number, 15 Isotopes, 16 Atomic Emission Spectra, 22-23 The Bohr Model, 24-25 Bohr Model Representations of Atoms, 26 Revisit Investigative Phenomenon, 27 Revisiting the Atomic Model, 28-29 Atomic Orbitals, 30-31 Revisit Investigative Phenomenon, 32 Valence Electrons, 39 Revisit Investigative Phenomenon, 40</p> <p>Teacher Guide: Inquiry Labs: Evaluate Atomic Spectra; Evaluate the Bohr Model of the Atom Performance Based Assessment: Evaluate Atomic Structure with Flame Tests Digital Activities: Explore Atomic Particles; Model Isotopes; A Quick Look at the Parts of an Atom; Dissect Atom Composition; The Quantum Mechanical Model and Atomic Orbitals</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM.1.c) Electron configurations	<p>Experience Notebook, Volume 1: Electron Configurations, 33 Energy and Stability in Electron Configurations, 34-35 Patterns in Electron Configurations, 36-38 Sample Problem: Electron Configurations, 37 Valence Electrons, 39 Revisit Investigative Phenomenon, 40 The Periodic Table as a Predictive Model, 50-51 Common Charges in Representative Elements, 62 Assessment, 65 Ions and the Octet Rule, 68-69 The Octet Rule in Molecules, 82-83</p> <p>Teacher Guide: Inquiry Labs: Model Electron Configuration Digital Activities: Patterns in Electron Configurations; Model Electron Configurations; How to Write Electron Configurations; Periodic Properties; Electron Configuration and Element Properties</p>
(C.PM.2) Periodic Table	
(C.PM.2.a) Properties	<p>Experience Notebook, Volume 1: Types of Atoms, 13-14 Patterns in Electron Configurations, 36-38 The Periodic Table, 43 Development of the Periodic Table, 44-45 The Modern Periodic Table, 46-48 Revisit Investigative Phenomenon, 49 The Periodic Table as a Predictive Model, 50-51 The Shielding Effect and Effective Nuclear Charge, 53-55 Revisit Investigative Phenomenon, 55 Assessment, 65</p> <p>Teacher Guide: Inquiry Labs: Develop a Periodic Table; Elemental Metals, Nonmetals, and Metalloids; Periodic Trends and Properties Digital Activities: Graphing Periodic Properties; The Design of the Periodic Table; Periodic Properties; Electron Configuration and Element Properties</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM.2.b) Trends	<p>Experience Notebook, Volume 1: The Shielding Effect and Effective Nuclear Charge, 53-55 Atomic Radius, 56-58 Ionization Energy, 59 Successive Ionization Energies, 60 Electron Affinity, 61 Common Charges in Representative Elements, 62 Connecting the Trends, 63 Revisit Investigative Phenomenon, 64 Assessment, 65 Electronegativity and Bonding, 86-87</p> <p>Teacher Guide: Inquiry Labs: Periodic Trends and Properties Performance Based Assessment: Gravimetric Analysis of Periodic Trends Digital Activities: Periodic Trends; Make a Claim About Periodic Trends; Reflect on Periodic Trends; Size Trends and Shielding Effect; Predict Reactivity Using Periodic Trends; Effective Nuclear Charge and Electron Shielding; Ionization Energy</p>
(C.PM.3) Chemical bonding	
(C.PM.3.a) Ionic	<p>Experience Notebook, Volume 1: Ions and the Octet Rule, 68-69 Ionic Bonds, 70-71 Sample Problem: Electron Dot Structures for Ionic Compounds, 71 Ionic Compounds, 72-73 Properties of Ionic Compounds, 74-75 Revisit Investigative Phenomenon, 76 Revisit Investigative Phenomenon, 90 Solids and Attractive Force, 120-121 Heating a Solid, 132 Representative Units, 136 Determining Compound Type, 137 Properties of Ionic and Molecular Compounds, 138 Revisit Investigative Phenomenon, 140 Electrolytes and Nonelectrolytes, 156-157</p>

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
Continued:	<p>Continued:</p> <p>Teacher Guide:</p> <p>Inquiry Labs: Characteristics of Ionic Bonds; Correlate Material Properties and Bond Type; Melt Ionic and Covalent Compounds</p> <p>Performance Based Assessment: Qualitative Analysis and Chemical Bonding</p> <p>Digital Activities: Ions and Electroplating; Electron Dot Structures for Ionic Compounds, Formation of Ionic Compounds; Describe Ionic Bonding and Properties; Compare Metallic and Ionic Substances; Compare Covalent and Ionic Bonds and Their Substances; Tough Tools; Predicting Bond Type</p>
(C.PM.3.b) Polar/covalent	<p>Experience Notebook, Volume 1:</p> <p>Molecular Compounds, 81</p> <p>The Octet Rule in Molecules, 82-83</p> <p>Types of Covalent Bonds, 84</p> <p>Sample Problem: Electron Dot Structures for Molecular Substances, 85</p> <p>Electronegativity and Bonding, 86-87</p> <p>Geometry and Polar Molecules, 88-90</p> <p>Revisit Investigative Phenomenon, 90</p> <p>Solids and Attractive Force, 120-121</p> <p>Heating a Solid, 132</p> <p>Representative Units, 136</p> <p>Determining Compound Type, 137</p> <p>Properties of Ionic and Molecular Compounds, 138</p> <p>Covalent Network Solids, 139-140</p> <p>Revisit Investigative Phenomenon, 140</p> <p>Water and Hydrogen Bonding, 148</p> <p>Surface Tension, 149-150</p> <p>Teacher Guide:</p> <p>Inquiry Labs: Characteristics of Covalent Bonds; Correlate Material Properties and Bond Type; Melt Ionic and Covalent Compounds; Investigate Surface Tension</p> <p>Performance Based Assessment: Qualitative Analysis and Chemical Bonding</p> <p>Digital Activities: Calculate Bond Polarity; Electron Dot Structures for Molecular Substances; Formation of Covalent Bonds; Compare Covalent and Ionic Bonds and Their Substances</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM.4) Representing compounds	
(C.PM.4.a) Formula writing	<p>Experience Notebook, Volume 1: Formulas for Ionic Compounds, 100 Compounds with Polyatomic Ions, 101 Sample Problem: Identifying Ionic Compounds, 102 Formulas for Molecular Compounds, 104 Sample Problem: Identifying Molecular Compounds, 105 Revisit Investigative Phenomenon, 106</p> <p>Teacher Guide: Inquiry Labs: Chemical Names and Formulas</p>
(C.PM.4.b) Nomenclature	<p>Experience Notebook, Volume 1: Naming Ions, 97-98 Names of Ionic Compounds, 99 Compounds with Polyatomic Ions, 101 Sample Problem: Identifying Ionic Compounds, 102 Names of Molecular Compounds, 103 Sample Problem: Identifying Molecular Compounds, 105 Revisit Investigative Phenomenon, 106</p> <p>Teacher Guide: Inquiry Labs: Chemical Names and Formulas Digital Activities: Infer Rules for Naming Compounds; Comparing Compound Nomenclatures; Compare Element Combinations and Nomenclature; Infer Rules for Naming Acids</p>

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Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM.4.c) Models and shapes (Lewis structures, ball and stick, molecular geometries)	<p>Experience Notebook, Volume 1: Atoms and Molecules, 6-8 Atomic Orbitals, 30-31 Valence Electrons, 39 Ions and the Octet Rule, 68-69 Ionic Bonds, 70-71 Sample Problem: Electron Dot Structures for Ionic Compounds, 71 Properties of Ionic Compounds, 74 Molecular Compounds, 81 The Octet Rule in Molecules, 82-83 Types of Covalent Bonds, 84 Sample Problem: Electron Dot Structures for Molecular Substances, 85 Geometry and Polar Molecules, 88-90 Solids and Attractive Force, 120 Crystal Structure, 122-123 Covalent Network Solids, 139-140</p> <p>Teacher Guide: Digital Activities: The Quantum Mechanical Model and Atomic Orbitals; Electron Dot Structures for Ionic Compounds; Evaluate Electron Dot Structures; Molecule Shapes; Electron Dot Structures for Molecular Substances; Investigate Molecule Polarity; Water’s Behavior on Earth</p>

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Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.PM.6) Intermolecular forces of attraction	
(C.PM.6.a) Types and strengths	<p>Experience Notebook, Volume 1: Van der Waals Forces, 91-92 Hydrogen Bonds, 93 Properties of Molecular Substances, 94-95 Revisit Investigative Phenomenon, 96 Liquids and Intermolecular Forces, 118-119 Solids and Attractive Force, 120-121 Phase Changes, 125-126 Heating a Liquid, 127 Vapor Pressure and Boiling, 130-131 Heating a Solid, 132 Sublimation, 133 Properties of Ionic and Molecular Compounds, 138 Water and Hydrogen Bonding, 148 Hydrogen Bonding and Boiling Point, 151</p> <p>Teacher Guide: Inquiry Labs: Intermolecular Forces Digital Activities: Intermolecular Forces in Liquids; Water’s Behavior on Earth; Relate Intermolecular Forces to States of Matter; Phase Changes and Intermolecular Forces; Intermolecular Forces and Surface Tension in Water; Compare Intermolecular Forces in Fresh and Salt Water</p>
(C.PM.6.b.i) Melting and boiling point	<p>Experience Notebook, Volume 1: Properties of Ionic Compounds, 74-75 Properties of Metals, 78-79 Properties of Molecular Substances, 94-95 Solids and Attractive Force, 120-121 Heating a Liquid, 127 Vapor Pressure and Boiling, 130-131 Heating a Solid, 132 Revisit Investigative Phenomenon, 135 Properties of Ionic and Molecular Compounds, 138 Covalent Network Solids, 139-140 Revisit Investigative Phenomenon, 140 Hydrogen Bonding and Boiling Point, 151</p> <p>Teacher Guide: Inquiry Labs: Characteristics of Ionic Bonds; Characteristics of Covalent Bonds; Melt Ionic and Covalent Compounds</p>

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
Continued:	Continued: Digital Activities: Describe Ionic Bonding and Properties; Patterns in Melting Points of Metals; Compare Metallic and Ionic Substances; Intermolecular Forces in Liquids; Tough Tools; Discuss Melting Materials; Metals and Nonmetals: Data About Their Properties
(C.PM.6.b.ii) Solubility	Experience Notebook, Volume 1: Properties of Ionic Compounds, 74-75 Solubility, 162 Solubility and Temperature, 163-164 Supersaturation, 165 Solubility and Pressure, 166 Sample Problem: Using Henry's Law, 167 Solubility and Strength of Intermolecular Forces and Bonds, 244 Formation of a Precipitate, 245 Teacher Guide: Inquiry Labs: Periodic Trends and Properties; Aqueous Solutions Performance Based Assessment: Gravimetric Analysis of Periodic Trends Digital Activities: Ions and Electroplating; Solubility and Temperature; Solubility and Percent by Mass
(C.PM.6.b.iii) Vapor pressure	Experience Notebook, Volume 1: Investigation 4 Vapor Pressure and Boiling, 130-131 Sublimation, 133 Revisit Investigative Phenomenon, 135 Hydrogen Bonding and Boiling Point, 151 Hydrates, 158-159 Solubility, 162 Teacher Guide: Digital Activities: Discuss Melting Materials

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.IM) Interactions of Matter	
(C.IM.1) Chemical reactions	
(C.IM.1.a) Types of reactions	<p>Experience Notebook, Volume 1: Types of Reactions, 227 Combination Reactions, 228 Decomposition Reactions, 229 Sample Problem: Writing Chemical Equations for Combination and Decomposition Reactions, 230 Single-Replacement Reactions, 231 Activity Series, 232 Sample Problem: Writing Chemical Equations for Single-Replacement Reactions, 233 Double-Replacement Reactions, 234 Sample Problem: Writing Chemical Equations for Double-Replacement Reactions, 235 Combustion Reactions, 236 Sample Problem: Writing Chemical Equations for Combustion Reactions, 237 Predicting the Products of Reactions, 238-239 Revisit Investigative Phenomenon, 240 Ions in Aqueous Solution, 241-242 Formation of a Precipitate, 245 Predicting the Formation of a Precipitate, 246</p> <p>Experience Notebook, Volume 2: Redox vs. Non-redox Reactions, 284 Sample Problem: Identifying Redox Reactions, 285 Revisit Investigative Phenomenon, 287 Single-Replacement Reactions, 288-289 Combination and Decomposition Redox Reactions, 290 Combustion Reactions, 291</p> <p>Teacher Guide: Inquiry Labs: Types of Chemical Reactions; Predict Chemical Reactions Performance Based Assessment: Identify Evidence of Chemical Reactions Digital Activities: Balance Combustion Equations; Classify Reactions and Predict Their Products; Predict Whether a Precipitate Will Form; Redox and Non- Redox Reactions</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.IM.1.b) Kinetics	<p>Experience Notebook, Volume 1: What Causes Reactions?, 225</p> <p>Experience Notebook, Volume 2: Collision Theory – A Review, 163 Effect of Temperature on Reaction Rates, 165 Activation Energy, 168 Energy Diagrams, 169 One-Step and Multistep Reactions, 170 Lowering Activation Energy, 171-172</p> <p>Teacher Guide: Inquiry Labs: Reaction Rates: Iodine Clock; Collision Theory Digital Activities: Factors That Affect Reaction Rate; Model Factors that Affect Reaction Rate; Reaction Rate and Molecular Collisions; Glow Sticks and Reaction Rate; Reaction Rates and Activation Energy; The Concept of Activation Energy; Looking Closely at Collisions and Activation Energy</p>
(C.IM.1.c) Energy	<p>Experience Notebook, Volume 1: Energy of Reactions, 223-224 What Causes Reactions?, 225 Revisit Investigative Phenomenon, 226 Combination Reactions, 228 Decomposition Reactions, 229 Thermochemistry, 281 Systems and Surroundings, 283 Enthalpy, 284 Bond Enthalpy, 285-286 Activation Energy, 287 Representations of Enthalpy, 288 Revisit Investigative Phenomenon, 290 Heat Summation, 292 Standard Enthalpy of Formation, 293 Standard Enthalpy of Reaction, 294 Enthalpy of Solution, 296-297 Revisit Investigative Phenomenon, 298 Assessment, 307</p>

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
Continued:	<p>Continued:</p> <p>Experience Notebook, Volume 2: Collision Theory – A Review, 163 Activation Energy, 168 Energy Diagrams, 169 Lowering Activation Energy, 171-172 Revisit Investigative Phenomenon, 173</p> <p>Teacher Guide: Inquiry Labs: The Thermodynamics of Hand Warmers; Hess’s Law and the Combustion of a Metal Engineering Design Challenge: Flameless Heating Systems Performance Based Assessment: Enthalpy of a Neutralization Reaction Digital Activities: Bonds Breaking and Forming; Temperature Changes in Chemical Reactions; Energy Changes in Reactions; Representations of Energy Changes; Energy in Reactions; Compare Heats of Formation; Bond Energy and Enthalpy; Energy Input for the Rusting of Iron; The Concept of Activation Energy; Looking Closely at Collisions and Activation Energy; Interpret Energy Diagrams</p>
(C.IM.1.d) Equilibrium	<p>Experience Notebook, Volume 2: Reversible Reactions, 174 Chemical Equilibrium, 175 Le Chatelier’s Principle, 176 How Concentration Affects Equilibrium, 177 How Pressure Affects Equilibrium, 178 How Temperature Affects Equilibrium, 179 Revisit Investigative Phenomenon, 180 Buffer Solutions, 223-224 Carbon Dioxide and Ocean pH, 230-231 Le Chatelier’s Principle and Future Ocean pH, 236-237 Calcification, 260-261</p> <p>Teacher Guide: Inquiry Labs: Explore Chemical Equilibrium; The Fate of Carbonate in Acidifying Oceans Engineering Design Challenge: Use Equilibrium for a Commercial Application; Design a Model of Ocean Acidification</p>

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
Continued:	Continued: Performance Based Assessment: Rates of Reaction and Dissolution Digital Activities: Equilibrium Shifting; Carbon Dioxide, Ocean Acidification, and Shell Formation
(C.IM.1.e) Acids/bases	<p>Experience Notebook, Volume 2: Properties of Acids, Bases, and Salts, 194 Defining Acids and Bases, 195-197 Calculating pH, 199-200 Strong Acids and Bases, 203 Weak Acids, 204-205 Weak Bases, 206-207 Calculating pH for Weak Acids and Bases, 208 Strength vs. Concentration, 210-211 Revisit Investigative Phenomenon, 211 Acid-Base Neutralization Reactions, 212-213 Salt Solutions and Salt Hydrolysis, 215-217 Acid-Base Titrations, 218 Titrations and pH Curves, 219 Revisit Investigative Phenomenon, 221 Buffer Solutions, 223-224 Buffer Capacity and Range, 225 Assessment, 227 Carbon Dioxide and Ocean pH, 230-231 Geographic Ocean pH Variation, 232-233 Le Chatelier’s Principle and Future Ocean pH, 236-237</p> <p>Teacher Guide: Inquiry Labs: Measure pH with Indicators; Measure Acid Strength; Titrations – The Study of Acid-Base Chemistry; Analysis of Buffer Solutions and Ranges; The pH of Seawater Engineering Design Challenge: Design a Natural pH Indicator; Design a Model of Ocean Acidification Performance Based Assessment: Quantitative Analysis of Acid Rain Digital Activities: Connect pH Changes to Particle-Level Changes; Compare Acid-Base Models; Exploring Acid Strength and Concentration; Conductivity of Strong and Weak Acids; Model an Acid-Base Titration; Salt Hydrolysis; Ocean pH; Pacific Ocean pH Changes</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.IM.2) Gas laws	
(C.IM.2.a) Pressure, volume and temperature	<p>Experience Notebook, Volume 2: Compressibility, 6 Gas Pressure and Amount of Gas, 7 Gas Pressure and Volume, 8 Gas Pressure and Temperature, 9 Boyle’s Law, 11 Sample Problem: Using Boyle’s Law, 12 Charles’s Law, 13 Sample Problem: Using Charles’s Law, 14 Absolute Zero, 15-16 Gay-Lussac’s Law, 17-18 Combined Gas Law, 19 Sample Problem: Using the Combined Gas Law, 20 Avogadro’s Law, 21 Revisit Investigative Phenomenon, 22 Dalton’s Law, 32</p> <p>Teacher Guide: Inquiry Labs: Compressibility; Relationships Between Gas Variables Engineering Design Challenge: What’s in a Container? Performance Based Assessment: Cartesian Divers Digital Activities: Analyze Gas Volumes; Explain Changes in Tire Pressure; Gas Volume and Temperature; Relate Gas Pressure and Temperature; Model the Combined Gas Laws</p>
(C.IM.2.b) Ideal gas law	<p>Experience Notebook, Volume 2: Investigation 9 Ideal Gas Law, 23 Sample Problem: Using the Ideal Gas Law, 24-25 Isobaric, Isovolumetric, and Isothermal Processes, 26 Real Gases, 27-28 Intensive and Extensive Properties of Gases, 29 Revisit Investigative Phenomenon, 30 Diffusion, 34-35 Wind, 37-38</p> <p>Teacher Guide: Inquiry Labs: The Ideal Gas Law; Gas Diffusion Digital Activities: Real vs. Ideal Gases; Why Are There No Ideal Gases?; Nature of Science in Gas Laws</p>

**A Correlation of Experience Chemistry ©2021
To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.IM.3) Stoichiometry	
(C.IM.3.a) Molecular calculations	<p>Experience Notebook, Volume 1: Empirical Formulas, 198 Sample Problem: Determining the Empirical Formula, 199 Molecular Formulas, 200 Sample Problem: Determining the Molecular Formula, 201 Equations as a Recipe, 252 Interpreting Chemical Equations, 254 Sample Problem: Interpreting a Balanced Chemical Equation, 255 Proportionality of Reactants and Products, 257 Revisit Investigative Phenomenon, 258 Mole Ratios, 259 Mole-Mole Calculations, 260 Sample Problem: Calculating Moles of a Product, 261 Mass-Mass Calculations, 262 Sample Problem: Calculating the Mass of a Product, 263 Volume-Volume Calculations, 264 Sample Problem: Calculating the Volume of a Product, 265 A Roadmap for Solving Stoichiometric Problems, 266 Sample Problem: Calculating Molecules of a Product, 267 Revisit Investigative Phenomenon, 268</p> <p>Teacher Guide: Inquiry Labs: Determine an Empirical Formula; Identify Unknowns Through Stoichiometry; Determination of Reaction Output Engineering Design Challenge: An Empirical Formula Challenge; Build a Film Canister Rocket Performance Based Assessment: Analysis of Basic Copper Carbonate; The Stoichiometry of Filling a Balloon Digital Activities: Proportional Relationships in Chemical Reactions; Parts and the Whole; Understanding Stoichiometry; Choose a Practical Unit; Stoichiometry Calculations</p>

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To the
Ohio 2018 Learning Standards for Science: High School Chemistry**

Ohio 2018 Learning Standards for Science High School Chemistry	Experience Chemistry ©2021
(C.IM.3.b) Solutions	<p>Experience Notebook, Volume 1: Molarity, 203-204 Sample Problem: Calculating Molarity, 205 Sample Problem: Calculating Moles of Solute in Solution, 206 Dilutions, 207-208 Sample Problem: Preparing a Dilute Solution, 209 Percent Solution, 210-211 Sample Problem: Calculating Percent by Volume, 211 Revisit Investigative Phenomenon, 212</p> <p>Teacher Guide: Inquiry Labs: Preparation of Solutions Performance Based Assessment: Analysis of Basic Copper Carbonate Digital Activities: Making Dilutions; Model Measures of Concentrations; Solubility and Percent by Mass</p>
(C.IM.3.c) Limiting reagents	<p>Experience Notebook, Volume 1: Limiting Ingredients, 269 Limiting and Excess Reagents, 270 Mass of Products and Reactants, 271 Sample Problem: Determining the Limiting Reagent, 272 Sample Problem: Using the Limiting Reagent to Find the Quantity of a Product, 273 Revisit Investigative Phenomenon, 278 Assessment, 279</p> <p>Teacher Guide: Inquiry Labs: Formation of Barium Iodate Performance Based Assessment: The Stoichiometry of Filling a Balloon Digital Activities: Limiting Reagent</p>

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