



Lab-Aids Correlations for

Ohio Learning Standards

Chemistry

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This document is intended to show how our curriculum products align with the *Ohio Learning Standards for Chemistry*.

ABOUT OUR PROGRAMS

Lab-Aids Core Science Programs are developed to support current knowledge on the teaching and learning of science. All materials support an inquiry-driven pedagogy, with support for literacy skill development and with assessment programs that clearly show what students know and are able to do from using the programs. All programs have extensive support for technology in the school science classrooms, and feature comprehensive teacher support. For more information please visit www.labaid.com and navigate to the program of interest.

ABOUT A Natural Approach to Chemistry

A Natural Approach to Chemistry (NAC) is written by Hsu, Chaniotakis, Carlisle, and Damelin, and is published by, and available exclusively from, Lab-Aids, Ronkonkoma NY. This correlation is intended to show selected locations in NAC programs that support the Ohio Department of Education Learning Standards for Chemistry. It is not an exhaustive list; other locations may exist that are not listed here.

A Natural Approach to Chemistry		
THEMES		
<ul style="list-style-type: none"> • Energy is a unifying theme that explains why chemistry occurs • The atomic model of matter is consistently woven through every chapter • Understanding of ‘why’ chemistry occurs is emphasized • Principles are illustrated with examples from the human body and the environment 		
ORGANIZATION OF CONTENT		
Fundamentals	Chapters 1-4	<p>Present comprehensive overview of all main ideas in chemistry such as the atomic nature of matter, systems, temperature, and energy.</p> <p><i>This is the “big picture” of chemistry.</i></p>
Core Concepts	Chapters 5-14	<p>Present in-depth coverage of all major topic areas. They developed usable understanding of the big ideas laid out in the first four chapters. The treatment includes strong conceptual development as well as algebra-based quantitative problem solving.</p> <p>All academic content and instruction standards for chemistry have been met by the end of Chapter 14.</p>
Applications	Chapters 15 - 21	<p>Provide deeper exploration of significant areas of interest in chemistry.</p> <p>Examples include rechargeable batteries, materials science, chemistry of the solar system, etc.</p>
COMPLETE LEARNING SYSTEM		
<ul style="list-style-type: none"> • Coordinated student textbook • Integrated laboratory investigations manual containing 58 labs to choose from • New laboratory control, data collection and probe system • Evaluation elements throughout the curriculum (student book and lab investigation manual) through which student knowledge or skills are assessed or applied 		

Nature of Science One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.	
Categories	High School
Scientific Inquiry, Practice and Applications All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.	<ul style="list-style-type: none"> • Identify questions and concepts that guide scientific investigations. • Design and conduct scientific investigations using a variety of methods and tools to collect empirical evidence, observing appropriate safety techniques. • Use technology and mathematics to improve investigations and communications. • Formulate and revise explanations and models using logic and scientific evidence (critical thinking). • Recognize and analyze explanations and models. • Communicate and support scientific arguments.
Science is a Way of Knowing Science assumes the universe is a vast single system in which basic laws are consistent. Natural laws operate today as they did in the past and they will continue to do so in the future. Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise and extend this knowledge.	<ul style="list-style-type: none"> • Various science disciplines use diverse methods to obtain evidence and do not always use the same set of procedures to obtain and analyze data (i.e., there is no one scientific method). <ul style="list-style-type: none"> ○ Make observations and look for patterns. ○ Determine relevant independent variables affecting observed patterns. ○ Manipulate an independent variable to affect a dependent variable. ○ Conduct an experiment with controlled variables based on a question or hypothesis. ○ Analyze data graphically and mathematically. • Science disciplines share common rules of evidence used to evaluate explanations about natural phenomenon by using

<p>Nature of Science</p> <p>One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.</p>	
<p>Categories</p>	<p>High School</p>
	<p>empirical standards, logical arguments and peer reviews.</p> <ul style="list-style-type: none"> ○ Empirical standards include objectivity, reproducibility, and honest and ethical reporting of findings. ○ Logical arguments should be evaluated with open-mindedness, objectivity and skepticism. <ul style="list-style-type: none"> ● Science arguments are strengthened by multiple lines of evidence supporting a single explanation. ● The various scientific disciplines have practices, methods, and modes of thinking that are used in the process of developing new science knowledge and critiquing existing knowledge.
<p>Science is a Human Endeavor</p> <p>Science has been, and continues to be, advanced by individuals of various races, genders, ethnicities, languages, abilities, family backgrounds and incomes.</p>	<ul style="list-style-type: none"> ● Science depends on curiosity, imagination, creativity and persistence. ● Individuals from different social, cultural, and ethnic backgrounds work as scientists and engineers. ● Science and engineering are influenced by technological advances and society; technological advances and society are influenced by science and engineering. ● Science and technology might raise ethical, social and cultural issues for which science, by itself, does not provide answers and solutions.
<p>Scientific Knowledge is Open to Revision in Light of New Evidence</p> <p>Science is not static. Science is constantly changing as we acquire more knowledge.</p>	<ul style="list-style-type: none"> ● Science can advance through critical thinking about existing evidence. ● Science includes the process of comparing patterns of evidence with current theory.

Nature of Science

One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.

Categories	High School
	<ul style="list-style-type: none">• Some science knowledge pertains to probabilities or tendencies.• Science should carefully consider and evaluate anomalies (persistent outliers) in data and evidence.• Improvements in technology allow us to gather new scientific evidence.

*Adapted from Appendix H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards

COURSE CONTENT

The following information may be taught in any order; there is no ODE-recommended sequence.

C.PM: STRUCTURE AND PROPERTIES OF MATTER		
Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i>: Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
<p>C.PM.1: Atomic structure</p> <ul style="list-style-type: none"> • Evolution of atomic models/theory • Electrons • Electron configurations 	<p>2.1: Matter and the Elements 2.2: Molecules and Compounds</p> <p>4.1 Understanding Chemical Change</p> <p>Inv 5A: Inside the Atom Inv 5C: Spectroscopy 5.1: The Atom Has a Structure 5.2: The Quantum Atom 5.3: Electron Configurations</p> <p>Inv 6A: Periodic Table Riddles Inv 6B: Periodic Table Fill in the Blank Inv 6C: Valence 6.1: The Periodic Table 6.2: Properties of Groups of Elements 6.3: Valence</p> <p>7.2 Valence Electrons and Bonding Patterns 7.3 Molecular Geometry and Lewis Dot Structures</p>	<p><u>Student Book</u> Ch 2: p. 66-69 Qs 2, 5, 7, 15, 45</p> <p>Ch 4: p. 128-131 Qs 7-9, 41, 42, 43, 45</p> <p>Ch 5: p. 162-165 Qs 6-8, 16-22, 23, 28-32, 37-40, 46-48, 52-63, 66-68, 71-75</p> <p>Ch 6: p. 192-195 Qs 8-11, 25, 30-39, 45-52</p> <p>Ch 7: p. 224-227 Qs 31, 32, 35, 36, 49-51, 53-62</p> <p><u>Laboratory Investigation Manual</u> Inv 5A: p. 47-48 Parts 2-4 Inv 5C: p. 51-52 Parts 2-3</p> <p>Inv 6A: p. 53-54 1-17 Inv 6B: p. 55-56 1, 2, 3, 5-8 Inv 6C: p. 57-58 Parts 2-4</p>
<p>C.PM.2: Periodic Table</p> <ul style="list-style-type: none"> • Properties • Trends 	<p>2.1: Matter and the Elements</p> <p>4.1: Understanding Chemical Change</p> <p>5.2: The Quantum Atom 5.3: Electron Configurations</p> <p>Inv 6A: Periodic Table Riddles Inv 6B: Periodic Table Fill in the Blank Inv 6C: Valence 6.1: The Periodic Table 6.2: Properties of Groups of Elements 6.3: Valence</p>	<p><u>Student Book</u> Ch 2: p. 66-69 Qs 8, 10, 38, 39</p> <p>Ch 4: p. 128-131 Q 61</p> <p>Ch 5: p. 162-165 Q 57</p> <p>Ch 6: p. 192-195 Qs 14, 21-27, 29, 35, 43</p> <p><u>Laboratory Investigation Manual</u> Inv 6A: p. 53-54 1-17 Inv 6B: p. 55-56 1-8 Inv 6C: p. 57-58 Parts 2-4</p>

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<p>C.PM.3: Chemical bonding</p> <ul style="list-style-type: none"> • Ionic • Polar/covalent 	<p>Inv 2B: The Chemical Formula</p> <p>4.1: Understanding Chemical Change</p> <p>Inv 6C: Valence</p> <p>6.2: Properties of Groups of Elements</p> <p>Inv 7A: Lewis Structures</p> <p>Inv 7B: The Geometry of Molecules</p> <p>7.1: What is a Chemical Bond</p> <p>7.2: Valence Electrons and Bonding Patterns</p> <p>16.1: The Properties of Solids</p> <p>16.2: The Microstructure of Solids</p> <p>17.1: Carbon Molecules</p> <p>17.2: Functional Groups</p> <p>Inv 18C: Building an Amino Acid Chain</p> <p>18.1: Fats and Carbohydrates</p> <p>18.3: Proteins</p>	<p><u>Student Book</u></p> <p>Ch 4: p. 128-131 Qs 5, 8, 10, 12, 13, 14, 39, 43-47</p> <p>Ch 6: p. 192-195 Qs 36, 37, 39</p> <p>Ch 7: p. 224-227 Qs 1-5, 15-18, 21-29, 31,42-48, 50</p> <p>Ch 16: p. 532-535 Qs 41, 45</p> <p>Ch 17: p. 564-567 Qs 24, 30, 54</p> <p>Ch 18: p. 600-603 Qs 22, 47, 54, 55, 90</p> <p><u>Laboratory Investigation Manual</u></p> <p>Inv 2B: p. 11-14 Parts 2-5</p> <p>Inv 6C: p. 57-58 Parts 2-4</p> <p>Inv 7A: p. 59-60 Parts 1-3</p> <p>Inv 7B: p. 61-62 Parts 1-4</p> <p>Inv 18C: p. 145 Parts 1-2</p>
<p>C.PM.4: Representing compounds</p> <ul style="list-style-type: none"> • Formula writing • Nomenclature • Models and shapes (Lewis structures, ball and stick, molecular geometries) 	<p>Inv 2B: The Chemical Formula</p> <p>2.2: Molecules and Compounds</p> <p>6.3: Valence</p> <p>Inv 7A: Lewis Structures</p> <p>Inv 7B: The Geometry of Molecules</p> <p>7.1: What is a Chemical Bond</p> <p>7.3: Molecular Geometry and Lewis Dot Structures</p> <p>Inv 8A: The Formula of a Hydrated Salt</p> <p>Inv 8B: Naming Chemical Compounds</p> <p>8.1: Ionic Compounds</p> <p>8.2: Molecular Compounds</p> <p>10.1: Chemical Equations</p>	<p><u>Student Book</u></p> <p>Ch 2: p. 66-69 Qs 13, 42, 43, 44</p> <p>Ch 6: p. 192-195 Qs 11, 39</p> <p>Ch 7: p. 224-227 Qs 12-14, 17, 20, 24, 33-36, 39-42, 47, 48, 53-62, 64-66</p> <p>Ch 8: p. 256-259 Qs 4, 10, 23-25, 27, 38, 48-51, 52-64, 69-77</p> <p>Ch 10: p. 322-325 Qs 8, 10, 30, 31, 33, 34</p> <p>Ch 18: p. 600-603 Qs 23, 27, 30, 35, 80, 91, 92</p>

C.PM: STRUCTURE AND PROPERTIES OF MATTER		
Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i>: Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
	<p>10.2: Methods for Balancing Chemical Equations</p> <p>Inv 18C: Building an Amino Acid Chain</p> <p>18.4: DNA and Molecular Reproduction</p>	<p><u>Laboratory Investigation Manual</u> Inv 2B: p. 11-14 Parts 2-5</p> <p>Inv 7A: p. 59-60 Parts 2-4 Inv 7B: p. 61-62 Parts 1-4</p> <p>Inv 8A: p. 63-64 Part 2 Inv 8B: p. 65-66 Parts 2-4</p> <p>Inv 18C: p. 145 Part 1, Part 2</p>
C.PM.5: Quantifying matter	<p>Inv 1B: Volume and Chemistry Inv 1C: Mass and Chemistry 1.1: What Chemistry is About</p> <p>Inv 2C: One in a Million Inv 2D: Density 2.1: Matter and the Elements 2.2: Molecules and Compounds 2.3: Mixtures and Solutions</p> <p>Inv 5B: Spectrophotometry Inv 5C: Spectroscopy 5.1: The Atom Has a Structure</p> <p>8.4: Formula Masses</p> <p>Inv 9A: Density and Concentration Inv 9B: Solutions and Beer's Law 9.2: Concentration and Stability</p> <p>Inv 11A: Stoichiometry Inv 11B: Stoichiometry: Quantitative Precipitate 11.1: Analyzing a Chemical Reaction 11.2: Percent Yield and Concentration 11.4: Solving Stoichiometric Problems</p> <p>Inv 14A: Determination of Butane's Molar Mass Inv 14B: The Density of Air 14.3: Stoichiometry and Gases</p>	<p><u>Student Book</u> Ch 1: p. 32-35 Qs 5, 7-15, 41-4760, 63, 66, 70-78</p> <p>Ch 2: p. 66-69 Qs 6, 9, 16, 24, 27, 40, 41, 50, 52-80</p> <p>Ch 5: p. 162-165 Qs 17, 18, 26, 27, 64-76</p> <p>Ch 8: p. 256-259 Qs 65-77</p> <p>Ch 9: p. 290-293 Qs 45, 50, 51, 55, 76-87</p> <p>Ch 11: p. 360-365 Qs 1-6, 9-11, 15-21, 28-29, 38-69</p> <p>Ch 14: p. 468-471 Qs 32, 73-81</p> <p><u>Laboratory Investigation Manual</u> Inv 1B: p. 3-4 Parts 1-3, Part 6 Inv 1C: p. 5-6 Parts 1-7</p> <p>Inv 2C: p. 17-20 Parts 1-3, Parts 5-8 Inv 2C: p. 21-22 Parts 1-2</p> <p>Inv 5B: p. 49-50 Parts 2-4 Inv 5C: p. 51-52 Parts 2-3</p>

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Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i>: Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
		Inv 9A: p. 67-68 Parts 1-3 Inv 9B: p. 69-72 Parts 1-6 Inv 11A: p. 83-87 Part 1, Parts 3-8 Inv 11B: p. 88-90 Parts 1-6 Inv 14A: p. 117-120 Parts 1-3 Inv 14B: p. 121-122 Parts 1-5
C.PM.6: Intermolecular forces of attraction <ul style="list-style-type: none"> • Types and strengths • Implications for properties of substances • Melting and boiling point • Solubility • Vapor pressure 	Inv 3D: Heat of Fusion 3.3: Phase Changes Inv 4A: Phase Changes of Water 4.1: Understanding Chemical Changes 8.3: Intermolecular Forces 9.1: Solutes, Solvents and Water 16.1: The Properties of Solids 16.2: The Microstructure of Solids 17.1: Carbon Molecules 17.2: Functional Groups 18.4: DNA and Molecular Reproduction	<u>Student Book</u> Ch 3: p. 98-101 Qs 16, 22-33, 48-50, 74-84 Ch 4: p. 128-131 Qs 1, 3, 5, 39 Ch 8: p. 256-259 Qs 15-19, 39-47, 63-64 Ch 9: p. 290-293 Qs 5-7, 32-35, 37 Ch 16: p. 532-535 Qs 32-34, 41-48, 66, 67 Ch 17: p. 564-567 Qs 43-45 Ch 18: p. 600-603 Qs 28, 59, 102, 103, 105 <u>Laboratory Investigation Manual</u> Inv 3D: p. 35-36 Parts 1-3 Inv 4A: p. 37-38 Parts 1-4

C.IM: INTERACTIONS OF MATTER		
Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i>: Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
C.IM.1: Chemical reactions <ul style="list-style-type: none"> • Types of reactions 	2.1: Matter and the Elements	<u>Student Book</u> Ch 2: p. 66-69 Qs 5, 32, 33, 35-37

C.IM: INTERACTIONS OF MATTER		
Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i> : Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
<ul style="list-style-type: none"> • Kinetics • Energy • Equilibrium • Acids/bases 	<p>Inv 4B: Indicators of Chemical Reactions</p> <p>Inv 4C: Chemical Changes</p> <p>4.1: Understanding Chemical Change</p> <p>4.2: Chemical Reactions</p> <p>4.3: Chemical Reactions in the Lab</p> <p>Inv 10A: Discovering the Solubility Rules</p> <p>Inv 10B: Chemical Reactions</p> <p>Inv 10C: Calorimetry: Hess's Law</p> <p>10.1: Chemical Equations</p> <p>10.3: Types of Chemical Reactions</p> <p>10.4: Chemical Reactions and Energy</p> <p>Inv 12A: Respiration and Temperature</p> <p>Inv 12B: Reaction Rate and Concentration</p> <p>Inv 12C: Le Chatelier's Principle</p> <p>12.1: Reaction Rates</p> <p>12.2: Chemical Equilibrium</p> <p>12.3: Chemical Pathways</p> <p>12.4: Catalysts</p> <p>Inv 13A: The pH Scale</p> <p>Inv 13B: Titration of Vinegar</p> <p>Inv 13C: Commercial Antacids</p> <p>13.1: The Chemical Nature of Acids and Bases</p> <p>13.2: The pH Scale</p> <p>13.3: Acid-Base Equilibria</p> <p>13.4: Acid-Base Reactions</p> <p>Inv 15C: Oxidation-Reduction Reactions</p> <p>15.2: Oxidation-Reduction (Redox) Reactions</p> <p>15.3: Balancing Redox Reactions</p> <p>17.3: Organic Reactions</p> <p>Inv 18B: Catalysis and Enzymes</p> <p>18.2: Photosynthesis and Respiration</p>	<p>Ch 4: p. 128-131 Qs 4, 6, 16-27, 36, 38, 48-59, 65-72</p> <p>Ch 10: p. 322-325 Qs 1-23, 29, 31, 39, 41-46, 64-71</p> <p>Ch 12: p. 404-407 Qs 1-64</p> <p>Ch 13: p. 436-439 Qs 1-81</p> <p>Ch 15: p. 506-509 Qs 19, 20, 22-28, 37-44, 48, 49, 60, 61, 64, 70-74, 81, 83, 89-91</p> <p>Ch 17: p. 564-567 Qs 20-31, 66-73, 76, 80, 81</p> <p>Ch 18: p. 600-603 Qs 9-18, 33, 60-79</p> <p>Ch 19: p. 630-633 Qs 36-38, 44, 51, 53, 54, 72, 80, 81</p> <p><u>Laboratory Investigation Manual</u></p> <p>Inv 4B: p. 39-41 Parts 2-13</p> <p>Inv 4C: p. 43-46 Parts 2-10</p> <p>Inv 10A: p. 75-76 Parts 1-4</p> <p>Inv 10B: p. 77-80 Parts 1-7</p> <p>Inv 12A: p. 91-94 Parts 5-7</p> <p>Inv 12B: p. 95-98 Parts 2-6</p> <p>Inv 12C: p. 99-100 Parts 1-4</p> <p>Inv 13A: p. 101-106 Parts 1-8</p> <p>Inv 13B: p. 107-108 Parts 1-4</p> <p>Inv 13C: p. 109-112 Parts 1-5</p> <p>Inv 15C: p. 127-128 Parts 1-4</p> <p>Inv 18B: p. 143-144 Parts 1-3</p>

C.IM: INTERACTIONS OF MATTER		
Ohio Chemistry Learning Standards	Lab-Aids <i>A Natural Approach to Chemistry</i>: Sections and Laboratory Investigations	Selected Assessment Opportunities in <i>A Natural Approach to Chemistry</i>
	19.1: The Chemistry of the Atmosphere	
C.IM.2: Gas laws <ul style="list-style-type: none"> • Pressure, volume and temperature • Ideal gas law 	Inv 14A: Determination of Butane's Molar Mass 14.1: Pressure and Kinetic Theory 14.2: The Gas Laws 14.3: Stoichiometry and Gases	<u>Student Book</u> Ch 14: p. 468-471 Qs 2, 3, 5, 6, 12-16, 17-31, 33-81 <u>Laboratory Investigation Manual</u> Inv 14A: p. 117-120 Parts 2-3
C.IM.3: Stoichiometry <ul style="list-style-type: none"> • Molecular calculations • Solutions • Limiting reagents 	2.3: Mixtures and Solutions 10.1: Chemical Equations 10.2: Methods for Balancing Chemical Equations Inv 11A: Stoichiometry Inv 11B: Stoichiometry: Quantitative Precipitate 11.1: Analyzing a Chemical Reaction 11.2: Percent Yield and Concentration 11.3: Limiting Reactants 11.4: Solving Stoichiometric Problems Inv 13D: Determining the Amount of Vitamin C Inv 14A: Determination of Butane's Molar Mass 14.3: Stoichiometry and Gases	<u>Student Book</u> Ch 2: p. 66-69 Qs 53-80 Ch 10: p. 322-325 Qs 32, 36-38, 52-63 Ch 11: p. 360-365 Qs 1-8, 9-11, 15-21, 28-69 Ch 14: p. 468-471 Qs 32, 73-81 <u>Laboratory Investigation Manual</u> Inv 11A: p. 83-86 Parts 1-8 Inv 11B: p. 87-90 Parts 1-6 Inv 13D: p. 113-116 Parts 4-5 Inv 14A: p. 117-120 Parts 2-3