LAB-AIDS CORRELATIONS FOR THE MINNESOTA 2009 STATE SCIENCE STANDARDS

GRADES 9-12 – 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 Minnesota 2009 Science Standards for chemistry. *It is not an exhaustive list*; other locations may exist that are not listed here.

This document was prepared by Mark Koker, Ph D, Director of Curriculum and Training at LAB-AIDS.

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The Natural Approach to Chemistry		
THEMES		
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	Present comprehensive overview of all main ideas in chemistry such as the atomic nature of matter, systems, temperature, and energy. *"Big Picture"*
Core Concepts	Chapters 5 -14	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. *All academic content and instruction standards for chemistry have been met by the end of Chapter 14.*
Applications	Chapter 15 - 21	Provide deeper exploration of significant areas of interest in chemistry. *Examples include rechargeable batteries, materials science, planetary atmospheres, etc.*
COMPLETE LEARNING SYSTEM		
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		

Correlation Citation Reference Key:

Locations are given in the student book (SB) and/or laboratory manual (LM).

SB 1.2 pp. 19-25

Means Student Book Chapter 1 Section 1.2 pages 19 – 25

LM 1A, 3D, 11A: 6, 12A: 6, 12B: 1, 6

Means Lab Investigations Manual Chapter 1 Investigation 1A;

Chapter 3 Investigation 3D;

Chapter 11 Investigation 11A Part 6;

Chapter 12 Investigation 12B Part 1 and Part 6

Relevant questions from the student book (SB) and lab manual (LM) problem sets and questions are indicated, e.g.,

SB 1.2 18-30, 51-55

Means Student Book Chapter 1 Section 1.2 questions 18-30 and questions 51-55

LM 9A Pt 4a-c; **9B** Pts 3-5

Means Laboratory Investigations Manual Chapter 9 Investigation 9A Part 4 a-c, Investigation 9B Part 3 – Part 5.

			Location in *Natural Approach to Chemistry*		
Descriptor	**Reference ID**	**Standard**	**Student Book**	**Lab Manual**	**Assessment**
NATURE OF SCIENCE Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	9.1.1.1.1	Explain the implications of the assumption that the rules of the universe are the same everywhere and these rules can be discovered by careful and systematic investigation.	5.4, p. 159; 21.1 – 21.3, pp. 664-687		**SB 5.4** 56, 61, 62, p. 164; **21.1** 2, 3, 7 **21.2** 10, 12, p. **688; 21.3** 21-23 pp. 688-689
	9.1.1.1.2	Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	1.2, pp. 19-26, 30; 2.1, p. 43; 2.2, p. 48; 3.1, p. 72; 5.1 p. 132; 5.2, p. 149; 6.3, p. 189; 7.3, p. 222; 8.4, p. 254; 11.4, p. 359; 18.4, p. 596		**SB 1.2** 18-30, pp. 32-33; 51-55, p. 34; **5.1** & **5.2** 23-28, 31-33, 37 p. 163
	9.1.1.1.3	Explain how the traditions and norms of science define the bounds of professional scientific practice and reveal instances of scientific error or misconduct. *For example:* The use of peer review, publications and presentations.	1.2, p. 26		**SB 1.2** 18-30, pp. 32-33; 51-55, p. 34
	9.1.1.1.4	Explain how societal and scientific ethics impact research practices. *For example:* Research involving human subjects may be conducted only with the informed consent of the subjects.	10.4, p. 318-321; 11.4, p. 359; 17.3, p 557; 18.4, pp. 598-599		Not assessed
	9.1.1.1.5	Identify sources of bias and explain how bias might influence the direction of research and the interpretation of data. *For example:* How funding of research can influence questions studied, procedures	Not covered		Not assessed

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		used, analysis of data, and communication of results.			
	9.1.1.1.6	Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge.	1.2, p. 20, 22; 5.1, pp. 135-136; 6.1, pp. 171-175; 14.2: p. 454		**SB 1.2** 18-30, pp. 32-33; 51-55, p. 34; **5.1** 23-25, 38 p. 163; **6.1** 12-13, 15-16, p. 192; **14.2** 25, p. 468
	9.1.1.1.7	Explain how scientific and technological innovations ─as well as new evidence─ can challenge portions of, or entire accepted theories and models including, but not limited to: cell theory, atomic theory, theory of evolution, plate tectonic theory, germ theory of disease, and the big bang theory.	5.1, pp. 135-136; 6.1, pp. 171-175; 14.2: p. 454		**SB 5.1** 23-25, 38 p. 163; **6.1** 12-13, 15-16, p. 192; **14.2** 25, p. 468
Scientific inquiry uses multiple interrelated processes to investigate and explain the natural world.	9.1.1.2.1	Formulate a testable hypothesis, design and conduct an experiment to test the hypothesis, analyze the data, consider alternative explanations and draw conclusions supported by evidence from the investigation.	1.2 pp. 19-25	1A, 11A, 12A, 12B	**SB 1.2** 18-30, pp. 32-33; 51-55, p. 34; **1.3** 57, p. 34 **LM 1A**, Pts 3-4, p. 2; **11A** Pt 6; **12A**: Pt 6 p.94; **12B** Pts 4, 6 p. 97-98
	9.1.1.2.2	Evaluate the explanations proposed by others by examining and comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the scientifically acceptable evidence, and suggesting alternative scientific explanations.	1.2 pp. 25-26	1A	**SB 1.2** 18-30, pp. 32-33; 51-55, p. 34 **LM 1A**, Pts 3-4, p. 2
	9.1.1.2.3	Identify the critical assumptions and logic used in a line of reasoning to judge the	1.2 pp. 19-25	1A, 3D, 11A, 12A,	**SB 1.2** 18-30, pp. 32-

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		validity of a claim.		12B	33; 51-55, p. 34 **LM 1A**, Pts 3-4, p. 2; **3D** Pt 3, p. 36; **11A** Pt 6; **12A**: Pt 6 p.94; **12B** Pts 4, 6 p. 97-98
	9.1.1.2.4	Use primary sources or scientific writings to identify and explain how different types of questions and their associated methodologies are used by scientists for investigations in different disciplines.	Not covered		Not assessed
Science, technology, engineering and mathematics rely on each other to enhance knowledge and understanding.	9.1.3.4.1	Describe how technological problems and advances often create a demand for new scientific knowledge, improved mathematics and new technologies.	1.3 pp. 30-31; 17.3 pp. 556-563; 20.1-20.5, p 636-659; 21.1, pp. 666-672	17A, 21A	SB **1.3** 57, p. 34; **17.3** 69, 70, 73-76, 79, 82-83, p. 567; **21.1** 2, 4, 5, 8, 9 p. 688
	9.1.3.4.2	Determine and use appropriate safety procedures, tools, computers and measurement instruments in science and engineering contexts. *For example:* Consideration of chemical and biological hazards in the lab.		See for example, xiii-xvi, 1C, 2A, 2C, 2D, 3A-B, 4A, 5B, 8A, 9A-C, 10B-C, 11A, 12A, 13A, 14B, 15A-D, 17B	**Safety: LM** xv-xiv (Safety quiz), **10B** Pt 1; **4C** Pt 1; **14B** Pt 1 Tools: **LM 1C** Pt 2; **2A**, Pt 2; **2C**: Pt 3; **2D**: Pt 2; **3A** pts 1-6; **3B** Pts 1,4; **4A** Pt 1; **5B** Pts 2-3…
	9.1.3.4.3	Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.		3C: Pt 1; 4A: Pts 2-3; 5B: Pt 4; 5C: Pt 3; 7A-B; 9A: 2; 9B; 12B: 5; 13A: 8; 14B: 3…	**LM 3C**: 2d; **4A**: 3a-d; **5B**: 4c, e-g; **5C**: see puzzle cards; **7A**: Pt 3-4; **7B**: 1a-b, 2a-c, 3a-d, 4a-d; **9A**: 2a, e; **9B**: Pts 4-5…

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	9.1.3.4.4	Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve data collection and analysis. *For example*: Use statistical analysis or error analysis to make judgments about the validity of results.		3B: 6; 8A: 3; 9B: 6; 11B: 5 & 6; 12B: 6; 13B: 4; 14A: 3	**LM 3B**: 6e; **8A**: 3a-f; **9B**: 6 steps 1-4; **11B**: 5g, 6d-f; **12B**: 6i-j; **13B**: 4b; **14A**: 3f
	9.1.3.4.5	Demonstrate how unit consistency and dimensional analysis can guide the calculation of quantitative solutions and verification of results.	1.1, p. 18	3B, 3D, 9C, 11A, 13D, 14A,	**SB 1.1**: 13, 33, 66-67, 73, 75, 76-78 p. 32-35 **LM 3B** Pt 2 all, 3c, e-f; 5d; **3D** Pt 2 all, pt 3b-3; **9C** Pt 4, steps 3, 5; **11A** Pt 3a, e, g, 4a-e, Pt 5a-f…
Developments in chemistry affect society and societal concerns affect the field of chemistry.	9C.1.3.3.1	Explain the political, societal, economic and environmental impact of chemical products and technologies. *For example:* Pollution effects, atmospheric changes, petroleum products, material use or waste disposal.	See for example, 1.3, pp. 30-31; 4.3, pp.126-127; 5.4, pp. 160-161; 6.3, pp. 190-191; 7.3, pp. 222-223; 10.4, pp. 318-319; 18.4, pp.598-599, etc.	17A, 19A, 19B	**SB 4.2**: 66-67, p. 130; **10.2**: 61, p. 324 **LM 17A**: 5d-f; **19A**: 6b-d; **19B**: 5e
Physical and mathematical models are used to describe physical systems.	9C.1.3.4.1	Use significant figures and an understanding of accuracy and precision in scientific measurements to determine and express the uncertainty of a result.	1.1, pp. 14-15	Appendix C, pp. 171-172	**SB 1.1**, 43-44, p. 33
The periodic table illustrates how patterns in the	9C.2.1.1.1	Explain the relationship of an element's position on the periodic table to its atomic number and electron configuration.	6.1, p. 168 6.2, pp. 177-182	6A, 6B, 6C	**SB 6.1**: 15, p. 192; **6.2** 24-25, 28-29 **LM 6A** 2-16; **6B**: 2-

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physical and chemical properties of elements are related to atomic structure.					8; **6C**: 4a-d
	9C.2.1.1.2	Identify and compare trends on the periodic table, including reactivity and relative sizes of atoms and ions; use the trends to explain the properties of subgroups, including metals, non-metals, alkali metals, alkaline earth metals, halogens and noble gases.	6.1, pp. 171-173, 176	6C	**SB 6.1**: 7, 12, 14, 15, p. 192 **LM 6C**: 4a-d
CHEMISTRY CONTENT Chemical and physical properties of matter result from the ability of atoms to form bonds.	9C.2.1.2.1	Explain how elements combine to form compounds through ionic and covalent bonding.	6.2, p. 183-184 7.1, pp.198-205	7A, 7B	**SB 7.1** 1-2, 15-18 p. 224
	9C.2.1.2.2	Compare and contrast the structure, properties and uses of organic compounds, such as hydrocarbons, alcohols, sugars, fats and proteins.	7.3, pp. 222-223 8.2, pp. 238-242	7B	**SB 7.3** 30-32, p. 225 **LM 7B** 1a-b, 2a-c, 3a-d, 4a-d, pp. 61-62
	9C.2.1.2.3	Use IUPAC (International Union of Pure and Applied Chemistry) nomenclature to write chemical formulas and name molecular and ionic compounds, including those that contain polyatomic ions.	8.2, pp. 243-244	8B	**SB 8.2** 4-15, 59-62 p. 256, 258 **LM 8B** Pt 4 1-4, p. 66
	9C.2.1.2.4	Determine the molar mass of a compound from its chemical formula and a table of atomic masses; convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.	8.4, pp. 250-251 14.2, pp. 456-459	8A 14A	**SB 8.4** 48-50, 65-77, p. 257-259 **14.2** 5-6, 28, p. 468 **LM 14A** 3a-h, p. 120
	9C.2.1.2.5	Determine percent composition, empirical formulas and molecular formulas of simple compounds.	8.4, pp. 251-253		**SB 8.4** 48-50, 65-77, p. 257-259

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Chemical and physical properties of matter result from the ability of atoms to form bonds.	9C.2.1.2.6	Describe the dynamic process by which solutes dissolve in solvents, and calculate concentrations, including percent concentration, molarity and parts per million.	9.2, pp. 262-265; pp 270-272	9A, 9B	**SB 9.2** 12-19, 43-55 p. 290-292 **LM 9A** Pt 4a-c, p. 68; **9B** Pts 3-5
	9C.2.1.2.7	Explain the role of solubility of solids, liquids and gases in natural and designed systems. *For example:* The presence of heavy metals in water and the atmosphere. *Another example:* Development and use of alloys.	2.3, pp. 57-59 9.2, pp. 273-277 9.3, pp. 288-289 16.3, p. 521-523	2C, 9B	**SB 2.3** 19-29, 47-52, pp. 66-68; **9.2** 12-19, 43-55 p. 290-292; **9.3** 20-22, 27, p. 290-291; **16.3** 27, 62, pp. 532-534 **LM 2C** Pts 5, 8; **9B** Pts 3-5
Chemical reactions describe a chemical change in which one or more reactants are transformed into one or more products.	9C.2.1.3.1	Classify chemical reactions as double replacement, single replacement, synthesis, decomposition or combustion.	10.3, pp. 305-307	10A, 10B	**SB 10.3** 7-14, 39-41, pp. 322-324 **LM 10A** Pt 3-4; **10B** Pt 2, 4, 6, 8a-g
	9C.2.1.3.2	Use solubility and activity of ions to determine whether a double replacement or single replacement reaction will occur.	10.3, pp. 307-309	10A	**SB 10.3** 7-14, 39-41, pp. 322-324 **LM 10A** Pt 3-4
	9C.2.1.3.3	Relate the properties of acids and bases to the ions they contain and predict the products of an acid-base reaction.	4.3, pp. 124-125 13.1 pp 410-415; 13.4, pp. 427-431	13B, 13C	**SB 4.3** 33-35 p. 129; **13.1** 1-9, 21-34 p. 436-437; **13.4** 14-20, 75-81

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					p. 436-437 **LM 13B**, Pt 3 – 4a-f; **13C**
	9C.2.1.3.4	Balance chemical equations by applying the laws of conservation of mass and constant composition.	10.1, pp. 301-304		**SB 10.1** 1-6, 29-37 pp. 322-323
	9C.2.1.3.5	Use the law of conservation of mass to describe and calculate relationships in a chemical reaction, including molarity, mole/mass relationships, mass/volume relations, limiting reactants and percent yield.	2.1, pp. 45-46; 2.2, p.54; 4.2, pp 114-117; 10.1 pp 298 -299; 11.1 pp 328-338; 11.2 pp 339-342; 11.2 pp 345-349	11B	**SB 2.1** 40-41, p. 67; **2.2** 42-46, p. 67-68, **4.2** 16-20, 48-52, p 128-129; **10.1** 1-6, 29-37, p. 322-323; **11.1-11.2** 9-29 **LM 11B** 5a-g, p. 89
	9C.2.1.3.6	Describe the factors that affect the rate of a chemical reaction, including temperature, pressure, mixing, concentration, particle size, surface area and catalyst.	12.1, pp 368-370; 372-377	12A, 12B	**SB 12.1** 1-4, 21-35 pp. 404-405 **LM 12A** Pts 6a-e, 7a-b, p. 94; **12B** Pt 6a-k, p. 98
	9C.2.1.3.7	Recognize that some chemical reactions are reversible and that not all chemical reactions go to completion.	12.2 pp 378-386	12C	**SB 12.2** 5-12, 36-47, p. 404-406 **LM 12C** Pts 3-4
States of matter can be described in terms of motion of molecules. The properties and behavior of gases can	9C.2.1.4.1	Use kinetic molecular theory to explain how changes in energy content affect the state of matter (solid, liquid and gaseous phases).	14.1, pp. 442-443; 16.1, pp. 512-515		**SB 14.1** 1-4, 7-15, p. 468; **16.1** 4-6, 41-44, p. 532-533
	9C.2.1.4.2	Use the kinetic molecular theory to explain the behavior of gases and the relationship	14.2, pp. 450-461	14A, 14B	**SB 14.2** 5-6, 17-31

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be explained using the kinetic molecular theory.		among temperature, pressure, volume and the number of particles.			pp 468-469 **LM 14A** 3a-h, p. 120; **14B** Pt 5a-e. p. 122