LAB-AIDS CORRELATIONS FOR
THE UTAH SCIENCE CORE CURRICULUM CHEMISTRY[1]

GRADES 10-12 – CHEMISTRY

A Natural Approach to Chemistry[2] (NAC) is written by Hsu, Chaniotakis, Carlisle, and Damelin. This correlation is intended to show selected locations in NAC programs that support the Utah Science Core Curriculum for chemistry. It is not an exhaustive document; other citations may exist that are not listed here.

This document was prepared by David Ziegler, consultant, with contributions from Oralia Gil, curriculum specialist at LAB-AIDS. This is not an exhaustive document. It is designed to provide a general overview of the alignment of *A Natural Approach to Chemistry* to the Utah science program standards, grades 9-12, for review and adoption purposes. Support for the state standards may be found at other locations besides those explicitly stated in this document.

For more information about this correlation or for questions about review copies, presentations, or any matters related to sales or service, please contact Ryan Luby, LAB-AIDS Regional Sale Manager, at 480.220.5516, or by email at ryan@lab-aids.com, or visit us on the web at www.lab-aids.com.

[1] http://www.schools.utah.gov/CURR/science/Secondary/Chemistry.aspx
[2] http://www.anaturalapproachtochemistry.com/natc_home.php

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.

Standards	Objectives	Indicators	Student Book	Lab Manual
STANDARD I: Students will understand that all matter in the universe has a common origin and is made of atoms, which have structure and can be systematically arranged on the periodic table.	**Objective 1:** Recognize the origin and distribution of elements in the universe.	a. Identify evidence supporting the assumption that matter in the universe has a common origin.	21.1, p. 670	
		b. Recognize that all matter in the universe and on earth is composed of the same elements.	21.1, pp. 664-666	21A
		c. Identify the distribution of elements in the universe.	21.1, pp. 666, 672	21A
		d. Compare the occurrence of heavier elements on earth and the universe.	21.1, p. 672 21.2, p. 681	
	Objective 2: Relate the structure, behavior, and scale of an atom to the particles that compose it.	a. Summarize the major experimental evidence that led to the development of various atomic models, both historical and current.	Ch. 5, p. 133 5.1, pp. 134-136	
		b. Evaluate the limitations of using models to describe atoms.	Ch. 5, p. 132; 5.1, p. 135; 5.2, p. 144	
		c. Discriminate between the relative size, charge, and position of protons, neutrons, and electrons in the atom.	5.1, pp. 137, 141	
		d. Generalize the relationship of proton number to the element's	2.1, p. 44	5A

Standards	Objectives	Indicators	Student Book	Lab Manual
		identity.		
		e. Relate the mass and number of atoms to the gram-sized quantities of matter in a mole.	2.1, pp. 45-46; 2.2, pp. 53-54; 11.1, pp. 337-338	
	Objective 3: Correlate atomic structure and the physical and chemical properties of an element to the position of the element on the periodic table.	a. Use the periodic table to correlate the number of protons, neutrons, and electrons in an atom.	5.1, pp. 138-139-141	5A 6C
		b. Compare the number of protons and neutrons in isotopes of the same element.	5.1, p. 138	6B p. 161
		c. Identify similarities in chemical behavior of elements within a group.	6.2, pp. 177-182	
		d. Generalize trends in reactivity of elements within a group to trends in other groups.	Ch. 6, p. 167 6.1, pp. 171-173	4C, 10A 15C
		e. Compare the properties of elements (e.g., metal, nonmetallic, metalloid) based on their position in the periodic table.	Ch. 6, p. 167 6.1, pp. 168, 170-175	6A 6B
STANDARD II:	**Objective 1:**	a. Identify the relationship	5.4, pp. 155-156	5B

Standards	Objectives	Indicators	Student Book	Lab Manual
Students will understand the relationship between energy changes in the atom specific to the movement of electrons between energy levels in an atom resulting in the emission or absorption of quantum energy. They will also understand that the emission of high-energy particles results from nuclear changes and that matter can be converted to energy during nuclear reactions.	Evaluate quantum energy changes in the atom in terms of the energy contained in light emissions.	between wavelength and light energy.		5C
		b. Examine evidence from the lab indicating that energy is absorbed or released in discrete units when electrons move from one energy level to another.	5.4, pp. 155-156	5C
		c. Correlate the energy in a photon to the color of light emitted.	5.4, pp. 158-159	5C
		d. After observing spectral emissions in the lab (e.g., flame test, spectrum tubes), identify unknown elements by comparison to known emission spectra.	5.4, pp. 159, 160-161	5C
	Objective 2: Evaluate how changes in the nucleus of an atom result in emission of radioactivity.	a. Recognize that radioactive particles and wavelike radiations are products of the decay of an unstable nucleus.	20.2, pp. 637, 639-641	
		b. Interpret graphical data relating half-life and age of a radioactive substance.	20.3, pp. 642-646	20A

Standards	Objectives	Indicators	Student Book	Lab Manual
		c. Compare the mass, energy, and penetrating power of alpha, beta, and gamma radiation.	20.2, pp. 639-641	
		d. Compare the strong nuclear force to the amount of energy released in a nuclear reaction and contrast it to the amount of energy released in a chemical reaction.	20.4, pp. 647-655	
		e. After researching, evaluate and report the effects of nuclear radiation on humans or other organisms.	20.5, pp. 656-659	
STANDARD III: Students will understand chemical bonding and the relationship of the type of bonding to the chemical and physical properties of substances.	**Objective 1:** Analyze the relationship between the valence (outermost) electrons of an atom and the type of bond formed between atoms.	a. Determine the number of valence electrons in atoms using the periodic table.	6.3, pp. 184-188	6C p. 159
		b. Predict the charge an atom will acquire when it forms an ion by gaining or losing electrons.	5.1, pp. 143-144; 7.2, pp. 207-209; 15.2, pp. 479-482	6C
		c. Predict bond types based on the behavior of valence (outermost) electrons.	7.1, pp. 201, 204-205; 7.2, p. 212	7A
		d. Compare covalent, ionic, and metallic bonds with respect to electron behavior	7.1, pp. 202-203; 8.1, p. 231;	

Standards	Objectives	Indicators	Student Book	Lab Manual
		and relative bond strengths.	8.2, p. 237	
	Objective 2: Explain that the properties of a compound may be different from those of the elements or compounds from which it is formed.	a. Use a chemical formula to represent the names of elements and numbers of atoms in a compound and recognize that the formula is unique to the specific compound.	2.1, p. 43; 2.2, pp. 49-52; 8.1, pp. 233-236; 8.2, pp. 243-244	2B
		b. Compare the physical properties of a compound to the elements that form it.	Ch. 2, pp. 64-65; 2.2, p. 48; Ch. 7, pp. 196-197; 8.1, p. 231	10B
		c. Compare the chemical properties of a compound to the elements that form it.	Ch. 2, p. 64-65; 2.2, p. 48; 4.1, p. 112; Ch. 7, p. 196	10B
		d. Explain that combining elements in different proportions results in the formation of different compounds with different properties.	2.2, p. 48	7B
	Objective 3: Relate the properties of simple compounds to the type of bonding, shape of molecules, and	a. Generalize, from investigations, the physical properties (e.g., malleability, conductivity, solubility) of substances with different bond types.	8.1, pp. 230-231; 8.2, p. 237	10B

Standards	Objectives	Indicators	Student Book	Lab Manual
	intermolecular forces.			
		b. Given a model, describe the shape and resulting polarity of water, ammonia, and methane molecules.	7.3, pp. 214-221	8B 7B
		c. Identify how intermolecular forces of hydrogen bonds in water affect a variety of physical, chemical, and biological phenomena (e.g., surface tension, capillary action, boiling point).	8.3, pp. 247-248; 9.1, pp. 263-264	16A 16B 17A 17B 19A
STANDARD IV: Students will understand that in chemical reactions matter and energy change forms, but the amounts of matter and energy do not change.	**Objective 1:** Identify evidence of chemical reactions and demonstrate how chemical equations are used to describe them.	a. Generalize evidences of chemical reactions.	2.1, p. 40; 4.1, pp. 104-105; 4.2, p. 114; 10.3, pp. 308-309	4B 4C 10B 10C
		b. Compare the properties of reactants to the properties of products in a chemical reaction.	4.2, p. 114	4B 4C 10B
		c. Use a chemical equation to describe a simple chemical reaction.	4.2, pp. 114-116; 10.1, pp. 296-300	4 C, 10B, 12A, 12B, 12C, 13B, 13C
		d. Recognize that the number of atoms in a chemical reaction does not	4.2, p. 115 10.1, pp. 296,	10A 11A

Standards	Objectives	Indicators	Student Book	Lab Manual
		change.	298, 300-301	11B
		e. Determine the molar proportions of the reactants and products in a balanced chemical reaction.	4.2, p. 116; 10.2, pp. 302-304; Ch. 11 p. 327; 11.1, pp. 329-335	11B 13C
		f. Investigate everyday chemical reactions that occur in a student's home (e.g., baking, rusting, bleaching, cleaning).	Ch. 2 p. 37; 4.1, p. 104; Ch. 10, p. 295	4C, 10B, 11A, 12A, 13B, 13C, 13D, 15A, 15C, 18A, 18B
	Objective 2: Analyze evidence for the laws of conservation of mass and conservation of energy in chemical reactions.	a. Using data from quantitative analysis, identify evidence that supports the conservation of mass in a chemical reaction.	4.2, p. 117; 10.1, p. 298	11A 11B
		b. Use molar relationships in a balanced chemical reaction to predict the mass of product produced in a simple chemical reaction that goes to completion.	Ch. 10, pp. 320-321	11A 11B
		c. Report evidence of energy transformations in a chemical reaction.	Ch. 10, p. 295	10C
		d. After observing or measuring, classify evidence of temperature change in a chemical reaction as endothermic or exothermic.	9.3, p. 280; 10.4, pp. 312-316	4B, 9C, 10C

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		e. Using either a constructed or a diagrammed electrochemical cell, describe how electrical energy can be produced in a chemical reaction (e.g., half reaction, electron transfer).	Ch. 15, pp. 472-473; 15.1, pp. 474-476; 15.3, pp. 489-492; 15.4, pp. 493-497, 500-403	15A 15B
		f. Using collected data, report the loss or gain of heat energy in a chemical reaction.	10.4, pp. 311-314	10C
STANDARD V: Students will understand that many factors influence chemical reactions and some reactions can achieve a state of dynamic equilibrium.	**Objective 1:** Evaluate factors specific to collisions (e.g., temperature, particle size, concentration, and catalysts) that affect the rate of chemical reaction.	a. Design and conduct an investigation of the factors affecting reaction rate and use the findings to generalize the results to other reactions.	Ch. 12, p. 367 12.1, p. 368	12A 12B
		b. Use information from graphs to draw warranted conclusions about reaction rates.	12.2, pp. 283-284	12A 12B
		c. Correlate frequency and energy of collisions to reaction rate.	12.1, pp. 373, 377	12B 12C
		d. Identify that catalysts are effective in increasing reaction rates.	12.4, pp. 398-401; Ch. 15, pp. 504-505	12B 18B

Standards	Objectives	Indicators	Student Book	Lab Manual
	Objective 2: Recognize that certain reactions do not convert all reactants to products, but achieve a state of dynamic equilibrium that can be changed.	a. Explain the concept of dynamic equilibrium.	12.1, pp. 378-383	12C
		b. Given an equation, identify the effect of adding either product or reactant to a shift in equilibrium.	12.2, pp. 384-385, 387-388	12C
		c. Indicate the effect of a temperature change on the equilibrium, using an equation showing a heat term.	12.1, pp. 374-376; 12.2, p. 386	12A
STANDARD VI: Students will understand the properties that describe solutions in terms of concentration, solutes, solvents, and the behavior of acids and bases.	**Objective 1:** Describe factors affecting the process of dissolving and evaluate the effects that changes in concentration have on solutions.	a. Use the terms solute and solvent in describing a solution.	9.1, p. 262; 16.3, p. 522	
		b. Sketch a solution at the particle level.	Ch. 9, pp. 260-261; 9.1, p. 265; 9.2, p. 273	

Standards	Objectives	Indicators	Student Book	Lab Manual
		c. Describe the relative amount of solute particles in concentrated and dilute solutions and express concentration in terms of molarity and molality.	9.2, pp. 270-272, 277; 9.3, p. 286	2C 9B
		d. Design and conduct an experiment to determine the factors (e.g., agitation, particle size, temperature) affecting the relative rate of dissolution.	9.2, pp. 274-276; 9.3, p. 278	
		e. Relate the concept of parts per million (PPM) to relevant environmental issues found through research.	Ch. 1, p. 31; 9.2, p. 271; 19.1, pp. 613-614	2C
	Objective 2: Summarize the quantitative and qualitative effects of colligative properties on a solution when a solute is added.	a. Identify the colligative properties of a solution.	9.3, pp. 284-287	
		b. Measure change in boiling and/or freezing point of a solvent when a solute is added.	9.3, pp. 284-286	
		c. Describe how colligative properties affect the behavior of solutions in	9.3, pp. 285-286; Ch. 16, p. 531	

Standards	Objectives	Indicators	Student Book	Lab Manual
		everyday applications (e.g., road salt, cold packs, antifreeze).		
	Objective 3: Differentiate between acids and bases in terms of hydrogen ion concentration	a. Relate hydrogen ion concentration to pH values and to the terms acidic, basic or neutral.	13.1, pp. 410-413; 13.2, pp. 416-420; 13.3, p. 422	13A
		b. Using an indicator, measure the pH of common household solutions and standard laboratory solutions, and identify them as acids or bases.	13.2, pp. 416, 421	13A
		c. Determine the concentration of an acid or a base using a simple acid-base titration.	13.4, p. 429	13B, 13C, 13D
		d. Research and report on the uses of acids and bases in industry, agriculture, medicine, mining, manufacturing, or construction.	13.4, pp. 427-428	
		e. Evaluate mechanisms by which pollutants modify the pH of various environments (e.g., aquatic, atmospheric, soil).	13.4, pp. 428, 434-435; 19.1, pp. 608-609, 615; 19.3, p. 627	