CORRELATIONS FOR THE GEORGIA SCIENCE STANDARDS OF EXCELLENCE 2016

GRADES 10-12 – 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 Connecticut 2005 Science Standards for chemistry. It is not an exhaustive list; other locations may exist that are not listed here.

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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 investigation manual (LIM).

5 pp. 134-154

Means Student Book Chapter 5 pages 134-154

Science Georgia Standards of Excellence

High School (9-12) Chemistry Standards Correlation to

A Natural Approach to Chemistry, 2nd Edition

Georgia Science Standard	Location in Student Book	Assessment
SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements.		
a. Evaluate merits and limitations of different models of the atom in relation to relative size, charge, and position of protons, neutrons, and electrons in the atom.	5-The Structure of the Atom, pp 134-154	pp 162-165 Q 27, 29, 33, 45
b. Construct an argument to support the claim that the proton (and not the neutron or electron) defines the element's identity.	5-The Atom Has a Structure, pp 134-143	pp 162-165 Q 6, 37, 38, 39, 44
c. Construct an explanation based on scientific evidence of the production of elements heavier than hydrogen by nuclear fusion.	20-Nuclear Chemistry and Radioactivity, pp 654; 21- The Chemistry of the Solar System, pp 670-671	pp 687-689 Q 7, 25
d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element.	5-The Structure of the Atom, pp 137-139 INV 5A-Inside the Atom, pp 48	pp 162-165 Q 40, 65 LIM pp 48
e. Construct an explanation of light emission and the movement of electrons to identify elements.	5-The Structure of the Atom, pp 158-159 INV 5C-Spectroscopy, pp 51-52; 21A-Astronomical Spectroscopy, pp 155-156	pp 162-165 Q 54, 55, 56, 58, 69, 70 LIM pp 51-52, 155-156
f. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms (i.e. including atomic radii, ionization energy, and electronegativity).	6- Elements and the Periodic Table, pp 171-182 INV 6A-Periodic Table Riddles, pp 53-54; 6B-Periodic Table Fill in the Blank, pp 55-56	pp 192-195 Q 25, 26, 27, 29, 46, 47, 53, 56 LIM pp 53-56
g. Develop and use models, including electron configuration of atoms and ions, to predict an element's chemical properties.	5-The Structure of the Atom, pp 144; 6-Elements and the Periodic Table, pp 171-182 INV 5A-Inside the Atom, pp 47-48; 6C-Valence, pp 57-58	pp 192-195 Q 23, 25, 26, 27, 29, 30, 31, 36, 37, 39, 46, 47, 56, 59 LIM pp 47-48, 57-58
SC2. Obtain, evaluate, and communicate information about the chemical and physical properties of matter resulting from the ability of atoms to form bonds.		

Georgia Science Standard	Location in Student Book	Assessment
a. Plan and carry out an investigation to gather evidence to compare the physical and chemical properties at the macroscopic scale to infer the strength of intermolecular and intramolecular forces.	INV 4A-Phase Changes of Water, pp 37-38	LIM pp 37-38
b. Construct an argument by applying principles of inter- and intra- molecular forces to identify substances based on chemical and physical properties.	3-Temperature, Energy, and Heat, pp 88-90; 4-Physical and Chemical Change, pp 104-113; 7-Bonding, pp 196-206; 8-Compounds and Molecules, pp 228-249	pp 98-101 Q 21, 47, 52; pp 128-131: Q 1, 48, 50, 51, 64 pp 224-227: Q 30, 42, 43, 44 pp 256-259: Q 5, 12, 16, 17, 20, 21, 24, 29, 30, 31, 33, 43, 46, 47, 48
c. Construct an explanation about the importance of molecular-level structure in the functioning of designed materials. (*Clarification statement:* Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.)	8-Compounds and Molecules, pp 254-255	pp 256-259: Q 21, 29, 30, 33, 35, 46, 47, 48
d. Develop and use models to evaluate bonding configurations from nonpolar covalent to ionic bonding. (*Clarification statement:* VSEPR theory is not addressed in this element.)	7-Bonding, pp 200-221; 8-Compounds and Molecules, pp 228-249 INV 2B-The Chemical Formula, pp 11-15; 7A-Lewis Structures, pp59-60; 7B-The Geometry of Molecules, pp 61-62	pp 224-227: Q 2, 3, 5, 9, 12-17, 20-30, 36, 37, 46-51, 56-65, 67-69 LIM pp 11-15, 59-62
e. Ask questions about chemical names to identify patterns in IUPAC nomenclature in order to predict chemical names for ionic (binary and ternary), acidic, and inorganic covalent compounds	8-Compounds and Molecules, pp 235, 236, 244 INV 8B-Naming Chemical Compounds, pp 65-66;	pp 256-259: Q 53-63 LIM pp 65-66
SC3. Obtain, evaluate, and communicate information about how the Law of Conservation of Matter is used to determine chemical composition in compounds and chemical reactions.		
a. Use mathematics and computational thinking to balance chemical reactions (i.e., synthesis, decomposition, single replacement, double replacement, and combustion) and construct an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	6- Elements and the Periodic Table, pp 173-185; 7-Bonding, pp 207-213; 10-Chemical Reactions, pp 294-310 INV 4C-Chemical Changes, pp 45; 10A-Discovering the	pp 322-325 Q 38-40, 55-66, 68

Georgia Science Standard	Location in Student Book	Assessment
	Solubility Rules, pp 76; 10B-Chemical Reactions, pp 80	
b. Plan and carry out an investigation to determine that a new chemical has been formed by identifying indicators of a chemical reaction (e.g., precipitate formation, gas evolution, color change, water production, and changes in energy to the system).	INV 4B-Indicators of Chemical Reactions, pp 39-41; 4C-Chemical Changes, pp 43-46; 10A-Discovering the Solubility Rules, pp 75-76; 10B-Chemical Reactions, pp 77-80	LIM pp 39-46, 75-80
c. Use mathematics and computational thinking to apply concepts of the mole and Avogadro's number to conceptualize and calculate • percent composition • empirical/molecular formulas • mass, moles, and molecules relationships • molar volumes of gases	11-Stoichiometry, pp 326-344, 353-359; 14-Gases, pp 457-465 INV 11A-Stoichiometry, pp 83-86; 11B-Stoichiometry: Quantitative Precipitate, pp 87-90	pp 360-364 Q 15-21, 29, 38-66, 68, 69 pp 468-471 Q 28, 32, 60-63, 76-78, 81 LIM pp 83-90
d. Use mathematics and computational thinking to identify and solve different types of reaction stoichiometry problems (i.e., mass to moles, mass to mass, moles to moles, and percent yield) using significant figures. (*Clarification statement:* For elements c and d emphasis is on use of mole ratios to compare quantities of reactants or products and on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.)	11-Stoichiometry, pp 326-344, 353-359 INV 11A-Stoichiometry, pp 83-86; 11B-Stoichiometry: Quantitative Precipitate, pp 87-90	pp 360-364 Q 15-21, 29, 38-66, 68, 69-73, LIM pp 83-90
e. Plan and carry out an investigation to demonstrate the conceptual principle of limiting reactants.	11-Stoichiometry, pp 345-352; INV 11A-Stoichiometry, pp 83-86; 11B-Stoichiometry: Quantitative Precipitate, pp 87-90	pp 360-364 Q 7, 8, 30-37, 58-64, 66-68 LIM pp 83-90
SC4. Obtain, evaluate, and communicate information about how to refine the design of a chemical system by applying engineering principles to manipulate the factors that affect a chemical reaction.		
a. Plan and carry out an investigation to provide evidence of the effects of changing concentration, temperature, and pressure on chemical reactions. (*Clarification statement:* Pressure should not be tested experimentally.)	INV 12A-Respiration and Temperature, pp 91-94; INV 12B-Reaction Rate and Concentration, pp 95-98; INV 12C-Le Chatelier's Principle, pp	LIM pp 91-100

Georgia Science Standard	Location in Student Book	Assessment
	99-100	
b. Construct an argument using collision theory and transition state theory to explain the role of activation energy in chemical reactions. (*Clarification statement:* Reaction coordinate diagrams could be used to visualize graphically changes in energy (direction flow and quantity) during the progress of a chemical reaction.)	12-Reaction Rates and Equilibrium, pp 366-377	pp 404-407 Q 1, 3, 4, 20, 25, 28-34
c. Construct an explanation of the effects of a catalyst on chemical reactions and apply it to everyday examples	12-Reaction Rates and Equilibrium, pp 393-401	pp 404-407 Q 18, 19, 52-58
d. Refine the design of a chemical system by altering the conditions that would change forward and reverse reaction rates and the amount of products at equilibrium. (*Clarification statement:* Emphasis is on the application of LeChatelier's principle.)	12-Reaction Rates and Equilibrium, pp 378-392 INV 12C-Le Chatelier's Principle, pp 99-100	pp 404-407 Q 5-11, 35-46 LIM pp 99-100
SC5. Obtain, evaluate, and communicate information about the Kinetic Molecular Theory to model atomic and molecular motion in chemical and physical processes.		
a. Plan and carry out an investigation to calculate the amount of heat absorbed or released by chemical or physical processes. (*Clarification statement:* Calculation of the enthalpy, heat change, and Hess's Law are addressed in this element.)	INV 3A-Heat and Temperature; 3D-Heat of Fusion; 4A-Phase Changes of Water; 4B-Indicators of Chemical Reactions; 10C-Calorimetry: Hess's Law	LIM pp 23-26, 35-36, 37-42, 81-82
b. Construct an explanation using a heating curve as evidence of the effects of energy and intermolecular forces on phase changes.	3-Temperature, Energy, and Heat, pp 88-94 INV 3D-Heat of Fusion; 4A-Phase Changes of Water	pp 98-101 Q 45-47, 52, 73 LIM pp 35-38
c. Develop and use models to quantitatively, conceptually, and graphically represent the relationships between pressure, volume, temperature, and number of moles of a gas.	14-Gases, pp 440-467 INV 14A-Determination of the Molar Mass of Butane; 14B-Density of Air	pp 468-471 Q 16-31, 36-75 LIM pp 117-122
SC6. Obtain, evaluate, and communicate information about the properties that describe solutions and the nature of acids and bases.		
a. Develop a model to illustrate the process of dissolving in terms of solvation versus dissociation.	9-Water and Solutions, pp 260-265, 273-274	pp 290-293 Q 3, 7, 29-31, 38, 57, 58
b. Plan and carry out an investigation to evaluate the factors that affect the rate at which a solute dissolves in a specific solvent.	9-Water and Solutions, pp 274-276	pp 290-293 Q 47, 48, 55, 58, 72

Georgia Science Standard	Location in Student Book	Assessment
c. Use mathematics and computational thinking to evaluate commercial products in terms of their concentrations (i.e., molarity and percent by mass).	9-Water and Solutions, pp 270-272 INV 9A, Density and Concentration; 13B, Titration of Vinegar; 13C, Commercial Antacids; 13D, Determining the Amount of Vitamin C	LIM pp 67-68, 107-116
d. Communicate scientific and technical information on how to prepare and properly label solutions of specified molar concentration.	9-Water and Solutions, pp 277, 287	pp 290-293 Q 79-81,
e. Develop and use a model to explain the effects of a solute on boiling point and freezing point.	9-Water and Solutions, pp 284-286	pp 290-293 Q 59, 69, 89, 90
f. Use mathematics and computational thinking to compare, contrast, and evaluate the nature of acids and bases in terms of percent dissociation, hydronium ion concentration, and pH. (*Clarification statement:* Understanding of the mathematical relationship between negative logarithm of the hydrogen concentration and pH is not expected in this element. Only a conceptual understanding of pH as related to acid/basic conditions is needed.)	13-Acids and Bases, pp 408-426	pp 436-439 Q 2, 3, 5, 22, 25, 30-32, 41, 43, 46, 48-50-53, 63-76
g. Ask questions to evaluate merits and limitations of the Arrhenius and Bronsted-Lowry models of acid and bases.	13-Acids and Bases, pp 412-413	pp 436-439 Q 7, 10, 28, 29, 34, 36, 37, 40,
h. Plan and carry out an investigation to explore acid-base neutralization.	INV 13B, Titration of Vinegar; 13C, Commercial Antacids; 13D, Determining the Amount of Vitamin C	LIM pp 107-116