LAB-AIDS CORRELATIONS FOR THE **INDIANA 2009 CHEMISTRY** STANDARDS

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 Indiana 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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	NAC LOCATION	
STANDARD	STUDENT BOOK	LAB GUIDE
C1 Students begin to conceptualize the general structure of the atom and the roles played by the main parts of the atom in determining the properties of materials. They investigate, through such methods as laboratory work, the nature of chemical changes and the role of energy in those changes.		
C.1.1 Differentiate between pure substances and mixtures based on physical properties such as, density, melting point, boiling point, and solubility. (Core Standard)	2.1, p. 38 2.2, p. 47 2.3, p. 56-58 3.3, p. 90	2A, 2D
C.1.2 Determine the properties and quantities of matter such as mass, volume, temperature, density, melting point, boiling point, conductivity, solubility, color, numbers of moles, and pH (calculate pH from the hydrogen-ion concentration), and designate these properties as either extensive or intensive. (Core Standard)	1.1, pp. 8, 10-11 2.1, pp. 39, 45-46 3.1, pp. 72-75 3.3, p. 90 9.2, pp. 271-272 13.2, pp. 419-421	1B, 1C, 3A, 3B, 9A, 13A
C.1.3 Recognize indicators of chemical changes such as temperature change, the production of a gas, the production of a precipitate, or a color change. (Core Standard)	2.1, p. 40 4.2, p.114 10.3, pp. 308-309	4B, 10B
C.1.4 Describe solutions in terms of their degree of saturation. (Core Standard)	9.2, p. 273	9A, 9B
C.1.5 Describe solutions in appropriate concentration units (be able to calculate these units), such as molarity, percent by mass or volume, parts per million (ppm), or parts per billion (ppb). (Core Standard)	9.2, pp. 270-273	9A, 9B
C.1.6 Predict formulas of stable ionic compounds based on charge balance of stable ions. (Core Standard)	8.1, pp. 233-235	

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C.1.7 Use appropriate nomenclature when naming compounds. (Core Standard)	8.1, pp. 235-236	8B
C.1.8 Use formulas and laboratory investigations to classify substances as metal or nonmetal, ionic or molecular, acid or base, and organic or inorganic. (Core Standard)	6.1, pp.175, 177-179 8.1, pp. 233-235 13.1, pp. 410-411 17.1, pp. 536-538	6A, 6B, 8B, 3A
C.1.9 Describe chemical reactions with balanced chemical equations. (Core Standard)	10.1, pp. 299-301 10.2, pp. 302-304	10B
C.1.10 Recognize and classify reactions of various types such as oxidation-reduction. (Core Standard)	10.3, pp. 305-307 15.2, p. 478	10B
C.1.11 Predict products of simple reaction types including acid/base, electron transfer, and precipitation. (Core Standard)	10.3, pp. 307-309 13.3 pp.427-428 15.2, pp. 478-479	10B, 13B,
C.1.12 Demonstrate the principle of conservation of mass through laboratory investigations. (Core Standard)	4.2, p. 117 10.1, p. 298	11A, 11B
C.1.13 Use the principle of conservation of mass to make calculations related to chemical reactions. Calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses. (Core Standard)	4.2, pp. 116-117 11.1, pp. 328-11.1	11A, 11B
C.1.14 Use Avogadro's law to make mass-volume calculations for simple chemical reactions. (Core Standard)	11.1, pp. 328-11.12.2, pp. 53-55	11A, 11B
C.1.15 Given a chemical equation, calculate the mass, gas volume, and/or number of moles needed to produce a given gas volume, mass, and/or number of moles of product. (Core Standard)	14.3, pp. 462-465	11A, 11B
C.1.16 Calculate the percent composition by mass of a compound or mixture when given the formula. (Core Standard)	11.2, pp. 339-344	11B
C.1.17 Perform calculations that demonstrate an understanding of the relationship between molarity, volume, and number of moles of a solute in a solution. (Core Standard)	9.2, pp. 270-272	9B
C.1.18 Prepare a specified volume of a solution of given molarity. (Core Standard)	9.2, pp. 270-272	9B
C.1.19 Use titration data to calculate the concentration of an unknown solution. (Core Standard)	9.2, p. 274 13.4, p. 429	9B
C.1.20 Predict how a reaction rate will be quantitatively affected by changes of concentration.	12.1, p. 368 12.2, p. 387	12B

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C.1.21 Predict how changes in temperature, surface area, and the use of catalysts will qualitatively affect the rate of a reaction.	12.1, p. 368	12A
C.1.22 Use oxidation states to recognize electron transfer reactions and identify the substance(s) losing and gaining electrons in an electron transfer reaction. (Core Standard)	15.2, pp. 478-482	15C
C.1.23 Write a rate law for a chemical reaction using experimental data.	12.1, pp. 371-372	12B
C.1.24 Recognize and describe nuclear changes.	20.2, pp. 637-641	
C.1.25 Recognize the importance of chemical processes in industrial and laboratory settings, e.g., electroplating, electrolysis, the operation of voltaic cells, and such important applications as the refining of aluminum.	8.4, pp. 254-255 10.4, pp. 318-319 15.4, pp. 493-505 20.5, pp. 658-659	10B, 12B, 15D
C.1.26 Describe physical changes and properties of matter through sketches and descriptions of the involved materials. (Core Standard)	2.1, p. 39 16.4, pp. 525-530	2D, 16A, 16B
C.1.27 Describe chemical changes and reactions using sketches and descriptions of the reactants and products. (Core Standard)	2.2, p. 40 10.3, pp. 305-310 10.4, pp. 311-312	2B, 10B
C.1.28 Explain that chemical bonds between atoms in molecules such as H2, CH4, NH3, H2CCH2, N2, Cl2, and many large biological molecules are covalent. (Core Standard)	7.1, p. 202 7.1, pp. 205-206 17.1, pp. 538-539 18.1, pp. 570-571	7A, 7B, 17B
C.1.29 Describe dynamic equilibrium. (Core Standard)	12.1, pp. 378-383	12B
C.1.30 Perform calculations that demonstrate an understanding of the gas laws. Apply the gas laws to relations between pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases. (Core Standard)	14.2, pp. 456-465	14A, 14B
C.1.31 Use kinetic molecular theory to explain changes in gas volumes, pressure, and temperature (Solve problems using pV=nRT). (Core Standard)	14.3, pp. 462-465	
C.1.32 Describe the possible subatomic particles within an atom or ion. (Core Standard)	5.1, pp. 134-140	5A
C.1.33 Use an element's location in the Periodic Table to determine its number of valence electrons, and predict what stable ion or ions an element is likely to form in reacting with other specified elements. (Core Standard)	6.2, pp. 177-182	6A, 6B, 6C
C.1.34 Use the Periodic Table to compare attractions that atoms have for their electrons and explain periodic properties, such as atomic size, based on these attractions. (Core Standard)	6.1, pp. 172-176	6C

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C.1.35 Infer and explain physical properties of substances, such as melting points, boiling points, and solubility, based on the strength of molecular attractions. (Core Standard)	2.3, p. 58 7.1, p. 201-203 (note: physical property not specifically linked to type of bond)	7A, 7B
C.1.36 Describe the nature of ionic, covalent, and hydrogen bonds, and give examples of how they contribute to the formation of various types of compounds. (Core Standard)	7.1, pp.198-203 9.1, pp. 263-264	7A, 7B
C.1.37 Describe that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship (E=hv).	5.2, p. 146 5.4, p. 159	5B, 5C
C.1.38 Distinguish between the concepts of temperature and heat. (Core Standard)	3.1, pp. 73-74 3.2, p. 79	3A, 3B, 3C
C.1.39 Solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change. (Core Standard)	3.2, pp. 83-86 3.3, pp. 88-91	3B, 3C
C.1.40 Classify chemical reactions and/or phase changes as exothermic or endothermic. (Core Standard)	10.4, pp. 311-313	10B, 10C
C.1.41 Describe the role of light, heat, and electrical energies in physical, chemical, and nuclear changes.	10.4, pp. 311-313 20.4, pp. 647-651	10B
C.1.42 Describe that the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E=mc2) is small but significant in nuclear reactions.	20.4, pp. 652-655	
C.1.43 Calculate the amount of radioactive substance remaining after an integral number of half-lives have passed. (Core Standard)	20.3, pp. 643-644	20A
C.1.44 Convert between formulas and names of common organic compounds. (Core Standard)	17.1, pp. 538-543 17.2, pp. 547-553	17B
C.1.45 Recognize common functional groups and polymers when given chemical formulas and names. (Core Standard)	17.1, pp. 538-543 17.2, pp. 547-553	17B
Historical Perspectives of Chemistry C.2 Students gain understanding of how the scientific enterprise operates through examples of historical events. Through the study of these events, students understand that new ideas are limited by the context in which they are conceived, that these ideas are often rejected by the scientific establishment, that these ideas sometimes spring from unexpected findings, and that these ideas grow or transform slowly through the contributions of many different investigators.		

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C.2.1 Explain that Antoine Lavoisier invented a whole new field of science based on a theory of materials, physical laws, and quantitative methods, with the conservation of matter at its core. Recognize that he persuaded a generation of scientists that his approach accounted for the experimental results better than other chemical systems.	Not covered	
C.2.2 Describe how Lavoisier's system for naming substances and describing their reactions contributed to the rapid growth of chemistry by enabling scientists everywhere to share their findings about chemical reactions with one another without ambiguity.	Not covered	
C.2.3 Explain that John Dalton's modernization of the ancient Greek ideas of element, atom, compound, and molecule strengthened the new chemistry by providing physical explanations for reactions that could be expressed in quantitative terms.	5.1, p. 135	
C.2.4 Explain how Frederich Wohler's synthesis of the simple organic compound urea from inorganic substances made it clear that living organisms carry out chemical processes. Describe how this discovery led to the development of the huge field of organic chemistry, and the industries based on it, and eventually to the field of biochemistry.	Not covered	
C.2.5 Explain how Arrhenius' discovery of the nature of ionic solutions contributed to the understanding of a broad class of chemical reactions. (Core Standard)	13.1, p. 412	
C.2.6 Explain that the appreciation of the laws of quantum mechanics to chemistry by Linus Pauling and others made possible an understanding of chemical reactions on the atomic level.	5.2, pp. 144-150	6C
C.2.7 Describe how the discovery of the structure of DNA by James D. Watson and Francis Crick made it possible to interpret the genetic code on the basis of a sequence of "letters."	18.4, pp. 594-497	