



## North Carolina Essential Standards Chemistry

The North Carolina Science Essential Standards maintain the respect for local control of each Local Education Authority (LEA) to design the specific curricular and instructional strategies that best deliver the content to their students. Nonetheless, engaging students in inquiry-based instruction is a critical way of developing conceptual understanding of the science content that is vital for success in the twenty-first century. The process of scientific inquiry, experimentation and technological design should not be taught nor tested in isolation of the core concepts drawn from physical science, earth science and life science. A seamless integration of science content, scientific inquiry, experimentation and technological design will reinforce in students the notion that "what" is known is inextricably tied to "how" it is known. A well-planned science curriculum provides opportunities for inquiry, experimentation and technological design. Teachers, when teaching science, should provide opportunities for students to engage in "hands-on/minds-on" activities that are exemplars of scientific inquiry, experimentation and technological design.

### Science as Inquiry

Traditional laboratory experiences provide opportunities to demonstrate how science is constant, historic, probabilistic, and replicable. Although there are no fixed steps that all scientists follow, scientific investigations usually involve collections of relevant evidence, the use of logical reasoning, the application of imagination to devise hypotheses, and explanations to make sense of collected evidence. Student engagement in scientific investigation provides background for understanding the nature of scientific inquiry. In addition, the science process skills necessary for inquiry are acquired through active experience. The process skills support development of reasoning and problem-solving ability and are the core of scientific methodologies.

## Matter: Properties and Change

|                | Essential Standard   | Clarifying Objectives |  |
|----------------|--|-----------------------|--|
| <b>Chm.1.1</b> | <b>Analyze the structure of atoms and ions.</b>  | Chm.1.1.1             | Analyze the structure of atoms, isotopes, and ions.  |
|                |  | Chm.1.1.2             | Analyze an atom in terms of the location of electrons.   |
|                |  | Chm.1.1.3             | Explain the emission of electromagnetic radiation in spectral form in terms of the Bohr model. |
|                |  | Chm.1.1.4             | Explain the process of radioactive decay by the use of nuclear equations and half-life.        |
| <b>Chm.1.2</b> | <b>Understand the bonding that occurs in simple compounds in terms of bond type, strength, and properties.</b> | Chm.1.2.1             | Compare (qualitatively) the relative strengths of ionic, covalent, and metallic bonds.         |
|                |  | Chm.1.2.2             | Infer the type of bond and chemical formula formed between atoms.                              |
|                |  | Chm.1.2.3             | Compare inter- and intra- particle forces.   |
|                |  | Chm.1.2.4             | Interpret the name and formula of compounds using IUPAC convention.                            |
|                |  | Chm.1.2.5             | Compare the properties of ionic, covalent, metallic, and network compounds.                    |

|                | Essential Standard   | Clarifying Objectives |  |
|----------------|--|-----------------------|--|
| <b>Chm.1.3</b> | <b>Understand the physical and chemical properties of atoms based on their position in the Periodic Table.</b> | Chm.1.3.1             | Classify the components of a periodic table (period, group, metal, metalloid, nonmetal, transition).   |
|                |  | Chm.1.3.2             | Infer the physical properties (atomic radius, metallic and nonmetallic characteristics) of an element based on its position on the Periodic Table. |
|                |  | Chm.1.3.3             | Infer the atomic size, reactivity, electronegativity, and ionization energy of an element from its position in the Periodic Table.                 |

### Energy: Conservation and Transfer

|                | Essential Standard   | Clarifying Objectives |   |
|----------------|--|-----------------------|---|
| <b>Chm.2.1</b> | <b>Understand the relationship among pressure, temperature, volume, and phase.</b>       | Chm.2.1.1             | Explain the energetic nature of phase changes.  |
|                |  | Chm.2.1.2             | Explain heating and cooling curves (heat of fusion, heat of vaporization, heat, melting point, and boiling point).  |
|                |  | Chm.2.1.3             | Interpret the data presented in phase diagrams.   |
|                |  | Chm.2.1.4             | Infer simple calorimetric calculations based on the concepts of heat lost equals heat gained and specific heat.   |
|                |  | Chm.2.1.5             | Explain the relationships between pressure, temperature, volume, and quantity of gas both qualitative and quantitative.   |
| <b>Chm.2.2</b> | <b>Analyze chemical reactions in terms of quantities, product formation, and energy.</b> | Chm.2.2.1             | Explain the energy content of a chemical reaction.  |
|                |  | Chm.2.2.2             | Analyze the evidence of chemical change.  |
|                |  | Chm.2.2.3             | Analyze the law of conservation of matter and how it applies to various types of chemical equations (synthesis, decomposition, single replacement, double replacement, and combustion). |
|                |  | Chm.2.2.4             | Analyze the stoichiometric relationships inherent in a chemical reaction.   |
|                |  | Chm.2.2.5             | Analyze quantitatively the composition of a substance (empirical formula, molecular formula, percent composition, and hydrates).  |

## Interactions of Energy and Matter

|                | Essential Standard   | Clarifying Objectives |  |
|----------------|--|-----------------------|--|
| <b>Chm.3.1</b> | <b>Understand the factors affecting rate of reaction and chemical equilibrium.</b> | Chm.3.1.1             | Explain the factors that affect the rate of a reaction (temperature, concentration, particle size and presence of a catalyst). |
|                |  | Chm.3.1.2             | Explain the conditions of a system at equilibrium.   |
|                |  | Chm.3.1.3             | Infer the shift in equilibrium when a stress is applied to a chemical system (Le Chatelier's Principle).                       |
| <b>Chm.3.2</b> | <b>Understand solutions and the solution process.</b>                              | Chm.3.2.1             | Classify substances using the hydronium and hydroxide ion concentrations.  |
|                |  | Chm.3.2.2             | Summarize the properties of acids and bases.   |
|                |  | Chm.3.2.3             | Infer the quantitative nature of a solution (molarity, dilution, and titration with a 1:1 molar ratio).                        |
|                |  | Chm.3.2.4             | Summarize the properties of solutions.   |
|                |  | Chm.3.2.5             | Interpret solubility diagrams.   |
|                |  | Chm.3.2.6             | Explain the solution process.  |