Kentucky Program of Studies (2006)
Selected Standards Relating to Content Covered in Chemistry

Scientific Ways of Thinking and Working

S-HS-SI-1
Students will identify and refine questions and identify scientific concepts to guide the design of scientific investigations.

S-HS-SI-2
Students will design and conduct different kinds of scientific investigations for a wide variety of reasons.

S-HS-SI-3
Students will use equipment (e.g., microscopes, lasers), tools (e.g., beakers), techniques (e.g., microscope skills), technology (e.g., computers), and mathematics to improve scientific investigations and communications.

S-HS-SI-4
Students will use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.

S-HS-SI-5
Students will communicate designs, procedures, and results of scientific investigations.

S-HS-SI-6
Students will review and analyze scientific investigations and explanations of others.

Physical Science

Conceptual Understandings
Patterns, Systems, Scale and Models, Constancy, and Change Over Time

Structure of Atoms

S-HS-PS-1
Students will analyze atomic structure and electric forces.

S-HS-PS-2
Students will examine nuclear structure, nuclear forces, and nuclear reactions (e.g., fission, fusion, radioactivity).

Structure and Properties of Matter

S-HS-PS-3
Students will investigate how the structure of matter (e.g., outer electrons, type of bond) relates to chemical properties of matter.

S-HS-PS-4
Students will investigate how the structure of matter (e.g., constituent atoms, distances and angles between atoms) relates to physical properties of matter.

Chemical Reactions

S-HS-PS-5
Students will investigate chemical reactions and the release or consumption of energy.

S-HS-PS-6
Students will examine the transfer of electrons or hydrogen ions between reacting ions, molecules, or atoms.

S-HS-PS-7
Students will investigate factors (e.g., temperature, catalysts) affecting reaction rates.

Conservation of Energy and the Increase in Disorder

S-HS-PS-10
Students will examine how energy is transferred (e.g., collisions, light waves) and recognize that the total energy of the universe is constant.

S-HS-PS-11
Students will distinguish between types of energy (e.g., kinetic energy, potential energy, energy fields).

S-HS-PS-12
Students will examine how everything tends to become less organized and less orderly over time (e.g., heat moves from hotter to cooler objects).

Kentucky Core Content for Assessment Version 4.1
Selected Standards Relating to Content Covered in Chemistry

SC-HS-1.1.1 **Students will classify or make generalizations about elements from data of observed patterns in atomic structure and/or position on the periodic table.** **The periodic table is a consequence of the repeating pattern of outermost electrons.** **DOK 2**
SC-HS-1.1.2 *Students will understand that the atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of*

neutrons, these atoms are called different isotopes of the element.
SC-HS-1.1.3 *Students will understand that solids, liquids and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart. The behavior of gases and the relationship of the variables influencing them can be described and predicted.*
SC-HS-1.1.4 *Students will understand that in conducting materials, electrons flow easily; whereas, in insulating materials, they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures, some materials become superconductors and offer no resistance to the flow of electrons.*
SC-HS-1.1.5 **Students will explain the role of intermolecular or intramolecular interactions on the physical properties (solubility, density, polarity, conductivity, boiling/melting points) of compounds.** **The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms.** **DOK 2**
SC-HS-1.1.6 **Students will:** **identify variables that affect reaction rates;** **predict effects of changes in variables (concentration, temperature, properties of reactants, surface area and catalysts) based on evidence/data from chemical reactions.** **Rates of chemical reactions vary. Reaction rates depend on concentration, temperature and properties of reactants. Catalysts speed up chemical reactions.** **DOK 3**
SC-HS-1.1.7 **Students will:** **construct diagrams to illustrate ionic or covalent bonding;** **predict compound formation and bond type as either ionic or covalent (polar, nonpolar) and represent the products formed with simple chemical formulas.** **Bonds between atoms are created when outer electrons are paired by being transferred (ionic) or shared (covalent). A compound is formed when two or more kinds of atoms bind together chemically.** **DOK 2**
SC-HS-1.1.8 **Students will:** **explain the importance of chemical reactions in a real-world context;** **justify conclusions using evidence/data from chemical reactions.** **Chemical reactions (e.g., acids and bases, oxidation, combustion of fuels, rusting, tarnishing) occur all around us and in every cell in our bodies. These reactions may release or absorb energy.** **DOK 3**
SC-HS-4.6.1

Students will:
explain the relationships and connections between matter, energy, living systems and the physical environment;
give examples of conservation of matter and energy.
As matter and energy flow through different organizational levels (e.g., cells, organs, organisms, communities) and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.
DOK 3

SC-HS-4.6.2
Students will:
predict wave behavior and energy transfer;
apply knowledge of waves to real life phenomena/investigations.
Waves, including sound and seismic waves, waves on water and electromagnetic waves, can transfer energy when they interact with matter. Apparent changes in frequency can provide information about relative motion.
DOK 3

SC-HS-4.6.3
Students will understand that electromagnetic waves, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays and gamma rays result when a charged object is accelerated.

SC-HS-4.6.4
Students will:
describe the components and reservoirs involved in biogeochemical cycles (water, nitrogen, carbon dioxide and oxygen);
explain the movement of matter and energy in biogeochemical cycles and related phenomena.
The total energy of the universe is constant. Energy can change forms and/or be transferred in many ways, but it can neither be created nor destroyed. Movement of matter between reservoirs is driven by Earth's internal and external sources of energy. These movements are often accompanied by a change in physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide and in all organisms as complex molecules that control the chemistry of life.
DOK 3

SC-HS-4.6.5
Students will describe and explain the role of carbon-containing molecules and chemical reactions in energy transfer in living systems.
Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to break weaker bonds in reactants (such as carbon dioxide and water) in chemical reactions that result in the formation of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy released when these molecules react with oxygen to form very strong bonds can be used as sources of energy for life processes.
DOK 3

SC-HS-4.6.6
Students will understand that heat is the manifestation of the random motion and vibrations of

atoms.
SC-HS-4.6.7 **Students will:** **explain real world applications of energy using information/data;** **evaluate explanations of mechanical systems using current scientific knowledge about energy.** **The universe becomes less orderly and less organized over time. Thus, the overall effect is that the energy is spread out uniformly. For example, in the operation of mechanical systems, the useful energy output is always less than the energy input; the difference appears as heat.** **DOK 2**
SC-HS-4.6.11 **Students will:** **explain the difference between alpha and beta decay, fission and fusion;** **identify the relationship between nuclear reactions and energy.** **Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission (alpha and beta decay) is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the Sun and other stars.** **DOK 2**