ARKANSAS
K-12 SCIENCE STANDARDS
EDUCATION FOR A NEW GENERATION

Accelerated Science Course Pathway

Chemistry - Integrated

2016

Table of Contents

Notes:

1. This is a companion document and instructors are to use the Arkansas K-12 Science Standards for Grades 5-8 document to guide curriculum development.
2. Student Performance Expectations (PEs) or standards may be taught in any sequence or grouping within a grade level. Several PEs are described as being "partially addressed in this course" because the same PE is revisited in a subsequent course during which that PE is fully addressed.
3. An asterisk (*) indicates an engineering connection to a practice, core idea, or crosscutting concept.
4. The clarification statements are examples and additional guidance for the instructor. AR indicates Arkansas-specific clarification statements.
5. The assessment boundaries delineate content that may be taught but not assessed in large-scale assessments. AR indicates Arkansas-specific assessment boundaries.

6. The examples given (e.g.,) are suggestions for the instructor.

Accelerated Science Course Pathway Overview

Arkansas Accelerated Science Course Pathway allows districts and schools an **option** to maximize opportunities for high-performing students to meet the Arkansas K-12 Science Standards as well as be prepared to pursue advanced level science courses earlier in middle and high school and at a more rapid pace. This accelerated science course pathway is not intended for all students, but for students who have demonstrated advanced academic proficiency in the prerequisite courses and who intend to pursue a specific college and career pathway beyond high school.

Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their understanding of mathematics. To achieve this alignment, the Arkansas K-12 Science Committee made every effort to ensure that the mathematics standards do not outpace or misalign to the accelerated pathway courses. If this pathway is implemented, it is recommended that a unit of algebra I be earned concurrently with a unit of accelerated physical science-integrated, which requires a Grades 5-8 course approval for both the algebra I and the accelerated physical science-integrated course from the Arkansas Department of Education. Arkansas Accelerated Science Course Pathway details the following optional accelerated courses.

Accelerated Grade 6 Science	Course is an integration of 6th, 7th, and 8th Grade life science, Earth and space science, physical science, and engineering design standards.
Accelerated Grade 7 Science	Course is an integration of 6th, 7th, and 8th Grade life science, Earth and space science, physical science, and engineering design standards.
Accelerated Grade 8/Physical Science - Integrated	Course is an integration of the balance of 8th Grade physical science standards not mapped in the accelerated 6th and 7th Grade models and the high school physical science - integrated standards. *(5-8 course approval for physical science- integrated required)
Accelerated Biology - Integrated	Course is an integration of the biology - integrated standards with additional life science standards and clarification statements written by the Arkansas K-12 Science Committee.
Accelerated Chemistry - Integrated	Course is an integration of the chemistry - integrated course standards with additional chemistry standards and clarification statements written by the Arkansas K-12 Science Committee.

* A course approval for Grades 5-8 is necessary for a high school course to be taught at the middle school level. Teachers must hold the appropriate 7-12 licensure. Contact the ADE Curriculum Support Services unit for more details.

Accelerated Chemistry - Integrated

Accelerated Chemistry - Integrated Learning Progression Chart

Topic 1: Matter and Chemical Reactions	Topic 2: Nuclear Reactions	Topic 3: Energy Flow	Topic 4: Waves	Topic 5: Forces	Topic 6: Behavior of Gases
AR ACI-PS1-1	ACI-PS1-8	ACI-PS1-4	AR ACI-PS4-1	AR ACI-PS2-1	ACI-PS6-1AR
ACI-PS1-1AR	ACI -ESS1-1	ACI-PS1-5	ACI-PS4-3	ACI-PS2-2	AR ACI6-ETS1-2
AR ACI-PS1-2	ACI-ESS1-3	AR ACI-PS3-1	ACI-PS4-4	ACI-PS2-4	AR ACI6-ETS1-4
AR ACI-PS1-3	ACI-ESS1-6	ACI-ESS1-2	ACI-PS4-5	ACI-PS3-5	
ACI-PS1-6	AR ACI2-ETS1-1	ACI-ESS2-3	AR ACI4-ETS1-4	ACI-ESS1-4	
AR ACI-PS1-7	AR ACI2-ETS1-2	AR ACI-ESS3-4		AR ACI-ESS1-5	
ACI-ESS2-5	AR ACI2-ETS1-3	AR ACI3-ETS1-1		AR ACI5-ETS1-2	
AR ACI1-ETS1-2	AR ACI2-ETS1-4				

Arkansas Clarification Statements/Assessment Boundaries (AR)

Arkansas Performance Expectation (AR)

Accelerated Chemistry - Integrated Overview

Accelerated chemistry - integrated is a course composed of the chemistry - integrated course standards with additional chemistry standards and clarification statements written by the Arkansas K-12 Science Committee.

The performance expectations in **Topic 1: Matter and Chemical Reactions** help students answer these questions:

- How can the structure and properties of matter be explained?
- How do substances combine or change (react) to make new substances?
- How can patterns be used to characterize and predict chemical reactions?

Students develop an understanding of the substructure of atoms and provide more mechanistic explanations of the properties of substances. Students learn how to use the periodic table as a tool to explain and predict the properties of elements. Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Using this expanded knowledge of chemical reactions, students are able to explain important biological and geophysical phenomena. Students apply an understanding of the process of optimization in engineering design to chemical reaction systems.

One performance expectation was written (ACI-PS1-1AR) and clarification statements (ACI-PS1-1, ACI-PS1-2,   ACI-PS1-3, and ACI-PS1-7) were revised to emphasize concepts of matter and chemical reactions. Emphasis is on stoichiometry with limiting reactants, net ionic equations, chemical analysis in the context of percent composition, empirical and molecular formulas, chemical nomenclature, and constructing particulate diagrams illustrating intermolecular forces.

The performance expectations in **Topic 2: Nuclear Reactions** help students answer these questions:

- How do nuclear reactions differ from chemical reactions?
- What nuclear processes are associated with stars?
- How do nuclear reactions differ from chemical reactions?
- How are elements transformed through nuclear processes?

Students develop an understanding of the formation and abundance of elements, radioactivity, the release of energy from the sun and other stars, and the generation of nuclear power.

The performance expectations in **Topic 3: Energy Flow** help students answer these questions:

- How does energy flow in a system?
- How is energy transferred?
- How is energy conserved?
- How does energy flow in a system?

This topic is organized into four ideas: definitions of energy, conservation of energy and energy transfer, the relationship between energy and forces, and energy in chemical process and everyday life. Students develop an understanding of energy as a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. The total change of energy in any system is always equal to the total energy transferred into or out of the system. Students develop an understanding that energy at both the macroscopic and the atomic scale can be accounted for as either motions of particles or energy associated with the configuration (relative positions) of particles. In some cases, the energy associated with the configuration of particles can be thought of as stored in fields. Additionally, students explore energy interactions associated with geologic processes such as plate tectonics, seismic waves, and convection. Students demonstrate understanding of engineering principles by designing, building, and refining devices associated with the conversion of energy.

The performance expectations in **Topic 4: Waves** help students answer these questions:

- How do the properties of waves affect their function?
- How are waves used to transfer energy?
- How are waves used to send and store information?
- What is the interact between electromagnetic radiation and matter?

This topic is organized into three ideas: wave properties, electromagnetic radiation, and information technologies/instrumentation. Students develop an understanding of how wave properties and the interactions of electromagnetic radiation with matter can transfer information across long distances, store information, and be used to investigate nature on many scales. Models of electromagnetic radiation as either a wave of changing electric/magnetic fields and/or as particles are developed and used. Students understand that combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. Students demonstrate understanding of engineering ideas by presenting information about how technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

The performance expectations in **Topic 5: Forces** help students answer these questions:

- How do forces cause microscopic to macroscopic changes?
- How can one explain and predict interactions between objects and within systems of objects?
- How do intermolecular forces determine properties such as melting point, boiling point, vapor pressure, and surface tension?
- How does the net momentum of particles on the microscale relate to Kinetic Molecular Theory?
- How can forces and momentum be modeled mathematically?

This topic is organized into two ideas: forces and motion as well as types of interactions. Students are expected to develop an understanding of forces and interactions as they are described by Newton's laws. Students develop an understanding that the total momentum of a system of objects is conserved when there is no net force on the system. Students use Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. Students apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

The performance expectations in **Topic 6: Behavior of Gases** help students answer these questions:

- How does the volume of a given mass of a gas relate to the pressure?
- What ideal gas laws can be applied to the engineering design of automobile airbags?

One performance expectation (ACI-PS6-1AR) was written to emphasize concepts related to the behavior of gases.

Topic 1: Matter and Chemical Reactions

ACI-PS1-1 **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.** [AR Clarification Statement: This PE is fully addressed in this course. Examples of properties predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [AR Assessment Boundary: Assessment is limited to main group elements. Assessment does not include exceptions to periodic trends.]

ACI-PS1-1AR **Construct and revise models representing coulombic interactions among molecular electron domains that produce stable molecular arrangements.** [Clarification Statement: Emphasis is on constructing Lewis structures, identifying atomic hybridization (sp, sp2, sp3), applying VSEPR theory to assign molecular geometry (trigonal planar, trigonal pyramidal, tetrahedral), and determining molecular polarity in the context of adding/canceling bond dipoles.]

ACI-PS1-2 **Construct and revise 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.** [AR Clarification Statement: This PE is fully addressed in this course. Examples of chemical reactions could include the reaction of sodium and chlorine, carbon and oxygen, and carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

ACI-PS1-3 **Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.** [AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on the strengths of forces between particles, including identifying and naming specific intermolecular forces (dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

ACI-PS1-6 **Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*** [Clarification Statement: Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.]

ACI-PS1-7 **Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.** [AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on demonstrating conservation of mass through the mole concept and stoichiometry. Emphasis is on assessing students' use of mathematical thinking, not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

ACI-ESS2-5 **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.** [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

ACI1-ETS1-2 **Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.** [AR Clarification Statement: Examples of real-world problems could include wastewater treatment, production of biofuels, and the impact of heavy metals or phosphate pollutants on the environment.]

The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.

Topic 2: Nuclear Reactions
Students who demonstrate understanding can: **ACI-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.** [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.] **ACI-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.** [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.] **ACI-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements.** [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.] **ACI-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.** [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.] **ACI2-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.** [AR Clarification Statement: Emphasis is on the specific needs and constraints involved with power generation.] **ACI2-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.** [AR Clarification Statement: Emphasis is on nuclear power management.] **ACI2-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.** [AR Clarification Statement: Emphasis is on the relationship between nuclear fission and fusion.] **ACI2-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.** [AR Clarification Statement: Examples could include nuclear weapons and nuclear medicine (radioisotopes or radiation therapy). Examples of possible computer simulations could include PhET.]
The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.

Accelerated Chemistry - Integrated

Topic 3: Energy Flow

Students who demonstrate understanding can:

ACI-PS1-4 **Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.** [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

ACI-PS1-5 **Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.** [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

ACI-PS3-1 **Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.** [AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on explaining the meaning of mathematical expressions used in the model.] [AR Assessment Boundary: Assessment is limited to systems of two or three components and to thermal energy, kinetic energy, and the energies in gravitational, magnetic, or electric fields.]

ACI-ESS1-2 **Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.** [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]

ACI-ESS2-3 **Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.** [Clarification Statement: Emphasis is on both a one dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.]

ACI-ESS3-4 **Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*** [AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on the impacts of human activities on physical systems. Examples of data on the impacts of human activities could include the quantities and types of pollutants released (fertilizer, surface mining, and nuclear byproducts). Examples for limiting future impacts could range from local efforts (reducing, reusing, and recycling resources) to large-scale engineering design solutions (nuclear power, photovoltaic cells, wind power, and water power).]

ACI3-ETS1-1 **Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.** [AR Clarification Statement: Examples of the applications could include renewable energy resources (solar cells and wind farms), the Haber process for the production of fertilizers, and increased fuel efficiency of combustion engines.]

The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.

Topic 4: Waves	
Students who demonstrate understanding can:	
ACI-PS4-1	**Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** [AR Clarification Statement: This PE is fully addressed in this course. Examples of data could include electromagnetic radiation traveling in a vacuum and glass as well as seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]
ACI-PS4-3	**Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.** [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]
ACI-PS4-4	**Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.** [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.]
ACI-PS4-5	**Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*** [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]
ACI4-ETS1-4	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.** [AR Clarification Statement: Examples could include information transfer using fiber optics, radio waves, and medical imaging.]
The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.	

Topic 5: Forces
Students who demonstrate understanding can: **ACI-PS2-1** **Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.** [AR Clarification Statement: This PE is fully addressed in this course. Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force (a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force).] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.] **ACI-PS2-2** **Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.** [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.] **ACI-PS2-4** **Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.** [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.] **ACI-PS3-5** **Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.** [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.] **ACI-ESS1-4** **Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.** [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's laws of orbital motions should not deal with more than two bodies, nor involve calculus.] **ACI-ESS1-5** **Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.** [AR Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal (continental and oceanic) rocks. Examples could include evidence of the ages of oceanic crust (lithosphere that includes crust and upper mantle and the asthenosphere) increasing with distance from mid-ocean ridges (a result of divergent boundaries/plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).] **ACI5-ETS1-2** **Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.** [AR Clarification Statement: Examples of solutions could include satellite deployment, airbag design, gravity assist, sports safety, and elevators.]
The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.

Topic 6: Behavior of Gases
Students who demonstrate understanding can: **ACI-PS6-1AR** **Use mathematical representations to support the kinetic molecular relationships between pressure, volume and temperature of a gas sample.** [AR Clarification: Emphasis is on qualitative predictions and calculations involving the ideal gas law given changes in pressure, volume, temperature, and mass of a gas sample.] **ACI6-ETS1-2** **Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.** [AR Clarification: Solutions could include student-designed simulated airbags with a weak acid and a strong base using the ideal gas law.] **ACI6-ETS1-4** **Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.** [AR Clarification: Examples of possible computer simulations could include PhET.]
The performance expectations above were rearranged using the Arkansas K-12 Science Standards for Chemistry - Integrated.