Broken Arrow Public Schools
Physical Science Instructional Sequence

Fall Semester - Chemistry Concepts

Standard Bundles	Performance Expectations	OSDE Assessment Boundaries
Unit 1 (Instructional Days: 30) Atomic Properties & the Periodic Table ***Essential Skill - Patterns****:* *Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*	HS-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.	Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Assessment is limited to main group elements. Assessment does **not** include quantitative understanding of ionization energy beyond relative trends.
	HS-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, knowledge of the patterns of chemical properties, and formation of compounds.	Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale (e.g. Law of Conservation of Mass). Assessment is limited to chemical reactions involving main group elements and combustion reactions.
Unit 2 (Instructional Days: 30) Properties of Chemical Reactions & Conservation of Energy ***Essential Skill - Patterns****:* *Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.*	HS-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.	Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature and concentration.
Essential Skill - Energy & Matter*:* *The total amount of energy and matter in closed systems is conserved.*	HS-PS1-7: Use mathematical representation to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale (e.g. Law of Conservation of Mass). Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques. Assessment does **not** include complex chemical reactions.

Broken Arrow Public Schools
Physical Science Instructional Sequence

Fall Semester - Waves

Standard Bundles	Performance Expectations	OSDE Assessment Boundaries
Unit 3 (Instructional Days: 15) The Use of Electromagnetism & Its Effect on the Biosphere ***Essential Skill - Cause & Effect**: Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.*	HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth. Assessment is limited to algebraic relationships and describing those relationships **qualitatively**.
***Essential Skill - Stability & Change**: Systems can be designed for greater or lesser stability.*	HS-PS4-2: Evaluate questions about the advantages and disadvantages of using a digital transmission and storage of information.	Examples of advantages could include the digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, & theft.
***Essential Skill - Cause & Effect**: Cause and effect relationships can be suggested and predicted for complex natural and human-designed systems by examining what is known about smaller scale mechanisms within the system.*	HS-PS4-4: Evaluate the validity & reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed my matter.	Emphasis is on the idea that 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.

Broken Arrow Public Schools
Physical Science Instructional Sequence

Spring Semester - Physics of Motion

Standard Bundles	Performance Expectations	OSDE Assessment Boundaries
Unit 4 (Instructional Days: 25) Momentum ***Essential Skill - Cause & Effect***: *Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.*	HS-PS2-1: Analyze data and use it 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.	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, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
Essential Skill - Systems & System Models: *When investigating or describing a system the boundaries and initial conditions of the system need to be defined.*	HS-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.	Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Assessment is limited to systems of two macroscopic bodies moving in one dimension.
Essential Skill - Cause & Effect: *Systems can be designed to cause a desired effect.*	HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision	Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. Assessment is limited to qualitative evaluations and/or algebraic manipulations.
Unit 5 (Instructional Days: 25) Acceleration and Things that Cause Acceleration ***Essential Skill - Cause & Effect***: *Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.*	HS-PS2-1: Analyze data and use it 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.	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, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.
Essential Skill - Cause & Effect: *Systems can be designed to cause a desired effect.*	HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	Assessment is limited to designing and conducting investigations with provided materials and tools.

Broken Arrow Public Schools
Physical Science Instructional Sequence

Spring Semester - Physics of Energy

Unit 6 (Instructional Days: 20) Defining & Calculating Energy ***Essential Skill - Systems and System Models:*** *Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.*	HS-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.	Emphasis is on explaining the meaning of mathematical expressions used in the model. Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and potential energy.
Essential Skill - Energy & Matter: *Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.*	HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.	Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models include diagrams, drawings, descriptions, and computer simulations. Assessment does **not** include quantitative calculations.
Unit 7 (Instructional Days: 20) The Use of Energy, Its Conservation, and Equilibrium ***Essential Skill - Energy & Matter:*** *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*	HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.
Essential Skill - System & System Models: *When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.*	HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).	Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water. Assessment is limited to investigations based on materials and tools provided to students.