Matter and Energy

All students will measure and describe the things around us:

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
MATTER	**KC:** Risk/benefit analysis. **RWC:** Herbicides, refrigerants, fertilizers, detergents. **KC:** Properties— state, reactivity, metal/non-metal, conductivity. **RWC:** Highly reactive metals (such as potassium, sodium), less-reactive metals (such as calcium), highly reactive nonmetals (such as chlorine, fluorine, and oxygen), almost completely nonreactive gases (such as helium and neon); relationships on the Periodic Table of Elements.	**IV.1.HS.1:** Analyze properties of common household and agricultural materials in terms of risk/benefit balance. **IV.1.HS.2:** Identify properties of common families of elements.		Various element samples.
All students will explain what the world around us is made of:				
MATTER	**KC:** Parts of atoms— nucleus, electron cloud. Subatomic particles— proton, neutron, electron. Electrical charges— positive, negative, neutral. Each element has a unique number of protons. See PMO m-3 (electric force). **RWC:** All elements.	**IV.1.HS.3:** Explain how elements differ, in terms of the structural parts and electrical charges of atoms.		
All students will explain how electricity (and magnetism; see PMO) interact with water:				
ELECTRICITY AND MAGNETISM	**KC:** Single path, multiple paths, switches, fuses, circuit breakers, power supply, batteries, household current, motors, bulbs, circuit diagrams. **RWC:** Basic household wiring, automobile wiring, flashlights, tree lights, power lines; electrical conductivity testing. **KC:** Current flow and direction, magnetic fields. See PMO m-4 (magnetism from electricity). **RWC:** Generators, alternating current, direct current.	**IV.1.HS.4:** Explain how current is controlled in simple series and parallel circuits. **IV.1.HS.5:** Describe how electric currents can be produced by interacting wires and magnets, and explain applications of this principle.		

Changes in Matter

All students will explain how visible changes in matter are related to atoms and molecules:

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
CHANGES IN MATTER	**KC:** Atom, molecule, ion, bond, reactant, product; conservation of mass; rate of reaction— temperature, surface area, concentration; specific chemical reactions— burning paper or wood, rusting iron, formation of sugars during photosynthesis. See PME h-3 (structure of the atom). **RWC:** Examples of chemical changes— see PME m-2.	**IV.2.HS.1:** Explain chemical changes in terms of the breaking of bonds and the rearrangement of atoms to form new substances.		
	KC: Atom, molecule, mass. **RWC:** Common physical and chemical changes, including matter cycles in ecosystems.	**IV.2.HS.2:** Explain why mass is conserved in physical and chemical changes.		
	KC: Nucleus, nuclear change, force that hold nucleus together, nuclear energy. Stable and unstable isotopes. Properties— mass, element, radioactivity. See PME h-3 (structure of the atom). **RWC:** Nuclear power plants, nuclear energy from sun, natural radioactive decay, use of radiation and radioactive isotopes in medicine.	**IV.2.HS.3:** Contrast nuclear fission, nuclear fusion, and natural radioactivity.		
All students will explain how changes in matter are related to changes in energy and how living things and human technology change matter and transform energy:				
CHANGES IN MATTER	**KC:** Potential energy, kinetic energy, heat, light, electrical energy, chemical energy, sound; temperature changes. Original sources of energy: sun, radioactivity. Conservation of energy, conservation of mass/energy; $E=mc^2$. See PCM m-4 (common energy transformations), PCM h-3 (nuclear changes). **RWC:** Common physical, chemical and nuclear changes, including changes of state, burning, electrical decomposition of water, photosynthesis, cellular respiration, fireworks and dynamite, nuclear power, stars.	**IV.2.HS.4:** Describe energy transformations involved in physical, chemical and nuclear changes, and contrast their relative magnitudes.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	KC: Mechanisms of heat transfer—convection, conduction, radiation. Conservation of energy, efficiency. Changes in matter related to heat transfer— changes in temperature, volume, pressure. See PCM m-1 (thermal expansion), EAW h-3 (convection). **RWC:** Convection currents, lake turnover, wind, hot frying pans, heating and cooling buildings, heat lamps, sunlight heating the earth, greenhouse effect, fires for warming.	**IV.2.HS.5:** Explain changes in matter and energy involving heat transfer.		

Motion of Objects

All students will describe how things around us move, explain why things move as they do, and demonstrate and explain how we control the motion of objects:

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
MOTION OF OBJECTS	**KC:** Electrical and/or mechanical components of complex machines. **RWC:** Machines, such as bicycles, automobiles, pumps, electrical motors.	**IV.3.HS.1:** Analyze patterns of force and motion in the operation of complex machines.		
All students will relate motion to energy and energy conversions:				
	KC: Types of energy— electrical energy, kinetic energy, gravitational potential energy, potential energy in springs, chemical potential energy, heat energy, radiation. Energy transformations— see PCM m-4. Efficiency. See PME h-4 (conservation of energy) and PCM h-4 (energy in physical and chemical changes). **RWC:** Simple and complex machines, roller coasters, swings, pendulums, elevators, automobiles, fans, motors.	**IV.3.HS.2:** Explain energy conversions in moving objects and machines.		

Waves and Vibrations

All students will describe sounds and sound waves:

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
WAVES	**KC:** Properties of sounds— pitch, volume. Characteristics of sound waves— frequency, amplitude, velocity. **RWC:** Common sounds that vary in pitch and volume— see PWV e-1.	**IV.4.HS.1:** Relate characteristics of sounds that we hear to properties of sound waves.		
All students will explain shadows, color, and other light phenomena:				
WAVES	**KC:** Characteristics of light— brightness, amplitude, colors of spectrum (red, orange, yellow, green, blue, indigo, violet), wavelength, frequency (see PWV h-3). Ways that objects interact with light— emission, reflection, absorption, transmission, scattering (see PWV m-4). **RWC:** Colored light-reflecting objects, such as books, clothes, color photographs; colored light-transmitting objects, such as stained glass, cellophane; colored light-emitting objects, such as television, neon lights. Scattering of light by the atmosphere.	**IV.4.HS.2:** Explain how we see colors of objects.		
All students will measure and describe vibrations and waves:				
WAVES	**KC:** Mechanical waves, electromagnetic waves— see PWV h-4. Colors of light. Properties of waves— frequency, amplitude, wavelength, wave velocity, energy. Units of measurement— hertz or cycles per second, micrometers, meters, meters per second. **RWC:** Examples of mechanical and electromagnetic waves— see PWV h-4. Colors of light, frequencies of radio and TV transmission.	**IV.4.HS.3:** Describe waves in terms of their properties.		**Tools for making spectra:** Prism, diffraction grating.

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	KC: Types of waves— mechanical: sound, ultrasound, water waves, shock wave; electromagnetic: radio waves, microwaves, radiant heat, infrared radiation, visible light, ultraviolet radiation, x-rays. Properties of waves— see PWV h-3. See PCM m-4 (energy transformations). **RWC:** Examples of mechanical waves— sound, ultrasound, ocean waves, wave tanks, earthquakes, seismic waves; examples of electromagnetic waves, such as light— see above, radio and television signals, heat lamps, microwave transmitters, radar, ultraviolet radiation in sunlight, X-ray machines, CAT-scans, gamma rays from radioactive decay.	**IV.4.HS.4:** Describe different types of waves and their technological applications.		