Chemistry: Energy

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies:

- **Cause & Effect:** Students will demonstrate the ability to investigate, explain, and evaluate potential causal relationships by using evidence to support claims and predictions about the mechanisms that drive those relationships.
- **Scale, Proportion, & Quantity:** Students will demonstrate the ability to describe and represent the significance of changes in observable and non-observable phenomena in terms of relative scale, proportion, and quantity.
- **Energy & Matter in Systems:** Students will demonstrate the ability to analyze evidence from a variety of sources (investigations, models) to predict, connect and/or evaluate the cycling of matter and flow of energy within and between systems in order to understand, describe, or predict possibilities and limitations of systems.
- ***Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.***
- ***Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.***
- ***Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.***

Content Standards:

- 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.
- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
- 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.
- HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of

Transfer

*Students will be able to independently use their learning to **make informed decisions based upon their understanding of change in energy.***

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- 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.
- 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.
- energy cannot be created or destroyed-it only moves between one place and another place, between objects and/ or fields, or between systems.
- science assumes the universe is a vast single system in which basic laws are consistent.
- feedback (negative or positive) can stabilize or destabilize a system.
- empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

ESSENTIAL QUESTIONS

- *Does energy ever end?*

Acquisition

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).	*Students will know…* • that energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • that at the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • that these relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. • that conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • that energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • that mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • that the availability of energy limits what can occur in any system. • that uncontrolled systems always evolve toward more stable states—that is, toward more	*Students will be skilled at…* • creating a computational model to calculate change. • developing and using models. • designing, building, and refining a device. • planning and conducting investigations.

	uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). • that when two objects interacting through a field change relative position, the energy stored in the field is changed. • that although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. *<u>vocabulary:</u>* melting, freezing, boiling, evaporating, condensing, hydrogen bonding, melting point, freezing point, kinetic molecular theory, critical temperature and pressure, phase change diagram, KMT, Van der Waals forces, Dipole, Ionic bond, Boiling point, Vapor pressure, reactants, products, rate law, rate determining step,catalyst, chemical equilibrium, intermediate products, activation energy, energy diagrams, heart of reaction, latent energy, gibbs free energy, Keq, endothermic, exothermic, activated complex, reversible reactions, anode, cathode, standard reduction potential, oxidation, reduction, entropy, electrolytic cell, voltaic cell, spontaneous, standard free energy	

Content Area Literacy Standards	***21st Century Skills***
• RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. • RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. • RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. • RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. • WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. • WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	• *use systems thinking* • *solve problems*

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

Stage 3 – Learning Plan	
Summary of Key Learning Events and Instruction	
Science and Engineering Practices	*Mathematics Integration*
	• **HSN-Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.** • **HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.** • **HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.** • **MP.2 - Reason abstractly and quantitatively.** • **MP.4 - Model with mathematics.**
Technology Integration	*District Materials*

Science and Engineering Practices	
S&EP 1. Asking questions and defining problems S&EP 2. Developing and using models S&EP 3. Planning and carrying out investigations S&EP 4. Analyzing and interpreting data S&EP 6. Constructing explanations (for science) and designing solutions (for engineering) S&EP 7. Engaging in argument from evidence S&EP 8. Obtaining, evaluating, and communicating information	