Honors Chemistry - Unit 5 - Thermochemistry

Unit Focus

Students will begin the thermochemistry unit with a phenomenon about endothermic and exothermic reactions. Students will explore how energy plays a role in chemical reactions throughout the unit by being absorbed or released during a chemical reaction. Students will use calorimetry and specific heat to quantify the heat change in a chemical reaction. Students will participate in a laboratory experiment where they will use an aluminum can as a calorimeter to determine the energy released when food is burned. This unit will draw connections between students understanding of the Law of Conservation of Matter and the Law of Conservation of Energy.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 11

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. *ETS1.9.A1*
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. *ETS1.9.A2*
- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *ETS1.9.B1*
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *ETS1.9.B2*
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *ETS1.9.C1*

Transfer

T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T2 Communicate effectively based on purpose, task, and audience to promote collective understanding and/or recommend actions.

Meaning

Understanding(s)	Essential Question(s)
U1 While energy within a system is continually changing forms, and being transferred, the total energy of the system is conserved. **U2** The Laws of Thermodynamics describe the essential role of energy and explain and predict the direction and magnitude of changes in matter.	**Q1** How can I quantify the heat change in a given scenario? **Q2** What makes an object feel hot or cold?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Chemical and physical changes can absorb or release heat energy. **K2** The law of conservation of energy states that the total amount of energy in the universe is constant. **K3** The state of a system is defined by properties such as composition, volume, temperature and pressure.	**S1** Calculate the change in enthalpy for a physical or chemical change using Hess's Law, calorimetry data or standard heats of formation. **S2** Analyze the direction of heat flow to classify reactions as endothermic or exothermic (or vice versa). **S3** Write and balance thermochemical equations.

Stage 1: Desired Results - Key Understandings

• A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. *PS1.9.A4* • 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. *PS3.9.A2* • The availability of energy limits what can occur in any system. *PS3.9.B4* **NGSS/NSTA Science & Engineering Practices** *NGSS Science & Engineering Practices: 9-12* • Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. *SE.9-12.1.1* • Ask questions to clarify and refine a model, an explanation, or an engineering problem. *SE.9-12.1.4* • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. *SE.9-12.1.6* **Madison Public Schools Profile of a Graduate** *Critical Thinking* • Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2) *Creative Thinking* • Design: Engaging in a process to refine a product for an intended audience and purpose. (POG.2.2)	**K4** The change in enthalpy is the measure of the heat of a reaction at constant pressure. **K5** Chemical systems undergo three main processes that change their energy: heating and cooling, phase transitions, and chemical reactions. **K6** Specific heat capacity is the amount of heat energy required to raise the temperature of a substance per unit of mass.	