04 Applications of Chemical Reactions

Content Area: **Science**
Course(s): **Chemistry CP**
Time Period: **Semester 2**
Length: **10 weeks**
Status: **Published**

Standards

SCI.HS.PS1.A	Structure and Properties of Matter
SCI.HS.PS1.B	Chemical Reactions
SCI.HS.PS3.A	Definitions of Energy
SCI.HS.PS3.B	Conservation of Energy and Energy Transfer
SCI.HS.PS3.D	Energy in Chemical Processes
SCI.HS.ETS1.C	Optimizing the Design Solution
SCI.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.
SCI.HS-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.
SCI.HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
SCI.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.
SCI.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).
	Developing and Using Models
	Systems and System Models
	Patterns
	Stability and Change
	Using Mathematics and Computational Thinking
	Energy and Matter
	Planning and Carrying Out Investigations
	Constructing Explanations and Designing Solutions

Enduring Understandings

1. Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in total binding energy (i.e., the sum of all bond energies in the set of molecules) that are matched by changes in kinetic energy.

2. In many situations, a dynamic and condition-dependent balance between a reaction and the reverse

reaction determines the numbers of all types of molecules present.

3. The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
4. Chemical processes and properties of materials underlie many important biological and geophysical phenomena.
5. The aim of engineering is not simply to find a solution to a problem but to design the best solution under the given constraints and criteria. Optimization can be complex, however, for a design problem with numerous desired qualities or outcomes.
6. 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. The comparison of multiple designs can be aided by a trade-off matrix. Sometimes a numerical weighting system can help evaluate a design against multiple criteria. When evaluating solutions, all relevant considerations, including cost, safety, reliability, and aesthetic, social, cultural, and environmental impacts, should be included. Testing should lead to design improvements through an iterative process, and computer simulations are one useful way of running such tests.

Essential Questions

1. How can one explain the structure, properties, and interactions of matter?
2. How do particles combine to form the variety of matter one observes?
3. How do substances combine or change (react) to make new substances?
4. How does one characterize and explain these reactions and make predictions about them?
5. Why do chemical reactions occur at different rates?
6. How can a chemical system be changed to produce an increased amount of product at equilibrium?
7. How can the various proposed design solutions be compared and improved?

Knowledge and Skills

Knowledge:

1. Students will know that 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. (DCI PS1.A Structure and Properties of Matter)
2. Students will know that chemical processes, their rates, and whether or not energy is stored or released

can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (DCI PS1.B Chemical Reactions)

3. Students will know that in many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the number of all types of molecules present. (DCI PS1.B Chemical Reactions)
4. Students will know that 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. (DCI ETS1.C Optimizing the Design Solution)
5. 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 the 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. (DCI PS3.A Definitions of Energy)
6. Students will know 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.
7. Students will know that energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (DCI PS3.B. Conservation of Energy and Energy Transfer)
8. Students will know that mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charge 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. (DCI PS3.B. Conservation of Energy and Energy Transfer)
9. Students will know that the availability of energy limits what can occur in any system. (DCI PS3.B. Conservation of Energy and Energy Transfer)
10. Students will know that uncontrolled systems always evolve toward more stable states - that is, toward more uniform energy distribution (e.g. water flows downhill, objects hotter than their surrounding environment cool down). (DCI PS3.B. Conservation of Energy and Energy Transfer)
11. Students will know that although energy cannot be destroyed, it can be converted to less useful forms - for example, to thermal energy in the surrounding environment. (DCI PS3.D. Energy in Chemical Processes)

Skills:

1. 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.
2. 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.
3. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

4. 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.

5. 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.)

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing