

7 Honors Chemistry Unit 7: Thermochemistry

Content Area: **Science**
Course(s): **Sample Course, Chemistry H/Lab**
Time Period: **Sample Time Period**
Length: **3 Weeks**
Status: **Published**

Title Section

Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

Honors Chemistry

10,11

Belleville Board of Education

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Board Approved: Aug 27, 2018

Suggested Activities & Best Practices

Unit Overview

In this unit, students will focus on the following topics as they relate to thermochemistry:

- Chemical hand warmers
- The nature of energy
- The first law of thermodynamics
- Quantifying heat and work
- Measuring the change of energy for chemical reactions
- Enthalpy: The heat evolved in a chemical reaction at a constant pressure
- Determining enthalpies of reaction from standard enthalpies of formation
- Energy use and the environment

NJSLS

HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
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.
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, and knowledge of the patterns of chemical properties.
HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Exit Skills

1. Calculate internal energy from heat and work
2. Find heat from temperature changes
3. Determine quantities in thermal energy transfer
4. Finding work from volume changes
5. Use bomb calorimetry to calculate the change in energy in a reaction
6. Predict endothermic and exothermic processes
7. Determine heat and change in heat and stoichiometry
8. Determine the change in heat of a reaction using calorimetry, Hess's Law, and standard enthalpies

Enduring Understanding

1. Representations and models can be used to communicate scientific phenomena and solve scientific problems
2. Mathematics, appropriately applied, can be used to explain phenomena.
3. Scientific questioning can be used to extend thinking or to guide investigations within the context of the AP course.
4. Planning and implementation of data collection strategies in relation to a particular scientific question, leads to supported conclusions and problem solutions
5. Proper data analysis and evaluation of evidence is imperative in scientific studies.
6. Scientific explanations and theories must be used as guiding principles for scientific investigations
7. Connections of knowledge across various scales, concepts, and representations in and across domains leads to comprehensive responses to problems in science.

Essential Questions

1. To what extent does a mathematical model represent natural phenomena?
2. What are the limitations when modeling the motion of gases as individual particles?
3. Why do some packaged foods have different cooking instructions for different locations?

Learning Objectives

1. The student is able to interpret observations regarding macroscopic energy changes associated with a reaction or process to generate a relevant symbolic and/or graphical representation of the energy changes.
2. The student is able to relate temperature to the motions of particles, either via particulate representations, such as drawings of particles with arrows indicating velocities, and/or via representations of average kinetic energy and distribution of kinetic energies of the particles, such as plots of the Maxwell-Boltzmann distribution.
3. The student can generate explanations or make predictions about the transfer of thermal energy between systems based on this transfer being due to a kinetic energy transfer between systems arising from molecular collisions.
4. The student is able to use conservation of energy to relate the magnitudes of the energy changes occurring in two or more interacting systems, including identification of the systems, the type (heat versus work), or the direction of energy flow.
5. The student is able to use conservation of energy to relate the magnitudes of the energy changes when two nonreacting substances are mixed or brought into contact with one another.
6. The student is able to use calculations or estimations to relate energy changes associated with heating/cooling a substance to the heat capacity, relate energy changes associated with a phase transition to the enthalpy of fusion/vaporization, relate energy changes associated with a chemical reaction to the enthalpy of the reaction, and relate energy changes to $P\Delta V$ work.
7. The student is able to design and/or interpret the results of an experiment in which calorimetry is used to determine the change in enthalpy of a chemical process (heating/cooling, phase transition, or chemical reaction) at constant pressure.
8. The student is able to draw qualitative and quantitative connections between the reaction enthalpy and the energies involved in the breaking and formation of chemical bonds.

Interdisciplinary Connections

LA.RST.11-12.1

Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

MA.K-12.2

Reason abstractly and quantitatively.

12.9.3.ST.5	Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.
12.9.3.ST.4	Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.
MA.K-12.4	Model with mathematics.
LA.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.
12.9.3.ST-ET	Engineering & Technology Career Pathway
12.9.3.ST.2	Use technology to acquire, manipulate, analyze and report data.
12.9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
12.9.3.ST.3	Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
12.9.3.ST.6	Demonstrate technical skills needed in a chosen STEM field.

Alignment to 21st Century Skills & Technology

Key SUBJECTS AND 21st CENTURY THEMES

- English, reading and language arts
- Mathematics
- Science
- Computer Science
- Economics and Government

21st Century/Interdisciplinary Themes

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

21st Century Skills

- Communication and Collaboration

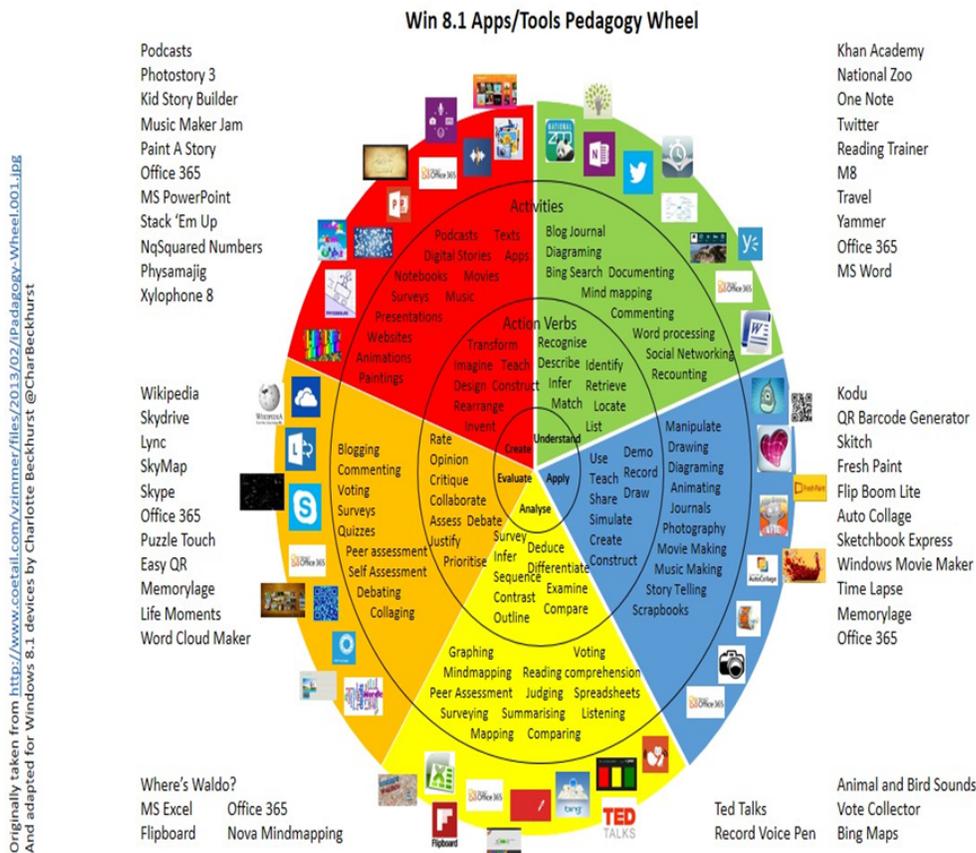
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks- personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas

and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

Technology Infusion

What technology can be used in this unit to enhance learning?



Differentiation

As a Reminder:

The basis of good differentiation in a lesson lies in differentiating by content, process, and/or product.

Resources:

- NJDOE: Instructional Supports and Scaffolds for Success in Implementing the Common Core State Standards <http://www.state.nj.us/education/modelcurriculum/success/math/k2/>

Special Education

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multiple test sessions
- multi-sensory presentation
- preferential seating
- preview of content, concepts, and vocabulary
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

ELL

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of work presented or required

- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

Intervention Strategies

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Evidence of Student Learning-CFU's

Please list ways educators may effectively check for understanding in this section.

- Admit Tickets
- Anticipation Guide
- Common benchmarks
- Compare & Contrast
- Create a Multimedia Poster

- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources

Chemistry – Matter and Change; McGraw Hill
Buthelezi, Dingrando, Hainen, Wistrom, and Zike

Ancillary Resources

1. Teacher and Publisher supplied powerpoints, notes, laboratory guides, and worksheets
2. Textbooks
3. Resource Manuals
4. Internet Resources
5. Computer and smartboard Activities

Sample Lesson
