# AP Chemistry Unit 9: Entropy, Free Energy, and Oxidation States

Content Area: **Science**
Course(s): **Sample Course**
Time Period: **April**
Length: **4 Weeks**
Status: **Published**

## Title Section

## Department of Curriculum and Instruction

**Belleville Public Schools**

Curriculum Guide

# AP Chemistry

# 11, 12

**Belleville Board of Education**

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Board Approved: OCTOBER 17, 2016

## Unit Overview

1. Entropy
2. Free energy and spontaneity
3. Oxidation numbers
4. Oxidation- reduction reactions
5. Oxidizing & reducing agents
6. Galvanic cells
7. Electrolytic cells
8. Standard reduction potentials

## NJSLS

| | |
|---|---|
| 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-PS1-1 | 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-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-PS2-6 | Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. |
| HS-PS1-7 | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. |
| 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-PS3-4 | 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). |
| HS-PS4-5 | Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. |
| SCI.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. |
| SCI.HS-PS1-7 | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. |
| 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. |

## Exit Skills

1. predict and calculate the change of entropy.
2. calculate free energy.
3. compare and contrast free energy and spontaneity.
4. compare and contrast free energy and equilibrium constant.
5. assign the oxidation numbers.
6. balance challenging redox reactions.
7. identify elements that are oxidized and reduced.
8. identify oxidizing and reducing agents.
9. sketch a galvanic cell.
10. the role of the salt bridge.
11. direction of the flow of electrons.
12. use the Standard reduction Potentials.
13. calculate cell potential under nonstandard conditions.
14. compare and contrast charge and amount of product in electrolysis

## Enduring Understanding

**Definition: *Enduring Understandings***

Enduring understandings are statements summarizing important ideas and core processes that are central to a discipline and have lasting value beyond the classroom. They synthesize what students should understand—

not just know or do—as a result of studying a particular content area. Moreover, they articulate what students should "revisit" over the course of their lifetimes in relationship to the content area.

Enduring understandings:

1. Frame the big ideas that give meaning and lasting importance to such discrete curriculum elements as facts and skills
2. Can transfer to other fields as well as adult life
3. "Unpack" areas of the curriculum where students may struggle to gain understanding or demonstrate misunderstandings and misconceptions
4. Provide a conceptual foundation for studying the content area and
5. Are deliberately framed as declarative sentences that present major curriculum generalizations and recurrent ideas.

**Example:**

**Reading/Literature**

**This is an Enduring Understanding**

Reading is a process by which we construct meaning about the information being communicated by an author within a print or non-print medium.

**This is an Essential Question**

How is reading a process of constructing meaning from text?

## Essential Questions

**Essential Question: A question that lies at the heart of a subject or a curriculum and one that promotes inquiry and the discovery of a subject.**

•They can help students discover patterns in knowledge and solve problems.
•They support inductive teaching—guiding students to discover meaning, which increases motivation to learn.
•They are one of the most powerful tools for helping students think at more complex levels.
•They engage the personal intellect—something that traditional objectives usually fail to do.
•Have no obvious "right" answer
•Raise other important questions, often across subject-area boundaries
•Address a concept
•Raise other important questions
•Naturally and appropriately recur
•Stimulate critical, ongoing rethinking
•Are framed to provoke and sustain student interest

**What makes a Questions "Essential?"**
•Continues throughout all our lives
•Refers to core ideas and inquiries within a discipline
•Helps students effectively ask questions and make sense of important and complex ideas, knowledge, and know-how
•Engages a specific and diverse set of learners

**Two Types of Essential Questions:**
•Overarching: The overall "Big Idea"
- •More general, broader
- •Point beyond specific topics or skills
- •Promote the transfer of understanding

•Topical: Unit or lesson specific but still promotes inquiry
- •Unit or lesson specific - used to guide individual units or lessons
- •Promote inquiry
- •Resist obvious answers
- •Require explanation and justification

**Examples:**
•What is a true friend?
•What makes an artist amazing?
•In what sense is the body a system?
•What is the law of nature, and how is it like or unlike social laws?
•To what extent is US history a history of progress?
•In what ways do diet and exercise affect health?
•Must heroes be flawless?
•How do effective writers hook and hold their readers?
•How do cultures affect one another?
•Does practice make perfect?
•What is healthy eating? Healthy living?
•How and when do we use mathematics?
•How does something acquire value?

## Learning Objectives

1. explain why heat is not the only driving force in a chemical/physical change
2. predict and calculate the change of entropy
3. use the free energy change to determine the tendency of a reaction tooccur
4. calculate the free energy under nonstandard conditions
5. assign the oxidation numbers to reactant and product
6. recognize a redox reaction
7. balance challenging redox reactions
8. application of redox reactions
9. sketch a galvanic cell and calculate the standard cell potential
10. calculate the cell potential under nonstandard conditions
11. compare and contrast charge and amount of product in electrolysis

## Interdisciplinary Connections

Please list all and any cross-curricular content standards that link to this Unit.

## Alignment to 21st Century Skills & Technology

**Key SUBJECTS AND 21st CENTURY THEMES**

Mastery of key subjects and 21st century themes is essential for all students in the 21stcentury.

Key subjects include:

- English, reading or language arts
- World languages
- Arts
- Mathematics
- Economics
- Science
- Geography
- History
- Government and Civics

## 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

## 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
- multi-sensory presentation
- multiple test sessions
- 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 clarif
- 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 workpresented 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 workpresented 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 secion.

- 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

Please list all resources available to you that are located either within the district or that can be obtained by district resources.

## Ancillary Resources

Please list ALL other resources available to strengthen your lesson.

## Sample Lesson

One Lesson per Curriculum must bein this lesson plan template.  I.e. one lesson in one unit

Unit Name:
NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: