Unit 8: Applied and Environmental Chemistry

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **15 Days**
Status: **Published**

Summary

Studying the chemistry of the environment allows scientists to understand natural chemical processes and the ways human activities interfere (positively or negatively) with them. “Green” chemistry is an example of how chemists can take tried-and-true processes and attempt to limit the generation of waste pre- and post-production. Students can apply chemistry they have learned to investigate complex topics from manufacturing and industrial chemistry to acid rain , climate change and greenhouse gases. Understanding these topics requires the foundations in concepts such as reactions, thermochemistry, and equilibrium.

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SCI.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.
MA.N-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.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
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.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.
LA.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
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-PS1-5	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-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
SCI.HS-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.

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).
SCI.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
SCI.HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
SCI.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
SCI.HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
SCI.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
SCI.HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
SCI.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.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.TL	Technology Literacy
TECH.9.4.12.GCA	Global and Cultural Awareness
TECH.9.4.12.IML	Information and Media Literacy

Essential Questions / Enduring Understandings

Essential Questions

What major chemical processes or cycles occur in the environment that, if disrupted, affect life on earth?

How can human activity impact natural chemical processes in both positive and negative manners?

How do “green” chemistry principles ensure that current methodologies account for potential environmental impact?

Enduring Understandings

The earth is a complex system composed of countless smaller ones all of which are connected in a manner that changing one will affect another (equilibrium).

Chemistry in the environment is not strictly an anthropogenic topic but human actions can alter natural chemical processes positively and negatively.

Objectives

Students will know the composition of the atmosphere and oceans.

Students will know how specific substances (i.e. carbon, nitrogen, water, etc.) are cycled among the four spheres (hydrosphere, atmosphere, geosphere, and biosphere).

Students will know how green chemistry will result in a positive change in the environment.

Students will know the effects of human activity on earth’s natural systems and what the system is doing in response (equilibrium).

Students will be skilled at recognizing areas where green chemistry can be applied to modern methods.

Students will be skilled at recognizing a positive or negative impact the use of resources has on local (or larger) environments.

Students will be skilled at interpreting data to analyze past, present, or predict future conditions.

Learning Plan

Preview essential questions and connect them to the concepts we will cover in the unit.

Compare and contrast the composition of the atmosphere and ocean (or other system) from points in the geological and recent past to the present.

Identify events, natural or human, that caused a significant change in the composition of the atmosphere, ocean, or other system.

Define the “spheres” of the earth and diagram how various substances move through them over time.

Identify resources used by civilizations and the impact the use of those resources had on the local, regional, or global environment.

Research and track current conditions using available data from air/water quality monitors or more specified resources (i.e. stratospheric ozone) in order to make predictions.

Evaluate examples of human activity to identify systems that were in equilibrium and how human activity altered it.

Analyze experiments to determine their “green”-ness and make proposals to improve ones that are not “green.”

Assessment

Formative Assessment

Analyze data to determine composition of the atmosphere, ocean, or other system.

Identify changes in a system (atmosphere, ocean, other) as a result of natural or human-caused event.

Diagram the cycle(s) of a substance(s) through the earth’s “spheres.”

Develop guidelines that can be used to assess an experiment’s “green”-ness.

Benchmark
Final Exam

Alternative

Collect and graph data from real-time air/water quality monitors.

Diagram a natural system at equilibrium and identify how human activity has altered the system.

Research the resources used by civilization to measure the impact using that resource has on local, regional, or global environment.

Summative

Unit Quizzes

Unit Tests

Materials

Guided notes or teacher handouts

Lab Handouts (Teacher Discretion of previous labs for “green” analysis, NOTE: Supplies for each lab included on handout.)

List of associated environmental/green chemistry videos (collaboration among teachers)

Simulations:

Rahway Air Quality Data (Real time) [https://aqicn.org/city/usa/newjersey/rahway-pm/]

Elizabeth AIr Quality Data (Real time) [https://aqicn.org/city/usa/newjersey/elizabeth-trailer]

NOAA Ocean Monitor (Real time) [https://www.nodc.noaa.gov/oads/stewardship/data_assets.html]

The Greenhouse Effect [https://phet.colorado.edu/en/simulation/greenhouse])

Integrated Accommodations and Modifications Spec Ed., ELL, At-Risk, G&T, Career Education, 504s

https://docs.google.com/spreadsheets/d/1CvoX6NXdGUPtTPcEqPOsnWbqpDLS4Ego1W1eaIrGYTo/