Unit 8: Energy!

Content Area: **Science**
Course(s):
Time Period: **Marking Period 3**
Length: **3 weeks**
Status: **Published**

Summary

Students will explore the sources of energy currently used and the alternative energy sources that have potential for practical development. Students will analyze the impact of fossil fuel extraction and combustion, debate the pros and cons of nuclear energy, and explore the alternatives currently being used and developed. Students will also explore how current energy consumption can affect climate change.

Revised July 2021

CS.9-12.8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
CS.9-12.8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.
CS.9-12.8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
CS.9-12.8.2.12.ETW.4	Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints.
LA.W.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
LA.RI.11-12.2	Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
LA.RI.11-12.3	Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.
LA.SL.11-12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.
LA.SL.11-12.1.B	Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g., student developed rubrics), and establish individual roles as needed.
LA.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural 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-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
SCI.HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
SCI.HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.

Modeling

Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).

Modeling Standards:

Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.

Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.

Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.

Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).

Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.

Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process.

Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process

releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Analytic modeling seeks to explain data on the basis of deeper theoretical ideas, albeit with parameters that are empirically based; for example, exponential growth of bacterial colonies (until cut-off mechanisms such as pollution or starvation intervene) follows from a constant reproduction rate. Functions are an important tool for analyzing such problems.

In descriptive modeling, a model simply describes the phenomena or summarizes them in a compact form. Graphs of observations are a familiar descriptive model— for example, graphs of global temperature and atmospheric CO_2 over time.

Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.

Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

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.

Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.

Essential Questions and Enduring Understandings

Essential Questions:

How has the need for energy changed over the course of human history?

In what ways did the industrial revolution change our relationship with the Earth's natural resources?

How does the finite availability of fossil fuels and nuclear materials influence our long-term use of energy in the future?

What is the relationship between current energy consumption patterns and climate change?

Enduring Understandings:

Many of our current energy resources exist in finite quantities an are linked with significant environmental impact through their extraction, combustion and long term storage of their waste.

Sustainable/renewable sources exist that can provide humankind with limitless energy without the significant environmental impact of fossil fuels or nuclear energy sources.

Objectives

Students will know key terms: fossil fuels, combustion, subsidy, scrubbers, fission, fusion, isotopes, radioactive half life, spent fuel, meltdown, NIMBY (not in my back yard), biomass, cogeneration

Students will know renewable vs. non renewable resources and provide examples of each

Students will know the long term impacts that fossil fuel extraction and combustion are having on the planet's systems and biodiversity.

Students will know why decision making when it comes to nuclear power involves numerous factors involving efficiency and human safety.

Students will know how the limited availability of fossil fuels makes them a poor choice as a long term energy solution.

Students will know the process of extraction and their environmental impacts for each of the major fossil fuels

Students will know the major air pollutants released through the combustion of each fossil fuel

Students will know the problems and challenges associated with long term storage of nuclear waste

Students will know the pros and cons of each renewable energy source

Students will be skilled at identifying the major renewable sources of energy and how they can be utilised for human needs.

Students will be skilled at mapping out a diagram of a nuclear power plant and explaining the process of nuclear fusion

Learning Plan

Guided PPT with notes: fossil fuel types and extraction methods (coal:mining, Oil:drilling, Natural Gas:fracking)

Independent research worksheet: impacts of fossil fuel combustion

PPT and discussion: Nuclear Enery, Fusion and Long term storage problems

Video and independent reading assignment: Nuclear Disasters at Three Mile Island, Chernobyl and Fukushima Daichi

Formal Debate: Nuclear Energy and a prosposed nuclear facility in Cranford

Case Study: Oyster Creek Nuclear Power Plant, Toms River, NJ

History Channel: Mega Disasters: Chernobyl and Three Mile Island Clips

Analyze a local solar panel system assess the pros and cons, and the cost effectiveness of the system and calculate how long it will take the consumer to pay off their investment.

Independent online/text research assignment: provide an explanation of how it works, the pros/cons and major locations of use for each of 8 major alternative enrgy sources

Class PPT and discussion: stand alone vs grid connected solar systems

History Channel: Modern Marvels: Sugar (Ethanol Clip) and duiscussion of ethanols/biofuels as a renwable source of energy

Assessment

Formative Assessments:

- Worksheets
- Do Nows
- Exit Tickets
- Class Discussions

Quizzes:

- Fossil fuels: Extraction and combustion impacts
- Nuclear Fusion, disasters and long term storage problems

Bench Marks:

Midterm and Final Exam

Alternative:

- Case Study Worksheet: Fossil Fuel Comparative Anatomy
- Independent reading and notes: impact of fossil fuel extraction
- Video and independent reading assignment: Nuclear Disasters at Three Mile Island, Chernobyl and Fukushima Daichi
- Formal Debate: Nuclear Energy and a prosposed nuclear facility in Cranford
- Case Study worksheet: Oyster Creek Nuclear Power Plant, Toms River, NJ
- Alternative energy research grid

Summative:

Unit Tests:

- Energy! Fossil Fuels, Nuclear and Alternative Energy Sources

Materials

Raven & Berg Evnironment Textbooks (ISBN: 978-1-119-39341-2)

Guided note packets (teacher developed)

Technology (student & teacher laptops, SmartBoard)

PowerPoints

Workshets/notes

Youtube/Netflix

Oyster Creek

Coal samples: anthracite vs lignite

Widn turbine kit

Solar panel kit

Popsicles and straws for wid turbine design

Suggested Strategies for Modification

https://docs.google.com/spreadsheets/d/1P8BzKodtBsbWi4rQ0tunGWhZkCOg52IvbNO7yy-TFJI/edit?usp=sharing