Energy

Suggested Pacing: Approximately 5-7 Blocks

Topics at a Glance:

- What is energy? How and where can we get it?
- Forms of energy and which are renewable and nonrenewable sources.
- What inputs are needed and what byproducts result?
- Pollutants from energy?

Stage 1 – Desired Results

Performance Expectations: (PE) (Established Goals / Content Standards)

- Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. [Clarification Statement: 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.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.] (HS-PS3-3)
- Communicate scientific and/or technical information describing an energy source that minimizes pollution in an effort to sustainably generate electricity. (HS-ESS3-2)
- Evaluate and propose an energy solution that reduces the impact of human fossil fuel usage on natural systems. (HS-ESS3-4)

Enduring Understandings (1-3 max)
Students will understand that:

- Human energy consumption plays a major role in impacting all of Earth's spheres.
- Renewable and Nonrenewable energy choices take into account geopolitical, social, and economic and environmental considerations and may place more emphasis on certain areas depending upon human biases.

Essential Questions (1-2 EQ per EU)

1. What is energy and how do humans utilize it?
2. What are the advantages and disadvantages of using different types of energy and how do they impact our planet's life support system (environment) overall?
3. What solutions and or improvements can humans make to mitigate negative impacts our energy choices have and move toward sustainability?

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Bolded SEP's are a suggested focus for this unit. ● **Ask questions and define problems** ● **Develop and use models** ● Plan and carry out investigations ● Analyze and interpret data ● Use mathematics and computational thinking ● **Construct explanations**	**PS3.A: Definitions of Energy** ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-3) **PS3.D: Chemical Processes and Everyday Life** ● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3) **ESS3.A: Natural Resources** ● All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as	**Bolded CC's are a suggested focus for this unit.** ● Patterns ● Cause & Effect: Mechanism & Explanation ● **Scale, Proportion, & Quantity** ● **Systems & System Models** ● **Energy & Matter: Flow, Cycle,**

and design solutions ● Engaging in argument from evidence ● **Obtaining, evaluating and communicating information**	well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) **ESS3.C: Human Impacts on Earth Systems** ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) **ETS1.B: Developing Possible Solutions** ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ESS3-4)	**Conservation** ● Structure & Function ● Stability & Change

Stage 2 – Model Assessments

Summative Performance Task(s)

- Evaluate and propose a local solution to replace or diminish the usage of fossil fuels. Solutions can include - but are not limited to - solar, wind, geothermal, hydrogen, hydroelectric and biomass.

1. Students will identify a local or personal fossil fuel dependency.
2. Students will highlight the pros and cons maintaining business as usual with that source versus continuing with the proposal. Considerations should include cost, safety, reliability, aesthetics, as well as social, cultural, and environmental impacts. (Short and long term).
3. Students will propose a means of eliminating or diminishing the use of the fossil fuel that is feasible and considers constraints, and the pros and cons highlighted. Students should also mention how the proposal works toward sustainability.

Formative Assessments:

- Student worksheets
- Checkpoint questions and submissions.
- Formative quizzes
- Teacher conferences and check-in's
- Student self-assessment & reflection

Stage 3 – Learning Plan / Road Map (Design to make as student-centered as possible)

Suggested Resources for Planning:

America Revealed - Electric Nation
https://www.pbs.org/video/america-revealed-electric-nation/

Withgott, J., Wiggins, G. P., Lisowski, M., Scotchmoor, J., Thanukos, A., & Pearson Education, Inc. (2011). Pearson environmental science: Your world, your turn. Boston, Mass: Pearson.

Learning Activities:

Energy Production

- Compare and contrast the technology differences between fossil fuel based methods for generating

electricity to low carbon technologies such as wind, solar photovoltaic, hydro, nuclear fission, biomass, and geothermal.

- Discuss the role of population level changes in energy use and efficiency in addressing the energy sectors affect on human health and environmental issues.
- Explain the history of human energy consumption with particular reference to the Industrial Revolution and our increasing dependence on fossil fuels.
- Compare extraction and transportation methods for different fossil fuels such as coal, oil and natural gas.
- Debate the merits of emerging motor vehicle power technologies such as hydrogen, electric battery, hybrid gas-electric, and turbo diesel.
- Analyze the contribution of human generated carbon dioxide emissions on ocean acidity and the health of marine ecosystems.