Project: Sustainable Energy Evaluation

FOR THE TEACHER

Summary
In this project, students will develop a presentation to compare the pros and cons of a sustainable resource. The explanation will involve researching the cost and benefits of the resource and analyzing if the resource should continue to be used.

Grade Level
High School

NGSS Alignment
This project will help prepare your students to meet the performance expectations in the following standards:

- **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.

- **Scientific and Engineering Practices**:
  - Analyzing and Interpreting Data
  - Engaging in Argument from Evidence
  - Obtaining, Evaluating, and Communicating Information

Objectives
By the end of this project, students should be able to

- Develop a visual aid to enhance a presentation.
- Identify all the aspects of developing and maintaining an energy resource.
- Defend a claim on whether a resource should continue to be used to solve a real-world problem.

Chemistry Topics
This project supports students’ understanding of

- Energy Resources
- Renewable Energy
- Sustainable Energy

Time
**Teacher Preparation**: 10 minutes
**Lesson**: ~6-8 hours (will vary based on time allowed for research and presentations)

Materials
- Computers/devices with internet access

Safety
- No specific safety precautions need to be observed for this activity.

Teacher Notes
- Prior to the assignment of the presentation, it may be beneficial to introduce what resources are being used around the world. Students can look for patterns in types of resources being used in certain areas and why they think that this pattern is occurring.
- Helpful links for this activity:
  - [Pros and Cons of Natural Gas](#)
  - [Renewable Energy](#)
Students should research a variety of videos and articles about their chosen topic. Below are links to the articles that could be used to start conversations with each group before they begin research on their own.

### Articles:
- [Geothermal Energy](#)
- [Wind Energy: Pros and Cons](#)
- [Wind Energy: Advantages and Challenges](#)
- [Solar Energy: 6 Things You Didn’t Know](#)
- [The Future of Solar Energy](#)
- [Reliability of Renewable Energy: Solar](#)
- [Ocean Wave Energy](#)
- [Why Wave Power has Lagged far behind as an Energy Source](#)
- [Wave Energy and Wave Changes with Depth](#)
- [The Future of Nuclear Energy](#)
- [National Geographic: Nuclear Energy](#)
- [The Energy Source of Tomorrow: Benefits of Nuclear Fusion Power](#)
- [Small-scale Nuclear Fusion](#)
- [Nuclear Fusions: Pros and Cons](#)
- [Benefits of Hydropower](#)
- [Hydroelectric Energy: Pros and Cons](#)
- [Biofuels Pros and Cons](#)
- [Benefits of Biodiesel](#)
- [Advantages of Biofuels](#)
- [Alternative Fuels: Ethanol](#)
- [MIT Ethanol Analysis](#)
- [Cornell: Ethanol Fuel Faulted](#)
- [MIT Coal Analysis](#)
- [Fossil Fuels: Coal](#)
- [Petroleum: Advantages and Disadvantages](#)
- [12 Advantages and Disadvantages of Petroleum](#)
- [Fuel Cells](#)
- [Benefits and Challenges of Fuel Cells](#)
- [https://fueleconomy.gov/feg/fcv_benefits.shtml](#)
- [Pros and Cons of Hydrogen Energy](#)
- [Natural Gas: Pros and Cons](#)
- [12 Pros and Cons of Natural Gas](#)
- [New Waste-to-Energy Plants](#)
- [Waste Incineration: Advantages and Disadvantages](#)

- It may be preferable to have students work in groups of 3-4 due to the amount of class time it takes for the presentations. If time permits, groups of 2 would be more desirable.
- Exit slips to check progress could be useful check points during research time.
- A “Note-Taking Guide” for student use during the research phase has been included.
- Choose a way for students to submit the presentation to you. I found it is easier on the teacher if students submit to Google Classroom or Turnitin.com. This provides one location for the teacher to pull up the presentations and reduces the down-time between presenters.
- Depending on how comfortable your students are with MLA or APA format, you might want to suggest an online citation generator such as easybib.com, bibme.org, or citationmachine.net.
- Suggestions on differentiation:
  - Lower level students may need more guidance on how to locate credible sources online (this resource may be helpful).
 Students with accommodations that restrict being able to verbally present in front of others - suggest recording their voice at home to place into the presentation.

- During presentations, students should take notes about the resources that others present. An example note-taking handout is included for use. The notes will help students provide evidence for their conclusions (conclusion questions are included on this handout as well).
- When working with groups, a group evaluation could be used following presentations. This allows students to communicate how the group worked together. An example form is provided the next page.

- Example Answers for Conclusion Questions:

  1. Which energy resource do you think impacts your life the most? Why?
     
     Coal impacts my life the most. It is the source of electrical energy at our local power plant.

  2. If you were an investor (like on Shark Tank), which energy resource would you choose to financially support? Why?
     
     I would invest in the waste to energy resource. There is an unending supply of waste for us to burn and it reduces our carbon footprint by reducing the amount of methane produced in landfills.

  3. If you were an environmentalist, which energy resource would you support the most? Why? Which would you least prefer? Why?
     
     I would support solar energy. It is easier to install for homes and businesses than others, as well as not have producing much waste.
     
     I would not support natural gas. Fracking disrupts habitats and can be dangerous to workers. It also increases our carbon footprint.

  4. Which resource do you think would be the best to continue development and use? Why?
     
     I would want to continue to develop wind energy. Although there is a small disruption to the landscape, overall it has very little impact on the environment. It has a larger output of energy than other renewables. The large upfront fee and maintenance costs can be recovered over time.
FOR THE STUDENT

Lesson

Sustainable Energy Evaluation

Background
Sustainable energy is a major concern for civilizations. The costs and benefits of each type of energy source is an ongoing discussion around the world. Through careful research and analysis of the aspects of each type of resource, could you make a choice for the future of mankind?

Problem
Which energy resources are the best choices for the future?

Materials
- Computer/device with internet access

Instructions
Research the following information about your resource.

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<tr>
<th>Category</th>
<th>Ideas for Writing</th>
<th>Value</th>
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| History and Discovery of the Resource | -What is the resource?  
-When/where was it discovered/created?  
-Who discovered/created it?  
-Why was it discovered/created? (What problem was trying to be solved? Was it created on accident?) | 5     |
| Science of the Resource               | Provide as many of these things as you can find:  
- Chemical Formula (elements)  
- Structure / model of compound  
- How is the energy from this resource generated? Is there more than one way to utilize it? | 10    |
| How the resource impacts your life    | -What is it currently being used for (transportation, home electricity, etc..)?  
-How is it used in your life? | 5     |
| Economic Impacts                      | -How is it cost effective?  
-What are the costs to build and maintain?  
-Are the costs upfront in building or from extracting the resource? | 5     |
| Environmental Impacts                 | -What type of emissions are produced?  
-Does it produce any harmful waste? How is waste managed?  
-At what point during its use is any waste produced? (extraction, during process, after process...) | 5     |
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<tr>
<th>Section</th>
<th>Questions</th>
<th>Points</th>
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| Future of the resource                                 | - How could the process be improved even more?  
- Is it renewable or non-renewable? What does this mean to its sustainability?  
- Is the use of this resource currently growing? Why? At what rate? | 10     |
| Recommendation for the resource                        | - Do you feel more should be invested into utilizing this resource?  
- Use evidence from your research to support your choice. (statistics, patterns/trends, environmental impact, etc...) | 10     |
| Scientific Content                                     | - Are science terms used correctly?  
- Are there any grammar and spelling errors?  
- Can a reader understand the concepts presented? | 5      |
| The student has documented sources completely, including in-text citations when appropriate. | - Are there citations, as appropriate?  
- Is there a Works Cited page with at least 5 sources documented correctly with MLA or APA format?  
- Did you support with evidence from credible sources? | 10     |
| Presentation Length                                    | 8-10 minute presentation                                                                                                                  | 5      |
| Presentation Skills                                    | eye contact, voice clarity, posture, etc...                                                                                               | 5      |
| Visual Aid                                             | neatness, images, appropriate length, overall effort                                                                                      | 10     |
| **Total Points Possible:**                             |                                                                                                                                           | 85     |

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<th>Presentations Start Date:</th>
<th>Visual Aid Due Date:</th>
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