STEM Careers Coalition

CLASSROOM ACTIVITY

Harnessing Energy

OBJECTIVES

Students will be able to:

- **Evaluate** the strengths and differences of the various sources of renewable and nonrenewable energy as potential solutions for the Alaskan Ranger Station
- **Analyze** the potential needs of an Alaska Ranger Station and collaborate to select the most reliable and efficient power solution for this station
  - Be sure to help students consider the climate, temperatures, and geography of rural Alaska
- **Create** a diagram that explains the functionality and benefits of this power solution, and then apply critiques to optimize their design

OVERARCHING QUESTION

What should be considered when designing an efficient and reliable power solution?

ACTIVITY SUMMARY

Students will investigate the different ways electricity can be generated from different types of energy sources, such as oil, gas, solar, wind, water, nuclear, or others – there are many types of renewable and non-renewable energy sources that can be investigated. They will consider the efficiency, reliability, cost, and environmental impact of each, and they will work together to propose an optimal power solution for a ranger station in rural Alaska.

MATERIALS

- Devices with internet access, one per student or at least enough for one-third of the class
- Designing Solutions Handout, one per student
- Copy paper, enough for one-quarter of the class

CHALLENGE

1. Three-Minute Quick Draw: Instruct students to use a piece of scrap paper to sketch what comes to mind when they picture renewable energy and non-renewable energy.
2. When three minutes are up, encourage students to share a summary of their sketches. Ask: How do you think these two sources of energy are different, what are the advantages and disadvantages of renewal and non-renewable energy sources?
3. Tell students that today they will be investigating both types of energy sources as they pretend to be energy engineers tasked with a new project: powering a Park Ranger Station in rural Alaska. Energy engineers work across the full lifecycle of energy, from extraction to distribution, to efficiently and reliably process energy from multiple sources (i.e., solar, wind, water, nuclear, oil, gas, etc.).

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4. Distribute one Designing Solutions Handout to each student, and then elaborate on the challenge by reading aloud the bullets listed under Step 1: Define the Challenge. Explain that students will complete this challenge in groups of six.
5. After answering questions, prepare student groups to perform research to better understand the challenge:
    - Write the following website on the board and explain that students should click on "Energy Sources" and then the renewable energy and nonrenewable energy links to complete their research: www.eia.gov/kids/
    - Explain that student groups will have about 15 minutes to perform research.
    - Encourage groups to divide the research responsibilities: Three students in each group should select one type of non-renewable energy to briefly research, and three students in each group should select one type of renewable energy to briefly research. At the end of the research period, group members will teach each other what they have learned about their energy types.

      Tip: If there are not enough devices for each student to have their own, assign energy sources for students to research, and instruct students who are researching the same content to work together across groups.

DESIGN

1. Bring the class back together and explain that it's now time to develop a solution to the challenge. Ask a student volunteer to read the handout's *Step 2: Create a Design* section aloud.
2. Tell the class that they will have 15–20 minutes to create their design. Quickly recap and encourage students to:
    - Briefly share their research with their group members, including if they believe the energy source that they researched is efficient and reliable enough to be considered for the remote Alaskan Ranger Station.
    - Evaluate all possible solutions with the other energy engineers in order to select the best energy source.
    - If there are more than one energy source that students are considering as the best option, encourage students to test their thinking against the energy sources that are most efficient, cleanest and most affordable.
    - Use a separate piece of paper to sketch a diagram that illustrates this energy solution and helps explain why it is the best power solution for the Alaska Park Rangers.
    - Be ready to explain and justify the rationale behind their design solution!

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SOLVE

1. When there are about 10 minutes left in the class period, instruct groups to pair together. Explain that an important part of the design process is the process of optimization, in which solutions are assessed and improved upon. When designing solutions for energy clients – which in this case is the Alaskan Park Ranger Station – it is important to ensure that the solution has the needs of the client in mind.
2. Explain that each group will share their designs with each other.
    - As they present, they must share the power solution they selected and why it will work well at the Alaskan Ranger Station. They should explain what they considered when making their choice, including efficiency, reliability, clean, and affordable.
    - As they listen, they must take on the perspective of Alaskan Park Rangers and ask questions from the viewpoint of rangers.
    - Remember that the ultimate goal of the solution is to create an efficient and reliable power solution for a remote location!
3. Go on to explain that once both designs have been shared, groups should complete the *Step 3: Analyze Solutions* portion of the handout and consider how to optimize their design.

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STANDARDS

Next Generation Science Standards

- Earth and Human Activity
    - MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
    - Disciplinary Core Idea - ESS3.A: Natural Resources: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)
- Engineering Design
    - MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
    - Cross-Cutting Concepts—Influence of Science, Engineering, and Technology on Society and the Natural World:
        - All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
        - The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

ITEEA Technological Literacy Standards

- Standard 1: Students will develop an understanding of the characteristics and scope of technology. In order to comprehend the scope of technology, students should learn that:
    - New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.
- Standard 9: Students will develop an understanding of engineering design. In order to comprehend engineering design, students should learn that:
    - G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.
- Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies. In order to select, use, and understand energy and power technologies, students should learn that:
    - I. Much of the energy used in our environment is not used efficiently.

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DESIGNING SOLUTIONS

STEP 1: DEFINE THE CHALLENGE

As a team of sustainability energy engineers, your challenge is to:

1. Research several types of renewable and non-renewable energy.
2. Consider how well each one may work in rural Alaska. Consider its efficiency, reliability, its impact (positive or negative) on the environment, and the affordability of the energy source.
3. Propose a power solution for this station that is as efficient and reliable as possible.

Capture your research notes that could help you tackle the challenge:

STEP 2: CREATE A DESIGN

Work with your group to select a power solution that you believe will be best for the Alaska Ranger Station.

Then, on a separate piece of paper, work as a group to write a description that justifies your selection and draw a diagram that you, as energy engineers, could present to the Alaskan park rangers to explain which power solution you selected, how it will work in this remote location, and why this option is the best choice. Explain to the park rangers what you considered when making your choice, including efficiency, reliability, affordability, and environmental impact.

STEP 3: ANALYZE SOLUTIONS

Think about the questions and feedback your power system design received and consider how you could improve upon your power solution. Then work as a group to either add clarifying information to your original diagram or describe at least one design optimization.