Building a Solar Generator

Description

After touring a local solar farm and learning about solar energy as a renewable resource, students will work in teams help to set up a solar panel and build a portable solar generator. Based on their observations and experiences during the lesson, students will evaluate and discuss the benefits and disadvantages of using solar energy to generate electricity.

Disclaimer: This project was made possible through grant funding.

Packet Contents

Introduction

This lesson explores the idea of solar energy as a renewable resource to produce electricity. In this lesson, students will learn about solar energy through a research activity, as well as by visiting a local solar farm. Once students are familiar with the basics of solar energy, the class will build a portable solar generator which will be used for activities in future lessons. As students develop a better understanding of solar energy, they should also begin to see some of the advantages of this renewable energy source (clean, low cost to operate, no additional fuel needed, etc.) as well as some disadvantages (limited power generation, expensive to build, space requirements, etc.) At the conclusion of the lesson, students will

use what they have learned evaluate and discuss their opinions about the use of solar energy for electric power generation. This project was made possible through grant funding.

Curriculum Alignment

NC Essential Standards – 4th Grade Science

4.P.3 Recognize that energy takes various forms that may be grouped based on their interaction with matter.
4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical, and magnetic) as the ability to cause motion or create change.
4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

Objectives

· Students will know that solar energy consists of light and heat from the sun.
· Students will describe the process used to convert solar energy to electrical energy.
· Students will build and implement a portable solar generator.
· Students will evaluate the advantages and disadvantages of using solar energy.

Time & Location

This lesson covers three 60 minute class periods with a fourth class period used for assessment. An additional field trip day will be needed if students are visiting a solar farm. Alternatively, the assessment for the lesson could be completed individually as a homework assignment in order to complete the lesson in three class periods. Lesson activities and building the solar generator will take place in the classroom, and additional time may be required for building the generator; but a secure outdoor area that receives a good amount of sunlight will be needed to set up the solar panel for the generator.

Teacher Materials

Solar pump, solar calculator, or any small solar-powered device
Solar generator materials (see attached list for materials and vendors)
Solar Energy Handouts
Solar Generator Wiring Schematic

Student Materials

Student science journals or science notebooks
Computers, Chromebooks, or other devices with internet access
Solar Energy Handouts (1 per student)
Solar Generator Wiring Schematic (1 per project group)

Safety

This lesson was planned and implemented with our local electric cooperative, which assisted our students in designing and constructing our solar generator. To ensure that the generator and solar panel is properly constructed, correctly wired, and safely implemented, consult with an electrical engineer or other qualified individual with a working knowledge of this type of project. Check with your school or district for requirements for setting up the solar panel, and ensure that the solar panel is set up in a secure location where it will be undisturbed.

Student Prior Knowledge

From previous lessons in the unit, students should understand that the sun gives off energy. They should also be familiar with the concept that energy is not created or destroyed, but rather changes forms as it is stored or used (Law of Conservation of Matter and Energy). Students should have a general understanding of renewable and non-renewable energy resources.

Teacher Preparations

Become familiar with solar energy and the processes for converting solar energy to electrical energy using a solar panel, inverter, charge controller, and battery bank. Ensure that all materials and resources for the solar generator project are on hand prior to the lesson. If visiting a solar farm, make tour and transportation arrangements. Designate four student project teams for work on designing and building the solar generator.

Activities

Day 1

Engage (10 minutes):
The teacher will begin the lesson by demonstrating a small solar-powered device such as a solar pump or solar calculator. Explain to the class that the device does not plug into an electrical outlet and does not require a battery to operate. Ask students to think about how the solar device is able to operate, and provide students with the opportunity to share and discuss their ideas about the solar device with the class.

Explore (50 minutes):
Using the internet, students will work in groups to learn more about solar energy. Students may work with their project team for this activity or in smaller groups of 2 - 4 students depending on class size. Some online resources will be provided on the Solar Energy handout, and students may also use appropriate websites of their choosing. Students will each use a copy of the Solar Energy handout to organize their information. If students are using science journals or science notebooks, the handout should be added to students' science journals.

Day 2

Explain:
Students will tour a local solar farm to learn more about the conversion of sunlight into electricity. Many local electric cooperatives and energy companies have small-scale solar farms, and many areas have larger privately-owned solar farms as well. Prior to the trip, encourage students to pay particular attention to the hardware used to produce electricity from solar energy (solar panels, inverters, solar controller,

etc.), as well as the steps involved in the process. During the tour, students will be able to see a functioning, larger-scale version of the generator that they will be building during this lesson. The tour guide at the solar farm should also be able to explain the process for capturing solar energy, as well as discuss the energy output of solar panels (i.e. What can a 300 watt solar panel power?) and answer other questions that students may have about solar energy.

Day 3 - 4

Elaborate:
The teacher will work with students to create a portable solar generator similar to https://www.youtube.com/watch?v=offgcMwuTGw. See attachments for a materials list for the project as well as a wiring schematic for constructing the generator. After familiarizing students with the components used to construct the generator students will work in four project teams to design and build the generator.

Each student project team will be responsible for planning a design idea for one component of the generator. Project teams will work with the teacher and other experts (i.e. electrical engineer, power company representative, etc.) to plan their portion of the generator design and will work with other teams to ensure that the designs will be compatible when the generator is fully assembled. Students should use the Solar Generator Wiring Schematic as a guide for planning how components should be connected. Each of the four student project teams should be responsible for one of the following tasks:

1. Solar Panel Mounting - Design a mount for the solar panel using steel and aluminum rods and determine an appropriate location to place the solar panel.
2. Generator Case - Plan the layout for the case including connections to the solar panel, switches, and for devices being connected to the generator.
3. Battery Bank - Plan a method to securely mount the batteries in the solar generator and connect them to the power supply.
4. Inverter and Solar Charge Controller - Plan a method to securely mount and connect the inverter and solar charge controller.

Additional information showing the design and case layout of the solar generator can be found at the following links:
https://www.youtube.com/watch?v=offgcMwuTGw
https://www.youtube.com/watch?v=qbkTrAuGemM
https://www.youtube.com/watch?v=1EPd8M4oMHI
https://www.youtube.com/watch?v=WlLhYc30qV4

Day 5

Evaluate:
See assessment section.

Assessment

Based on their experiences from this lesson, students will evaluate the advantages and disadvantages of solar energy as a renewable resource and present their opinions and supporting evidence to the class.

Individually, in their science journals or notebooks, students will describe at least two positive aspects of solar energy, as well as two negative aspects of solar energy. Examples of positive aspects include no cost to operate, renewable energy source, doesn't pollute, etc. Examples of negative aspects include less power on cloudy days, doesn't produce power at night, expensive to set up, requires lots of space, etc.

Students will also write their opinion to answer the following questions:
1. Based on what you have learned about solar energy, do you believe that solar energy is overall an effective renewable source? Why or why not?
2. Describe an example in which solar energy could be used effectively.
3. Describe an example in which the use of solar energy would not be effective.

Once the written assignment is complete, students will share their ideas and opinions about solar energy with their project group group. Each project group will be given three minutes to present their group discussion to the class.

Critical Vocabulary

Renewable Energy – energy collected from sources that can be replenished
Solar Energy – light and heat energy that is given off by the sun
Solar Panel – a panel that absorbs the sun's rays to generate electricity
Solar Farm – a collection of connected solar panels used to provide larger amounts of electricity

Author Information

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