Solar Powered Car Investigation

Grade Level	3rd	**Subject**	Solar Energy/Energy Sources

Objective(s):
The student will investigate solar energy as a method to power a solar car, measure distances traveled by the car at 3 different times of the day outside, compare and contrast the distances traveled by the car at the different times. The student will collect this data for a week and then graph it. He/she will also observe, describe, and compare the amounts of solar energy collected by the CEED building versus their solar powered cars.

SOL Addressed: Science – 3.1 a, b, e, g, h, i, j, k- The student will demonstrate understanding of scientific reasoning by conducting experiments in which:
* Observations are made and repeated to ensure accuracy,
* Predictions will be formulated
* Distance will be estimated and measured in metric and standard units **(This also goes with Math SOL 3.9.)**
* Questions are developed to formulate hypothesis
* Data are gathered, charted, graphed, communicated, and analyzed **(This also goes with Math SOL 3.17.)**
*Unexpected or unusual quantitative data are recognized
* Inferences are made and conclusions are drawn

3.2 Students will explain which types of simple machines are present in the solar powered cars.

3.11 a & b – The student will investigate and understand solar energy (energy from the sun) as a renewable resource.

Common Core Standards: **4-PS3-2.** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4 – Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

4 – ESS3 – 1- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Materials Needed Per Class of 30

and

Prior Knowledge

- Assembled Solar Powered Cars **(10 pack classroom kits - can be ordered from SunWindSolar.com)**
- Scissors
- Notebooks & pencils for collecting data
- Rulers, yard sticks, meter sticks
- Stopwatch (if you wanted to measure the time the cars travel a certain distance)

(Notes to teacher: These cars run better on a smooth surface and work well in the sun! When they get into the shade, they come to a stop. If students test other light sources, incandescent bulbs work best but must be held close to the solar panel to make the car move.)

	Prior Knowledge: Review question from teacher: What simple machines do you see represented here in your solar car? Students must also know the terms: renewable and nonrenewable resources and be able to distinguish between these. They must also be able to give examples of both kinds of resources. They are to know that energy from the sun is also called solar energy and that it can be harnessed by using solar panels. It is a renewable resource. Students need to know how long a foot, a yard, and a meter are. They also need to be able to measure accurately with a ruler, a yard stick, and a meter stick. *****Before this lesson begins, the solar powered cars need to be assembled. This could take about 1 to 1½ hours and the younger students will need adult supervision and help to assemble these correctly. This is especially important when the holes are being made for the wooden blocks.**
Ways to differentiate this lesson plan	• **EXTENSION** for Higher Level Learner - 1. Different Light Intensities can be tested. Other light sources could be used – Incandescent bulbs, flashlights with new batteries and the same light intensities, etc.) ***IT IS VERY IMPORTANT TO USE THE SAME LIGHT INTENSITY IN AN ATTEMPT TO CONTROL VARIABLES IF YOU ARE COMPARING DISTANCES TRAVELED BY THE DIFFERENT STUDENTS' CARS.)*** 2. Average velocity can be calculated (Distance traveled/time it takes to travel that distance) The *average* velocity $\bar{v}$ of an object moving through a displacement (Δx) during a time interval (Δt) is described by the formula: $$\bar{v} = \frac{\Delta x}{\Delta t}.$$ 3 . Unit conversions can be made. Students may use the following website to make quick conversions between measured units. As a differentiated lesson enhancement, students may be asked to perform actual math operations. This is an advanced skill and should only be put in place if students have the prerequisite skills necessary for completion. http://www.onlineconversion.com/speed_common.htm • **MODIFICATIONS** - Students will be grouped together in teams of no more than 3 students, making sure that all strengths are represented in groups. (Data recorder, strong math student, etc.)

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<tr>
<td>Introduction/
Anticipatory Set</td>
<td>Anticipatory Set: Review the terms renewable and nonrenewable resources and view the Renewable/Nonrenewable Energy Power-point on the CEED website for 3rd grade. (http://ceed.frco.k12.va.us/?attachment_id=897)

Questions to ask students:
What energy resource is being shown by each of the pictures in the Power-point?
Which category would you place each example in? Why do you say this?
Which source of energy is the most powerful that is used here on earth?
How can solar energy be harnessed and used to produce electricity?</td>
<td>Introduction:
The class will discuss solar energy as a very powerful source of energy that all living things use.

The discussion will continue with the way to harness solar energy.

Students will be asked this question,
“Have you ever seen solar panels being used in real life? If so, where?</td>
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<td>Guided Practice</td>
<td colspan="2">Students will need to be placed into teams of no more than 3 people in a group. Each team has their own car.
As a class, discuss briefly about what will make the car move.
During a school day, 3 times need to be established to go outside and test the workability and distance traveled by the cars.
Predictions need to be made and recorded by student teams:
Which time of day do you think the car will go the farthest distance? Why?
Which time of day do you think the car will go the shortest distance? Why?
How far do you think your car will travel at each time of the day? Why?
How far will your car travel at a cloudy time? Why?
If the car gets into the shade, how can you possibly start it again without moving it with your hand?</td>
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<tr>
<td>Independent
Practice</td>
<td colspan="2">At the 3 chosen times daily, everyone goes outside. Teams of students try their cars out from an established starting point to see how far the cars travel.
They measure the distances traveled by their cars at those times and record these in their notebooks. There should be a recorder for each team. The same unit of measure needs to be used each time distances are recorded.
At the end of each day or at the end of the week, have teams discuss and compare the results to their predictions. Then have them explain possible reasons for their results.</td>
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	• At the end of the week, students should graph their data. • For those students who inquire about other light sources (like flashlights, light bulbs, etc.), these light sources/intensities could be tested as well. Results could be discussed and recorded, along with possible reasons why these results took place. • During the testing times, the teacher should be monitoring and questioning students about their results and why they believe these results happened the way they did.
Closure (Summary of Lesson)	Students should have their data graphed and explanations should be present to follow up on their original predictions. What are some advantages to using solar power? What are some disadvantages to using solar power?
CEED Building Application/ Sensor Data	Students will use the 3rd grade Power-point on the CEED website. 3rd grade students will also look at the CEED dashboard each day for this same week. A class discussion will take place to make general observations about the amounts of solar energy that are being collected to power/run the CEED building. What times of the days are the highest amounts and lowest amounts being collected by the solar panels? Students will be asked to explain their reasons for their explanations. These amounts could be compared to the very small (0.5 watt) solar panels that power their cars.
Assessment	Students completed data charts and graphs can be assessed. Students should write down their conclusions drawn from the car investigation, including the advantages and disadvantages for using solar power. Students could also be asked to record all of the types of simple machines that are present in their solar cars.

INQUIRY LEARNING RESEARCH PROCESS GUIDELINES

The following table is just one guideline to use for developing your own inquiry materials. The seven steps in the Learning Research Process include not only how people learn but also how research is conducted. The heart of the design, the three-stage learning cycle of exploration, concept invention or formation, and application is embedded in the middle. In addition to these three stages, this design takes into account that learners need to be motivated to spend the time required for understanding complex subjects and that learners need to build this new knowledge onto prior knowledge. These are similar to the 5E and 7E learning models.

The Learning-Research Process

Steps in the Learning-Research Process	7E Equivalent	Component of the Activity
1. Identify a need to learn.	Engage	An issue that excites and interests is presented. An answer to the question *Why?* is given. Learning objectives and success criteria are defined.
2. Connect to prior understandings.	Elicit	A question or issue is raised, and student explanations or predictions are sought. Prerequisite material and understanding is identified.
3. Explore	Explore	A model or task is provided, and resource material is identified. Students explore the model or task in response to critical-thinking questions.
4. Concept invention, introduction, and formation	Explain	Critical-thinking questions lead to the identification of concepts, and understanding is developed.
5. Practice applying knowledge.		Skill exercises involved straightforward application of the knowledge.
6. Apply knowledge in new contexts.	Elaborate and Extend	Problems and extended problems require synthesis and transference of concepts.
7. Reflect on the process	Evaluate	Problem solutions and answers to questions are validated and integrated with concepts. Learning and performance are assess

Hanson, D. (2006). POGIL Instructor's Guide to Process-Oriented Guided-Inquiry Learning. Lisle, IL: Pacific Crest