



the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

Here Comes the Sun!

Grade Level	3	Subject	Science
<p>Objective(s): TSW use a model solar panel fan and a model solar panel powered house to see how the sun can be used to generate electricity.</p> <p>TSW gain a working knowledge of how a solar panel works to harness solar energy to provide electrical energy.</p> <p>TSW measure how much voltage is generated in sunlight compared to how much is generated in shade.</p> <p>TSW conclude that renewable solar energy is preferable to non-renewable energy resources from an economic and conservation standpoint.</p>		<p>SOL Addressed: 3.11 The student will investigate and understand different sources of energy. Key concepts include a) energy from the sun b) sources of renewable energy</p> <p>Next Generation Science Standards: -PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</p> <p>4-PS3-4 – Apply scientific ideas to design, test, and refine a device that converts energy from one form to another</p> <p>4 – ESS3 – 1- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.</p>	
<p>Materials Needed Per Class of 30</p> <p>and</p> <p>Prior Knowledge</p>	<ul style="list-style-type: none"> - 4 multimeters (meters can be shared; I will try to get at least 4 by borrowing from the community) - 5 (up to 7 for 30 students) solar powered fans - 1 (up to 3 for 30 students) mini solar powered house kits (all kits need to be assembled prior to class) - notebooks and pencils - 5 solar powered calculators (borrowed from community/school) <p>The solar houses and mini solar powered fans can be obtained from https://us.vwr.com Multimeters can be purchased at Lowe’s but are somewhat expensive, so I will try to borrow them instead of buying them.</p> <p>**Prior Knowledge: Students in third grade will need to have a background knowledge of electricity and circuits before they work with the model and mini solar panels. We will also need to briefly discuss how many kilowatt hours a typical household uses in one day so we have a frame of reference. The teacher could use his/her own house/electric bill for this. A discussion of coal power generated electricity and how AEP is our source is warranted. Students will also need to learn how to hook up and read a voltmeter/multimeter.</p>		
<p>Ways to differentiate this lesson plan</p>	<p>EXTENSION for Higher Level Learner Students can read about and construct a solar powered oven and try cooking something on it. Students would need Internet access, aluminum foil and cardboard, cutting tool and a small pizza to cook in the oven. www.solar-energy-for-homes.com: shows how to make a solar oven and how to use it</p> <p>MODIFICATIONS Students will need to be in groups of 4 to 5 for this activity.</p>		

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	<p>Anticipatory Set: How will the teacher introduce the lesson to the students?</p> <p>Discussion of renewable energy resources and possible uses of them. Brief discussion of previously presented basic knowledge of how electrical energy works and is used to power electrical appliances such as a calculator.</p> <p>Questions to ask students:</p> <ul style="list-style-type: none"> • What are the small windows on a solar powered calculator for? • How do you think the sun can be used to generate the electricity to turn on the calculator? • What advantages can you list for solar power over coal generated electricity? • What disadvantages can you list for solar power over coal generated electricity? 	<p>Introduction:</p> <p>Review the terms renewable and nonrenewable resources and view the Renewable/Nonrenewable Energy PowerPoint on the CEED website for 3rd grade. (http://ceed.frco.k12.va.us/?attachment_id=897)</p> <p>View a solar panel and a solar cooker online at www.solar-energy-for-homes.com</p> <p>We will also go to the CEED site and look at the building and the solar array in particular. I will explain in simple terms how a solar panel works. This is where an explanation and discussion session on electricity/ DC/AC power would be necessary.</p>
<p>Guided Practice</p>	<p>(This lesson will take longer than one typical class period to complete.)</p> <ul style="list-style-type: none"> - Students will look at the calculators, take a look at the online solar panel, and the CEED website first. - Students will review renewable resources and name all 5 by reviewing with CEED PowerPoint. - Students will discuss and be able to hold a multimeter and the teacher will give instruction about how to read it. - Students will move into predetermined groups and take our mini solar panel fans outside and test them out in sunlight (recording voltage generated) and then in shade, once again recording data. Students will record these same voltage measurements during the morning, around midday and finally during the later afternoon. (4 multimeters= 5 groups; each student will have a chance to read and record data; each student will be responsible for turning data and written conclusions) - Students will discuss and write conclusions after analyzing data about solar powered fans. - Students will take out pre-constructed solar model houses outside, measure voltage produced, and once again recording their findings. Data will be gathered in sunlight and shade. - Students will discuss and write conclusions about solar energy and its use from their observations. Student groups will lead their own discussions then we will debrief as a whole group. <p>At this point, the class will go to the CEED center website and see actual voltage numbers generated in the same week the class exploration was done and discuss the meaning of the graph on the site, what it means, and then move into a discussion of the power grid, AEP, and the cost of starting to use renewable energy versus the long term cost savings and benefits to the environment. This discussion and writing will take more than one class period.</p>	

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Independent Practice	Independent practice will include discussion within student groups first after gathering our data. Individual students will write conclusions based on small group discussion, then the whole group will listen to conclusions and questions together. Discussion is meant to lead students to the conclusion that renewable energy resources are preferable to our current non-renewable resource generated electricity currently in place.
Closure (Summary of Lesson)	To conclude, students will discuss how solar energy is advantageous, what some of the problems are to obtaining it and using it, and possibilities for its use that are currently on the table. The group will also compare/contrast it to wind energy by using CEED website data and draw conclusions about which students would prefer and why.
CEED Building Application/ Sensor Data	(See guided practice and closure above.)
Assessment	The student assessment for this activity may contain both formal and informal components. Students with experience in activity based instruction may be provided with a rubric and students experiencing this type of instruction for the first time may require more guidance. This teacher’s preference is a written assessment that refers to the data. This is an ambitious goal for third graders, but this lesson can be adapted for higher grade levels.

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 <i>Why?</i> is given. Learning

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		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