



## Exploring Solar Energy

<b>Grade Level</b>	3	<b>Subject</b>	Energy Resources
<b>Objective(s): The student will be able to...</b> <ol style="list-style-type: none"> <li>1. Identify the sun as a renewable source of energy</li> <li>2. Explain how solar energy is collected and used</li> </ol>		<b>SOL Addressed:</b> Science 3.11- 3.11 The student will investigate and understand different sources of energy. Science 3.1- The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations	
		<b>Common Core Standards:</b> 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	
<b>Materials Needed Per Class of 30  and  Prior Knowledge</b>	<b>Materials:</b> <b>Part 1-</b> 30 snack size Ziploc bags 300 UV beads (10 per student) Bottles of a variety of sunscreens (lotion, spray, various SPF, etc.) <b>Part 2-</b> 8-10 clear plastic cups (1 per small group) 1 roll Saran Wrap 4-5 rubber bands Black and white construction paper 8-10 thermometers (1 per small group) Water <b>Part 3-</b> 5 Volta Racers (or other solar cars)  <b>Prior Knowledge:</b> Students should be able to identify natural and renewable resources. Students should also know that heat and light are forms of energy.		
<b>Ways to differentiate this lesson plan</b>	<ul style="list-style-type: none"> <li>• <b>EXTENSION</b> for Higher Level Learner  <b>Part 1:</b> Allow the higher level learners to experiment independently. Give the students multiple sunscreens to use to determine which protects from UV light the best. The teacher can design the experiment or allow the students to design the experiment.  <b>Part 3:</b> Have the higher level learners design an experiment to complete with the Volta Racers.</li> <li>• <b>MODIFICATIONS</b>  <b>Part 1:</b> As a group, experiment with a variety of different sunscreens; or, have the students make</li> </ul>		

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	<p>observations as the teacher leads the experiment.  <b>Part 2:</b> As a class, create different solar collectors and observe the small set of collectors as a whole group.</p>	
<b>Introduction/ Anticipatory Set</b>	<p><b>Anticipatory Set:</b>  <b>Part 1-</b> Review concepts including energy, natural resources, and renewable versus nonrenewable resources.  <b>Part 2-</b> Review how the students know the sun has energy.  <b>Part 3-</b> Review the sun as a source of energy and how people collect it.</p> <p><b>Questions to ask students:</b>  <b>Part 1-</b> What is energy? Why do we need it? What are natural resources? What is the difference between a renewable and nonrenewable resource?  <b>Part 2-</b> How do you know the sun has energy that we can use? What else uses energy from the sun? How do they (plants) collect the solar energy?  <b>Part 3-</b> What do humans use to collect solar energy? How do we use the solar energy we collect?</p>	<p><b>Introduction:</b>  <b>Part 1-</b> This part will have little introduction. The students should be able to explore and engage in the lesson using only their schema.  <b>Part 2-</b> Last time the class was together, we studied what solar energy can do. Now that we understand what solar energy is, we have to figure out how to trap it.  <b>Part 3-</b> We have learned what solar energy is and how to collect it. But we can't use the energy we collected in our solar collectors to power a TV, cell phone, or lights; so, the last thing we have to do is change the solar energy into usable energy.</p>
<b>Guided Practice</b>	<p><b>Part 1-</b>  (Inside) The teacher will give each student a bag containing 10 UV beads. The teacher should allow the students to have 1-2 minutes to look at the beads and make observations. As a whole, the teacher should facilitate a discussion about the students' observations.  What do the students notice about the beads? What color are they? How many are there?  Make a prediction about how we might use the beads to help us investigate the sun and it's energy?  After the discussion, the teacher should take the students outside (make sure they have their bags with them)</p> <p><b>Part 2- *note: this lesson is adapted from "ELEMENTARY EXPLORATION: Solar Collectors" attached as additional materials</b>  (Inside) The teacher will break the students into 3 or 4. Each group will be given directions to make one solar collector. There should be 4 different kinds of solar collectors made:</p>	

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	<ol style="list-style-type: none"><li>1. White construction paper, no cover</li><li>2. Black construction paper, no cover</li><li>3. White construction paper, cover</li><li>4. Black construction paper, cover</li></ol> <p>Before the appropriate solar collectors are covered, the teacher should fill all the collectors with about 2 inches of cold water.</p> <p>The students should put a thermometer in each collector and cover the appropriate collectors using Saran Wrap and a rubber band. After a couple minutes, the students should read and record the temperature of their water. The teacher should then take the students with their solar collectors outside.</p> <p><b>Part 3-</b> (Inside) As a whole group, explore the CEED dashboard with a focus on the solar panels. The teacher should relate back to solar energy and solar collectors. Discuss how the solar panels help the CEED Building be efficient and produce usable energy. Ask students for their birthdays and look to see how much solar energy was collected on their birthday.</p> <p>Why is more solar energy collected on summer birthdays than on winter birthdays?</p> <p>The teacher will introduce the Volta Racers and discuss how they use solar collectors and convert solar energy into usable energy. The teacher will then divide the students into small groups (5-6 students) and take the students and cars outside.</p>
<b>Independent Practice</b>	<p><b>Part 1-</b> (Outside) The teacher should tell the students to find somewhere to put their bags (allow the students to place their bags anywhere, even in shaded areas). The students should observe their beads for 5 minutes. After 5 minutes, the teacher should bring the students together and facilitate a discussion.</p> <p>Where did you put your beads? What happened to your beads? If you put your beads in the shade, did they change color, too? Did the beads in the shade change as much as the beads in other places? Where did the beads change color the most? Why do you think the beads changed color? If the beads change color because of the sun, then why did the beads in the shade change color, too?</p> <p>Once the students understand that the beads change color because of solar energy, the teacher should facilitate a discussion on the effect of the sun's energy on people.</p> <p>If the sun's energy can change the color of the beads, what else do you think it can do? What can it do to people? How can we stop the sun's energy from hurting us?</p> <p>When the students begin to talk about sunscreen, the teacher will give the students sunscreen to put on their bags. Ask the students to place their bags in the sun for another 5 minutes.</p> <p>What happened to the beads this time? What stopped them from changing colors? Does change anything you will do when you play in the sun?</p> <p><b>Part 2-</b> (Outside) The students should place their solar collectors in a sunny place. The class can either wait outside for or go back out in 10 minutes. After the time is up, have the students re-read and re-record the temperature on the thermometers. Have the students calculate the change in temperature of their water and discuss whose solar collector worked best.</p> <p>What happened to the temperature of your water? How much did it change? Whose</p>

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	<p>temperature changed the most? Why did their solar collector get warmer? How did the solar collectors collect solar energy?</p> <p><b>Part 3-</b> (Outside) Allow the students to explore the solar cars in their small groups. The teacher can choose to organize races or time trials, as well.</p>
<p><b>Closure (Summary of Lesson)</b></p>	<p><b>Part 1-</b> The teacher will take the students back inside with their beads. Ask the students to share something they learned about energy from the lesson (i.e. “the sun gives off light and heat energy,” “you should wear sunscreen outside to block UV light,” etc.).</p> <p><b>Part 2-</b> The teacher will take the students back inside with their solar collectors. The teacher will relate this lesson back to the UV bead lesson. Why do we need solar collectors? Is solar energy renewable or nonrenewable? Can we use the energy we collected with our solar collectors?</p> <p><b>Part 3-</b> The teacher will take the students back inside with the Volta Racers. The teacher should use this lesson to wrap the whole concept of solar energy together. How did the Volta Racers use solar energy? How did they collect the solar energy?</p>
<p><b>CEED Building Application/ Sensor Data</b></p>	<p>See Guided Practice, Part 3.</p>
<p><b>Assessment</b></p>	<p><b>Part 1-</b> Ask the students to complete an exit ticket answering the question: How do you know the sun is an energy resource?</p> <p><b>Part 2-</b> Ask the students to complete an exit ticket answering the question: If I was going outside on a hot day, would I want to wear a white shirt or a black shirt? Why?</p> <p><b>Part 3-</b> If you had a car that could run off of solar energy would you be able to drive your car anywhere at anytime?</p> <p><b>All Parts-</b> Unit Assessment on Energy Resources</p>

**INQUIRY LEARNING RESEARCH PROCESS GUIDELINES**

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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**

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

## ELEMENTARY EXPLORATION: Solar Collectors

Solar collectors absorb radiant energy, convert it into heat and hold the heat.

**PURPOSE:** To explore solar collection.

**MATERIALS:** 4 plastic containers, black & white construction paper, water, thermometer, plastic wrap, rubber bands, scissors

- Step 1: Cut two circles each of white and black construction paper to fit the bottom of the containers. Place the circles on the bottom of the containers and cover with 100 ml of cold water. Record the temperature of the water.
- Step 2: Cover one black and one white container with clear plastic wrap held in place with rubber bands.
- Step 3: Place the containers in a sunny place so that the sun is directly over the containers. Record the temperature of the water after ten minutes.
- Step 4: Calculate and record the changes in temperature.

### RECORD THE DATA

	WHITE NO COVER	BLACK NO COVER	WHITE WITH COVER	BLACK WITH COVER
Original Temperature-C				
Temperature-C After 10 min				
Change in Temperature				

**CONCLUSIONS:** Look at your data. What have you learned about collecting solar radiation?

