Solar Panels on Ice
A Discussion of Radiant and Thermal Energy

Subject: This lesson explores people's common misconception that heat is necessary for a solar panel to produce electricity

Grade Levels: 7-12

Lesson length: 60 min

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Have you ever noticed how the display of your cell phone changes when exposed to extreme heat conditions? For instance, what happens when on a hot summer day you go to the pool and leave your phone in direct sunlight? Most cell phones shut down and produce a warning to the user. Temperature affects how electricity flows through an electrical circuit by changing the speed at which electrons travel. In metals, this is due to an increase in resistance of the circuit that results from an increase in temperature. Likewise, resistance is decreased with decreasing temperatures. Temperature effects the voltage of electrical devices but will it also effect the efficiency of a solar panel? A popular misconception is that solar panels do not work in cold regions. This is simply not true—in fact it's quite the opposite. Heat is the enemy of solar panels; what happens is that during the summer the days are longer which more than makes up for the impact. Not all solar panels are created equal and the impact of heat is one of the critical aspects that sets brands apart. An important module specification is called the "temperature coefficient". If the temperature coefficient rating of a panel is -0.46%, this means for each degree over standard testing conditions (STC= 25 °C) the module's output is reduced by -0.46%.

Objectives

People often have the misconception that heat is necessary for a solar panel to produce electricity, and the related misconception that the hotter the temperature the more electricity is produced. In this lesson, participants will investigate the voltage of a solar panel that has been placed on dry ice and compare it to a panel that has not been exposed to dry ice. Through these experiments, students will understand that radiant light is the driving force behind photovoltaic responses, and how temperature affects the efficiency.

Materials

- 2 Solar panels
- Cardboard to cover panels
- Alligator clips
- Dry ice
- Temperature gun
- Multimeter
- Worksheet and pencil

Instructions

Part 1: Scientific Method

Participants will answer the following questions:

Does the temperature outside affect the efficiency of a solar panel? Write down your hypothesis:

What are the independent variables in your experiment?

ANSWER: Temperature

What are the dependent variables in your experiment?

ANSWER: Voltage

What variables do you need to keep constant?

ANSWER: Time

What procedure would you use?

Part 2: Solar cell not exposed to ice

1) Obtain a solar panel that has NOT been exposed to ice from your teacher.
2) Using a temperature gun, take the initial temperature of the panel.

3) Place the panel in direct sunlight.
4) Attach the multimeter to the panel by using the alligator clips.
5) Record the voltage in table #1 every 30 seconds for 4 min.
6) Cover the panel with the piece of cardboard.
7) Record the voltage in table #2 every 30 seconds for 4 min.

Data Table #1 Uncovered solar cell (NOT exposed to ice) initial temperature of cell _______	
Time (sec)	Voltage (V)
30 sec	
60 sec	
90 sec	
120 sec	
150 sec	
180 sec	
210 sec	
240 sec	

Data Table #2 Covered solar cell (NOT exposed to ice) initial temperature of cell _______	
Time (sec)	Voltage (V)
30 sec	
60 sec	
90 sec	
120 sec	
150 sec	
180 sec	
210 sec	
240 sec	

Data Table #3 Uncovered solar cell (EXPOSED to ice) initial temperature of cell _______	
Time (sec)	Voltage (V)
30 sec	
60 sec	
90 sec	
120 sec	
150 sec	
180 sec	
210 sec	
240 sec	

Data Table #4 Covered solar cell (EXPOSED to ice) initial temperature of cell _______	
Time (sec)	Voltage (V)
30 sec	
60 sec	
90 sec	
120 sec	
150 sec	
180 sec	
210 sec	
240 sec	

Part 2: Solar cell exposed to dry ice

8) Obtain a solar cell that HAS been exposed to ice from your teacher.
9) Using a temperature gun, take the initial temperature of the panel.
10) Place the panel in direct sunlight.
11) Attach the multimeter to the panel by using the alligator clips.
12) Record the voltage in table #3 every 30 seconds for 4 min.
13) Cover the panel with a piece of cardboard.
14) Record the voltage in table #4 every 30 seconds for 4 min.
15) Collect and compare data.

Assessment

Construct 2 line graphs using Table #1 and Table #3. Use the following questions to reflect on the activity:

1) Is the panel more efficient when it has been exposed to ice or not? Use your data to explain your answer.
2) What effect did covering the panel with cardboard have on the voltage?
3) What would an engineer need to consider when designing a solar array (system) in your area?
4) Where do you think would be the best place (countries around the world) to place solar panels? Participants might plot them on a googlemap.