

Teacher(s): Schmidt	Unit Title: Circuits and Electricity
Subject: Physics	Lesson Title: Investigating Temperature Effects on PV Arrays
Grade Level(s): 11/12	
Date(s): July 18, 2014	Lesson Length: 1 Class Period (65 minutes)

- **Learning Goal(s)** [What should students know, understand, or be able to do as a result of this lab or activity.]
 Students will be able to measure current and voltage using a Multimeter.
 Students will be able to calculate the power of a PV array using voltage and current.
 Students will understand the effects of temperature on solar panel efficiency.
- **Energy Connection** [How is this lesson connected to energy or renewable energy concepts.]
 Students will be able to apply concepts learned in class (voltage, current, etc.) to solar power. Students will gain a deeper understanding as to how solar panels work and the variables involved in determining their efficiency.
- **Connection to Standards** [List local, state, and/or national standards addressed by this lab or activity.]

 - S1C1: Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.
 - S1C3: Evaluate experimental design, analyze data to explain results and propose further investigations.
 - S5C5: Understand the interactions of energy and matter.
- **Materials and Resources** [List materials, handouts, and any other resources needed to complete this lab or activity.]
 Lab handout, 500 W Halogen Lamp, 1 W Solar Panel, Frozen Ice-Packs, Alligator Clip Wires, Multimeters, 1 Low Power DC bulb.
- **Procedure** [List all necessary steps for the lab or activity.]

 1. Attach the Multimeter to the PV array wired in series with an electrical load.
 2. For Room Temperature, arrange the Halogen lamp so that the solar panel is receiving direct light. Record data in room temperature chart.
 3. For Cooled Array, place solar panel on an ice pack and cover with a second, then allow it to cool for a five minutes. While still on the ice packs, record data on Cooled Array table.
 4. For Warm Array, warm the panel with the halogen light for 10 minutes before recording new data in the Warm Array table.
 5. Students should complete check for understanding questions before coming together for a group discussion.
- **Technology Integration** [List and/or describe the technology that will be used and how it will be integrated into the lesson.]

This lab includes the use of solar technology to generate the power being measure by students. Multimeters will be used to measure voltage and current for calculating power output.

- **Modeling & Guided Practice** [List and/or describe any modeling or guided practice] Teacher will model measuring voltage and current from the Multimeter, and how to use that information to calculate power output.
- **Checks for Understanding** [Identify when and how checks for understanding will be done.]
Questions included on lab sheet to check for understanding.
 - 1) Based on the data you have collected, what is the effect of the temperature on energy production of a solar system?
 - 2) When comparing two solar sites, such as Arizona and Oregon, what would be the positives and negatives of each potential site?
 - 3) What measures could be taken to increase the power output of a solar system in a hot desert setting. Come up with three ideas and describe them.
- **Independent Practice** [List and/or describe any work students will be asked to do independently to reinforce the learnings associated with this lesson.]
- **Assessment & Closure** [Describe how this lesson will be brought to a close and how student understanding will be assessed.]

After completion of lab sheet discussing scale and how this lab compares to a 5 kWh system on a house, or a solar farm.