



## Introduction to the Photovoltaic Effect

**AUTHOR:** Clayton Hudiburg

**DESCRIPTION:** This lesson begins with basic chemistry with regards to atomic structure. The lesson then moves to understanding the special properties of silicon as a photoelectric semiconductor. Building on this, the basic structure of photovoltaic solar cells is described in detail.

**GRADE LEVEL(S):** 9, 10, 11, 12

**SUBJECT AREA(S):** Chemistry, electricity, physics, photovoltaics

**ACTIVITY LENGTH:** 1 hours, 40 minutes

### **LEARNING GOAL(S):**

- Students will be able to describe the basic structure of a photovoltaic solar cell.
- Students will be able to outline or summarize how solar cells produce electricity.
- Students will be able to explain why silicon, boron and phosphorous are most often used to construct solar cells.

### **STANDARDS MET:**

#### **Common Core:**

- WHST.11-12.8. Gather relevant information from multiple authoritative print and digital sources.
- WHST.9-12.7. Conduct short as well as more sustained research projects to answer a question or solve a problem.
- RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.

### **Next Generation Science Standards:**

- PS1.A. Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons and surrounded by electrons. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.
- PS2.B. Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter as well as the contact forces between material objects.

Solar 4R Schools™ is a program of BEF.

**BONNEVILLE** : 240 SW 1st Avenue  
**ENVIRONMENTAL** : Portland OR 97204  
**FOUNDATION** : 503-248-1905  
: [www.b-e-f.org](http://www.b-e-f.org)

- PS3.B. Energy cannot be created or destroyed, but it can be transported from one place to another or transferred between systems.
  - PS4.B. Photoelectric materials emit electrons when they absorb light of a high enough frequency.
- 

### Student Background:

- This lesson assumes little to no chemistry background, but even if students have a strong background in chemistry, they should find the review helpful.
- My students will be completing this unit near the end of the school year after having already been through units on energy and climate change. Therefore, I am taking for granted that they already understand the need for technology such as photovoltaics, along with an understanding of the difference between renewable and nonrenewable resources.

### Educator Background:

- If you are not particularly confident teaching the structure and “how it all works” aspects of photovoltaic technology, you can probably learn to do so with a few hours of searching the Internet. The YouTube video you will show the students was also helpful for me as a primer.
- If you are unfamiliar with Cornell Notes feel free to have students take notes using whatever format you generally permit.

### Other Materials List:

- Computer access to show/watch YouTube video
- “Student Worksheet #1” (one per student)
- “Photovoltaic Effect Summary Scoring” (cut in half, one per student)
- “Macro-Scale Photovoltaic Technology” PowerPoint presentation
- Cornell Notes paper

### Vocabulary:

- Semi-conductor
- Electrons
- Photons
- Silicon
- Solar Cell
- Doping
- N-type silicon
- P-type silicon
- Boron

Solar 4R Schools™ is a program of BEF.

- Phosphorous
  - Electrical Load
- 

## Lesson Details:

### Day 1:

#### **Opening (20-30 minutes)**

Hand out Student Worksheet #1. The list of key vocabulary at the top of the student sheet should probably be addressed prior to watching the video. Feel free to employ your own personal methods for introducing new vocabulary.

Before showing the video, have the students read the prompt and guiding questions as a focus for their note taking.

### Day 1 and 2

#### **Body (30-40 minutes)**

Have the YouTube clip (<http://www.youtube.com/watch?v=u0hckM8TKY0>) loaded and ready to show the students. I recommend watching the video once or twice prior to showing the students so that you can identify good places to pause and clarify, or to review a particular segment.

### Day 2

#### **Conclusion (30 minutes)**

Go through the first few slides of the Macro-Scale Photovoltaic Technology PowerPoint presentation and allow the students ample time to do the collaboration and summary. This may take more or less time than indicated on the slides depending on the level of your students.

#### **Assessment:**

I suggest establishing a scoring rubric or itemized scoring guidelines for the student summaries. At this point I would structure the evaluation as formative rather than summative.

Solar 4R Schools™ is a program of BEF.

**BONNEVILLE** : 240 SW 1st Avenue  
**ENVIRONMENTAL** : Portland OR 97204  
**FOUNDATION** : 503-248-1905  
: www.b-e-f.org