**Solar Cells and Solar Panel Workshop Instructors Guide**

In this workshop you will explore the electronics and engineering of solar cells and then design and construct a solar panel.

Objectives

1. Understand the role that photovoltaics can play in our energy future
2. Experiment with solar cells and meters to discover and construct circuit rules
3. Use terminology of electricity volts, amps, watts in context
4. Use series and parallel circuits to design an arrangement
5. Gain experience with the engineering design cycle
6. Practice skills of soldering and work carefully to build a working device

Instructional Sequence

1. Introductory Slide Show- (refer to sections after completing each activity- let students discover design principles by experimentation if possible.)
2. Solar Cell Exploration-
	1. Measure the voltage of a variety of solar cells, under a light bulb, in the sun, try covering parts of the cell in one direction and then the other,
	2. Tilting the cells with respect to light source while measuring angle and voltage. Discuss what you have learned about the cells. Record observations on the data sheet.
	3. Series and parallel circuits- use the encased mini cells to try different circuits- measure voltage and current
	4. Try unequal size cells in series and parallel = (parallel tracks must have same area)
	5. Measure current from cell with a diode placed in different orientations
3. Discussion of results and continue presentation presenting rules.
4. Power calculations- Discuss definition of power and generate example of power requirements of different common devices. Calculate the power of sample cells and panels using the formula- P=I X V. Estimate number of cells
5. Panel Design- Define the use you intend to make of the panel. Select the cells and draw a schematic of how the cells will be arranged. Use the worksheet to calculate the voltage and current that you expect your panel to generate in full sun
6. Soldering- layout the pieces, cut the ribbon wire, practice on scraps and then carefully build a panel. Tab the top side of each cell first. Flip the over and use tape to hold the cells in position while soldering down free tabs to the connection spot on the back side. Test connections as you go and test the whole thing before housing it. Add diode to circuit in the right direction. The striped end of the diode is the cathode, the other end is the anode. The anode should be connected to positive side of the cell (the back).
7. Housing- use hot glue to secure the cell array at a few spots. Solder to the flat ribbon to regular insulated wire with an extra bend and extra glue so it can’t pull loose. Use a dab of hot glue at each corner then gentile press the top plate down without crushing the cells. Apply clear packing tape to the edges to seal the unit.
8. Try it out.

Vocabulary

Solar cell- a single wafer having the characteristic voltage of the basic material

Solar panel- an array of many solar cells, wired in series and parallel and usually encapsulated in a durable container to protect the cells

Diode- and electronic device which allows current to flow in only one direction. This is a necessary part of a battery charging circuit to prevent the battery from discharging into the solar panel at night.

Semiconductor- a type of material which conducts electricity under some conditions but not others

Power- the rate of total energy flow – equal to volts x amps- measured in watts

Voltage- the potential difference or electromotive force- measured in volts

Current- the flow of electrons over time measured in amps

Kilowatt hour- an amount of energy equivalent to 1000 watts expended for one hour.

Parallel circuit- an arrangement in which electricity can flow through more than one path to the same destination

Series circuit- an arrangement in which all electricity must flow through the same single path.

Videos

Soldering solar cells

<https://www.youtube.com/watch?v=NJYaI3NGfXk>

Materials and tools

Electric Meter

Flat rigid surface

weights for holding down ribbon

solder

flux

40 watt soldering iron $8.95

[http://www.amazon.com/gp/product/B0006NGZK0/ref=oh\_aui\_detailpage\_o02\_s00?ie=UTF8&psc=1shotkey diode](http://www.amazon.com/gp/product/B0006NGZK0/ref%3Doh_aui_detailpage_o02_s00?ie=UTF8&psc=1shotkey%20diode)

diodes- 3 am 20 pack $8.99

[http://www.amazon.com/gp/product/B0068AF32Q/ref=oh\_aui\_detailpage\_o02\_s00?ie=UTF8&psc=13x6](http://www.amazon.com/gp/product/B0068AF32Q/ref%3Doh_aui_detailpage_o02_s00?ie=UTF8&psc=13x6)

Encased practice solar cells for exploration- Pitsco

<http://www.pitsco.com/Solar_Mini_Panels>

solar cells- 1.8W $36 for 36

[http://www.amazon.com/dp/B008A090L2/ref=wl\_it\_dp\_o\_pC\_nS\_img?\_encoding=UTF8&colid=WH6BS871V8F3&coliid=I3TZB8816BQFYC](http://www.amazon.com/dp/B008A090L2/ref%3Dwl_it_dp_o_pC_nS_img?_encoding=UTF8&colid=WH6BS871V8F3&coliid=I3TZB8816BQFYC)

186 soldering flux 3.50

[http://www.amazon.com/gp/product/B00EWLA24C/ref=oh\_aui\_detailpage\_o01\_s00?ie=UTF8&psc=1](http://www.amazon.com/gp/product/B00EWLA24C/ref%3Doh_aui_detailpage_o01_s00?ie=UTF8&psc=1)

tab wire, pre-tinned 200 fit roll $12.95

[http://www.amazon.com/gp/product/B00E28OG8S/ref=oh\_aui\_detailpage\_o03\_s00?ie=UTF8&psc=1](http://www.amazon.com/gp/product/B00E28OG8S/ref%3Doh_aui_detailpage_o03_s00?ie=UTF8&psc=1)

Small electric motor

<http://www.goldmine-elec-products.com/prodinfo.asp?number=G18050>

Small motor with fan blade

<http://www.goldmine-elec-products.com/prodinfo.asp?number=G18541>

Or get a single user set with multiple cells, ribbon, flux and solder…

Solar cell sample kit $14.95

<http://www.siliconsolar.com/solar-cell-sample-pack-p-84.html>