**LESSON 3**

SOLAR ENERGY LAB

GOALS

1. Understand the science behind solar energy
2. Knowing what conditions maximize and minimize solar energy output
3. Calculate the impact of solar energy

MATERIALS

a. Solar Kits (Solar panels, Multi-meters, Alligator Clips and Wires and LED lights)

b. Data graphing programs or plain paper

c. Solar Energy Lab: Worksheet

BENEFITS

a. Create scientists by working on hand’s on experiments, using the Scientific Method

b. Inspire students to be scientifically curious and interested

ADVANCE PREPARATION

Review the presentation and lesson materials ahead of time.

HANDOUT LIST

1. Solar Lab PPT
2. Solar Lab Work Sheet
3. Solar Energy Explained Presentation (if didn’t do lesson 2)

PROCEDURE

Duration: 90 minutes

Targeted Students: 6-8 Grade

 **Lesson Agenda:**

1. Introduction: Background and Review Information on Solar Energy (10 minutes)
2. Group Lab Work: Maximizing solar panel output (30 minutes)
3. Analysis, Discussion and Calculation (15 minutes)
4. Review Questions: What did you learn? (5 minutes)
5. Student Questions (15 minutes)

**1. Introduction:**

**Who can tell me about solar?**

**What are solar panels made of?**

 **(silicon with positive and negative side)**

**How does a solar panel work?**

**(radiant energy acivates the electrons who run into each and make energy)**

**How do solar panels harness the energy of the Sun?**

* + Diagram to draw on the board to help explain:



**2. LED Demonstration**

(hook up a solar panel to an LED and show how it works using ambient light, show how it works only if the negative and positive sides are lined up correctly)

**3. Group Lab-Work: Maximizing Solar Panel Output**

**Question:** What is the optimal direction and angle for a solar panel to be in order to have the highest voltage output?

**Hypothesis:**

(Ask students to guess)

**Experiment:**

* Students are divided into small groups. Each group receives a kit and handout.
* Students collect data on the current and voltage generated by their solar panel outside of the classroom. They use three different variations to measure the current and voltage.
	+ Three different variations are: -
		- Light intensity
			* Shade, direct sunlight, inside the classroom
		- Angle from sun (perpendicular, 45 degree, etc.)
			* Angle to the ground: 0,45,90
		- Orientation
			* North, East, South, West

Reminder: Consider the time of day and position of the sun

* Graph data in terms of the variations in groups using the supplied worksheet, If graphing is too hard, then any format of showing what they found is acceptable= example all data facing North - 0, 30, 45, 60, 90)

(Need to give examples of possible graphs to use,

* + How does the set up affect the current and voltage generated?
* Using Solar Energy to Power Lights:
	+ Connect circuit to power an LED light.

**3. Analysis, Discussion and Calculations:**

* Each group presents their data:
	+ How did the set up affect the voltage and current? Why?
	+ Have each group share what was their conclusion. You will get lots of answers, ask the students why the answers are so different-

(Possible Answers: Each group was in a different location, too many variables, inaccurate experience with the equipment, Sun is constantly shifting with the Earth Rotating....)

* Come to a consensus as a class for a **Conclusion**

(Possible Conclusion, more date is needed, too many variables involved)

1. Instructor Lead:
	* How can we maximize solar panel output at a larger scale?
	* In which countries would this technology prove to be favorable?

 **Additional Activity: How Much Sunshine is required to power California?**

 **\*** Support with a Presentation - How much solar energy do we need?--- Could use new data here...

 Duration: 10 minutes

* + Step 1: How much energy does California use in a day?
		- Hint: Used 288,245,000 megawatt hours in 2005
		- Answer: around 780,000 megawatts a day

(288,245,000 divided by 365- though this is still not correct answer but close)

* + Step 2: How much energy does one square mile of sunlight produce in 24 hours?
		- Hints;
			* One square yard of land receives 5 kilowatts of energy a day
			* Convert to square miles (1760 yards in a mile: 3,097,600 square yards in a square mile) (3,097,600\*5)
			* Most recent solar technology is at most 30% efficiency (multiply by 0.2)
			* Convert to megawatts (divide by 1000)
		- Answer: 3,098 megawatts of energy
	+ Step 3: How many square miles of solar plants will produce enough energy for California?
		- Hint: Use answers to previous two steps
		- Answer: 251 square miles (780,000 divided by 3098)
	+ Step 4: How much is 250 square miles?
		- Ex: comparison to Death Valley (more than 2000 square miles)
	+ Step 5: Think about it!

**4. Review:**

Class discussions. Have students share:

* + How does the solar panel work?
	+ What did they learn about the variation in solar energy output?

**Student Questions:**

Time allocated for students to ask questions regarding the lesson.