Name ______________________________ Date ___________ Period _______ Lab 12

Solar Power Analysis Lab

VIDEO INSTRUCTIONS

What if there was a solar panel on every roof? Would it be possible to produce enough energy from solar power to offset most of the use of natural gas and coal for generating electricity? In this engineering lab, you will develop a plan for powering your house or a portion of the school with solar power.

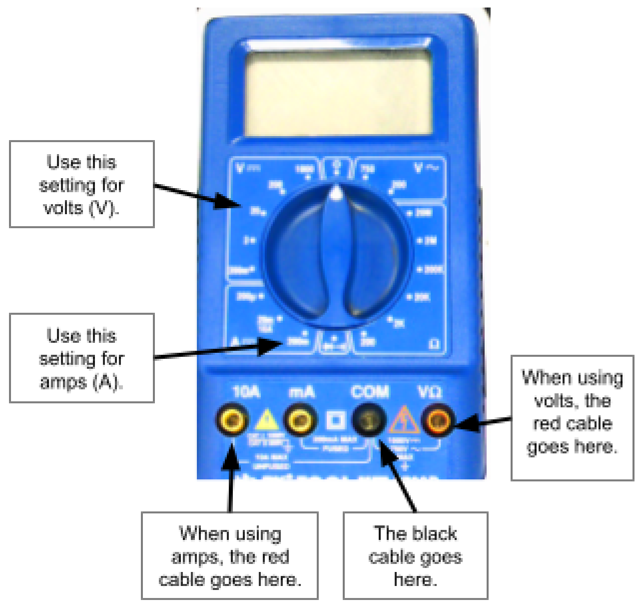
Background:

a. Research the percentages of electricity in the United States that comes from coal, natural gas, nuclear power, and renewable energy. See: https://www.eia.gov/energyexplained/?page=us_energy_home

b. You will estimate the number of watts possible from solar power by measuring the light intensity in the unit lux. Lux can be measured on a pocket lab or on a typical smartphone using the Google Science Journal app or Arduino Science Journal app. If the value is in EV, convert it to lux.

c. Lux measures light intensity, which is not the same as the watts that a solar panel produces. We will use a small solar panel to create a calibration curve between watts (y-axis) and lux (x-axis). Watts is calculated by multiplying the amps by volts, which can be measured with a multimeter (see diagram).

d. You will need to calculate the area of this solar panel. Area = length x width. Calculate the area and write the answer in the unit m^2. Dimensions: length & width.



e. Energy conversion factors:
W = A x V
kWh = kW x h
1 kWh = 3600 kJ

Procedure 1 -- calibration curve

1. For each group, obtain a pocket lab (or smartphone), multimeter, solar panel, black & red cable, ruler, protractor, & book.
2. Set the solar panel and pocket lab next to each other on a flat surface in full sun.
3. Record the lux value on the pocket lab (or smartphone).
4. Set the multimeter to voltage and connect the probes of the multimeter to the red and black wires of the solar panel. Record the voltage.
5. Repeat step 4 except set the multimeter to amps to record the amperage.
6. Now tilt the book to a 30 degree angle and set both the solar panel and the pocket lab/smartphone the edge of the book so they both have the same angle. Angle both the solar panel and the pocketlab/smartphone toward direct sunlight. Repeat steps 3 to 5.

7. Tilt the book to a 45 degree angle and a 60 degree angle. At each angle repeat steps 3 to 5. Obtain at least four measurements. You may also try pointing the solar panel away from direct sunlight to obtain additional measurements.

Data table 1

Volts	Amps*	Lux	Watts

Use Google sheets to create a graph of the watts (y-axis) vs. Lux (x-axis). Use the scatter graph format and include units in each axis label as well as a chart title. Insert a logarithmic trendline and display the equation on the chart. How to make graphs in Google Sheets (or video).

[Insert graph here]

Write the trendline equation:

Procedure 2 -- measuring light intensity

1. Identify an area at your house or the school where solar panels could be installed. Measure the area by measuring the length and width with a tape measure or other tool. Alternatively, you may use the measurement feature on Google Earth if the area is difficult or unsafe to measure. **Note: DO NOT CLIMB ON A ROOF.**
2. Go outside to measure the lux using a pocket lab, Google Science Journal app, or Arduino Science Journal app. Make one measurement every 2 hours from around 8 am to around 6 pm. Point the light sensor in the same direction and at the same angle each time. Try to make this angle and direction match the way the solar panels would face. For instance, if the solar panels will be on a roof angled toward the south. Angle your phone to the same angle as the roof and point the sensor to the south like the roof. **Note: DO NOT CLIMB ON A ROOF.**
3. Share at least one measurement here: data share.

Data table 2 (spreadsheet template):

[paste table from spreadsheet here]

Use Google sheets to create a graph of watts (y-axis) vs. hours (x-axis) here. Use the scatter graph format and include units in each axis label as well as a chart title. Insert a polynomial trendline with a degree of 2 and display the equation on the chart. How to make graphs in Google Sheets (or video).

[paste graph here]

Calculations (show work for all calculations and submit answers to Google Form):

1. Provide a diagram showing the location of the solar panels. Show the dimensions length & width of the solar panels in meters.

[insert diagram here]

2. Calculate the total area (m^2) of the solar panels in the diagram above. Area = width x length. **Show work.**

3. Using the total watt-hrs calculated in the data table and the area of the solar panel (pt. d), use conversion factors to calculate the **kilo**watts-hours (kWh) that could be produced in the area calculated in calculation 2.

4. Using the result from #3, Calculate the number of kWh that could be produced in a year by multiplying by 303. *Note: December and January have the least amount of available solar energy, so we will make a rough adjustment by omitting these two months from the annual solar energy.*

5. Obtain an electricity bill from your parents and lookup the annual electricity use in kWh. If you cannot find this number, use 9,000 kWh as an estimated value for a home. 2,860,000 kWh is the approximate annual electricity usage for Pitman High School.

6. Divide the answer in #4 by #5 and convert this value to a percent. This is the percent of your annual electricity use that could be offset with solar power.

7. Find or calculate from the electricity bill the annual amount paid for electricity.

8. Calculate the yearly savings by multiplying the percentage as a decimal from number 7 by number 8.

9. **Bonus:** research the cost of installing enough solar panels to cover the area in the diagram from number 1. Provide sources MLA style.

Conclusion:
Would this plan be cost effective? What other factors may need to be considered? Explain.

Sources (if any):