

LEARNING GUIDE

Programs Electrical

Module RENEWABLE ENERGY

Learning Unit Discovering the power of a
Solar Photovoltaic System

Introduction

The utility of a solar photovoltaic panel requires that the necessary components be arranged so that they maximize the energy gathered by the sun's rays. This learning guide will teach you how to arrange solar photovoltaic panels so that the energy derived from the sun will offer the most output from the photovoltaic panels. From this information we will maximize the effectiveness of the panels so that they produce as much energy as possible.

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Components of a Solar Photovoltaic System

Performance Objective: The student will determine how variables like angle of incidence, shadows and temperature affect the output of the photovoltaic cell(s).

Given: An instruction sheet, schematic, instructor lecture, photovoltaic panel(s), ice, aluminum foil and appropriate tools (not limited to but to include a multimeter, side cutting pliers, screwdrivers and a protractor).

The Student Will: Assemble and test a small photovoltaic panel for various output quantities, all the while reconfiguring the array for various angles of incidence and temperature.

How Well: You must successfully pass a knowledge test and a performance test.

NAME: _____

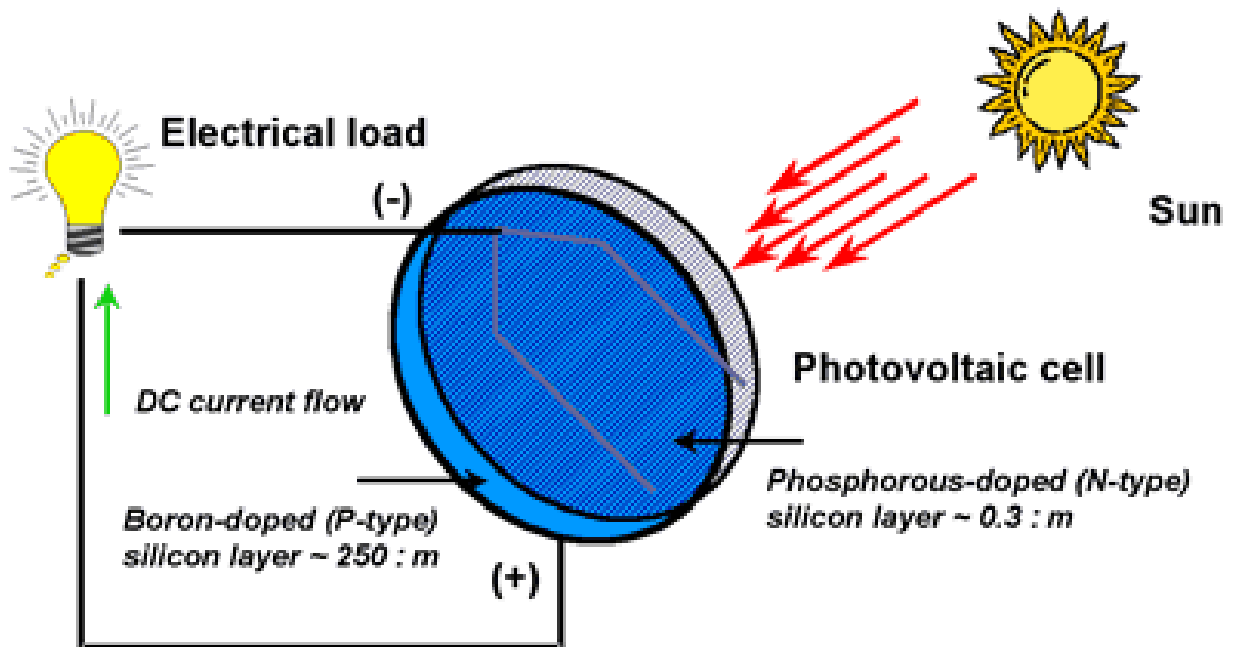
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GRADE: _____

INSTRUCTION SHEET

Photovoltaic Systems directly convert sunlight into electricity, and are made of a material called silicon. The simplest photovoltaic cells power watches and calculator, while more complex systems can light houses and provide power to the electrical grid schools and businesses.

Reading Assignment: Photovoltaic Fundamentals - <http://www.fsec.ucf.edu/pvt/pvbasics/>



COMPONENTS

Amp: Also known as Amperes. Amperes are a quantitative measure of current flow. Indicating the number of electrons flowing through a conductor.

Angle of Incidence: Angle that the sun meets the flat surface of the photovoltaic cell. This will vary according to the time of day.

Current output: The quantity of amperes flowing through the circuit at a particular time.

Compass: A tool used to determine magnetic heading.

Efficiency: A ratio of energy to waste.

Multimeter: A tool used to measure the quantities of voltage and current for the purposes of testing and evidencing the presence of electricity.

Orientation: Position relative to compass direction and elevation angle.

Photovoltaic System/Cell/Panel: Electric generating devices, which directly convert sunlight into electricity, are made of silicon.

Protractor: A tool used to determine angles and direction calibrated in degrees.

Volt: Also known as potential. The unit used to measure the force of electricity in a circuit.

Watt: A function of volts multiplied by amperes. A watt is a standard unit of power usage.

Wire: Also known as a conductor. A wire is an insulated piece of copper used to carry electricity from one place to another.

Massachusetts Frameworks/Technology (HS)

5. Energy and power Technologies-Electrical Systems

Broad Concept: Electrical Systems generate, Transfer, and Distribute Electricity

5.1 - Describe the different instruments that can be used to measure voltage.

5.2 – Identify and explain the components of a circuit including a source, conductor, load and controllers.

5.3 – Explain the relationship between resistance, voltage, current and Ohm’s Law.

5.4 – Determine the voltages and currents in a series circuit and a parallel circuit.

5.5 – Explain how to measure voltage, resistance and current in an electrical circuit.

5.6 – Describe the differences between Alternating Current (AC) and Direct Current (DC)

Massachusetts Frameworks/Science (HS)

Broad Concept: Stationary and moving charge particles result in the phenomenon known as electricity and magnetism.

5.4 - Develop a qualitative and quantitative understanding of current, voltage, resistance and the connection between them.

5.5 – Identify appropriate units of measurement for current, voltage and resistance and explain how they are measured.

5.6 – Analyze circuits (find the current at any point and the potential difference between any two points in the circuit) using Kirchoff’s and Ohm’s Laws.

KNOWLEDGE TEST

Directions

Evaluate your knowledge by achieving “Proficient” on the following question.

Explain how the angle of incidence affects the voltage reading on the meter. Include how shadowing and compass heading affect this reading.

Grading Rubric

Mastery

Complete and accurate account including correct terminology, direction, and usage of meters.

Proficient

Basically accurate account, student lacks a complete understanding of component operation

Needs Improvement

Incomplete data, does not understand the operation of the system

PERFORMANCE TEST

Directions

Given access to a work station, the proper tools, and the schematic drawing in this learning guide, you will design and install all of the components required for a solar photovoltaic system. You will be evaluated for attainment of this task based on the items listed below.

Performance Standards All items must be marked YES for attainment	Yes	No
PROCESS		
1. Were all safety rules observed?		
2. Are all components installed as per drawing?		
3. Are all components installed in proper sequence?		
4. Are all straight and neat?		
5. Were all meters used properly?		
6. Are all terminations tight?		
7. Was the installation in accordance with the <u>National Electrical Code</u> ?		
8. Did the student return all excess materials and tools to the designated area?		

List of RESOURCES

Photovoltaic Fundamentals - <http://www.fsec.ucf.edu/pvt/pvbasics/>