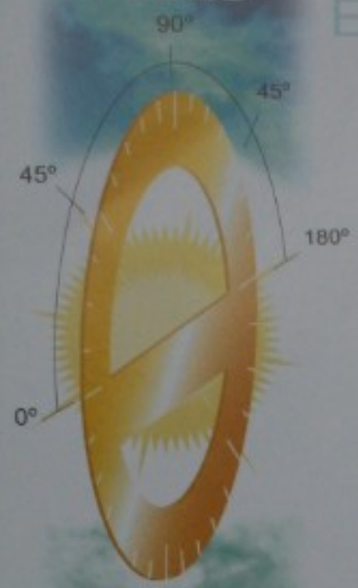


Experiment 05

The Sun Compass
A Device for Tracking the Sun

Objective

Using two small solar modules and a motor, students build a device that actively points toward the sun and follows or tracks the sun throughout the day. If the students change the orientation of the pointing device, it will move back to face the sun.

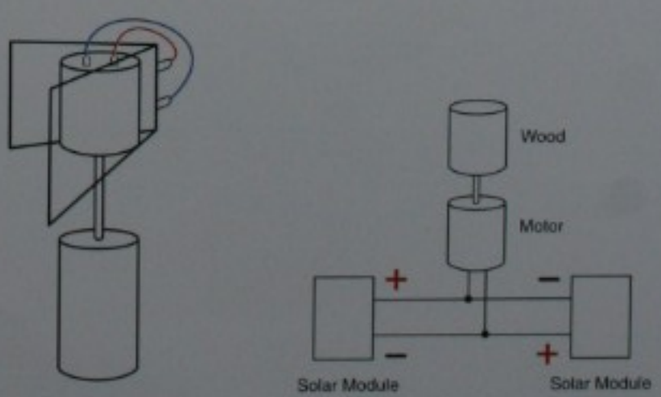
If the device is inverted in such a way that the shaft points up and is free to turn then small differences in the light intensity falling on the two modules cause the shaft to spin in a direction and speed dependent upon the ratio of the light levels on the two solar modules.

Value

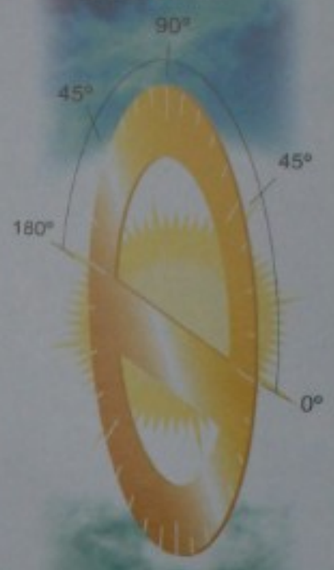
The student becomes acquainted with the concept of equilibrium. Electrical observations on the multimeter of the voltage across the motor parallels the real world observed effects. At equilibrium, (with the device actively pointing toward the sun) there is a small or zero voltage across the motor. When the device is turned by hand away from the sun a voltage is developed across the motor. The magnitude and polarity of the voltage is dependent upon the degree of deviation from the device's optical equilibrium point.

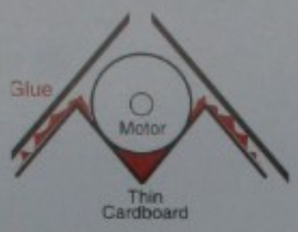
Devices based on this concept could be attached to solar arrays to actively point to solar modules directly at the sun. This would allow the array go generate the maximum possible current throughout the day.

The Sun Compass.

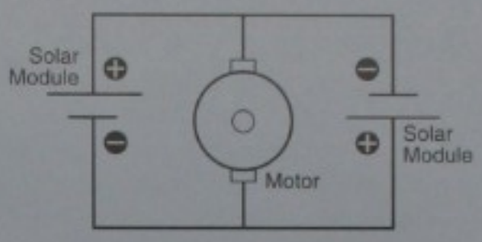


Construction diagrams of the "Sun Compass".





Hot gluing of cardboard, motor and solar modules.



Solar modules "short circuited" together.

Notes

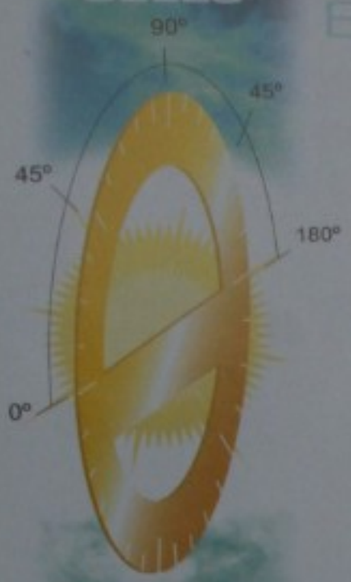
Cardboard card stock is folded to form a "W" shape. The "W" is turned up side down and the motor is hot glued into the centre "V" of the cardboard. The two solar modules are connected in short-circuit mode with each solar module's positive terminal going directly to the other solar module's negative terminal. The solar modules are then hot glued to the cardboard in such a way that the motor shaft is as close as possible to the centre of mass of the solar module set. Each of the two sets of solar module terminals is then connected to a motor terminal. If the motor spins the solar modules away from the sun rather than pointing to the sun then swap the wires connected to the motor.

Spinning shaft voltage measurements of "Inverted Sun Compass".

Equipment

Two 1-volt solar modules, one motor, one multimeter with alligator clips.
Also needed: cardboard card stock, short length of wooden dowel with a hole drilled for the motor shaft, hot glue gun, wire & solder.

EXPERIMENTS



Method

Once constructed, a voltmeter is connected to the two wires going to the motor. In "sun compass mode" (with the wooden shaft held stationary and the solar modules & motor free to move) and in bright sunlight the sun compass will point towards the sun. Note the voltage's polarity and value as displayed on the meter while the device points towards the sun. Without casting a shadow on the solar modules: by hand move the solar modules a little so that they point away from the sun (away from the equilibrium point). Note the voltage's polarity and value. Release the modules, observe that the system physically seeks the equilibrium point, and watch the meter reading move back towards zero.

Hold the sun compass at the end of an outstretched arm and spin in a complete circle. Note that the sun compass continues to point at the sun. Observe the voltage as you spin in different directions. Note the voltage magnitude with different rates of spin.

With the sun compass inverted (solar modules & motor held stationary with the wooden shaft free to turn) point the solar modules at the sun and observe that slight differences between the illuminations of the two modules will cause the shaft to spin. Observe the direction and speed of rotation. Note the polarity and magnitude of voltage as the angle of the solar modules change with respect to the sun.