Pump in a Bucket: A Method for Teaching Teachers and Students Solar Energy Concepts

Introduction

Solar energy can be infused in many agriculture science courses at all levels. Pumping water with solar energy can be included in both plant science and animal science courses. Solar energy projects fit readily into a STEM career path curriculum. Topics include electricity, chemistry, physics, math, and project design (engineering). Components for assembling and demonstrating a solar-powered water pumping system are available online or from local DIY building centers. Curriculum (lesson plans, projects) for teaching solar energy are available online. The simplest system to assemble is called "PV-direct". The load (12 volt DC pump) is matched to the source (a 17 volt DC module). The voltage of the load and source need to be the same (12 volts).

Procedure

Materials for the project include a 20-watt solar module (designed for charging 12 volt batteries), a 12 volt DC bilge pump (300 gph), a five gallon bucket, and various pieces of ½ inch diameter PVC pipe and pipe fittings. Use no glue. Let your audience pick and choose fittings to assemble their project. The key is to assemble a structure which connects to the submersible pump, and moves water up and out of the bucket, and letting it return. A two-inch piece of 5/8-inch clear poly tubing is used to connect the barbed pump fitting to a poly barb x male pipe fitting (mpt) that screws into a PVC female pipe adapter.

When teaching the subject, introduce the audience to an operating system. The leads of the module are connected to the leads of the pump outside of the bucket of wire with wire nuts. When the module is exposed to the sun, DC current is sent to the pump. Adjusting the tilt angle of the module toward the sun affects the performance of the pump. Teachers and students are drawn to the sight and sound of the flowing water. Working in small groups, have several sets of PVC components on tables with pumps and buckets. Some audiences will go back to the working model and attempt to copy or replicate. Others attempt to create their own model. Demonstrate how to safely connect the ends of the pump leads to the bare ends of the pump leads. Wire nuts can be used to secure the ends. Be sure the leads are outside of the bucket and not submerged in the water.

Any hands-on activity involving electricity needs to include a discussion of personal safety. A solar module exposed to the sun can produce electrical current. Use a digital meter to measure power output (voltage and current). Make sure modules are positioned face down when making connections to the ends of the leads. Have your audience ask what the expected level of voltage or current is before taking the measurement. Follow this with the taking of the measurements. Is your meter functioning correctly? Be familiar with functioning of the meter. Solar energy produces Direct Current (DC) electricity. A clamp on meter can measure electrical current by clamping around the leads.

Assessment

Several opportunities to assess student learning exist. A pre-activity survey can measure student knowledge and skill set working with solar energy systems. Compare the findings with a post-activity survey. Another method is to have a prepared worksheet with questions. Have your audience illustrate the flow of electrical current, and/or draw a pictorial diagram. Expand on the activity. Wire multiple modules in series (+ to -) or in parallel (+ to + and – to -) to see the effect of altering the flow of electrical current. What happens when the module is shaded? Develop a student solar fair competition. Have groups of students demonstrate methods of using solar modules to move water for various projects such irrigation, hydroponics, aquaponics, and livestock watering.

Submitted by

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