Solar Ammo Can – Lesson Plan

NGSS Standards

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Vocabulary

chemical energy	electrical energy	solar energy	transformer
semiconductor	voltage	current	resistance
alternating current	direct current		

Materials (per group)

15Ah 12V SLA battery
.50-cal ammo can (or equivalent box to fit battery)
12V automotive socket
12V to 5V socket panel
12V voltmeter
Rocker switches
Red/Black speaker wire (12-16awg) and assorted connectors
Assorted lever nuts
20W solar panel
10-20A solar charge controller

Procedure

Day 1 - Introduction

Students watch the overview video contained in the Instructable as an introduction to the project. Teacher describes different forms of energy as pertains to the project (chemical, electrical, solar) and students discuss in groups the benefits and drawbacks to each kind of energy. Teacher introduces/reviews electrical concepts and terms.

Day 2 - Exploration

Students watch/Teacher presents the physics behind solar panels and how they convert solar energy into electrical voltage. A brief safety demonstration regarding how to hook up accessories and batteries, lever nuts and same-colored wires, etc. is given. Students are then presented increasingly complex wiring tasks (make the voltmeter work, make the voltmeter and the USB socket work, make the voltmeter and an on/off switch work, etc.)

Day 3 – Build Day

Background regarding the need for solar charge controllers is given, and why an on/off switch is necessary between the battery and the controller (long-term storage drain). Teacher should refer students to the videos (including some not in the Instructable, such as how to wire a 3-pin rocker switch with LED, solar panel basics, etc.) and guide them, checking their wiring before final connections to the

battery are made. For differentiation, teacher could provide simple wiring diagrams to help struggling learners. At the end of the day, each group should have a completed system.

Day 4 – Test Day

Students will take their boxes out to test the solar panels as well as the system as a whole. A 12v load is provided by the teacher (in my case, I bring out a field amateur radio with antenna and we attempt to make some on-air contacts). Success isn't contingent on a radio contact, but rather that the system works when under load. Day 4 also begins the writing piece (detailed in Day 5)

Day 5 – Reflection

Students are given a writing piece assignment that asks them to detail their design process. This is why it is important that the teacher only guides rather than gives steps to follow; the piece asks students to highlight struggles and successes in their build process, what changes they would incorporate in version 2, and how this project helped them understand energy transformations.