Constructing a Solar-Powered MintyBoost USB Charger

Activity Summary:

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DESCRIPTION: Students will receive a background on solar energy, solar energy applications, and electrical circuit components. Students will then apply these concepts to a Home Energy Consumption worksheet and the construction of a Solar Module MintyBoost USB Charger, which will use solar modules as opposed to batteries. Finally, students will use the charger to create a real world product and present it to a panel of "investors."

GRADE LEVEL(S): 6, 7, 8

SUBJECT AREA(S): Power, energy, electricity, solar energy, electronics

ACTIVITY LENGTH: 10 hours

LEARNING GOAL(S):

- Students will gain a background on solar energy and be able to apply terms such as solar modules, photovoltaics, and solar power.
- Students will gain a background on electrical circuit components and be able to apply terms such as capacitor, resistor, diode, alternating and direct current, amps, inductor, volts, and watts.
- Through the completion of the Home Energy Consumption worksheet, students will determine their family's monthly energy consumption and calculate the monthly dollar cost for household items such as light bulbs, game consoles, and televisions.
- Students will demonstrate their understanding of solar energy and electrical circuits through the construction of a Solar Module MintyBoost USB Charger and a presentation of their own unique product that utilizes the solar charger.

STANDARDS MET:

Oregon:

6.1P.1	Describe physical and chemical properties of matter and how they can be measured.
6.1P.2	Compare and contrast the characteristic properties of forms of energy.
6.1E.2	Describe the properties of objects in the solar system. Describe and compare the position of the sun within the solar system, galaxy, and universe.

6.2P.2	Describe the relationship between: electricity and magnetism, static and current electricity, and series and parallel electrical circuits.
6.2L.2	Explain how individual organisms and populations in an ecosystem interact and how changes in populations are related to resources.
6.4D.1	Define a problem that addresses a need and identify science principles that may be related to possible solutions.
6.4D.2	Design, construct, and test a possible solution to a defined problem using appropriate tools and materials. Evaluate proposed engineering design solutions to the defined problem.
6.4D.3	Describe examples of how engineers have created inventions that address human needs and aspirations.

Next Generation Science Standards:

MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

SCIENCE KIT MATERIALS LIST:

- 6-Volt solar module
- USB-charged battery operated device
- Solar Lipoly charger
- Lithium ion battery pack

- (2) MintyBoost USB Charger Kits, one pre-soldered
  - 5% 3.3K resistor
  - 1% 75K resistors
  - 1% 49.9K resistors
  - (2) 0.1uF ceramic capacitors
  - Schottky diode
  - IC socket
  - Inductor
  - Electrolytic capacitors
  - Chip
  - USB type-A connector

OTHER MATERIALS LIST:

- "Circuit Board Schematic" student handout
- "Electrical Circuit Components" PowerPoint presentation
- "Interesting Solar Applications" PowerPoint presentation
- "Solar Energy Background" PowerPoint presentation
- Colored pencils

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Vocabulary:

- Power
- Energy
- Watt
- Resistor
- Capacitor
- Inductor
- Diode

Student Background:

- Students should have a basic understanding of electricity, power and energy

Educator Background:

- Teachers should have a fundamental understanding of electronics components
- Teachers should be comfortable soldering
- It is helpful to have a working understanding on battery charging and basic power conditioning

Lesson Details:

Notes for Teachers:

- One high-powered floodlight for the class would be useful in order for students to test their products regardless of weather.

- Instead of starting with the MintyBoost, an option is to have students start with the Elenco SC-750R Snap Circuits Training Program **(http://www.testequipmentdepot.com/elenco/toys_educational/snap_circuit_training/sc750r.htm)** and then make the Solar Module MintyBoost USB Charger.

Lesson Instructions:

Day 1: Teacher shows “Solar Energy Background” PowerPoint. Stop at the “Solar Energy” slide.

Day 2: Teacher finishes “Solar Energy Background” PowerPoint.

Day 3: Teacher shows “Electrical Circuit Components” PowerPoint.

Day 4: Using the instructions from Minty Boost below, have students draw in the circuit components onto the “Circuit Board Schematic” student handout using the colored pencils.

Day 5: Students put together MintyBoost USB Chargers. They should bend back the leads but not cut or solder them. After students have shown their teacher their completed MintyBoost USB Chargers, they can get a soldered MintyBoost USB Charger. With the completed charger, students can experiment with adding a solar module.

MintyBoost USB Charger construction directions:
http://makeprojects.com/Project/MintyBoost-USB-Charger-Kit-v3-0/1096/1#.UAzQslFD6-8

Day 6: Teacher shows “Solar Energy Applications” PowerPoint and students begin brainstorming ideas for a real world product that would utilize the Solar Module USB MintyBoost Charger.

Day 7-11: Students work on solar product presentation. The final presentation will be before a panel of “investors” (like the TV show “Shark Tank”). With a model of their product and a visual presentation (such as a PowerPoint or Haiku Deck), students will compete for product funding.

Day 12: Final presentations.