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Technology Integration Workshop 2019

Unit Title: Solar Suitcase and Circuits

Grade Level: 10-12

Subject Area: Engineering Principles

Duration/Length/Number of class periods: 5 class periods

Description:
Students will learn the basic principles of both “series” and “parallel” electrical circuits, and employ them toward building “solar suitcases” to be deployed overseas to schools in need of sufficient lighting for students.

Established Goals (National, State, Local):
Proficiency in the following areas/understandings:
Science and Engineering Practices:

a) Developing and using models
b) Planning and Carrying out Investigations
c) Using Mathematics and Computational Thinking
d) Constructing Explanations and Designing Solutions

Disciplinary Core Ideas:

a) PS3.A - Definitions of Energy
a) PS3.B - Conservations of Energy and Energy Transfer
b) PS3.C - Relationship Between Energy and Forces
c) PS3.D - Energy in Chemical Processes
d) ETS1.A - Defining and Delimiting an Engineering Problem

Crosscutting Concepts:

a) Cause and Effect
b) Systems and System Models
c) Energy and Matter

Connections to Engineering, Technology, and Applications of Science:

- Influence of Science, Engineering, and Technology on Society and the Natural World

Connections of Nature of Science

- Scientific Knowledge Assumes and Order and Consistency in Natural Systems

What Enduring Understandings are desired?

- Students will be able to distinguish basic characteristics between both a “series” and “parallel” circuit.
- Ability to follow the flow of electricity from the source (sun) to the load (light bulb, USB charger, etc.) through the solar suitcase system.
- Extent of global access to energy
- Basic DC electricity for solar
- System functioning principles

What Essential Questions will be considered?

- What kind of access do we have to energy on a global scale?
- Provide an overview of energy available and utilized in the U.S.
- What are the basic functions of DC electricity for solar powered systems?
- Describe the process of assembly and commissioning for a solar suitcase, and how it relates to a general electrical system.
- Design a stand-alone electrical system

Students will know / be able to:

- Understand and create both a “series” and “parallel” circuit with the various electrical connections made in their solar suitcases through the electrical connections necessary for its full functionality
- Fully build/assemble a functioning solar suitcase fit for deployment and real world use at another school in need of lighting for its students.

Description *Units must include at least one of each formative, summative, introductory activity and learning activity. Check the appropriate box; one per row.*	Formative	Summative	Introductory Activity	Learning Activity	Student Technology Used	Teacher Technology Used	ISTE Standards
Day 1: Electricity Basics 1. Introduce the topic 2. Present the Basic Electricity for Solar PowerPoint 3. Demonstrate the concept of power (volts x amps = watts) using the Water bottle/Fulcrum set up (see the See-Saw Demo set up sheet) 4. Review vocabulary terms 5. Give Assessment: Basics of DC for Solar	Basics of DC Electricity for Solar Lab Worksheet		“Solar Cell,” “Basics of DC,” and “Simple Solar Circuits” Power Points	Student Collaboration and Cooperative work on lab worksheet	Classroom Desktops	Promethean Board	See “Disciplinary Core Ideas” above for ISTE STandards
Day 2: The Solar Cell 6. Present the Simple Solar Circuits PowerPoint	PV Effect		“Simple	Student	Same	Same	

7. Complete the Lab: PV Effect with Mini Panels 8. Present the Understanding the Solar Cell PowerPoint	with Mini Panels Lab		Solar Circuits" Power Point	collab with lab			
Days 3 & 4: System Assembly 1. Set up tables with System Assembly Guide, a Solar Suitcase, tool kit, and large sheet of white paper. 2. Remove battery from the solar suitcase and put them aside in a safe area away from the students. Cover the battery terminals to prevent an accidental short circuit. Students should not have access to the batteries during this exercise. 3. Provide and require all students to wear safety glasses when working on the suitcase. This is important for the safety of everyone. 4. Have students start by spreading out all the parts on top of the large piece of white paper, organize them, and count and label each on the paper. This is very helpful to get familiar with all the parts and make sure that nothing is missing. See the System Assembly Guide for details. 5. Instruct students to complete the assembly process following the guide. It is important to follow the order of the guide, because some parts will be hard to bolt or wire if they are installed in a different order. Teachers should go between groups answering questions and making sure that all students are using the tools and are engaged. Students tend to get very excited about putting the suitcase together and may need to be slowed down, because it is important to be careful when assembling an electrical system, especially the one that is going to a remote part of the world. Make sure they not only look at the pictures in the guide, but also read the steps and the notes. Have students check off each step on the "System Assembly Checklist" as they complete it. 6. Engage students during the assembly process by asking them questions about what they are doing, to make sure they understand why they are doing it. E.g., Why is the yellow solar wire going to a breaker and the white solar wire going straight to the charge controller? What is the function of the charge controller? What are the names of the various tools? At different points in the process, have each of the students show how the electricity will flow through the system. You will see that many of these questions are in the Assembly Guide. 7. After the system is assembled, continue using the Quality Control Guide which is the following section in the Assembly Guide.	Evaluate System ASsembly		Classroom setup, introduction of assembly guide, solar suitcase, and tool kit	Student assembly of suitcase	Solar suitcase assembly components	Solar suitcase demo kit	

Day 5: Assessment Quality Control Checklist		Manual use of checklist to check for system build completion				System Design Checklist	

Materials, tools and resources:
https://www.wesharesolar.org/

- Unit/Lesson Plans
- Content Tutorials
- Instruction/Assembly guide(s)
- Quality Control Checklist
- System Design Instructions
- Suitcase Deployment Guidelines

Unit Plan Author (name, school and optional email address or hyperlink to teacher's web page)
We Share Solar (Facilitated by Lars Peterson - Patrick Henry High School, Minneapolis, MN)

Additional credit given to:
We Care Solar/We Share Solar