



SolarSPELL

Lesson Plan: Introduction to Solar Power Using the SolarSPELL

Topics Covered	Difficulty	Duration
<ul style="list-style-type: none"> Solar Power Solar Panel 	Beginner	4 to 5 days Day 1: Engagement and Exploration Day 2 - 3: Exploration and Explanation Day 4: Elaboration Day 4 or 5: Evaluation

Key Inquiry Questions

- What is solar power?
- Why is solar power an effective solution for energy in remote areas like the Pacific Islands?

Overview

This activity introduces students to solar power by using SolarSPELL. Ideally, students must not be familiar with SolarSPELL and have only had a brief introduction. If students already have experience with the SolarSPELL, the teacher may modify the lesson plan to accommodate the students' current knowledge of solar power.

Objectives

- Students will be able to explain that the sun can provide power to charge batteries and other electronic devices.
- Students will be able to explain why solar power is an effective solution for remote areas.
- Students will be able to differentiate effective methods for charging solar panels.

Materials

- SolarSPELL (everything included)

Teacher Preparation

The teacher shall get the needed materials listed above. In this particular lesson, the teacher only needs the SolarSPELL and all of its components. The worksheets included in the lesson plan are supplemental. Depending on the availability of resources at each school, the teacher may either print the worksheets directly from the lesson plan or find an alternative method for students to record their work.

Teachers shall purposefully unplug the Raspberry Pi from the battery pack. Meanwhile, for this lesson to work, the battery pack must not be fully charged. To figure out the battery's charge, turn on the battery pack and count the number of bars on the left side of the power button. Four lit buttons indicate a fully charged battery pack. If the battery pack LEDs do not light up, the battery is most likely drained.



All four of the LEDs are lit up in the photo above, indicating a fully-charged battery. It is highly suggested to have a battery prepared that only has 1 or 2 bars lit up. Do NOT fully drain your battery because it damages and reduces battery life.

Background Information

The lesson plan is meant to introduce students to the concept of solar power. The provided worksheets allow students to explore how the sun is important for charging SolarSPELL.

Engagement

This activity will focus students on the topic.

- The teacher will bring out the SolarSPELL and ask the class to connect to it using a tablet or smartphone. Students do not know that the teacher did not plug in the Raspberry Pi to the battery pack.
- After giving the students a few minutes to fail connecting to the SolarSPELL, the teachers will ask the students, “Why can you not connect to the SolarSPELL?”. The teacher will pass out the SolarSPELL to the class for the students to investigate.
- The teacher will run a class discussion and write down students’ guesses on why they cannot connect to the SolarSPELL.
- Once the class discussion is over and the students’ ideas are written down, the teacher will show the teachers that the SolarSPELL is not plugged into the battery pack.
- The teacher then plugs in the Raspberry Pi to the battery pack. Students are now able to connect to the SolarSPELL. The teacher explains briefly that for the Raspberry Pi (mini computer) to work, it needs a source of power to turn on and stay on. Electricity is needed to power other electronics like cell-phones and televisions.

Exploration

This is a student-led activity with guidance from the teacher.

- Students will be exploring how the SolarSPELL charges the battery pack.
- The teacher will ask students to guess which of the following will allow the battery pack to charge the fastest within a day:
 - Leaving the SolarSPELL inside the classroom.
 - Leaving the SolarSPELL inside the classroom near a window.
 - Leaving the SolarSPELL outside the classroom (in a place with no shade).
- The teacher will try each hypothesis for 3 days. Before doing this, the teacher writes down the original amount of bars lit up for the battery pack. This is to show how much the battery pack was initially charged before any experiments.

- For the first day, the teacher will leave the SolarSPELL overnight in the classroom. The class will check the battery pack's charge the next morning and write down the number of lit up bars. This new number will be used for the next experiment.
- Once the SolarSPELL has been charged inside the classroom, the teacher will leave the SolarSPELL by the window during the night. The SolarSPELL should be left there for roughly the same amount of time that the SolarSPELL was left inside the classroom. The next day, students will check the battery pack's new charge and write down the number of lit up bars. This new number will be used for the last experiment.
- The teacher will place the SolarSPELL outside the classroom, preferably at a spot where the panel isn't covered by shade. The next day, students will check the battery pack's new charge and write down the number of lit up bars.
- Teachers will determine how much each experiment charged the battery. The hypothesis that charged the battery pack the most is the most effective way to charge the SolarSPELL.
- Disclaimers: Each experiment should be done within the same amount of time. If the teacher leaves the SolarSPELL inside the classroom for roughly 8 hours, then the SolarSPELL needs to be inside the classroom by a window for 8 hours and outside the classroom for 8 hours. If the SolarSPELL is left inside the classroom for 4 hours, then the other two experiments must allow the SolarSPELL to be placed in their respective locations for 4 hours as well.

Explanation

Students discuss their understanding of the concept.

- Based on the results of the previous activity, students will explain why their explanation was or was not correct.
- Students will explain why it is most effective to charge the solar panel outside rather than inside the closed classroom.

Elaboration

Students apply the idea in a new context.

- Students will discuss why solar power is an effective solution for energy in remote areas like the Pacific Islands.
- Students will be given a worksheet with a table to record different times of the day. The worksheet is included in the lesson plan and has students check every hour whether or not the sun was shining outside.

- Students will add in additional notes for observations. For instance, they can write down if the sky was clear. Or they can write down that it was cloudy outside.
- Once students have all their observations recorded, the teacher will write down on the board the amount of hours that the sun was shining in the day, how many times the sky was cloudy, and how many hours it was dark outside.
- The teacher will use these results to explain that solar panels are able to charge for a great majority of the day in places like the Pacific Islands. However, the teacher will also explain that when it is cloudy, the solar panels do not charge as effectively because the clouds cover up the sun.
- Meanwhile, the teacher will explain that because it is dark during the night, a battery is needed to store the power charged during the day so the SolarSPELL can still be used even if it is dark or cloudy outside.

Evaluation

Students assess their knowledge, skills, and abilities

The teacher will do a class discussion to recap how solar power is used to charge the SolarSPELL. Students will explain why solar power is beneficial for remote areas like the Pacific Islands. Lastly, students will explain the efficient methods to charge a solar panel.

Exploration Worksheet

What is the most effective way to charge the SolarSPELL?

- Leaving the SolarSPELL inside the classroom.
- Leaving the SolarSPELL inside the classroom near a window.
- Leaving the SolarSPELL outside the classroom.

Guess: _____

Experiment	Original Number of Bars Lit Up on Battery Pack	New Number of Bars Lit Up on Battery Pack After Charging	Amount of Power Charged = New Number of Lit Up Bars – Original Number of Bars Lit Up on Battery Back
SolarSPELL inside classroom			
SolarSPELL inside classroom near a window			
SolarSPELL outside the classroom			

Was your guess correct? Explain why or why not:

Elaboration Worksheet

How often is the sun up in your location?

Instructions: Students will record every hour whether or not the sun was up during that time, if it was cloudy (clouds covering sun), and if it was dark.

Time	Was the sun shining? (Yes or No)	Was it cloudy outside? (Yes or No)	Was it dark outside?
8:00 A.M.			
9:00 A.M.			
10:00 A.M.			
11:00 A.M.			
12:00 P.M.			
1:00 PM.			
2:00 P.M.			
3:00 P.M.			
4:00 P.M.			
5:00 P.M.			
6:00 P.M.			
7:00 P.M.			
8:00 P.M.			

Number of Hours Sun was Shining: _____ Number of Hours it was Dark: _____

Number of Hours it was Cloudy Outside: _____

Was it sunny, dark, or cloudy most of the day? _____