SOLAR SCIENCE STATION LAB

Elementary Lesson Plan

LESSON OVERVIEW:

The focus of this activity is utilizing the Solar Science Station as a tool for science discovery. The Station can be used in a variety of contexts to highlight the content that is most important to your course of study. It could easily be used to explore electricity, solar photovoltaics, or the steps of the scientific method. Additionally, this could be done in small groups with multiple Solar Science Stations or as a whole class activity with one Station.

LEARNING OUTCOMES:

Learners will be able to explain how solar panels work.
Learners will be able to apply the scientific method.
Learners will be able record and synthesize data.
Learners will be able to apply their knowledge of circuit function.

TIME:

At least 3 45-minute periods. More time may be needed for building background knowledge regarding circuits, scientific method or solar photovoltaics.

MATERIALS:

- Science stations
- Sunny location
- A protractor
- Pen / pencil
- Timer
- may want to use additional graph paper

STANDARDS:

NEXT GENERATION SCIENCE STANDARDS

CROSSCUTTING CONCEPTS EMPHASIZED

2. Cause and Effect: Mechanism and Explanation
4. Systems and System Models
5. Energy and Matter: Flows, Cycles and Conservation
6. Structure and Function

SCIENTIFIC AND ENGINEERING PRACTICES

1. Asking questions (for science) and defining problems (for engineering)
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions

(for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

DISCIPLINARY CORE IDEAS - PERFORMANCE EXPECTATIONS

Students who demonstrate understanding can:

Grade 4-PS3 Energy

Students who demonstrate understanding can:

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

MATH

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.

Reading (K-5)

7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

Writing (K-5)

1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences

SOCIAL STUDIES (Texas Science, Technology, and Society standards)

Elementary (various grades)

- The student understands ways technology is used in the home and school and how technology affects people's lives.
- The student understands how technology affects daily life, past and present.

- The student understands how science and technology have affected life, past and present.
- The student understands how individuals have created or invented new technology and affected life in various communities, past and present.
- The student understands the impact of science and technology on life in Texas.
- The student understands the impact of science and technology on society in the United States.

PROCESS:

1. Depending on your class' previous experiences, you may want to engage them with a background video or reading on one of the following: circuits, scientific method solar photovoltaics or the scientific method. You can find age-appropriate readings to build background knowledge at BrownDogGadgets.com.

2. Start with presenting the Research Question to the class: Which angle will produce the highest voltage during a set time period?

3. Help build some background knowledge via a video such as this one from TedEd: http://ed.ted.com/lessons/why-aren-t-we-only-using-solar-power-alexandros-george-charalambides. Use information from the video to answer the question in the BACKGROUND KNOWLEDGE section of the student page: "How does a solar panel work?" Then have students "Draw a sketch of a solar panel", including its main structural components.

4. Remind or instruct students about what a HYPOTHESIS is. Their hypothesis should be making a prediction in order to answer the research question. The term "Cause" is representing the idea of the Independent Variable, or what we are changing. The term "Effect" is really representing the Dependent Variable, or what we are measuring as an outcome. The comfort level for you and your students may dictate the terms that you use. Regardless, discuss the hypothesis as a class. *If the panel angle changes, then voltage will stay the same.* is a great example of a potential hypothesis. You may either have students write their own hypotheses and then share out or write a hypothesis together as a class. Either way, write it as an If..., then... statement.

5. Read through the Materials list with students. You may want to delete the list from their page and have the students write in the materials: Solar Science Stations, a sunny location, a protractor, pen/pencil, and a timer.

6. Read through the procedure either individually, in small groups, or as a class.

7. Distribute the Solar Science Stations and have students look at how their diagram matches the real physical Stations.

8. Assign the roles of a timekeeper, a voltage reader for each station, a writer, and recorder for everyone else.

9. Assign a unique angle for each individual Station. Have students use the protractor and the angle markings on the side to set the angles.

10. Find a sunny place to set up your stations, keeping them covered from sunlight. You will want a place that can accommodate all of your groups of students.

11. Project or otherwise display the data table on the front white board so your various student groups can all share the data.

12. Have all of the student groups record the voltage as baseline data at 0 minutes.

13. The timer should start the stopwatch, letting everyone know when it has been 2 minutes. At 2 minutes, have the readers look at the voltage on their solar station. The writer should then write the amount on the front board. Make sure to get the data in the right combination of time and angle! The recorders, everyone else, should be carefully recording the data for all of the groups' angles.

14. Continue until minute 12. You may extend or shorten the time based on your time available. You would then want to alter the data tables as well.

15. Once all of the data is collected, your students may need a few minutes to make sure that everyone has their data collected. Ask students to look at their data. This may be a great opportunity for a think/group/share with these questions:

a. Which group has the highest voltage at minute 6?
b. Which group has the highest voltage at minute 12?
c. Did it change or was it always the highest?
d. Why do you think that this particular panel angle had the highest voltage?

16. Next, we will graph the data.

17. Explain to the students that the "Cause", or Independent Variable, will be placed on the horizontal (x) axis. The "Effect", or Dependent Variable, will be placed on the vertical (y) axis.

18. Once the data points are placed on the graph, students can connect them and see the change over time.

19. Students can move on to answering the Conclusion questions. Once students finish, a discussion about their hypotheses and results should help highlight the class' process. Listen especially closely to the students' answers to the last Discussion section questions:

What are some possible improvements we could make to the lab?
What is something slightly different that could be tested next time?

Their input can be really enlightening regarding making improvements for future labs and the next time this topic is taught.