Unit: Understanding Science and Engineering Through Solar Power

Lesson 2 Probes of Prior Knowledge

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DESCRIPTION: Teacher will administer worksheet probes (formative assessments) of students' prior knowledge about "making electricity" and "things that run on electricity."

GRADE LEVEL(S): 2, 3, 4, 5

SUBJECT AREA(S): Electricity, energy,

ACTIVITY LENGTH: 60 minutes (Lesson could be broken into two separate lessons –Probe #1 and Probe #2--if necessary.)

LEARNING GOAL(S): Students will be able to identify the different ways that electrical energy (electricity) is transformed (generated) and identify different everyday items that use electricity.

STANDARDS MET:
Common Core:

- W.2.8. Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1)
- RI.2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text (2-ESS1-1)
- SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media
- RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers
- W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories
- SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace
- RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

- W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.
- W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently
- W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

Next Generation Science Standards:

- 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-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

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Student Background:

- Students should be familiar with the basic idea that there are things in our world that "make" electricity. For example, when we turn on a light, the electricity to power that light bulb comes from somewhere. Some English language learners might need visuals (or a "word wall") to facilitate their understanding of some of the terms on the probe.
- It's best if students have already completed the following activities as a part of a larger solar pumping unit:
    - **Understanding Science and Engineering Through Solar Power: Lesson 1 Setting Expectations for Science and Engineering Projects**

Educator Background:

- **Solar cells** or **modules** are thin wafers of **silicon** that convert sunlight or **light energy** into **electrical energy** using the **photovoltaic effect**.
- A **circuit** is a circular path by which electricity flows from a power source (solar module in this case) to a device that does work (water pump in this case) and then back to the power source. Several power sources can be linked together in a series circuit to produce more power.
- **Scientific inquiry** is the "diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work." *(National Science Education Standards*, p. 23). Scientific inquiry requires students to form testable questions about the natural world that they have observed. After developing a hypothesis (or educated guess) related to their question, students design and conduct experiments to test whether or not their hypothesis is correct. Conducting an experiment includes gathering data and recording observations. Often time scientists display their data using graphs,

which is good practice for students. Students then analyze the data gathered during the experiments and draw conclusions about whether or not their hypothesis was correct.

- **Engineering design** is a process by which students identify or are given a problem to solve. The problem must have given constraints (time, materials, money etc.). Students then design a solution to the problem, create a prototype, and test their design. Data from testing the prototype is collected and the design is evaluated. The prototype is then modified based on the results from the first test and then tested and evaluated again. Finally both designs are evaluated against the criteria of the problem to determine effectiveness. The process can continue iteratively until the design criteria are met.

Other Materials List:

- Class sets of "Solar Student Worksheet, Part 1: Making Electricity" and "Solar Student Worksheet, Part 2: What Things Use Electricity?"
- Digital copy of the PowerPoint: "Making Electricity PowerPoint", which highlights various forms of electricity (to be used with **"**Solar Student Worksheet, Part 1: Making Electricity")

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Lesson Details:

Probe #1: Making Electricity

1. Probe Procedures
   a. Hand out a copy of the student worksheet "Part 1: Making Electricity**"** to each student. Read over the probe as a class and explain that each student must mark with an "X" all the ways that they think electricity is made. Give students a couple of minutes to think about their answers.
   b. Then have students share their thinking with a partner. Students partner off as Partner 1 and Partner 2. Have Partner 1 share his/her answer with Partner 2. Have partners switch roles so that each student has a chance to listen and to share their thoughts.
   c. Ask students to share what their partner thought and what their rationale was.
   d. Then take a tally of the class as to what each individual thought. Mark the total number of responses on a master copy displaying it for students to see.
   e. Ask for volunteers to explain what they were thinking and or why they believe what they do. Use your established scientific discourse to engage students in the discussion. (Perhaps those developed in **Understanding Science and Engineering Through Solar Power: Lesson 1 Setting Expectations for Science and Engineering Projects**).

2. Constructing new knowledge about how electricity is made.
   a. Show the PowerPoint slide show titled "Making Electricity PowerPoint"
   b. Following the slideshow, have each student now mark on the "Part 1: Making Electricity" probe all the ways that they think electricity is made with an "O".

c. Discuss what they have learned by asking students how their thinking has changed. After viewing the slideshow did they add or subtract ways that electricity is made? What was their biggest surprise?
d. Review the lesson's objective and collect the student worksheets for evaluation.

Probe #2: What Things Use Electricity?

1. Probe Procedures
   a. Hand out a copy of the student probe "Part 2: What Things Use Electricity" to each student. Read over as a class and explain that students are to mark all items they think run on electricity with an "X". Give students a couple of minutes to think about their answers.
   b. Next, have students share their thinking with a partner. Students partner off as Partner 1 and Partner 2. Have Partner 1 share his/her answer with Partner 2. Have partners switch roles.
   c. Ask students to share what their partner thought and what their rationale was.
   d. Then take a tally of the class as to what each individual thought. Mark the total number of responses on a master copy displaying it for students to see.
   e. Ask for volunteers to explain what they were thinking and or why they believe what they do. Use your established scientific discourse to engage students in the discussion.

2. Constructing new knowledge about everyday items that run on electricity.
   b. Begin discussion about what items use electricity. Go through each item at a time and use the established scientific discourse to promote peer-to-peer discussions, before the teacher reveals the correct answer.
      i. The correct answers are: computers, dishwashers, cell phones, lights, cars, an elevator, an air conditioner, and a clock. Students might want to argue that a battery uses electricity, but in fact in generates electricity and does not use it.
   b. Following this discussion, have students go back to the student worksheet "Part 2: What Things Use Electricity" and mark which items they now think run on electricity with an "O".
   c. Discuss what they have learned by asking students how their thinking has changed. After the class discussion did they add or subtract items that use electricity? What was their biggest surprise?
   d. Review the lesson's objective and collect the student worksheets for evaluation

3. Tell students that in the next lesson we will look at one way that electricity is made and a device that uses it.

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