6th Grade Daily Lesson Plan
By Roger Barker

Concept / Topic To Teach: (What will the student know/be able to do by the end of class?)	**All students:** During this lesson, Students will learn what factors affect the efficiency of a photovoltaic cell. **TAG/PreAP students:** Students research and debate the advantages and disadvantages of using solar energy resources. Students then design a logical plan to manage energy resources in the home, school, or community based on the research they have done.
Standards Addressed: (summarize)	***6.7 Matter and energy. The student knows that some of Earth's energy resources are available on a nearly perpetual basis, while others can be renewed over a relatively short period of time. Some energy resources, once depleted, are essentially nonrenewable. The student is expected to:*** **6.7A Research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources.** **6.7B Design a logical plan to manage energy resources in the home, school, or community.** ***6.9 Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to:*** **6.9C Demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy.** **6.1B Practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.** ***6.4 Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:*** **6.4A Use appropriate tools to collect, record, and analyze information, including journals/notebooks, meter sticks, computers, timing devices, and other equipment as needed to teach the curriculum.**
Required Materials:	• **INB** • Photovoltaic Cell • Ruler • Protractor • Sun lamp • Multi-meter • Colored transparencies (red, blue, green, yellow) • Cardboard (cut 1” larger than photovoltaic cell) • Blow dryer • Gloves
Anticipatory Set (Lead-In):	Review prior knowledge about solar energy. Have several demonstrations set up showing photovoltaic cells powering machines (i.e. robot, clock, calculator, yard light, etc.).

Step-By-Step Procedures:	• Pass out **Photovoltaic Lab sheet** (1 per student) • Review **Problem** with students • Read **Information** to students ○ Give students 1-2 minutes to discuss in groups • Have students complete **Hypothesis** • Go over **Materials** to ensure students understand what each item in the lab is and how to use the materials. **Review lab safety procedures with students.** • Explain the **Experiment** procedures and how to record **Results**. • As each group finishes, have students answer **Conclusion** questions. • Clean up lab station
Closure (Reflect on Anticipatory Set): (wrap up the lesson)	**Lesson Closure** Have students discuss in groups how solar power could be used in the future to meet energy needs and the benefits/problems of using solar energy. Groups should be prepared to share with class.
Assessment Based On Objectives: (how will I know what they have learned today?)	Teacher observation INB entries Lab sheet
Adaptations (For Students With Learning Disabilities):	• Assist the student in finding effective peer note takers from the class. • Provide the student with a copy of your lecture notes or outline. • Allow the student additional time to complete in-class assignments, particularly writing assignments. • Provide feedback and assist the student in planning the workflow of assignments. • Break the larger assignment into smaller components with opportunities for draft feedback. • Provide assistance with proofreading written work. • Shorter reading and writing assignments, or an alternate assignment • Working in a small group, or peer tutoring • Working one-on-one with the teacher • Reducing the difficulty of assignments • Allowing answers to be given orally or dictated • Adapted materials—large print, or highlighted notes • Collaboration/consultation among staff, parents, and/or other professionals
Modifications for ELL	• Pre-teach vocabulary • Allow extra time for written responses • Group heterogeneously

Extensions (For Gifted Students): those identified and those not identified	Students will research and report on current Photovoltaic research focusing on one or two approaches to increasing efficiency. Report can be written, oral, poster, digital, etc.
Possible Connections To Other Subjects: (specific)	X MATH X SCIENCE O SOCIAL STUDIES - Historical Timelines/photos X LANGUAGE ARTS – Reading/writing X TECHNOLOGY & DESIGN CYCLE – Research and Report O ELECTIVES O OTHER _____

Photovoltaic Cell Lab

Problem: What factors affect a photovoltaic cell's ability to create electricity?

Information: Photovoltaic cells produce electricity by converting light energy into electrical energy. Photons enter the photovoltaic cell and excite electrons in the n-type material. These electrons move away from the n-type material towards the p-type material. The flow of these electrons is electrical current (DC current).

Hypothesis: If physical changes, such as color of light, amount of light, angle of photon contact, distance from light source, and temperature are made to the environment of the photovoltaic cell then …

Experiment:

Materials:

Photovoltaic cell, sun lamp, blow dryer or heat gun, colored film (cut to size of photovoltaic cell) in red, blue, yellow, green, cardboard (cut to size of photovoltaic cell), ruler, multi-meter, and protractor.

Experiment Steps: Clean the photovoltaic cell. Connect the multi-meter to the photovoltaic cell. Set sun lamp at six inches directly above the photovoltaic cell and turn on (Safety note: the sun lamp will get extremely hot). Take a reading of the voltage produced by the cell and record your results in table 1. Take the cardboard and cover the top 25% of the cell and record your results in table 1. Move the cardboard to cover 50% of the cell and record your results in table 1. Continue this procedure for 75% coverage and 100% coverage and record results.

Remove the cardboard and set aside.

Take a reading of the voltage and record your results. Using the colored film, lay each film on the photovoltaic cell covering the entire cell and record the voltage in table 2. Repeat for all other colors.

Take a reading of the voltage and record your results in table 3. Keeping the light 6" above the cell, use the protractor to angle the cell to 15^{o} and record the voltage in table 3. Continue to angel the cell through all of the other angles and record your results.

Place the cell back directly under the sunlamp and take a voltage reading recording your results in table 4. Using the hair dryer, heat the cell up for 15 seconds and take a voltage reading. Record your results. Heat the cell up for 30 seconds and take a voltage reading. Record your results. Repeat for 1 minute and 2 minutes. Record your results.

Take a voltage reading with the sunlamp at 10 cm above the cell and record your results on table 5. Move the lamp to 20 cm above the cell and record your results. Repeat procedure at 30 cm and 50 cm.

Results:

Table 1

% covered	Voltage
0%	
25%	
50%	
75%	
100%	

Table 2

Color of filter	Voltage
No filter	
Red	
Blue	
Yellow	
Green	

Table 3

Angle	Voltage
0º	
15º	
30º	
45º	
60º	
75º	
90º	

Table 4

Heating time	Voltage
15 seconds	
30 seconds	
1 minute	
2 minutes	

Table 5

Distance	Voltage
10 cm	
20 cm	
30 cm	
50 cm	

Conclusion:

1. **In each table, where was the greatest voltage recorded? Why do you think that the voltage was greatest at each of these points?**

2. **Which experiment had the greatest voltage? Explain why you believe this occurred.**

3. **Which experiment had the least voltage? Explain why you believe this occurred.**

4. **What do you predict would happen if you used the event in each experiment with the highest voltage all at the same time? (i.e. 50% covered, yellow film, 30^{o} angle, 1 minute, 20 cm) List all of the highest voltages below and explain why you think this is the best setup and what do you think the voltage would be.**

5. **Set up your experiment as you laid out in question 4 and record results below.**