<table>
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<th><strong>Lesson Plan Title:</strong> Solar Angle Energy via Solar Cells</th>
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<td><strong>Teacher Name:</strong> Doug Hess</td>
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<td><strong>Subject:</strong> Weather/Climate/Seasons</td>
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## Problem statement, Standards, Data and Technology

### Asking questions and defining problems

Establish driving question for the lesson plan or define problem students will be solving.

How does direct and indirect visible light energy affect earth?

Background: All weather and climate begins with the sun’s energy. Create a simulation of angles and use solar cells to measure the amount of energy received. Make conclusions on what that energy may affect. Introduction to making connections between energy and water cycle, weather, climate, and seasons.

This is a lead in activity to discuss the causes of seasons.

### Incorporating Next Generation Science Standards, Common Core, or State Standards

State the standards that will be covered during this lesson plan. Include all standards which may apply (NGSS, Common Core, or State Standards).

**NGSS:** HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

**MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

**IN STATE: 8.ESS.1** Research global temperatures over the past century. Compare and contrast data in relation to the theory of climate change.

**IN STATE: 8.ESS.2** Create a diagram or carry out a simulation to describe how water is cycled through the earth’s crust, atmosphere and oceans. Explain how the water cycle is driven by energy from the sun and the force of gravity.

### Obtaining and evaluating information

How will students be obtaining and/or collecting the information?

Data collection using solar cells during simulation.

Students will compare info gathered in lab to an online simulation interactive (optional…if time).

For extension: research online for global temperatures over the last century.
### Analyzing and Interpreting Data
How will students be analyzing and interpreting the collected data?

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<td>Students create a table and graph using the average of the three solar cells to show the difference at different solar angles of 30, 60, and 90 degrees. Students should discuss the differences obtained from the data and what implications that data may have affecting any of the following: earth’s surface, weather, or climate, or water cycle, or seasons.</td>
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### Use of Technology and Software
Indicate the type of technology and software students will be using in order to implement this lesson plan.

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<tr>
<td>Laptops internet browser.</td>
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<tr>
<td>- 2V/400mA Solar Panel (3)</td>
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<td>- Power Output Pack (1)</td>
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<tr>
<td>- Sound and Light Board (1)</td>
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<td>- Digital Multimeter (1)</td>
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### Collaboration, Critical Thinking, and Communication

#### Collaboration
Indicate how students will be collaborating during the implementation of the lesson plan

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<td>Students work in groups of 2-4. Each student collects own data during the lab. During/after the simulation lab, students should discuss the differences obtained from the data and what implications that data may have affecting earth’s weather, or climate, or water cycle. Share collection of data for averages (optional).</td>
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#### Critical Thinking
How will the students evaluate the question or defined problem to reach an objective conclusion? How will the students use the learned content and collected data to be able to critically think about the established question and/or problem on this lesson plan?

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<td>By viewing the amount of energy received at the different angles, hopefully the students will relate those angles to locations or latitudes on the surface of the earth and determine which position receives more direct visible light energy and which receives the least. With that data, students apply this knowledge to what possible affects the amount of energy striking the earth would affect (in general). Examples: More energy means more heat which means warmer weather or climate or warmer season.</td>
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Communication
How will the students communicate their findings and conclusion regarding the established question and/or problem?

A lab report showing a data table, graph, and conclusion will be written in science lab books/journals. Once completed, groups may share with each other their findings. After viewing online interactive, students should discuss how their data related to information shown in the interactive.

References

Teacher’s References
Include all references used to develop and implement this lesson plan.

Products and main concept: http://www.vernier.com/experiments/

Seasons interactive simulation to compare recorded data:
http://www.sepuplhs.org/students/iaes/simulations/SEPUP_Seasons_Interactive.swf

Data for long term temperatures: https://www.climate.gov/maps-data/datasets
If using thermometers instead of solar cells, http://mrschamberlain.com has the solar isolation lab well set up with a pdf of the lab.

Student’s References
Include all references students will need to complete this lesson plan.

Seasons interactive simulation to compare recorded data:
http://www.sepuplhs.org/students/iaes/simulations/SEPUP_Seasons_Interactive.swf

Extension: Data for long term temperatures: https://www.climate.gov/maps-data/datasets

Assessment Plan

Assessment Plan
How will the students be assessed during and/or at the end of the lesson plan?

Include resources that will be used to assess the students for the lesson plan.

Lab Report:
Data table created and filled in correctly. Graph shows data from table properly. Conclusion paragraph discusses differences in energy received and proposes effects on earth based on the data. Conclusion rubric: 0-not completed. 1-attempted, but no discussion of data connected to earth’s surface. 2-data compared but no discussion of earth’s surface. 3-data compared and mention of earth’s surface. 4-data shows relationship with the angles of the earth’s surface. 5-data shows relationship with the angles of the earth’s surface (direct and indirect light) and proposes effects on earth’s atmosphere, weather, climate, etc.
Resources and Costs

| Resources Needed | KidWind Sun Angle Science Kit  
| Or just the solar cells & multimeter | 24 triangle blocks of wood cut into 30°, 60°, 90° angles |
| Lab desk, pencil, ruler, protractor | Lamp with 100 W light bulb, Graph paper (optional) |
| Student lab book/journal | Computer for extension activities |

Costs

List the estimated cost of implementing this lesson plan.

Include all costs related to equipment, materials and any resource critical to the implementation of the lesson plan.

- **KidWind Sun Angle Science Kit** $49.00 x 8 groups = $392 + tax  
- 8 Desk lamps (Wal-mart) approx. $9 x 8 = $72
- 8 incandescent light bulbs approx. $2 x 8 = $16
- In place of solar cells: Delta Education V-Back Metal Thermometers - Fahrenheit - Pack of 30 = $60

Implementation Plan

| Implementation Plan Timeline | Day 1: Students design and perform the lab to view the energy from the lamp (sun) at different angles (30°, 60°, and 90°). Record data in a table and begin making a graph.  
| Day 2: Students complete a conclusion paragraph to show connections to solar angle striking earth’s surface (direct and indirect light) and what effects it may have on the atmosphere. If time, students go to the online simulation and compare their results to what the simulation of showing the seasons. Discuss connections to lab and simulation with group. |

Establish the timeline to implement the lesson plan.

Provide an estimate of time and days in order to complete the lesson plan.