Solar Energy Lesson Plan

Grade Level:
7, 8, 9, 10, Vocational Education

Subject(s):
Science
Vocational Education/Technology

Duration:
Eight 45-minute sessions

Description:
Using the Ameren.com solar energy website, students will explore, compare and analyze available solar technologies, determining the effectiveness of each when utilized in the Midwest.

Goals and Objectives:
Students will…

1. Explore the role of solar energy as a renewable energy resource.
2. Identify the importance and effectiveness of solar energy.
3. Analyze Ameren's solar energy data to solve problems related to implementing solar energy.
4. Identify the basics of renewable energy, specifically solar energy.
5. Describe optimal conditions and equipment for the generation of solar energy.
6. Describe how a solar energy system functions.

Materials:

- Worksheets (see resources below)
- Solar Vocabulary Sheet
- Solar Vocabulary Crossword Puzzle
- Ameren.com/solar website: http://www.AmerenSolar.com

Procedure

Day 1:
Introduce the Ameren.com/solar website to the class. Students will be given study sheet #1, vocabulary list and vocabulary crossword for silent or group review for the remainder of the class period.

Day 2:
Review the previous day's worksheet definitions. Give students a few minutes of study time (group or individual) to review notes, the study sheet #1, and class discussions. Administer the "What is Solar Energy" examination. Correct the examination and discuss points presented.

Day 3:
Field trip to visit the Ameren Learning Center. Tour the site and see Ameren's solar technology.

Days 4-5:
Answer questions from study sheet #2. Using information from the Ameren.com/solar site, the National Weather Service website, and Earthcam.com website, compare the various technologies (Mono, Poly, Thin Film, Tracker) taking into account the amount and directness of sunlight, time of year, weather, etc.

Day 6-8:
Using the Ameren.com/solar website, the National Weather Service website and the Earthcam.com website, answer questions from study sheet #3.

Assessment:
As a result of participating in these activities, students will be able to identify basic components of a solar energy photovoltaic (PV) system. Students should complete and turn in the Post-Activity Assessment Form (PAAF) prior to beginning a new activity.

Useful Internet Resources:
http://www.ameren.com/solar The Ameren Solar Energy Project Website

http://www.crh.noaa.gov/lsx/hrlywx.php National Weather Service Hourly Weather Data

http://www.earthcam.com/usa/missouri/stlouis/keiner St Louis Webcam: present conditions downtown.

http://www.illinoissolar.org Illinois Solar Energy Association

http://www.moseia.org Missouri Solar Energy Federation

http://www.eia.doe.gov/kids/ Energy Kids Website

http://www.energystar.gov/index.cfm?c=kids.kids_index Energy Star Kids

http://www.getintoenergy.com/students.php Get Into Energy

Crossword Answer Guide:
Across: 3. tracker 7. electron 9 . panel 11. watt 12. photovoltaic 13. inverter
Down: 1. grid 2. nonrenewable 4. renewable 5. tilt 6. voltage 8. photon 10. load

Vocabulary

1. **Alternating Current (AC)**
   The form of electric power that is delivered to businesses and residences in which the movement of the electric charge periodically reverses direction.

2. **Direct Current (DC)**
   The form of electrical current produced by batteries or solar cells in which the movement of the electrical current is in a single direction.

3. **Efficiency**
   The ratio of power output of a photovoltaic cell to the incident power from the sun or simulated sun sources under specified standard insolation conditions.

4. **Electrons**
   A negatively charged particle. The movement of electrons in an electrical conductor constitutes an electric current.

5. **Grid**
   Transmission line network used to distribute electric power.

6. **Inverter**
   A device that converts electricity from DC to AC.

7. **Kilowatthour**
   Unit of energy used to perform work (energy and work are equivalent in units, energy being the potential value and work the achieved value).

8. **Load**
   Refers to equipment that is powered by electricity. Expressed in terms of watts. In an electrical circuit, any devise or appliance that uses power (such as a light bulb or water pump).

9. **Non-renewable Resource**
   A natural resource which cannot be produced, grown, generated, or used on a scale which can sustain its consumption rate.

10. **Photon**
    The actual (physical) particle unit of light, as the electron is of electric charge and the atom and molecule are of matter.

11. **Photovoltaic Cell**
    A device composed of specially prepared semiconductor material or material combinations exhibiting the ability to convert incident solar energy directly into electrical energy.

12. **Renewable Energy**
    Energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are naturally replenished.

13. **Solar Cell**
    The basic photovoltaic device which generates electricity when exposed to sunlight.

Vocabulary cont.

14. **Solar Panel**
    A collection of solar modules connected in series, in parallel, or in series- parallel combination to provide greater voltage, current, or power than can be furnished by a single solar module.

15. **Tilt Angle**
    A fixed angle measured from the horizontal to which a solar array is tilted. The tilt angle is chosen to maximize the array output. Depending upon latitude, season and time of day this angle will vary.

16. **Tracking Array**
    An array that is mounted on a movable structure that follows the path of the sun.

17. **Voltage**
    A measure of the force or "push" given the electrons in an electrical circuit; a measure of electrical potential. One volt produces one amp of current when acting against a resistance of one ohm.

18. **Watt**
    Unit of power. Power is the rate of using energy to do work.

Solar Energy Lesson Sheet 1

Student Name _____

Date_____

Photovoltaic Energy

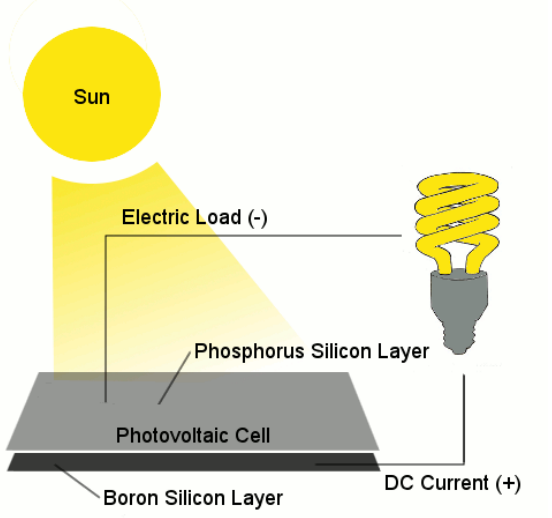
Photovoltaic energy is a method of generating electrical power by converting solar radiation into electricity. At the molecular level, within the actual solar panel, a process of using solar radiation to begin an exchange of electrons between negatively and positively charged plates causes the reaction that generates energy.

Silicon atoms have room for eight electrons. By combining silicon with phosphorus to form a plate, the builder of the solar panel creates an additional, negatively-charged (n-type) electron on the plate.

In the second plate silicon is combined with boron, creating room for an additional electron. This silicon/boron plate is considered to be positively charged (p-type) since it has room for an additional electron.

The two plates (one negatively-charged and one positively-charged) are sandwiched together with conductive wires running between them.

Photons from the sun bombard the plates, breaking off the ninth electron of the silicon/phosphorus atoms. Then this electron is attracted to the open spot in the positive silicon/boron's outer band. As the sun breaks off more of these electrons, causing an ongoing transfer, electricity is generated.



1. The sun's photons act like billiard balls, knocking electrons off the negatively charged plates where they are attracted to the positively charged plates. A direct hit is more effective at doing this than a glancing blow. What does this tell you about the way the panel should be aligned with the sun?

2. Based on information above, would a solar energy installation likely be more or less successful closer or farther from the equator? Why?

3. What other weather factors, besides directness of sunlight, might influence how successful a solar energy installation is?

4. What is the different between Alternating Current (AC) and Direct Current (DC)? Do our homes use AC or DC? What does an inverter do?

Solar Energy Lesson Sheet 2

Student Name _____

Date_____

Use These Internet Resources:
http://www.ameren.com/solar The Ameren Solar Energy Project Website
http://www.crh.noaa.gov/lsx/hrlywx.php National Weather Service Hourly Weather Data
http://www.earthcam.com/usa/missouri/stlouis/keiner St Louis Webcam: present conditions downtown.

How much energy is currently being produced by the Ameren Solar Energy Project?
What might be the reason the project is producing this amount of energy?
Which technology is producing the most energy? The least?

How much energy did the Ameren Solar Energy Project produce one month ago today?
Using the Weather Service website, what were the sunlight conditions on that day?
Which technology produced the most energy? The least?

Using the Weather Service website, find a sunny day, document the date.
Using the Ameren.com/solar website, locate that day on the history.
What was the energy produced that day?
Which technology produced the most? The least?

Using the Weather Service website, find a day with little sunlight, document the date.
Using the Ameren.com/solar website, locate that day on the history.
What was the energy produced that day?
Which technology produced the most? The least?

Using the Weather Service website, find a summer month, document the month.
Using the Ameren.com/solar website, locate that month on the history.
What was the energy produced that month?
How many average homes could have been powered that month?
Which technology produced the most? The least?
How many average houses could have been powered by the Ameren project that month?

Using the Weather Service website, find a winter month, document the month.
Using the Ameren.com/solar website, locate that month on the history.
What was the energy produced that month?
How many average homes could have been powered that month?
Which technology produced the most? The least?
How many average houses could have been powered by the Ameren project that month?

Solar Energy Lesson Sheet 3

Student Name _____

Date_____

Use These Internet Resources:
http://www.ameren.com/solar The Ameren Solar Energy Project Website
http://www.crh.noaa.gov/lsx/hrlywx.php National Weather Service Hourly Weather Data
http://www.earthcam.com/usa/missouri/stlouis/keiner St Louis Webcam: present conditions downtown.

1. How does the seasons, cloud cover and time of day affect a solar energy installation in the Midwest?

2. Based on your findings, which technology overall (monocrystalline, polycrystalline, thin film, or monocrystalline on trackers) produces the most energy in the Midwest? Give examples.

3. Based on your findings, which technology (monocrystalline, polycrystalline, thin film, or monocrystalline on trackers) produces the most energy on cloudy days? On rainy days? Give examples.

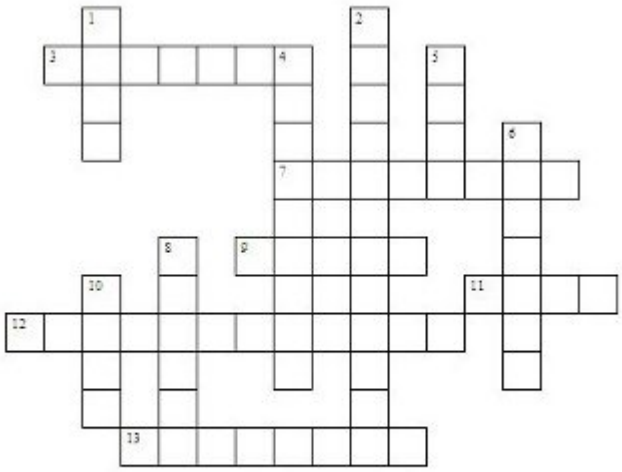
4. Based on your findings, which technology (monocrystalline, polycrystalline, thin film, or monocrystalline on trackers) produces the most energy in the winter? Give examples.

5. Explain the differences between photovoltaic technology mounted on trackers and stationary solar panels.

Solar Energy Vocabulary Crossword Puzzle

Student Name _____

Date_____



Across

3. A movable structure that attempts to follow the path of the sun.

7. A negatively charged particle.

9. A collection of solar modules connected in series, in parallel or in series-parallel to provide greater voltage, current, or power than can be created by a single solar module.

11. A unit of power. Power is the rate of using energy to do work.

12. The type of cell composed of specially prepared semiconductor material with the ability to convert solar energy into electrical energy

13. A device that converts electricity from DC to AC.

Down

1. The transmission line network used to distribute electrical power.

2. The type of natural resource which cannot be produced, grown, generated or used on a scale which can sustain its consumption rate.

4. The type of energy that comes from a natural resource such as sunlight, wind, rain, tides and geothermal heat which are naturally replenished.

5. The angle chosen to maximize the solar array output. Depending upon latitude, season and time of day this angle will vary.

6. A measure of the force or “push” given the electrons in an electrical circuit; a measure of electrical potential.

8. The actual (physical) particle unit of light, as an electron is of electric charge and the atom and molecule are of matter.

10. Refers to equipment that is powered by electricity such as a light bulb or water pump.

Solar Energy Post-Activity Assessment Form

Student Name _____

Date_____

1. What was the name of the activity that you worked on?

2. Who else (if anyone) worked with you on this activity?

3. What did you like most about this activity?

4. What did you like least about this activity?

5. What tools, equipment, or materials did you use to complete this activity?

6. Name one occupation (job) where you would use what you learned from this activity.

7. How would you use the information you learned from this activity in the job that you wrote down in question #6?

8. If you were to do the activity again, what would you do differently, if anything, to learn more than you did?