

To Go Solar or Not to Go Solar!
SPN LESSON #3



TEACHER INFORMATION

LEARNING OUTCOME

Through conducting research and evaluation, composing a summary, and participating in a role-play of a community meeting, students decide on the feasibility of photovoltaics as an alternative source of energy.

LESSON OVERVIEW

This lesson is a role-play that invites students to evaluate the feasibility of installing a photovoltaic system on the roof of a new school being planned for their community. The PV system would supply most or all of the building's electricity requirement. Students research the topic and then each student assumes the role of a specialist having a specific point of view and knowledge base, or the role of a community member. Each specialist prepares a presentation to be made to the class. The community members prepare a list of questions for the specialists and then, depending on their role, prepare a specific type of written summary (newspaper article, letter to a friend, or letter to the editor). Students investigate a topic, evaluate data, determine the validity and reliability of a variety of sources, listen and speak critically, ask questions, and prepare a written report or presentation. To Go Solar or Not to Go Solar! would be a good choice for a collaborative science or technology education with language arts project.

GRADE-LEVEL APPROPRIATENESS

This Level II general energy, technology education, language arts lesson is intended for use with students in grades 6–8.

MATERIALS

Students will need:

- access to reference materials both printed and electronic
- access to the Internet
- presentation materials including transparencies, LCD projector, computer, printer, poster board, etc.

SAFETY

There are not safety concerns associated with this activity.

TEACHING THE LESSON

Before class:

- Run off copies of the student handout.
- *To Go Solar or Not to go Solar!* can be taught at any point during the school year. It serves as a good introduction to the photovoltaic panel on the roof of the school. Using it as a writing exercise, rather than a science or technology lesson, is another way to incorporate this lesson into the curricula.

During class:

- Ask students if they have attended any community meeting where issues of concern to residents have been discussed. This could be a village board meeting, or an informational meeting about a new industry that would like to locate in the area but poses some issues of concern. There are frequent zoning meetings and less frequent environmental impact and toxic waste cleanup meetings. In some parts of the state, dredging and garbage burning facilities have been politically charged topics. You might have student volunteers attend and report back on a school board meeting or other community gathering where experts make a presentation and citizens ask questions afterward. Discuss with students why such public forums are important.
- Pass out the student handouts. Read through the handouts with students, and before assigning roles (or permitting students to select roles), have them research the advantages and disadvantages of photovoltaic panels. Remind students that they each must reference sources of information. Provide them with a model to follow so they will know what you expect by way of notation for the various types of sources they will be using.
- Assign roles or allow students to select the role each wishes to play.
- Post the date of the “community meeting” on the board or in another visible location. Also provide students with a copy of the “self-check” rubric.
- You can discuss with students some of the following ideas, which might help them in their work:
 - (a) Some may view solar energy as free energy and therefore consider it an attractive alternative energy source. However, there are expenses associated with solar power. The setup costs are higher than for a more traditional energy source. The PV system, to provide a school with a constant supply of electricity, needs to have an energy storage system. This is usually a series of large batteries. Also, the cells must occasionally be replaced. Conventional sources also have ongoing costs. There are the expenses of the fuel (coal, oil, etc.) and transportation of the fuel. There are emission controls and pollutants. These costs are all passed along to the community, but are not obvious.
 - (b) Students should consider these issues: jobs are created if a power plant is built but they are lost if a power plant cuts back; a nuclear power plant and a coal-fired plant both have wastes and pollutants associated with the generation of electricity; if snow or ice covers the panels, the supply of electricity will be cut off and school may have to be closed; if there is not enough money in the school building budget to fund the PV system, taxes will have to be raised; the cost of electricity purchased from a power utility will continue

to go up and cost taxpayers more over the years; long-term planning is important when energy is considered because a large investment now may save money in the future; during part of the year, the PV system will produce more electricity than the school needs, and this electricity can be sold back to the power company.

- As the day of the “meeting” approaches, check to make certain that everyone’s research is progressing and that the presentations and lists of questions are nearing completion. Encourage students to dress for the role they are playing.
- Videotape the role-play activity. Depending on school policy, you may want to obtain signed consent forms from the students’ parents or guardians. Students can then use the video for self-assessment purposes.

SOURCE OF THIS ADAPTED ACTIVITY

The idea for this activity came from a case study by the same name in *Science II: Essential Interactions*, published by Centre Pointe Learning, Inc., Cincinnati, Ohio.

ACCEPTABLE RESPONSES FOR DEVELOP YOUR UNDERSTANDING SECTION

Activity Analysis

Use the assessment rubric to score student work.

Extended Activities

Letter Writing

Have students refine the letters, news articles, and presentations they create. Encourage them to submit their work to the school or local newspaper for publication.

Art/Advertising

Ask students to create an advertisement for a housing development that uses solar energy for electricity. The development will consist of single-family homes situated in a wooded New York State setting. The advertisement might be a brochure or a TV infomercial.

ADDITIONAL SUPPORT FOR TEACHERS

BACKGROUND INFORMATION

The initial developers of photovoltaic systems were the scientists researching reliable ways to power spacecraft and satellites. Bell Labs developed silicon-based solar cells in the 1950s. Through continued research associated with the space program and independent energy investigators, solar technology has become increasingly efficient.

Solar generated electricity will have a dramatic effect on our lives and our economy. On a clear day, the sun shines about 1,000 watts of energy per square meter on Earth’s surface. The idea of using this “free” electrical energy from the Sun is appealing, but there are costs associated with collecting solar energy, converting it to electrical energy, and then distributing it. When the Sun

is not shining, no electricity is generated. This leads to the need for battery storage systems, which in the past have been bulky and expensive.

Advocates of solar energy have suggested solutions to these costs. Seventy percent of the electrical demand in the United States occurs during the day. Savings could be realized by using solar panels to satisfy daytime needs and conventional sources at night. In addition, the demand for air conditioning, which, after refrigeration, is the second largest power consumer in the United States, can be satisfied by PV systems. Solar-powered air conditioners could operate independently from the rest of the electrical system. There are many options and permutations for combining solar and traditional sources of electricity.

Solar energy is one of those “events” waiting to happen. Even though the cost continues to decline, it has not met the level of market penetration expected. Nevertheless, the gap between conventional and solar sources is narrowing. It is anticipated that public-policy changes will encourage the spread of solar energy electrical generation. It is important for students to be aware of the options solar-generated electricity provides. Students should also be active participants in community decision-making processes.

The PV system described in the role-play differs from that on the roof of your school. The role-play PV system, when the sun shines, provides sufficient electricity to address electrical needs of the building. The 2 kW PV system on your roof, when the Sun shines, provides sufficient energy for about half the electrical use of a typical home. Also, your school’s system has stationary panels rather than a tracking system. At some point you will want to describe these differences to your students and explain that the role-play was designed to introduce the need for storage batteries, whereas your PV system continues to depend heavily and continually on electrical energy from your electrical provider. Instead of “selling” back to your provider the excess electrical energy produced in your system, the electrical meter turns backwards, saving your school money.

REFERENCES FOR BACKGROUND INFORMATION

Chiras, Daniel D. *Environmental Science: A Framework for Decision Making*. Addison-Wesley Publishing Company, Menlo Park, CA, 1989.

Miller, Kenneth and Joseph Levine. *Biology*. Pearson Education, Inc., Upper Saddle River, NJ, 2003.

Smith, Leo. *Ecology and Field Biology*. 4th edition. HarperCollins Publisher, New York, NY, 1990.

Wright, Richard T. and Bernard J. Nebel. *Environmental Science: Toward a Sustainable Future*. Pearson Education, Inc., Upper Saddle River, NJ, 2002.

Produced by the Research Foundation of the State University of New York with funding from the New York State Energy Research and Development Authority (NYSERDA)
nysesda.ny.gov

(STUDENT HANDOUT SECTION FOLLOWS)

Name _____

Date _____

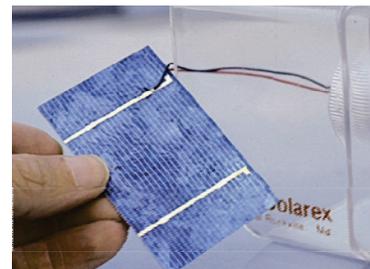
To Go Solar or Not to Go Solar!

About Solar Energy

Imagine how nice it would be if you could leave your microwave, computer, TV, or family car out in the sunlight for a while to make it work. This isn't far from reality. First, sunlight energy must be converted into electrical energy. Electricity can then be used to make all of these devices—the microwave, computer, TV, or even the car—work!

A solar cell is a device that does just that! It converts light energy into electrical energy. Solar cells are commonly used in calculators and watches. Light energy strikes silicon crystals, causing electricity to flow. Wires coming from the solar cell(s) are connected to an appliance.

Solar cell technology got its real start from space scientists in the 1950s. Bell Telephone researchers discovered the sensitivity of a properly prepared silicon wafer to sunlight, and the “solar cell” was born. These scientists knew that the Sun was the best source of energy for satellites and spacecraft. In order to supply the large amounts of electricity that satellites and spacecraft required, the scientists developed solar panels, which are collections of solar cells. Solar panels installed on the roof can provide electricity to a school, home, or business. What happens when the Sun is hidden by clouds or when the Sun goes down during the night? Energy collected during sunny periods can be stored for use during less sunny times. Rechargeable batteries are used for this purpose.



Three main factors affect the technological design of solar cells/panels. They are:

- the efficiency of cells in converting sunlight energy into electrical energy
- the amount of solar energy that strikes the solar cells/panels
- the capacity of rechargeable batteries.

During the 1950s–1990s, solar cell efficiency rose to about 15%. It increased to about 18% with the use of mirrors and lenses to focus the Sun's light onto the cells. If mirrors and lenses are used, then expensive tracking systems have to be a part of the panel's design. The Sun's light must be focused on the panel all day. The tracking system allows the panel to move and follow the angle of the sunlight. Many solar panel systems do not have built-in tracking systems. Many are stationary and are positioned to receive the most sunlight possible for their fixed location.

Role-Play: A Solar School

A new school is being planned for your area. To discuss sources of electricity for this school, a community meeting is to be held. It is your task to invite five specialists to provide the community with information about solar power.

The Roles

Specialists

Engineer: You work as a design specialist for a solar panel manufacturer. The cost of electricity purchased from a utility will keep going up. It is true that a solar voltaic system is expensive to begin with, but over several decades, the money saved will pay for the system and its cost of installation.

Environmentalist: You work for a state organization concerned with air quality. Using solar panels will help reduce the number of pollutants released into the air. Therefore, installing photovoltaic panels to provide energy to the new school will help to protect the environment.

School Board Member: You want to keep construction costs down. A new school is important for the community but you want it to cost as little as possible and not cause taxes to go up.

Power Utility Manager: You are the manager for an electrical generating station that supplies electricity to the community. You are concerned that building a solar school will encourage others to use solar energy and thereby reduce the need for electricity in the area and result in the loss of jobs.

State Legislator: You are elected by the people in the community to represent them in Albany. You are pleased that the state government will provide some money toward the construction of the photovoltaic system on the school. The school will be a model for other energy-conscious communities and industries.

Community Members

Reporters: You work for one or more local newspapers. You want to provide readers with unbiased coverage of the proposed solar panels for the new school. It is important that you ask the right questions to the right people and report both the advantages and disadvantages of using solar panels.

Students: You have heard a lot of discussion about the advantages and disadvantages of using photovoltaic panels to provide electricity to the new school. However, you are not sure yet what questions you should ask to find out how the panels would affect you or if they would affect you.

Parents: You want the best school for your children but don't want it to cost a fortune. You are also concerned about the safety of your children. What questions should you ask to find out about costs and safety issues associated with photovoltaic power systems?

The Task

You will assume the role of one of the specialists or a community member. Prepare for your role by considering the advantages and disadvantages of having solar panels serve as the primary source of electricity for the new school in your community. Whether you are a specialist or a community member, you will need to research the use, cost, and environmental impact of photovoltaic panels.

As a *specialist*, it is your task to prepare a three- to five-minute presentation that explains your position. The presentation should be factual and incorporate data to support your claims. Use

charts, diagrams, and/or graphs. You may want to quote a state or national expert(s). Be prepared to respond to questions from community members.

As a **community member**, it is your task to prepare a series of questions to ask the specialists. Write out your questions on index cards or half sheets of paper. Have one question per card. When one of the specialists answers your question, take notes about what they say. You should also take notes from the presentations. Record which specialist answers your question, and whether the information is provided through their presentation or in response to a direct question from you or another community member. As a concerned citizen, you want to share your information with others who could not attend the meeting.

- **Reporters:** Write a column for your newspaper. Be sure to present both the positive and negative aspects of installing solar panels on the new school. Check a local newspaper to find the format used for news articles such as this. Find out how to include data and quotations.
- **Students:** Write a letter to a student in a school that is also considering the installation of photovoltaic panels. Tell the other student what you learned from the meeting and ask them some questions that you still have about the advantages and disadvantages of solar energy being used to generate electricity.
- **Parents:** After doing your own research, listening to the specialists, and asking questions, you now know how you feel about installing photovoltaic panels on the roof of the new school. Write a letter to the editor of the local newspaper. Be sure to use facts to support your claims. Remember that the article written by a reporter from the newspaper will appear in the same issue as your letter. Stating a lot of opinions with little or no data will not help convince citizens reading your letter that you know about the issue.

Name _____
 Class _____

Date _____

Scoring Guide—Written Report/Questions

Hand in this scoring guide along with your written report.

Skills	Good	Fair	Poor	Unacceptable	Does Not Apply
Mechanical Skills					
spells correctly					
punctuates correctly					
writes legibly					
Word Choice					
uses words correctly					
uses clear, concrete language					
uses appropriate, scientific vocabulary					
Sentence Structure					
varies sentence structure					
uses complete sentences					
keeps subject-verb agreement					
Communication					
follows directions					
focuses on topic					
excludes irrelevant information					
supports generalizations					
demonstrates understanding of the objective					
Content					
provides data to support statements					
asks questions that are relevant and organized					
describes position clearly					
demonstrates a knowledge of the difference between fact and opinion					
writes from the point of view of the role assigned					
Overall Score					

Teacher Comments:

Name _____
 Class _____

Date _____

Scoring Guide—Presentation

Hand in this scoring guide just before you make your presentation.

Skills	Good	Fair	Poor	Unacceptable	Does Not Apply
Graphic Techniques					
draws accurately					
labels accurately and completely					
matches captions to structures					
selects appropriate video clips/graphics					
hands in work that is neat and clear					
makes presentation that is visually effective					
Performance					
speaks clearly and makes eye contact with audience					
information is complete and detailed					
describes position clearly					
speaks from the point of view of the role assigned					
supports generalizations					
Communication					
focuses on topic					
excludes irrelevant information					
provides data to support statements					
demonstrates a knowledge of the difference between fact and opinion					
demonstrates understanding of the topic					
provides information that is scientifically correct					
Overall Score					

Comments: