Solar Education for NY
SchoolPower...Naturally

Energy Solutions: A Brochure

SPN LESSON #6

TEACHER INFORMATION

LEARNING OUTCOME

Students are able to communicate to others the benefits of photovoltaic systems as an alternative source of energy, as evidenced by brochures they develop.

LESSON OVERVIEW

This lesson increases student awareness of energy alternatives with a focus on photovoltaic systems. The final product is a collection of informative brochures to be handed out during parent night or at a public meeting. Individuals with little or no knowledge of photovoltaic systems should be able to read any of the brochures and come away with a basic understanding of the need for alternative energy sources and the strengths of PV systems.

A rubric that establishes the criteria to be met is provided. Students are required to use a minimum of four sources and select only relevant material for inclusion in the brochure. The information and graphics must be concisely formatted.

GRADE-LEVEL APPROPRIATENESS

This Level II or III language arts/art/general energy lesson is intended for use with students in grades 6–8, but can be adapted for older students.

MATERIALS

Each student should have:

- access to the Internet, library, and other sources of energy information
- access to a computer and color printer
- paper (8.5 x 11 inch)
- software for creating brochure layout
- copy of scoring rubric for *Energy Solutions: A Brochure* (see student handout)

SAFETY

There are no safety concerns associated with this lesson.

TEACHING THE LESSON

Before class:

- Run off copies of the student handout.
- Assemble a collection of informational brochures for students to use for design and format ideas. These brochures will model how concise the wording must be and how to organize information.

Brochures are readily available at medical offices, travel agencies, and so on. Do not provide students with energy-related brochures. These could stifle student creativity.

- *Energy Solutions: A Brochure* can be taught at any point during the school year. It is designed to serve as an introduction for both students and parents to the photovoltaic panel on the roof of the school.
- Interdisciplinary Connection: *Energy Solutions: A Brochure* could be used as a writing exercise, rather than a science or technology lesson.

During class, before starting the activity:

- Since this is an awareness activity, merely ask students if they are aware of the school's photovoltaic system and if they know how one operates, what it provides, and so on. This should be a very general discussion.
- Explain to students that they will be doing several laboratory investigations throughout the year that rely on data generated by the system, and introduce the term *DAS* (an acronym for "data acquisition system"). Students should be made aware of the fact that the system is being provided through New York State Energy Research and Development Authority (NYSERDA) funding.
- Assign the brochure project. Tell students that some of their brochures will be copied and given to parents during parent night and handed out at school board meetings. The purpose of the brochure design project is to provide the students, as well as their parents and other community members, with more information about what the photovoltaic system does and how it operates.
- Encourage students to use graphics and data from the school's DAS in the brochures.

During class, after completing the activity:

Display all of the brochures. Invite students to look through them and to select those that should be distributed to parents, the school board, and other members of the community.

ACCEPTABLE RESPONSES FOR DEVELOP YOUR UNDERSTANDING SECTION

Activity Analysis

1. (a) Make a list of five or more criteria you would use to judge energy resources. The criteria listing could include cost, environmental impact, reliability, and so on. Once your list is complete, rank the criteria, from most important to least important.

   Answers will vary. Check to see if there are at least five criteria. Cost, reliability, and environmental impact may be included in the five. Other criteria might include whether it is available, whether it is renewable or nonrenewable, and if it must be imported.

   (b) Use your list to evaluate photovoltaic cells as a source of electrical energy. Explain how each criterion is met or not met, and describe the overall rating you would assign to a photovoltaic system.

   Answers will vary. Check to see that an explanation is provided for whether or not photovoltaic systems meet each criterion. The overall rating should also be provided.

2. How did creating the brochure increase your understanding of photovoltaic systems and their potential as a source of energy for many homes and businesses?

Answers will vary. Student knowledge of photovoltaic systems should have increased as a result of the activity.

3. If you were able to build a new home within the next year, explain why you would or would not install a photovoltaic system.

   Answers will vary. Students should provide a sound explanation that uses information from the research they did for the brochure. It is important for them to support the decision to install or not to install a PV system with facts rather than opinions.

ADDITIONAL SUPPORT FOR TEACHERS

BACKGROUND INFORMATION

It is important for students to understand that a permanent source of energy must be renewable. Realistically, society's future relies on two major energy sources: the Sun and the Earth's interior heat. Energy from these sources can take many forms. The Sun creates heat that keeps Earth warm. The Sun is also responsible for making the wind blow, the rain fall, and plants grow. All of these processes can be used for energy.

Presently, solar energy provides only a tiny fraction of our energy requirements. Significant amounts of solar radiation are available across the United States. Many think that specific regions of the country, such as the Southwest, are appropriate for increased reliance on solar energy while other regions are not. This is a misconception. Maine receives 70% as much sunlight as Arizona. Solar energy can be successfully utilized in both locations.

Solar energy can be broken down into two major categories: direct and indirect. Direct solar energy is captured from sunlight and used for generating electricity, heating, and cooling. Indirect solar energy comes from natural processes driven by the Sun. Biomass, wind, and hydroelectric power are examples.

Photovoltaic or solar cells fall into the direct solar energy category. They provide a way of generating electricity from sunlight. Solar cells are typically composed of thin wafers of silicon that emit electrons when struck by light. PV production has grown at a rate of 50% per year since the 1970s. During this rapid growth period, the cost has fallen. For example, between 1950 and 1980, the cost per watt fell from the $400/watt it cost on NASA's *Vanguard I* to about $5/watt retail. At PV manufacturing costs of about $400/watt in the 1950s, the cost of electricity generated from a PV system was about $25/kilowatt-hour. At PV manufacturing costs of about $4/watt today, the cost of electricity generated from a PV system is about 25¢/kilowatt-hour. New developments in PV cell production are making photovoltaics competitive with traditional electricity sources. Cost and availability are not prohibitive factors—but awareness is.

REFERENCES FOR BACKGROUND INFORMATION

A Web site with an informative PowerPoint slide show on energy, including photovoltaic energy, is:
cstl-cst.semo.edu/bornstein/BS105/ Energy%20Use%20-%204.ppt

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.

National Science Education Standards. National Academy Press, Washington, DC, 1996.

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

EXTENDED ACTIVITIES

Graphic Arts

Students could make a poster to go along with the brochure. The theme of the poster might be "Traveling to Our Future." The design should incorporate some of the elements typically seen in travel posters—great pictures, color, and minimal text. Photovoltaic energy should be the featured energy source.

Technology Education

Provide students with several solar cells, wires, a milliammeter, and construction materials. Invite them to design and construct a model home that relies on photovoltaic cells as a source of electricity. Students must consider factors such as the placement of the cells, the design of the house, and the location of the house on its lot. The goal is to provide electricity to each room for as long as possible before the owner would need to resort to other electricity sources.

LINKS TO MST LEARNING STANDARDS AND CORE CURRICULA: 1: S1.1b; 2: 1.1, 1.3, 1.4a,b,c, 2.1a; 4: 7.1, 4.1a,c,d, 4.4d; 6:1

Standard 1 – Analysis, Inquiry, and Design: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Science Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

S1.1: Formulate questions independently with the aid of references appropriate for guiding the search for explanations of everyday observations.

S1.1b: Identify appropriate references to investigate a question.

Standard 2 – Information Systems: Students will access, generate, process, and transfer information, using appropriate technologies.

Key Idea 1: Information technology is used to retrieve, process, and communicate information as a tool to enhance learning.

1.1: Use a range of equipment and software to integrate several forms of information in order to create good-quality audio, video, graphic, and text-based presentations.

1.3: Systematically obtain accurate and relevant information pertaining to a particular topic from a range of sources, including local and national media, libraries, museums, governmental agencies, industries, and individuals.

1.4: Collect data from probes to measure events and phenomena.

1.4a: Collect the data, using the appropriate, available tool.

1.4b: Organize the data.

1.4c: Use the collected data to communicate a scientific concept.

Key Idea 2: Knowledge of the impacts and limitations of information systems is essential to its

effectiveness and ethical use.

2.1: Understand the need to question the accuracy of information displayed on a computer because the results produced by a computer may be affected by incorrect data entry.

2.1a: Critically analyze data to exclude erroneous information.

Standard 4

Living Environment

Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.

7.1: Describe how living things, including humans, depend upon the living and nonliving environment for their survival.

Physical Setting

Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved.

4.1: Describe the sources and identify the transformations of energy observed in everyday life.

4.1a: The Sun is a major source of energy for Earth. Other sources of energy include nuclear and geothermal energy.

4.1c: Most activities in everyday life involve one form of energy being transformed into another. For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine. Energy, in the form of heat, is almost always one of the products of energy transformations.

4.1d: Different forms of energy include heat, light, electrical, mechanical, sound, nuclear, and chemical. Energy is transformed in many ways.

4.4: Observe and describe the properties of sound, light, magnetism, and electricity.

4.4d: Electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy.

Standard 6: Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Key Idea 1: Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.

LINKS TO THE LEARNING STANDARDS FOR ENGLISH LANGUAGE ARTS

Standard 1: Language for Information and Understanding

Listening and Reading

1. Listening and reading to acquire information and understanding involves collecting data, facts, and ideas; discovering relationships, concepts, and generalizations; and using knowledge from oral, written, and electronic sources.
   Students:
   - interpret and analyze information from textbooks and nonfiction books for young adults, as well as reference materials, audio and media presentations, oral interviews, graphs, charts, diagrams, and electronic databases intended for a general audience
   - compare and synthesize information from different sources
   - distinguish between relevant and irrelevant information and between fact and opinion
2. Speaking and writing to acquire and transmit information requires asking probing and clarifying questions, interpreting information from one context to another, and presenting the information and interpretation clearly, concisely, and comprehensively.
   Students:
   - produce oral and written reports on topics related to all school subjects
   - establish an authoritative stance on the subject and provide references to establish the validity and verifiability of the information presented

- develop information with the appropriate supporting material such as facts, details, illustrative examples or anecdotes, and exclude extraneous material
- use standard English for formal presentation of information, selecting appropriate grammatical constructions and vocabulary, using a variety of sentence structures and observing the rules of punctuation, capitalization, and spelling

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www.nyserda.org

Should you have questions about this activity or suggestions for improvement,
please contact Bill Peruzzi at billperuz@aol.com

(STUDENT HANDOUT SECTION FOLLOWS)

Name _____

Date _____

Energy Solutions: A Brochure

Introduction

You are challenged to create a trifold brochure to be handed out at a public meeting or parent night at your school. The brochure should provide concerned citizens/parents with information about solar energy with a focus on the school's photovoltaic system. It is your task to compare solar energy to more traditional sources such as fossil fuels and explain why a greater use of solar energy is a part of everyone's future.

The brochure should be creative as well as informative so that people will be interested in picking it up and reading through it. Be sure to include accurate, up-to-date information and graphics that illustrate important ideas. You should reference at least four sources of information on a separate "works cited" page to be handed in along with your brochure.

Refer to the scoring rubric for *Energy Solutions: A Brochure* to help you select the information to be included and for general guidelines. The rubric will be used for grading purposes.

DEVELOP YOUR UNDERSTANDING

Materials

Each student should have:

- access to the Internet, library, and other sources of energy information
- access to a computer and color printer
- paper (8.5 x 11 inch)
- software for creating brochure layout
- copy of scoring rubric for *Energy Solutions: A Brochure*

Activity Analysis

1. (a) Make a list of five or more criteria you would use to judge energy resources. The criteria listing could include cost, environmental impact, reliability, and so on. Once your list is complete, rank the criteria, from most important to least important.

   (b) Use your list to evaluate photovoltaic cells as a source of electrical energy. Explain how each criterion is met or not met and the overall rating you would assign to a photovoltaic system.

2. How did creating the brochure increase your understanding of photovoltaic systems and their potential as a source of energy for many homes and businesses?

3. If you were able to build a new home within the next year, explain why you would or would not install a photovoltaic system.

Scoring Rubric for *Energy Solutions: A Brochure*

Rating Scale: 4 = Excellent 3 = Very Good 2 = Acceptable 1 = Unacceptable 0 = Missing

Section of Brochure	Score	Comments
Overall appearance of brochure		
• printed on 8.5 x 11 inch paper	4 3 2 1 0	
• includes graphics	4 3 2 1 0	
• neat and appealing	4 3 2 1 0	
Works cited		
• 4 sources referenced	4 3 2 1 0	
• printed on separate page from brochure	4 0	
Graphic of a photovoltaic panel		
• drawing, photocopy, or photograph of a photovoltaic system is included in the brochure	4 3 2 1 0	
• key parts of the panel are clearly indicated	4 3 2 1 0	
• function of each of the parts is explained	4 3 2 1 0	
Information about photovoltaic systems includes a:		
• rationale for investing in alternative energy sources	4 3 2 1 0	
• listing of the benefits of solar energy	4 3 2 1 0	
• description of what a photovoltaic system is and how it works	4 3 2 1 0	
• cost analysis (How does the cost of electricity from a PV system compare to the cost of electricity generated by more traditional sources? What does a PV system cost? What is the payback time?)	4 3 2 1 0	
• description of complications associated with solar energy	4 3 2 1 0	
• discussion of the research outlook	4 3 2 1 0	
Two other interesting facts about solar energy (e.g., Solar energy is important to all life on Earth because….)	4 3 2 1 0	
Total Points	**Grade =**	

Comments: