K-W-L

Student Objective
The student:
- will be able to list what they have learned about solar energy
- will understand how knowledge of a subject creates further questions.

Materials:
- 4 sheets of large paper, flip chart size
- markers of various colors

Key Words:
energy
photovoltaic
photosynthesis
solar
solar thermal

Time:
½ hour each discussion

Background Information
Our Sun
- The Sun is a medium-sized yellow star. It is a main sequence star sometimes referred to as a yellow dwarf.
- The Earth is 93,000,000 miles away from the Sun.
- If you were to drive a car from the Earth to the Sun at 70 miles per hour it would take you 151 years to reach the Sun.
- It would take about 109 Earths lined up end to end, to equal the diameter of the Sun.
- Our Sun provides the Earth with heat and light.
- The Sun is expected to burn out in another 4.5 to 7 billion years.
- It takes approximately 8 minutes for sunlight to reach Earth.
- The Sun is the center of our solar system. All of the planets orbit the Sun. .
- Without the Sun, life would not exist on our planet.
- If you were to draw the Sun on the board one meter in diameter, the Earth you would draw would be approximately one centimeter in diameter.
- Sunlight intensity varies in different places around the world. It is affected by latitude, altitude and seasons.
- Sun blockers can prevent the Sun's rays from reaching the Earth. They include clouds, wind, and pollution.
- The energy from sunlight can be transformed to electricity by photovoltaic cells and this energy can be stored in batteries.
- The Sun is a giant ball of gas, mostly hydrogen and helium.
- In a series of reactions in the Sun, four atoms of hydrogen are fused into helium atoms. The loss of atomic matter (photons) is radiated into space and hits the Earth, providing light and heat.

Solar Energy

The Sun is the ultimate source of all energy on earth. Even our fossil fuels were created by solar energy thousands of years ago. In general, solar energy can be grouped into eight types: photosynthesis, wind energy, hydroelectric power, ocean energy, passive solar heating, active solar heating and photovoltaics.

Solar energy is using the energy radiated by the chemical reactions of our Sun for heat and electricity. During the nuclear fusion process in our Sun, four hydrogen atoms combine to form one helium atom with a release of matter that is emitted and travels outward from the Sun as radiant energy. The unit of measure for this energy is the *photon*. It takes these photons of energy a little under eight minutes to travel to Earth. There is so much energy radiating from our Sun that it produces more energy in one second than the Earth has used since time began.

Of the total energy from the Sun that reaches the Earth, about 30% is immediately bounced back into space by the atmosphere. The atmosphere, land masses and oceans absorb 45% in the form of heat. Almost 23% operates the water cycle, about 1% is used in air and ocean circulation, and less than 1% is used by plants.

Sunlight provides energy through **photosynthesis**. This energy is recoverable through burning of wood and fossil fuels such as coal, petroleum, and natural gas which are created through the process of photosynthesis. Photosynthesis is also the basis of all food energy; our food chain on Earth begins with the Sun.

Sunlight heating the ground and the lower atmosphere produces wind which powers wind turbines. **Wind power** has the potential to become a very significant alternative fuel in many areas of the world.

Sunlight stored as the gravitational energy of water through the water cycle can be extracted with dams and electric generators. **Hydroelectric power** is renewable and considered a "clean" energy since no burning is required, but it is limited in quantity.

Ocean Energy - The use of the ocean tides has been harnessed to make electricity along with a variety of other methods which make use of the motions and thermal gradients in the ocean. A heat engine can derive useful energy through the use of the temperature difference between the sun-warmed surface layers of the ocean and the colder depths, in a process called ocean thermal energy conversion (OTEC). This technology is complex, therefore limiting the use of the tremendous amount of stored energy in the ocean thermal gradients.

Solar thermal uses the energy of the Sun to make heat; solar thermal is mainly used to heat water for domestic and industrial use or for heating a building interior; however, it has also been used experimentally to create steam from a liquid that can then be turned into electricity with a turbine. **Photovoltaic** refers to the process of turning the energy of the Sun directly into electricity. Photovoltaic cells (commonly called solar cells) are made from silicon that undergoes a chemical process to add electrons and increase its instability, then the silicon mixture is allowed to form crystals from which the photovoltaic cells are made. Electricity is produced when a photon of light energy strikes the solar cell, causing the electrons to flow. The action of the electrons starts an electric current. This conversion of sunlight to electricity happens silently and instantly with no moving parts to wear out and no depletion of resources.

Documented use of solar thermal dates back at least to ancient Greek and Roman times. Recent research indicates that they used glass as a passive solar thermal collector. However, photovoltaic technology is relatively new; as a viable energy source, it is only 50 years old.

Solar energy has great potential now and for the future. As a source of energy, sunlight is

free, its supplies are unlimited and it is available in the majority of areas of the world. However, at this time the relatively high cost of photovoltaic cells and systems is limiting its use. This is expected to change as our supplies of fossil fuels diminish, new methods of producing photovoltaic cells are discovered, and the increase in demand for the technology brings the price down.

Procedure (Introductory Lesson)

1. Title two sheets of paper *Solar Energy* (the other two sheets will be used on the follow-up day).
2. Under the title, label one sheet, **K** - Things I know about solar energy, and the other sheet, **W** - Things I want to find out about solar energy.
3. Lead a brainstorming session with the class to fill in the first sheet. Write all of the information offered by the students. Alternate the color of the marker for each statement. It is very important to use the words stated by the children or to ask permission to paraphrase. If they give false information, refrain from correcting them!
4. Then, ask the students what they would like to learn about solar energy. Use their questions to fill in the second sheet in the same manner.
5. Save the K and W sheets for the follow-up lesson.

Procedure (Follow-up Lesson–to be used at the end of the solar unit)

1. Hang the K and W sheets from the first lesson.
2. Hang the third sheet and title it *Solar Energy* and under the title, label it **L** - Things I learned about solar energy.
3. Lead a brainstorming session with the class to fill in the last sheet. Refer back to the first two sheets and make sure the items listed in the second column have either been answered, or the students know where they could go to find their answers. At this time they should also revise misconceptions that they had at the beginning of the unit.
4. On the fourth sheet of paper write the title *Further Study*.
5. Explain to students how scientific study spawns new questions of inquiry. Brainstorm with the students what new questions they now have about solar energy. Write these on the *Further Study* sheet.

Key Words & Definitions

- **energy -** the ability to do work. Also, a source of usable power
- **photosynthesis** - the process by which plants using light energy make their "food" using carbon dioxide and water
- **photovoltaic (PV)** - the effect of producing electric current using light
  "photo": light
  "voltaic": relating to electricity (volt)
- **solar -** having to do with the Sun
- **solar thermal** - using the Sun's energy to heat something. Common uses include water heaters and pool heaters

Further Activities

1. Pick one or more of the questions on the *Further Study* sheet that you created as a class in the beginning lesson, to research in groups or as a class project.

Related Reading

- ***Sun*** by Steve M. Tomecek (National Geographic Society, 2001)
  This book follows two kids and a purple cat as they learn about sunspots and solar flares, see how the Sun creates night and day and the seasons, and learn how the Sun warms the Earth. It shows the Earth's place in the solar system, scientists studying the Sun through special telescopes, and the bounty of life on Earth nurtured by the heat-giving rays of our star.
- ***The Sun: Our Nearest Star (Let's-Read-and-Find-Out*)** by Franklyn M. Branley (HarperCollins, 2002)
  This book discusses the sun and its importance to life on this planet, as well as supplying information on how large, hot and distant the sun in, and how its energy is stored in the foods we eat and also the fossil fuels we use.
- ***The Sun Is My Favorite Star*** by Frank Asch (HMH Books for Young Readers, 2008)
  The young narrator of this book follows the Sun ("my favorite star") from morning to night with the authentic observations.

K-W-L

Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6
Grade K								
The Practice of Science	**Big Idea 1**	**SC.K.N.1**		**X**				
Earth in Space and Time	**Big Idea 5**	**SC.K.E.5**		**X**	**X**			
Grade 1								
The Practice of Science	**Big Idea 1**	**SC.1.N.1**			**X**			
Earth in Space and Time	**Big Idea 5**	**SC.1.E.5**				**X**		
Grade 2								
Earth Systems and Patterns	**Big Idea 7**	**SC.2.E.7**	**X**	**X**				
Language Arts Standards	**Kindergarten:** LAFS.K.W.3.7, LAFS.K.W.3.8, LAFS.K.SL.1.3, LAFS.K.SL.2.6, LAFS.K.L.3.6, **First Grade:** LAFS.1.W.3.7, LAFS.1.W.3.8, LAFS.SL.1.1, LAFS.1.L.3.6 **Second Grade:** LAFS.2.W.3.7, LAFS.2.W.3.8, LAFS.2.SL.1.3, LAFS.2.L.3.6							

Kindergarten Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.K.N.1.2 - Make observations of the natural world and know that they are descriptors collected using the five senses.

Science--Big Idea 5: Earth in Space and Time

- SC.K.E.5.2 - Recognize the repeating pattern of day and night.
- SC.K.E.5.3 - Recognize that the Sun can only be seen in the daytime.

Language Arts–Writing Standards

- LAFS.K.W.3.7 - Participate in shared research and writing projects.
- LAFS.K.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Speaking and Listening

- LAFS.K.SL.1.3 - Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- LAFS.K.SL.2.6 - Speak audibly and express thoughts, feelings, and ideas clearly.

Language Arts–Language Standards

- LAFS.K.L.3.4 - Use words and phrases acquired through conversations, reading and being read to, and responding to texts.

First Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.1.N.1.3 - Keep records as appropriate - such as pictorial and written records of investigations conducted.

Science–Big Idea 5: Earth in Space and Time

- SC.1.E.5.4 - Identify the beneficial and harmful properties of the Sun.

Language Arts–Writing Standards

- LAFS.1.W.3.7 - Participate in shared research and writing projects.
- LAFS.1.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Speaking and Listening

- LAFS.1.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 1 topics and text with peers and adults in small and larger groups.

Language Arts–Language Standards

- LAFS.1.L.3.6 - Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using frequently occurring conjunctions to signal simple relationships.

Second Grade Benchmarks

Science–Big Idea 7: Earth Systems and Patterns

- SC.2.E.7.1 - Compare and describe changing patterns in nature that repeat themselves, such as weather conditions including temperature and precipitation, day to day and season to season.
- SC.2.E.7.2 - Investigate by observing and measuring, that the Sun's energy directly and indirectly warms the water, land, and air.

Language Arts–Writing Standards

- LAFS.2.W.3.7 - Participate in shared research and writing projects.
- LAFS.2.W.3.8 - Recall information from experiences or gather information from provided sources to answer a question.

Language Arts–Speaking and Listening

- LAFS.2.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

Language Arts–Language Standards

- LAFS.2.L.3.6 - Use words and phrases acquired through conversations, reading and being read to, and responding to texts, including using adjectives and adverbs to describe.

National Next Generation Science Standards

Kindergarten Standards

Earth's Systems

- K-ESS2-1 - Use and share observations of local weather conditions to describe patterns over time.

Earth and Human Activity

- K-ESS3-3 - Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other things in the local environment.

From Molecules to Organisms: Structures and Processes

- K-LS1-1 - Use observations to describe patterns of what plants and animals (including humans) need to survive.

Energy

- K-PS3-1 - Make observations to determine the effect of sunlight on Earth's surface.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

First Grade Standards

Earth's Place in the Universe

- 1-ESS1-1 - Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.