

Summary: Students construct a timeline to interpret solar energy use throughout history.

Over the Years



Grade Level: 5–8 (9–12)

Subject Areas: Art and Design Education, English Language Arts, Social Studies (History)

Setting: Classroom or activity room

Time:

Preparation: 30 minutes

Activity: 50 minutes

Vocabulary: Active solar heat gain, Passive solar heat gain, Renewable energy, Solar concentrator, Solar engine, Solar or Photovoltaic cell

See the *Solar Energy Timeline Student Cards* for titles and definitions of renewable energy technologies used in this activity.

Major Concept Areas:

Theme II

- Development of renewable energy resources
 - Solar energy

Theme III

- Quality of life
 - Cultural

Standards Addressed:

Wisconsin Model Academic:

ADE: B.8.1, B.8.2

SS: A.8.8, A.8.10, B.8.8, D.8.11, E.8.9, E.8.10

Common Core ELA: L.6-8.6, SL.6-8.3, SL.6-8.4, SL.6.1, WHST.6-8.4

Objectives

Students will be able to

- recognize that solar energy has a long history of human use; and
- provide examples of solar energy use throughout history.

Rationale

By exploring historical events, students develop an accurate conception of how renewable energy use, particularly solar energy, has evolved.

Materials

- 30–35 ft. piece of rope
- Clothespins or paperclips (22 per set of cards)
- Tape
- 3"×5" index cards
- Copies of *Solar Energy Timeline Student Cards* (see **Getting Ready**)
- Art supplies: markers, pens, paints, etc.
- Large sheets of blank paper (for murals)

Getting Ready

Photocopy and cut the *Solar Energy Timeline Student Cards* into individual cards. Make them more durable by attaching them to 3"×5" cards and laminating them.

Background

"If we modern Americans, who spend an average of 80 percent of our time indoors, wish to exist in harmony with our environment, we must do by choice what our ancestors did out of necessity—design with the climate and with a sense of place."

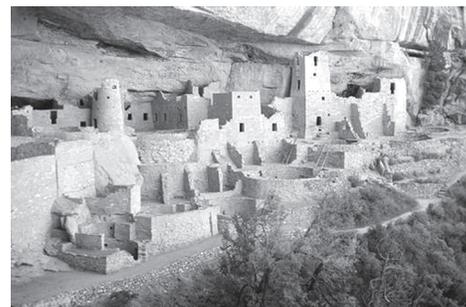
Diana Lopez Barnett

Renewable energy. This phrase is often used as an indication of 'new' technology: harnessing the wind, sun, water, underground steam, and wood resources in a sustainable manner for electric and non-electric work. Yet, renewable energy use is not new. In fact, it is the oldest form of energy. Humans throughout the ages have utilized renewable energy to maintain daily

life. For instance, we have used biomass for cooking, wind for sailing, and the sun for warmth. Through historical documents and artifacts, we can see that humans have been utilizing solar energy for a long time. For example, ancient Greeks oriented their homes for passive solar gain because it was practical and useful.

In Xenophon's *Memorabilia*, written 2,400 years ago, Socrates observed:

"Now in houses with a south aspect, the sun's rays penetrate into the porticos in winter, but in the summer, the path of the sun is right over our heads and above the roof, so that there is shade. If then this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the winter winds. To put it shortly, the house in which the owner can find a pleasant retreat at all seasons and can store his belongings safely is presumably at once the pleasantest and the most beautiful."



Past use of solar energy: Anasazi cliff dwellings demonstrate passive solar design.



Current use of solar energy: Photovoltaics

See **Solar Energy Answer Key** for an overview of human use of the sunlight since 400 B.C. Modern humans, whether homeowners, scientists, or others, benefit daily from the use and development of solar energy technology.

Procedure

Orientation

Ask students if renewable energy is a new type of resource or an old one? Is there a shortage of renewable energy resources? Ask them if it is a common resource and if so, why is it not a “mainstream” resource in America?

Hang a piece of rope across the room. Explain that the rope represents a timeline. Label one end as the “Beginning of human history,” and the other end, “Today.”

Explain that today they are going to focus on solar energy. Ask the class to list ways solar energy is used. Write four or five of the items they listed on 3"×5" cards. Ask students where they think each card should be placed on the timeline based on when humans first started using the solar energy resource listed.

Steps

1. Divide students into groups of two or three and provide each group with several **Solar Energy Timeline Student Cards**.
2. Ask each group to place their cards on the timeline according to when humans first started using the solar energy resource listed. Encourage students to discuss their choices and rearrange the cards until they believe all the cards line up correctly.
3. Share the correct chronology of renewable energy use (see **Solar Energy Answer Key**. NOTE: Numbers correspond between the answer key and **Solar Energy Timeline Student Cards**). Discuss differences in what they guessed and the actual dates. Allow students to rearrange all cards.

Closure

Have students revisit the placement of the items they originally listed on 3"×5" cards (see **Orientation**). Compare students' initial thoughts on renewable energy with the solar timeline. Ask students if they are surprised by the rich history of solar energy and solar technology development. Work with students to arrange the cards correctly and share further information about each card, where appropriate.

Assessment

Formative

- Did students recognize that solar energy has a long history of use by humans?
- Were students able to explain examples of solar energy use through time?

Summative

Have students write a paragraph about the use of solar energy throughout time. Seeing the history, what do they anticipate will happen in the near and distant future? Have them write a second paragraph defining their predictions for solar energy.

Extensions

Lay large sheets of blank paper below the completed timeline. Have students choose a section of the ‘mural’ to illustrate. Instruct students to incorporate their solar facts with other historical images (art, culture, lifestyle, religion, etc. within the date/location, if given). Combine illustrations into a class mural.

Have students research other historical facts and events that occurred around the same time as a particular solar energy activity.

Have students conduct the same activity as above with geothermal, wind, biomass, or hydropower historical facts. These can be found on the KEEP website.

Use **Source of Symbolism and Inspiration** to have students view examples of how solar energy has been honored and used throughout history. Have students find their own examples of symbolism and inspiration.

Final Connection

Use this activity to provide a basis for thinking how humans have used renewable energy throughout history. Then, challenge students to incorporate what they have learned into a cumulative project, such as “Sustainable Communities” or “Green Home Design.”



Solar Energy Timeline Student Cards

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|--|---|
| First “solar hot box” is invented 1 | Solar engine is patented 12 |
| Solar water heater is patented 6 | Over 60,000 solar water heaters in place in America 10 |
| Predecessor of today’s solar collector is invented 18 | Solar water heaters flourish until natural gas and electric heaters become inexpensive and readily available 2 |
| ‘Solar Homes’ become possible as more buildings are designed with consideration for active and passive solar gain 14 | First home with integrated photovoltaic system, passive solar, and other ‘green’ features is completed 11 |
| The ‘solar cell’ is developed 9 | Oil embargo spurs interest in photovoltaics 17 |
| Homes are designed for passive solar heat gain in winter and to block the hot summer sun 16 | Solar energy industry is launched by scientists developing solar engines to power steam generators for ships 19 |



Solar Energy Timeline Student Cards

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|---|---|
| Reflective surfaces are shaped as a parabola to light fires 3 | Light is converted directly into electric current 7 |
| First solar concentrator project is proposed for industrial use 21 | Roof-mounted solar water heaters are produced in California 8 |
| Photovoltaic cells are used to power U.S. space satellites 13 | Solar powered, 2-way radios provide coast-to-coast conversations 5 |
| More than 20 U.S. companies start producing flat plate solar collectors 4 | Second oil embargo strengthens solar industry; solar panels are installed on the White House 15 |
| First solar cell power plant is dedicated in Utah 20 | Cost of solar cells are about \$77 per watt 22 |
| Solar panels are removed from the White House 28 | 20% efficient solar cells are developed; cost of solar cells are about \$6.50 per watt 30 |



Solar Energy Timeline Student Cards

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|--|---|
| 40% efficient solar cells are developed 33 | “Big Box” home improvement stores sell residential solar power systems 35 |
| 9 kW of solar power is installed on the White House 29 | A 30% tax credit is made available for solar installations 23 |
| A world record in solar cell efficiency is set (40.8%) 27 | Cost of solar cells are about \$1.50 per watt 32 |
| Solar electric power installations grow at a rate of 60% per year 34 | In a five-year span, the number of jobs in the solar industry double 26 |
| Juno reaches Jupiter’s orbit and is the most distant solar powered system 31 | National Energy Act is signed, regulated feed-in of solar to the electric grid 24 |
| First solar-powered calculators are used 25 | First solar-powered flight around the world 36 |

Solar Energy Answer Key

| | |
|---|-----------|
| 400 B.C.E.: Socrates promotes passive solar design for comfortable living. Ancient Greeks use the sun's position in the sky to heat their homes in winter and keep them cool in summer. The open front of a Greek house faces south. Winter sunshine fills the house and warms the air inside, the earth floor, and thick walls. At night, the warm floor and walls continue to radiate heat and keep the temperature comfortable. The Greeks build porticos, or covered porches, over the front of their houses. The roof of the portico blocks the rays of the summer sun. The house stays cool inside. | 16 |
| 200-300 B.C.E: A Greek mathematician shows that a reflective surface shaped like a parabola can concentrate sunlight to a point. Ancient Greeks, Romans, and Chinese use these early solar concentrators to light fires including spiritual fires. | 3 |
| 1500s: Leonardo da Vinci proposes the first industrial applications of solar concentrators. | 21 |
| 1767: Swiss scientist Horace de Saussure invents the world's first solar collector, or "solar hot box." | 1 |
| 1839: French scientist Edmund Becquerel first observes the photovoltaic effect. Becquerel experimented with two identical electrodes in a conducting solution, converting light directly into electrical current. | 7 |
| 1861: French scientist Augustin Mouchot patents a solar engine, the first machine which produced electricity from the sun by evaporating steam which propelled a small engine. | 12 |
| 1880s: American engineer John Ericsson launches the solar energy industry in the U.S. Ericsson develops several solar-driven engines to power steam generators for ships. | 19 |
| 1891: Father of solar energy in the U.S., Clarence Kemp, patents first solar water heater. | 6 |
| 1890s: First commercially available (roof-mounted) solar water heaters are produced in southern California. | 8 |
| 1908: William J. Bailey of the Carnegie Steel Company invents solar collectors that became predecessors of today's solar collectors. | 18 |
| 1920-50s: South Florida develops as a significant market for solar water heaters (thermosiphon design). Several companies service a market of about 50,000 homes. The industry virtually expires in the 1950s, unable to compete against cheap and readily available natural gas and electric service. | 2 |
| 1941: Over 60,000 solar water heaters in place in America. | 10 |
| 1940s: 'Solar Homes' become popular. More builders consider active and passive solar housing design. | 14 |
| 1954: Bell Telephone researches the sensitivity of a properly prepared silicon wafer to sunlight. The 'solar cell' is developed. Initial solar cells were about 4% efficient at converting sunlight to electricity and later became 11% efficient. | 9 |
| 1950s: Photovoltaic cells are used to power U.S. space satellites. | 13 |
| 1960: First solar powered, 2-way radio, coast-to-coast conversation takes place between the U.S. Army Signal Corps in New Jersey and California. | 5 |
| 1973: Spurred by the first oil embargo, interest in terrestrial applications of photovoltaics blossoms. | 17 |
| 1974: More than 20 companies start production of flat plate solar collectors in the U.S. | 4 |
| 1977: The cost of solar cells are about \$77/watt. | 22 |
| 1978: Under President Jimmy Carter, the National Energy Act (NEA) is signed, which regulates renewable energy producers feed-in to the electric grid. | 24 |
| 1978: The first solar-powered calculators are used. | 25 |
| 1979: Second oil embargo strengthens solar industry. Solar panels are installed on the White House under President Jimmy Carter. | 15 |

Solar Energy Answer Key (continued)

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| 1980: First solar cell power plant dedicated at Natural Bridges National Monument, Utah. | 20 |
| 1980: Carlisle residence, featuring the first building-integrated photovoltaic system, passive solar heating and cooling, superinsulation, internal thermal mass, earth sheltering, daylighting, a roof-integrated solar thermal system, and a 7.5 kilowatt-peak (kWp) photovoltaic array of polycrystalline modules is completed. | 11 |
| 1981: President Reagan has solar panels removed from the White House. They were on the White House for three years. | 28 |
| 1985: 20% efficient solar cells are developed by the University of New South Wales. The cost of solar cells are about \$6.50/watt. | 30 |
| 1994: Solar PV cells reach the potential for 40% efficiency, developed by the U.S. National Renewable Energy Lab. | 33 |
| 2001: "Big box" home improvement stores begin selling residential solar power systems in California. A year later, solar electric systems are sold in big box stores nationwide. | 35 |
| 2003: President George Bush has 9 kW of solar panels installed on the White House, as well as a solar thermal system. Additional solar power was added again in 2010 under President Barack Obama. | 29 |
| 2006: The Energy Policy Act creates a 30% investment tax credit for commercial and residential renewable energy systems, including solar. | 23 |
| 2008: A new world record in solar electric efficiency is set when the U.S. National Renewable Energy Lab converts 40.8% of the sun's light into electricity using solar photovoltaic technology. | 27 |
| 2011: The cost of solar cells falls to \$1.50/watt. | 32 |
| 2005-2015: Solar electric power installations grow at a rate of 60% per year. | 34 |
| 2015: 209,000 American jobs are with solar industries, which is more than double the solar jobs of 2010. The solar industry is expected to provide 420,000 jobs by 2020. | 26 |
| 2016: Juno, a spacecraft launched in 2011, reaches Jupiter's orbit. This research station is the most distant completely solar-powered system known to humanity. | 31 |
| 2016: Solar Impulse 2, powered by more than 17,000 solar cells on its wings, is the first solar-powered plane to tour the globe. | 36 |

