Wonders of the Sun
Student Guide
Our Earth gets most of its energy from the sun. We call this energy **solar energy**. The root *sol* refers to the sun.

Solar energy travels from the sun to the Earth in **rays**. Some are light rays that we can see. Some are rays we can't see, like x-rays. Energy in rays is called **radiant energy**.

The sun is a star, made of mainly hydrogen and helium. It sends out huge amounts of energy every day in every direction. Most of this energy goes off into space. Even though only a tiny fraction of the sun's energy reaches the Earth, it is still more energy than we can use.

When the rays reach the Earth, some bounce off clouds back into space—the rays are **reflected**. The Earth **absorbs** most of the radiant energy. This solar energy becomes **thermal energy**, which warms the Earth and the air around it, the **atmosphere**. Without the sun, we couldn’t live on the Earth—it would be too cold. This is called the **greenhouse effect**.
Solar Energy is Important

We use solar energy in many ways. During the day, we use sunlight to see what we are doing and where we are going. The amount of light you receive depends on the season, the location, and the weather. Solar energy is also important to nature.

FOOD

Plants use the light from the sun to grow. Plants absorb (take in) the solar energy through their leaves and use it to grow. The plants keep some of the solar energy in their roots, fruits, and leaves. They store it as chemical energy. This process is called photosynthesis.

The energy stored in plants is the beginning of most food webs. When herbivores and omnivores eat plants and food made from plants, this solar energy is stored in their bodies. We use the energy to grow and move. We use it to pump our blood, think, see, hear, taste, smell, and feel. We use energy for everything we do.

When carnivores and omnivores eat meat, it also can be traced to the sun. Animals eat plants to grow. The animals store the plants’ energy in their bodies. The energy moves from producers to consumers through the food chain.

Photosynthesis

In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose (or sugar). Photosynthesis occurs in the leaves of a plant.

WATER
GLUCOSE
RADIANT ENERGY
CARBON DIOXIDE
OXYGEN

Carbon Dioxide
Oxygen
Radiant Energy
Water
Glucose

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FOSSIL FUELS CONTAIN ENERGY FROM THE SUN

Coal, oil, and natural gas are called fossil fuels because they were made from prehistoric plants and animals. The energy in the plants and animals originally came from the sun.

We use the energy in fossil fuels to cook our food, warm our homes, run our cars, and make electricity. Most of the energy we use today comes from fossil fuels.

THERMAL ENERGY

We also use the energy stored in plants to stay warm. We burn wood (biomass) in campfires and fireplaces. Early humans burned wood to provide light, cook food, make tools, scare away wild animals, and stay warm.

How Coal Was Formed

Before the dinosaurs, many giant plants died in swamps. Over millions to hundreds of million of years, the plants were buried under water and dirt. Heat and pressure turned the dead plants into coal.
All objects are made of very tiny particles called **atoms**. Atoms are too small to see with a microscope! When solar energy hits objects, it transforms, or changes, into thermal energy. Just like when you move faster, you feel warmer; as the atoms move faster, they get warmer. We feel warmer in the sun than the shade because solar energy makes atoms move faster.

**THERMAL ENERGY OF SOLIDS AND LIQUIDS**

Everything is made of atoms. Atoms combine to form **molecules**. When the substance is a solid, the atoms or molecules are fixed in one location and just vibrate back and forth in place. This is why solids stay the same shape.

The atoms or molecules in a liquid move around much more, and often tumble around each other. However, the molecules do not have enough energy to completely get away from each other. This is why a liquid spreads itself out to the shape of the container, but does not necessarily fill the container.

The molecules in a gas have enough energy to move all over the place and get away from each other. Gases spread out to completely fill whatever container they are in. Gas molecules are moving very fast and bump into each other as well as other objects. You cannot feel air molecules bumping into you because they are very small.
WATER CYCLE

Solar energy powers the water cycle. The water cycle is how water moves through the atmosphere and the Earth’s surface. The sun heats water on the Earth. The water evaporates—it turns into water vapor and rises into the air. The air in the atmosphere is cool. The water vapor condenses into liquid water to form clouds. The water falls from the clouds as precipitation—rain, sleet, hail, or snow.

When water falls on high ground, gravity pulls it to lower ground. There is energy in the moving water. We can capture that energy with dams and use it to make electricity. The electricity made from moving water is called hydropower.

The amount of water on Earth does not change. All of the water is found in one of four places: in the atmosphere as a gas or moving through the water cycle; in bodies of water as a liquid; in the ground as a liquid; or frozen solid in ice and snow. When precipitation falls, it either adds to ice and snow, is pulled by gravity into streams and rivers, or filters into the ground, collecting in aquifers.
The Sun Makes the Wind

Solar energy is responsible for the winds that blow over the Earth. The sun shines down on the Earth. Some parts of the surface heat up faster than others. Land usually heats more quickly than water. Areas near the Equator receive more direct sunlight. These areas get warmer than regions near the North and South Poles. When air is warmed, it becomes less dense and rises. Cooler air moves in to replace the warm air that has risen. This moving air is called wind.

Wind turbines can capture the wind’s energy. The wind turbines turn the energy in moving air into electricity. The wind pushes against the blades of the turbine and they begin to spin. A generator inside the turbine changes the motion into electricity.

Latitude and Intensity of Solar Energy

The Earth is not standing still in space. It moves around the sun in an orbit, taking one year to make a full revolution around the sun.

The Earth is slightly tilted on an axis. This tilt, combined with its revolution around the sun, are what cause the seasons of spring, summer, autumn, and winter. People who live in the southern hemisphere, south of the Equator, experience their hottest summer days when the northern hemisphere is experiencing winter.

The Earth also rotates on its axis. This rotation is what gives us sunlight during the day and darkness at night.
Why are areas closer to the Equator usually warmer than areas closer to the North or South Pole? This is due to the location’s latitude, or distance from the Equator. The sun strikes different latitudes at different angles. Even during spring or fall, areas near the poles receive less direct sunlight than the Equator. This is because the Equator is always receiving its sunlight directly from overhead. As you move away from the Equator, you are actually walking on the surface of a sphere, and moving so the sun is no longer directly overhead.

Sunlight is most intense when it is directly overhead, and least intense when it is coming in from a low angle in the sky. This is why the hottest part of the day is when the sun is at its highest point compared to where you are, and why the days are cooler at sunrise and sunset.

**Solar Energy is Renewable**

Solar energy is free and clean. Solar energy is renewable. We will not run out of it. The sun will keep making energy for millions of years.

Why don’t we use the sun for all our energy needs? We don’t have the technology to do it yet. The hard part is capturing the sun’s energy. Only a little bit reaches any one place. On a cloudy day, some of the solar energy never reaches the ground at all. Although the sunlight is free, the equipment needed to capture and store the energy can be expensive. Scientists and engineers are working to create more efficient technology.

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**Solar Collector**

On a sunny day, a closed car becomes a solar collector. Light or solar energy passes through the window glass, is absorbed by the car’s interior, and converted into thermal (heat) energy. The heat energy becomes trapped inside.

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**We Can Capture Solar Energy**

Lots of people put solar collectors on their roofs. Solar collectors capture the energy from the sun and turn it into heat. People heat their houses and their water using the solar energy. A closed car on a sunny day is a solar collector.
Solar Energy Can Make Electricity

Photovoltaic (PV) cells turn the sun’s energy into electricity. The root *photo* means light, and *volt* is a measure of electricity. Most PV cells are made of pieces of silicon, the main component in sand. Each side of the silicon has a different chemical added. When radiant energy from the sun hits the PV cell, the sides of the silicon work together to change the energy into electricity. Scientists are always researching other materials to use in PV cells.

Some toys, calculators, and outdoor lights use small PV cells instead of batteries. Large groups of PV cells can make enough electricity for a house. They can be expensive, but are good for houses far away from power lines, or for homes that want to save energy costs.

Some schools have PV cells on their roofs or on the school grounds. The electricity helps reduce the amount of money schools must pay for energy. The students learn about the PV cells on their school buildings.

Today, solar energy provides a little more than one percent of the electricity we use in the U.S. In the future, it could be a major source of energy. Scientists are constantly working on new ways to capture and use solar energy.
Reading a Thermometer

**Freezing Water**
32°F

**Body Temperature**
98-99°F

**Warm Summer Day**
89°F

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**Very Cold Winter Day**
10°F

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**Cold Water**
Freezing Water
32°F

**Body Temperature**
98-99°F

**Warm Summer Day**
89°F
Solar Energy to Heat

Question
What is the relationship between absorbed solar energy and color?

Hypothesis
Before going outdoors, predict which thermometer will be the hottest by numbering the thermometers 1-3. Label the hottest with a 1 and the coolest with a 3.

Procedure
1. Put three thermometers in a sunny or bright place.
2. Cover the bulb of one thermometer with black paper. Cover the bulb of one thermometer with white paper. Leave the bulb of the third thermometer uncovered.
3. Complete Reading a Thermometer activity.
4. Record your results by coloring the tubes of the thermometers to show their temperatures.
5. Look at the results and re-number the thermometers 1-3 with 1 as the hottest, and 3 as the coolest.

Conclusion
1. Which color absorbed the most energy? What evidence from the activity shows you this?
2. How should this information affect your clothing choices?
3. Which will be hotter on a sunny day, a car with a dark blue interior, or a car with a light gray interior? How do you know? Use your results to explain your answer.
NaturePrint® and Construction Paper

**Question**
How does sunlight affect the chemicals in different kinds of paper?

**Hypothesis**
Predict how sunlight will affect construction paper.

Predict how sunlight will affect NaturePrint® Paper.

Predict whether a plastic bag will make a difference in how the sunlight will affect NaturePrint® Paper.

**Materials**
- 1 Cut-out of the sun
- 2 Sheets of NaturePrint® Paper
- Objects found outside or brought from home
- One plastic bag
- Sunscreen
- Pencil or pen
- Shallow pan of water
- Watch or stopwatch
✓ Procedure

Part A
1. Cut out the sun picture on page 15.
2. Place the sun picture and/or your objects on the NaturePrint® Paper.
3. Place the piece of paper in direct sunlight.
4. After two minutes, pick up the NaturePrint® Paper and carefully carry it to the shade.
5. Remove the objects and sun picture and place the NaturePrint® Paper in water for one minute.
6. Allow the NaturePrint® Paper to dry.

Part B
1. Place a new piece of NaturePrint® Paper inside a plastic bag. Leave a half inch of the NaturePrint® Paper outside of the plastic bag exposed to the sun.
2. Take the plastic bag and apply sunscreen in a design to cover approximately half of the NaturePrint® Paper.
3. Arrange one of your objects on the plastic bag over the NaturePrint® Paper beside the sunscreen, but not touching the sunscreen, and place in direct sunlight.
4. Observe and record what you see every 30 seconds for two minutes. Make sure to note any color differences between the paper within the plastic bag and the paper outside of it.
5. After two minutes, pick up the NaturePrint® Paper and carefully carry it to the shade.
6. Remove the object and take the paper out of the plastic bag. Place the paper in water for one minute.
7. Allow the NaturePrint® Paper to dry.

Part C
1. Record what you see when looking at your dried NaturePrint® Papers on your observation charts.

Part D
1. Look at the five pieces of construction paper your teacher prepared. Observe similarities and differences. Record your observations.
**Observations**

Make a diagram of your first piece of dried NaturePrint® Paper below.

<table>
<thead>
<tr>
<th>Side with Sun Cutout</th>
<th>Side with Objects You Chose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Make a diagram of your second piece of NaturePrint® Paper placed within the plastic bag below.

<table>
<thead>
<tr>
<th>Side with Sunscreen</th>
<th>Side with Objects You Chose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Data
NaturePrint® Paper with the sunscreen and plastic bag at 30 second intervals

<table>
<thead>
<tr>
<th>Time in the Sun</th>
<th>Appearance of NaturePrint® Paper within the plastic bag</th>
<th>Appearance of NaturePrint® Paper outside of the plastic bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>Solid Blue</td>
<td>Solid Blue</td>
</tr>
<tr>
<td>30 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 Seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120 Seconds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Analysis
Use your data table above to describe how the NaturePrint® Paper changed over time. Why did this happen?
### Construction Paper Data

Make a diagram of your final observation of the construction paper sheets below.

<table>
<thead>
<tr>
<th>Time in the Sun</th>
<th>Appearance of Construction Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Hours</td>
<td></td>
</tr>
<tr>
<td>1 hour</td>
<td></td>
</tr>
<tr>
<td>2 hours</td>
<td></td>
</tr>
<tr>
<td>3 hours</td>
<td></td>
</tr>
<tr>
<td>4 hours</td>
<td></td>
</tr>
</tbody>
</table>
**Conclusions**

*Write your conclusions using complete sentences.*

1. How does sunlight affect construction paper?

2. Compare the amount of time required for the NaturePrint® Paper to change to the amount of time for the construction paper to change.

3. You and your little sister receive the same plastic toy as a gift. You keep yours in your room on a shelf, carefully taking it down to play. Your little sister leaves it outside over summer vacation. At the end of vacation, you both take your toys and compare them. Explain the differences you see and what might have caused them.
UV Bead Activity

Question
What factors affect the amount of sunlight that reaches plants?

Background
UV stands for ultraviolet light, a type of electromagnetic radiation that travels in a wave-like pattern. UV light is found within sunlight, but is invisible. You are probably aware of the effects of UV radiation because you wear sunscreen and sunglasses to protect you from it. UV light causes chemical reactions that can make a substance glow or your skin to burn or tan. It also causes the formation of Vitamin D, an essential vitamin for humans and other organisms. A good amount of harmful UV radiation is blocked by the Earth’s ozone layer, but the little amounts that get through will cause these chemical changes. UV beads contain special color-changing pigments that are sensitive to UV light from the sun and other sources.

Hypothesis
Predict how sunlight will affect the UV beads.

Predict how sunlight affects plant growth.

Materials
- 5 UV beads
- 1 Pipe cleaner
- Writing utensil
- Plant information sheets

Procedure
1. String the UV beads onto the pipe cleaner. Twist the pipe cleaner into a loosely-fitting bracelet and wear on your wrist.
2. Bring your bracelet, plant information sheet, and materials for mapping outside.
3. Draw a map of the outdoor area where your teacher directs you to explore. On your map, label which locations are sunny, partially shaded, and full-shade areas, and show where you would plant each type of plant using a key you create.
4. On page 24 or in your science notebook, write a letter to your principal explaining how you used the UV beads to discover and decide which plant would grow best in which area.
**Data**

Map of the assigned area

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**Key**

( ) Sunny Area  ( ) Plant #1 Sunflower
( ) Partially Shaded Area  ( ) Plant #2 Maidenhair Fern
( ) Fully Shaded Area  ( ) Plant #3 Impatiens

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The Sunflower is a plant native to the Americas. To grow best, sunflowers need full sun.

The Maidenhair Fern is a fern native to the Americas that thrives with no direct sun. Source: Smithsonian Institute

Impatiens are a plant which prefer partial shade. Source: Smithsonian Institute
Write a letter to your principal explaining how you used your beads to discover which plant would go in which area.
**Radiometer Activity**

**Question**
How does color affect the direction of a radiometer’s spin?

**Background**
A radiometer has four vanes. One side of each vane is white, the other side is black. When radiant energy hits the vanes of the radiometer, they begin to spin. One side of the vanes gets hotter than the other. The air near the hotter side of the vanes gets hotter and pushes against the vanes. The radiometer changes radiant energy to heat, then to motion.

**Hypothesis**
Predict the direction the radiometer will spin by shading in the appropriate prediction arrow on the diagram below.

**Materials**
- Radiometer
- Bright sunlight, or a bright source of light

**Procedure**
1. Put the radiometer in bright sunlight or another bright light source.
2. Observe the radiometer.
3. Record your results.
4. Color the result arrow that shows the direction the vanes are spinning in the diagram below.

**Conclusions**
1. Explain why the radiometer spins in the direction you observed.
2. Make a diagram showing how the radiometer transforms energy.
Solar Oven Activity

Question
How can solar energy be used to cook food?

Materials
- Solar oven
- Oven thermometer
- Dish on which to cook food
- Food to cook

Procedure
1. On a very sunny day, take the solar oven outside and put it in a sunny place.
2. Place the food and thermometer in the oven.
3. Observe how long it takes to cook the food and how warm the oven becomes.

Observations
Draw a diagram of the solar oven. Use arrows to show how solar energy cooks the food.

Record your observations below. How long did it take to cook the food? How did the food change in appearance or smell as it was cooking?

Conclusion
Describe when a solar oven would be useful.

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Solar House

Question
How can solar energy be used in your house?

Materials
- Cardboard box
- Scissors
- Clear transparency film or plastic wrap
- Black construction paper
- 2 Sheets of white paper
- Clay
- Tape
- Solar house kit
- Ruler

Procedure
1. Using the scissors, cut large windows and a door on one side of the box.
2. Tape clear transparency film over the windows if you have it. Use plastic wrap as a substitute.
3. Make a round water storage tank from black construction paper. Attach it to the side of the house with tape.
4. Make two holes 1 cm in diameter in the top of the box.
5. Push the shaft of the motor through one of the holes.
6. From the inside of the house, attach the fan blades to the motor. Make sure there is enough room above the blades for the fan to turn without bumping the ceiling. Use a strip of tape to hold the motor in place.
7. Push the LED through the other hole and tape it in place.
8. Attach the PV cells to the fan and LED.
9. Lay the PV cell with tubing on top of the house with the tubing extending down to the black water storage tank. Tape in place, or use clay to hold in place.
10. Carefully carry the house model into the sun. Observe the speed of the fan and the brightness of the LED. Tilt the PV cells so they are directly facing the sun. How does this affect the speed of the fan? Use a piece of clay under the PV cells to leave them in this position.
11. Simulate a bright, overcast day by placing a single sheet of white paper over the PV cells. Observe the speed of the fan and the brightness of the LED.
12. Simulate a very cloudy day by placing two sheets of white paper over the PV cells. Record your observations of the fan speed and LED brightness.
13. Simulate nighttime by placing a piece of cardboard over the PV cells. Record your observations of the fan speed and LED brightness.
Data and Observations

Make a diagram of your solar house below. Label the parts.
Data and Observations Continued

Record your observations in the table below.

<table>
<thead>
<tr>
<th>Light Conditions</th>
<th>Fan Speed</th>
<th>LED Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright sunlight, PV cells laying flat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bright sunlight, PV cells tilted toward the sun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bright overcast (one sheet of paper)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloudy (two sheets of paper)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nighttime (cardboard)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

1. Did the PV cells work differently laying flat or pointed towards the sun? Explain which worked better.

2. How would the change in seasons and different location of the sun in the sky affect how well a PV cell works where you live?
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>absorb</td>
<td>to pull into oneself</td>
</tr>
<tr>
<td>aquifer</td>
<td>underground reservoir of collected water</td>
</tr>
<tr>
<td>atmosphere</td>
<td>mixture of gases surrounding a planet</td>
</tr>
<tr>
<td>atom</td>
<td>smallest unit of matter; smallest particle of an element</td>
</tr>
<tr>
<td>axis</td>
<td>imaginary line running through the center of the Earth from pole to pole</td>
</tr>
<tr>
<td>biomass</td>
<td>renewable energy source from recently living things, such as grass and trees</td>
</tr>
<tr>
<td>carnivore</td>
<td>organism that exclusively eats animals</td>
</tr>
<tr>
<td>chemical energy</td>
<td>form of potential energy that is used by causing chemical reactions</td>
</tr>
<tr>
<td>condensation</td>
<td>process of a gas changing to a liquid</td>
</tr>
<tr>
<td>consumer</td>
<td>organism that cannot create its own food and depends on other organisms for nutrients</td>
</tr>
<tr>
<td>Equator</td>
<td>imaginary line running around the midpoint of the Earth’s surface, halfway between each pole</td>
</tr>
<tr>
<td>evaporation</td>
<td>process of a liquid changing to a gas; evaporation is usually accomplished slowly</td>
</tr>
<tr>
<td>fossil fuel</td>
<td>nonrenewable sources of energy formed from living things that died many years ago</td>
</tr>
<tr>
<td>generator</td>
<td>device that transforms motion energy into electrical energy by rotating a coil of copper between magnets</td>
</tr>
<tr>
<td>gravity</td>
<td>force of attraction between two objects; smaller object usually feels a stronger pull toward the larger object</td>
</tr>
<tr>
<td>greenhouse effect</td>
<td>when the atmosphere allows light to pass through but traps the energy as heat</td>
</tr>
<tr>
<td>hemisphere</td>
<td>one half of a sphere; one half of the Earth</td>
</tr>
<tr>
<td>herbivore</td>
<td>organism that exclusively eats plants</td>
</tr>
<tr>
<td>hydropower</td>
<td>source of energy obtained from moving water</td>
</tr>
<tr>
<td>latitude</td>
<td>imaginary lines of reference that are parallel to the Equator</td>
</tr>
<tr>
<td>molecule</td>
<td>two or more atoms chemically bonded together; smallest particle of a compound</td>
</tr>
<tr>
<td>omnivore</td>
<td>organism that eats both plants and animals</td>
</tr>
<tr>
<td>photosynthesis</td>
<td>process plants use to transform radiant energy from the sun into chemical energy</td>
</tr>
<tr>
<td>photovoltaic cell</td>
<td>object that transforms radiant energy into electrical energy; also called a solar cell</td>
</tr>
<tr>
<td>precipitation</td>
<td>water falling from clouds to the ground, in solid (snow, sleet) or liquid (rain) form</td>
</tr>
<tr>
<td>producer</td>
<td>green plant or organism that makes food from photosynthesis</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>radiant energy</td>
<td>energy released by stars that travels in rays outward from the star</td>
</tr>
<tr>
<td>rays</td>
<td>energy that travels in one direction only, such as from the sun to Earth</td>
</tr>
<tr>
<td>reflection</td>
<td>radiant energy striking one surface, and bouncing off that surface in a different direction</td>
</tr>
<tr>
<td>renewable</td>
<td>energy sources that are easily replaced, such as biomass, or will never run out, such as wind or solar energy</td>
</tr>
<tr>
<td>revolution</td>
<td>the Earth's movement around the sun in its orbit</td>
</tr>
<tr>
<td>rotation</td>
<td>the spin of the Earth around its axis</td>
</tr>
<tr>
<td>silicon</td>
<td>second most plentiful element on Earth; major component of sand</td>
</tr>
<tr>
<td>solar collector</td>
<td>device that collects solar energy and transforms it into thermal energy that is either used or stored</td>
</tr>
<tr>
<td>solar energy</td>
<td>radiant energy from the sun</td>
</tr>
<tr>
<td>thermal energy</td>
<td>energy found within a solid, liquid, or gas; the particles of warmer substances are moving faster</td>
</tr>
<tr>
<td>turbine</td>
<td>device that changes straight-line motion into rotating motion, such as in a windmill or hydropower plant</td>
</tr>
<tr>
<td>water cycle</td>
<td>process of evaporation, condensation, precipitation, and runoff of water on Earth</td>
</tr>
<tr>
<td>water vapor</td>
<td>gas phase of water (H₂O)</td>
</tr>
<tr>
<td>wind</td>
<td>air moving across the Earth's surface</td>
</tr>
</tbody>
</table>
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Gulf Power
Harvard Petroleum
Hawaii Energy
Houston LULAC National Education Service Centers
Illinois Clean Energy Community Foundation
Illinois International Brotherhood of Electrical Workers Renewable Energy Fund
Illinois Institute of Technology
Independent Petroleum Association of New Mexico
Jackson Energy
James Madison University
Kansas Corporation Commission
Kentucky Office of Energy Policy
Kentucky Environmental Education Council
Kentucky Power–An AEP Company
Kentucky Utilities Company
League of United Latin American Citizens – National Educational Service Centers
Leidos
Linn County Rural Electric Cooperative
Llano Land and Exploration
Louisiana State University – Agricultural Center
Louisville Gas and Electric Company
Midwest Wind and Solar
Minneapolis Public Schools
Mississippi Development Authority–Energy Division
Mississippi Gulf Coast Community Foundation
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
Nebraskans for Solar
New Mexico Oil Corporation
New Mexico Landman’s Association
NextEra Energy Resources
NEXTracker
Nicor Gas
Nisource Charitable Foundation
Noble Energy
North Carolina Department of Environmental Quality
North Shore Gas
Offshore Technology Conference
Ohio Energy Project
Oklahoma Gas and Electric Energy Corporation
Oxnard Union High School District
Pacific Gas and Electric Company
PECO
Pecos Valley Energy Committee
People’s Electric Cooperative
Peoples Gas
Pepco
Performance Services, Inc.
Petroleum Equipment and Services Association
Permian Basin Petroleum Museum
Philips 66
Pioneer Electric Cooperative
PNM
PowerSouth Energy Cooperative
Providence Public Schools
Quarto Publishing Group
Prince George’s County (MD)
R.R. Hinkle Co
Read & Stevens, Inc.
Renewable Energy Alaska Project
Resource Central
Rhodes Energy
Rhode Island Office of Energy Resources
Rhode Island Energy Efficiency and Resource Management Council
Robert Armstrong
Roswell Geological Society
Salal Foundation/Salal Credit Union
Salt River Project
Salt River Rural Electric Cooperative
Sam Houston State University
Schlumberger
C.T. Seaver Trust
Secure Futures, LLC
Seneca Resources
Shell
Shell Carson
Shell Chemical
Shell Deer Park
Shell Eco-Marathon
Sigora Solar
Singapore Ministry of Education
Society of Petroleum Engineers
Sports Dimensions
South Kentucky RECC
South Orange County Community College District
SunTribe Solar
Sustainable Business Ventures Corp
Tesla
Tri-State Generation and Transmission
TXU Energy
United Way of Greater Philadelphia and Southern New Jersey
University of Kentucky
University of Maine
University of North Carolina
University of Oklahoma
University of Rhode Island
University of Tennessee
University of Texas Permian Basin
University of Wisconsin – Platteville
U.S. Department of Energy
U.S. Department of Energy–Wind for Schools
U.S. Energy Information Administration
United States Virgin Islands Energy Office
Volusia County Schools
Western Massachusetts Electric Company - Eversource

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