Grade: 3-5 | Time: 1 hour

THE SUN'S ENERGY

Essential Question: **What kinds of energy are converted from sunlight?**

Overview

Students explore the idea that most of the energy we use comes from the sun, by reading, discussing, playing a game, and making a concept map.

Assessment

Can students

- Draw a concept map that traces the source of energy back to the sun for a simple food chain as well as for other types of energy?

Vocabulary

- Solar Energy
- Radiant Energy
- Chemical Energy
- Water Cycle
- Electricity
- Generator
- Fossil Fuel

Teacher Information and Procedure

Prior knowledge for students: Experience in drawing a "concept map". For information about concept maps, see: http://www.cotf.edu/ete/pbl2.html If students have not made concept maps previously, show them examples and have them practice mapping other concepts before doing the assessment.
Some basic familiarity with energy from wind, water, and fossil fuels will help.

Source: New. Student handout is adapted from NEED "Energy from the Sun", pages 3-9. Solar to Heat experiment is from page 14 of the same. (Graphics on page 5 from the NEED.org, others various source files from Depositphotos.com)

Materials needed

For "Solar to Heat Experiment"

- 3 thermometers for class or group
- Black paper
- White paper
- Student handout
- Crayons
- Large sheets of paper or tag board, and drawing materials
- Timer

For "Energy Chains Game"

- Energy use cards
- Energy chain cards
- Paper
- Colored pencils or crayons

What to do in advance

- Copy "Solar Energy" handout for students
- Copy "Energy Use Cards" and cut out the cards

Alaska Standards Addressed

Science GLEs

The student demonstrates an understanding:

- that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by [5}SC3.2 organizing a simple food chain of familiar plants and animals that traces the source of the energy back to the sun

- the processes of science by [3,4,5]SA1.1 asking questions, predicting, observing, describing, measuring, classifying, inferring, and communicating

Writing GLEs

The student
- comprehends literal or inferred meaning from text by [3] 1.2.1 [4][5] 2.2.1 Locating information explicitly stated in narrative and informational text to answer literal-comprehension questions
-restates/summarizes information by [3] 1.4.2 Restating information after reading a text or identifying accurate restatements

[4] 2.4.2 Restating and summarizing information after reading a text or identifying accurate restatements and summaries
[5] 2.4.1 Restating and summarizing main ideas or events in correct sequence after reading a text (e.g., paraphrasing, constructing a topic outline, using graphic organizers) or identifying accurate restatements and summaries of main ideas or events or generalizations of a text.

Alaska English/Language Arts and Mathematics Standards (2012)

- RI.K-5.1, RI.K-5.4
- SL.K-5.1, SL.K-5.5

Teaching the Lesson

Gear-up

Do the "Solar to Heat" experiment (see handout), and/or have students hold their hand near a light bulb, and then turn the light on. They can feel the heat almost instantly even though they are not touching it.

Explain that the heat is traveling by radiation, much the same way that heat travels to the earth from the sun.

Ask students for their ideas about what kind of work the sun's energy does when it gets to Earth.

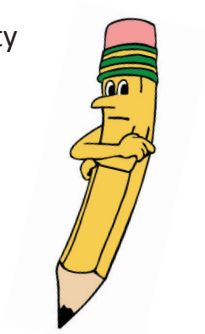
Explore

Read and discuss the handout about energy from the sun.

Divide students into groups of two or three and assign one of the following to each group.

Hand out drawing materials and ask each group to make a large picture or sign that illustrates their word:

- Sun
- Heat
- Light
- Berries, roots, leaves (use names of plants in your part of the state that are eaten by animals and humans)
- Trees
- Caribou, fish, porcupine (use animals from your area that are used for subsistence)
- Small sea plants and animals
- Humans
- Moving Water
- Wind
- Electricity
- Oil
- Gas
- Coal



Play the following "Energy Chains" game in two or three teams, as a way of discussing and analyzing the ways in which all of the energy we use originally comes from the sun.

1. The first team draws a card with a use of energy. The team has three minutes to discuss and then hold up the pictures or signs to illustrate how the sun's energy is connected to the action. They should be able to answer questions to explain their connections. For each sign used correctly, they get one point for their team.
   For example, the action drawn is *"using a computer".* Students might go up in front of the class and hold up the pictures: Sun-heat-wind-electricity. They would get 4 points for their team.
2. The other team(s) is invited to illustrate different ways that the same action is related to the sun. They also have 3 minutes to discuss and show the "energy chain" . Examples: Another team might show: Sun-light-small sea plants and animals-oil-electricity. They would get 5 points. A very astute team could show a "double" chain, with sun-light-"berries"-"caribou"-human beings (punching the keys) in one direction and sun-moving water-electricity in another direction and get 9 points, while another could show sun-electricity for 2 points.
3. Once each team has had a turn, it's time for the first team to draw a card again.

Variations

Students can make their own cards with ways that they use energy.

- Signs/pictures can be made ahead of time by volunteers, to save time.
- To make the game and lesson easier, eliminate types of energy (such as coal, wind, water) that are not used locally.
- All teams can build their "chains" at the same time and then tke turns comparing chains.

Generalize

Discuss the ways that most of our energy needs are provided by the sun, directly or indirectly. If students missed any important "energy chain" connections during the game, review those. Ask students if they can think of any kinds of energy that do not come from the sun, and discuss their answers.

Note: Some energy can also come from tides (gravitational forces), geothermal heat stored in the earth (from original Earth aggregation and radioactive decay), fission fuels (unstable uranium and thorium nuclei), and fusion fuels (deuterium and tritium).

Assess

Have students draw an energy concept map using the list of words that they illustrated and used in the game (see handout). Students should show how the words are related to each other, using connecting words like "driven by", "makes" or "comes from". There are many ways that the map can be drawn correctly, but you should expect students to illustrate the ways in which each word relates to the sun, to show several different sources of electricity, and to connect humans' energy back to the sun through a simple food chain.

Extensions, adaptations, and more resources:

Energy Sources and Natural Fuels Volume 2 NSTA/ API Monograph by Aldridge et al. (background for teachers).

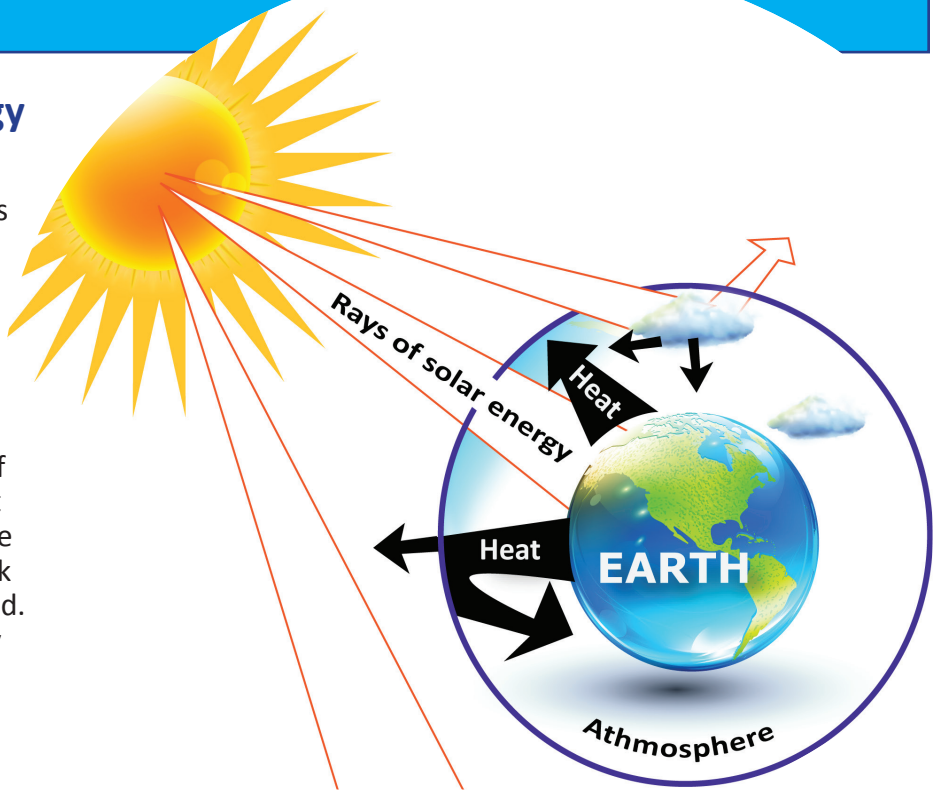
Handout

Solar Energy

Our earth gets most of its energy from the sun.

We call this energy solar energy. **Sol** means 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.

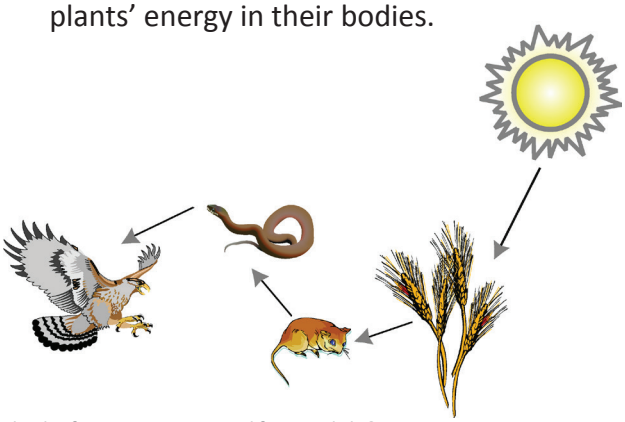
The sun is a giant ball of gas. It sends out huge amounts of energy every day. Most of the rays go off into space. Only a small part reaches the earth. When the rays reach the earth, some bounce off the clouds and back into space. In this way, the rays are reflected. The earth absorbs most of the solar energy and turns it into heat. This heat warms the earth and the air around it, which is the atmosphere. Without the sun, we couldn't live on the earth; it would be too cold.



We use solar energy to see and grow things

We use solar energy in many ways. During the day, we use sunlight to see what we are doing and where we are going. Plants use the light from the sun to grow. Plants absorb (take in) the solar energy 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.

The energy stored in plants feeds every living thing on the earth. When we eat plants and food made from plants, we store the energy in our 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. The energy in the meat that we eat also comes from plants. Animals eat plants to grow. They store the plants' energy in their bodies.



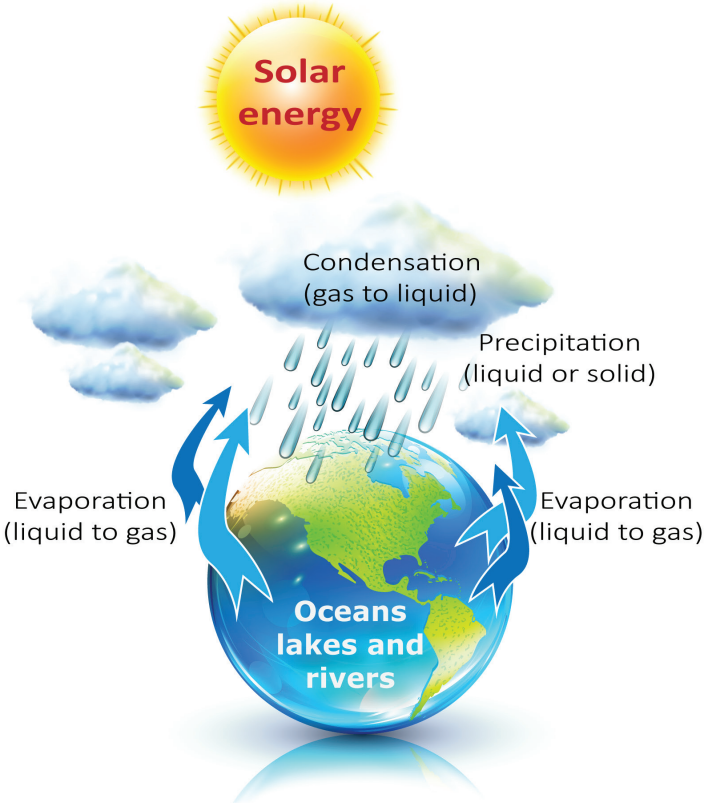
Handout Solar Energy (*continued*)

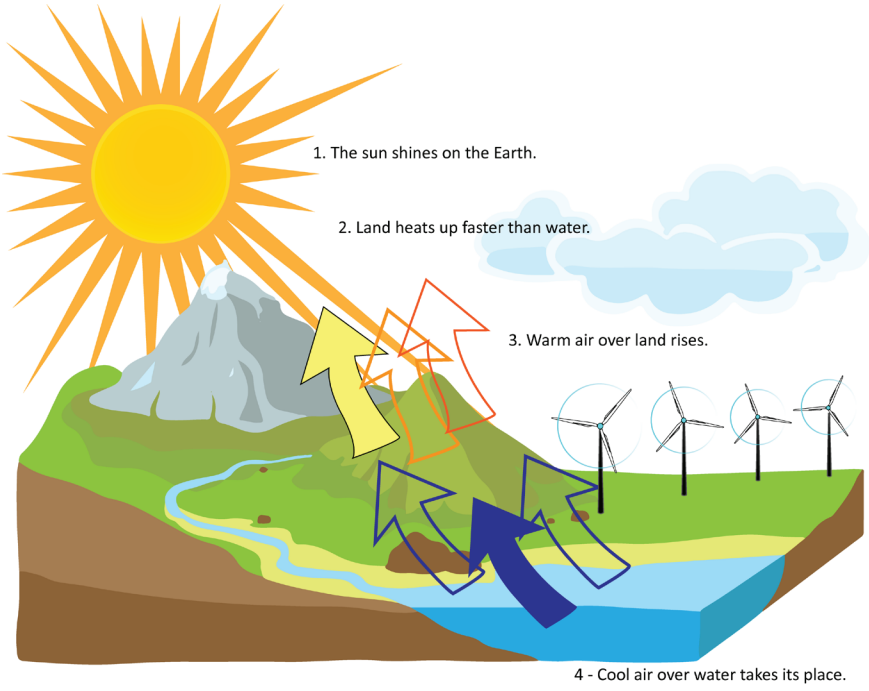
We can use the sun's energy for heat

We also use the energy stored in plants to make heat. We burn wood in campfires and fireplaces. Early humans burned wood to cook food, scare away wild animals, and keep warm. Solar energy turns into heat when it hits objects. That's why we feel warmer in the sun than in the shade. The light from the sun turns into heat when it hits our clothes or our skin. We use the sun's energy to cook food and dry our clothes.

The sun's energy is in many things

Solar energy powers the water cycle. The water cycle is how water moves from clouds to the Earth and back again. The sun heats water on the earth. The water evaporates, which means it turns into water vapor and rises into the air to form clouds. The water then falls from the clouds as precipitation, such as 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.





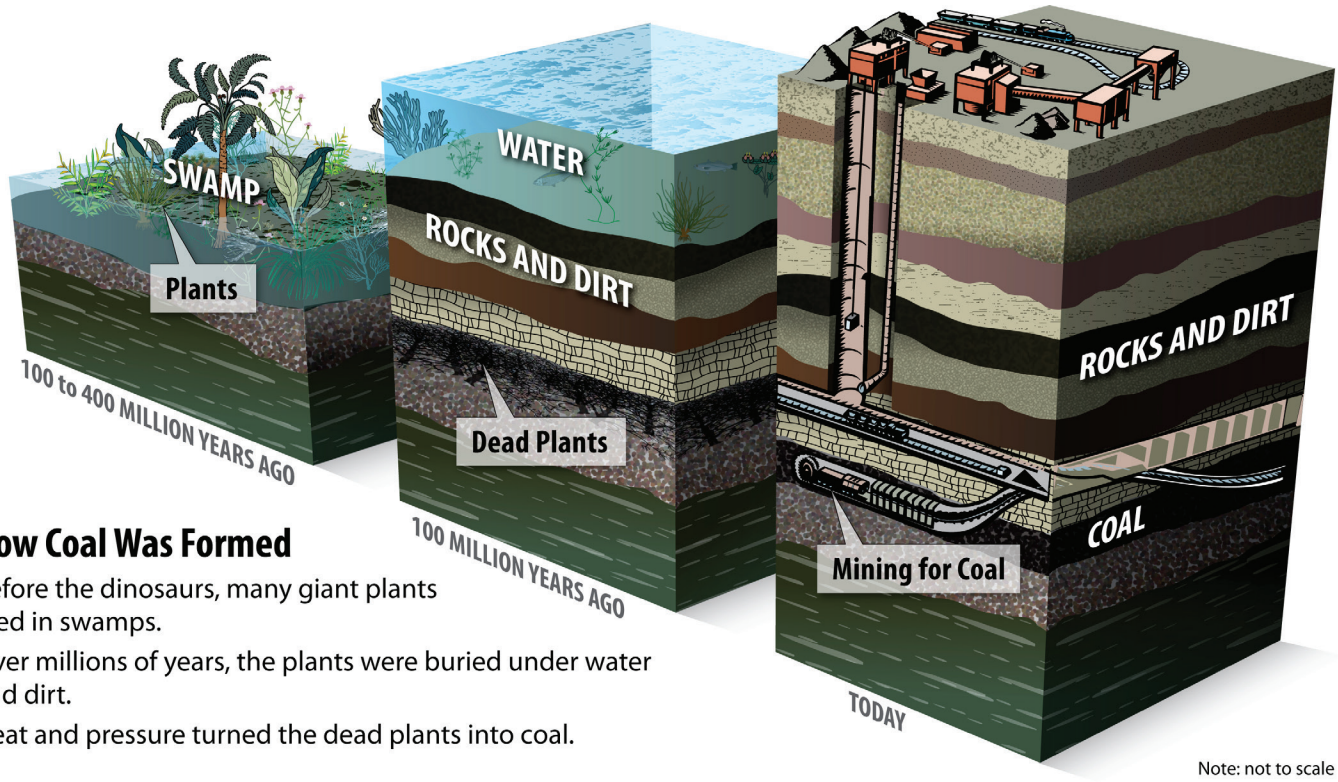
The sun makes the wind

Solar energy makes the winds that blow over the earth. The sun shines down on the land and water. However, the land heats up faster than the water, and then the air over the land gets warm. This warm air rises, and the cooler air over the water moves in where the warm air was. This moving air is wind.

Windmills can capture the wind's energy by turning the energy in moving air into electricity. The wind pushes against the blades of the windmill and they begin to spin. A generator inside the windmill changes the motion into electricity.

Fossil fuels have solar energy

Coal, oil, and natural gas are called fossil fuels because they were made from prehistoric plants and animals. The energy in them 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 still comes from fossil fuels.

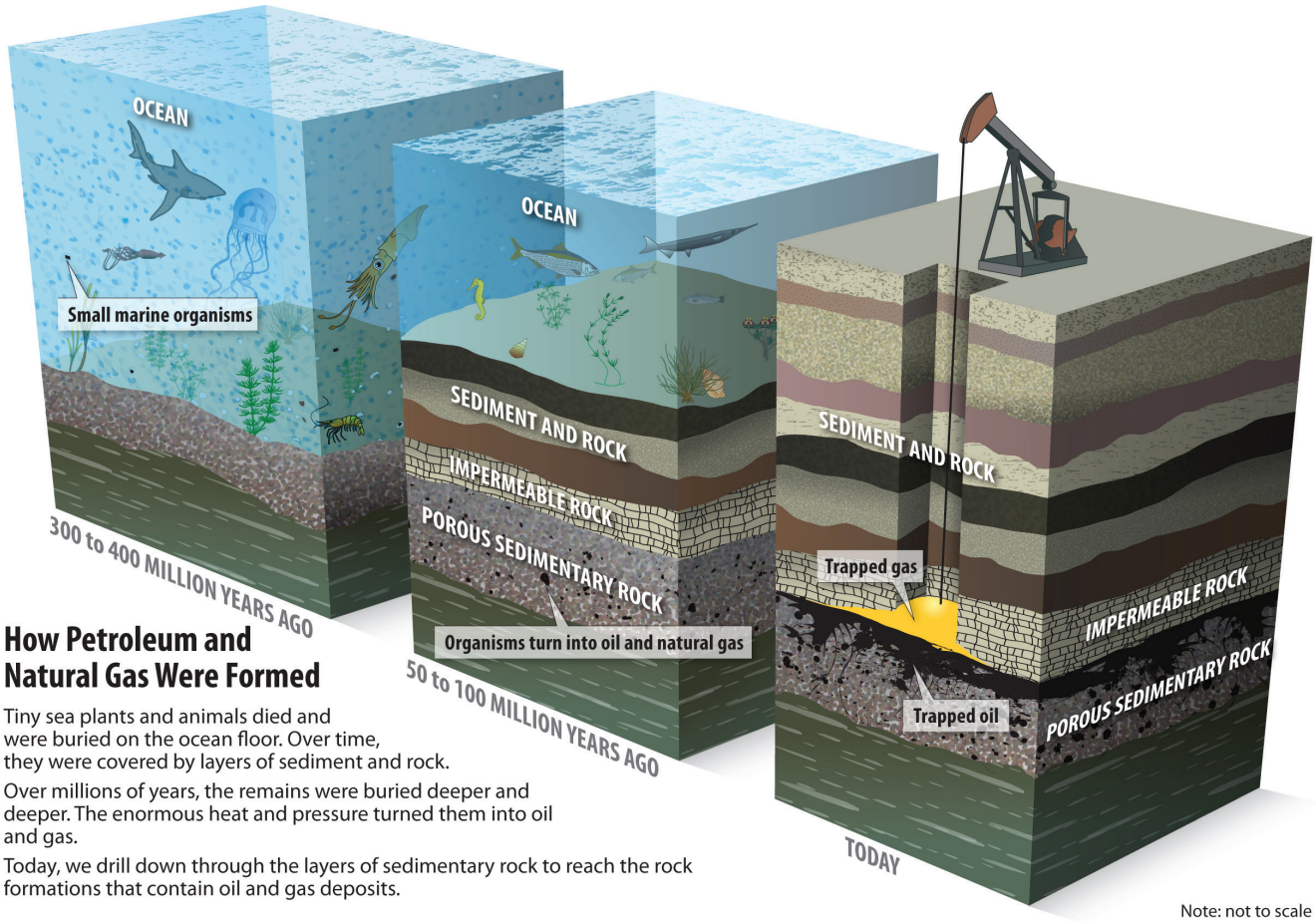


How Coal Was Formed

Before the dinosaurs, many giant plants died in swamps.

Over millions of years, the plants were buried under water and dirt.

Heat and pressure turned the dead plants into coal.



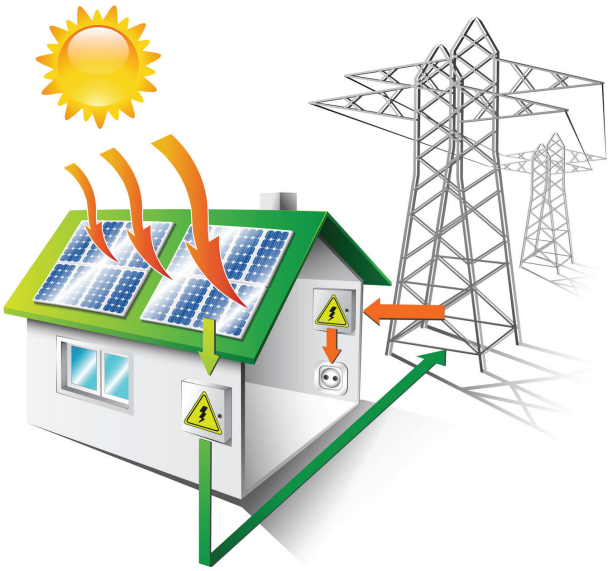
How Petroleum and Natural Gas Were Formed

Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of sediment and rock.

Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.

Today, we drill down through the layers of sedimentary rock to reach the rock formations that contain oil and gas deposits.

Handout Solar Energy (*continued)*



Solar energy can make electricity

Photovoltaic (PV) cells turn the sun's energy into electricity. "Photo" means light and "volt" is a measure of electricity. PV cells are made of two pieces of silicon, the main ingredient in sand. Each piece of silicon has a different chemical added. When radiant energy hits the PV cell, the layers of silicon work together to change the radiant energy into electricity.

Some toys and calculators use small PV cells instead of batteries. Big PV cells can make enough electricity for a house. They are expensive, but good for houses far away from power lines. Some schools are adding PV cells to their roofs. The electricity helps lower the amount of money schools must pay for energy. Do you have PV cells on your school building? Today, solar energy provides only a small amount of the electricity we use. In the future, it could be a major source of energy. Scientists are looking for new ways to capture and use solar energy.

Solar energy is renewable

Solar energy is free, clean, and renewable. We will never 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 know how to, yet. The hard part is capturing the energy. Only a little bit reaches any one place. On a cloudy day, most of the solar energy never reaches the ground at all.

Ways we capture solar energy

Lots of people put solar collectors on their roofs. Solar collectors capture the energy from the sun and tum 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 passes through the glass, hits the inside of the car, and changes into heat. The heat gets trapped Inside.

Energy Use Cards

Heating a house	*Paddling a kayak or canoe*	*Playing basketball*
Riding on a snowmachine	*Swimming*	*Turning on the lights*
Riding in a car	*Riding a bicycle*	*Cooking dinner*
Washing the dishes	*Flying a kite*	*Drying clothes*
Riding on a dog sled	*Walking to school*	*Watching television*

Activity

Solar to Heat

When radiant energy hits objects, some of the energy is reflected and some is absorbedand changed into heat. Some colors absorb more radiant energy than others.

Step 1 : Put three thermometers in a sunny place, or under a fixed light source.

Step 2: Cover the bulb of one with black paper. Cover the bulb of one with white paper.

Step 3: Predict which thermometer will get hottest. Number them 1-3, with 1 as the hottest.

Step 4: Observe the thermometer for three minutes.

Step 5: Record your results by coloring the tubes of the thermometers.

Step 6: Look at the results and number the thermometers 1-3 with 1 as the hottest.

Step 7: Explain your results.