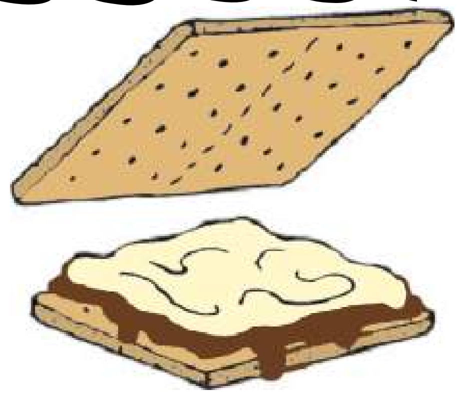
Cooking with the Sun!

Grades 3-6 Meets Grades 3 & 6 Standards



Lesson Summary

Students learn how the sun's heat can be harnessed to cook food and based on their findings, they construct and use a solar cooker.

Overview

In this lesson, students will:

- Learn about non-renewable and renewable sources of energy.
- Recognize that light from the sun can be converted to heat.
- Conduct an experiment and read thermometers to determine how efficiently various colors absorb the sun's radiant energy.
- Build a solar cooker using their experiment findings.
- Bake S'mores with their solar cookers.
- Learn about the benefits of solar energy.

Time

Three 60-minute sessions

Background

Energy is the power to do work. We can't see energy, but we can see its results. Energy moves, lights and heats objects. Right now, most of the energy that humans use comes from burning **fossil fuels**. It took millions of years for heat and pressure to turn layers of dead plants, dinosaurs, sand and mud into fossil fuels such as petroleum, natural gas, coal and oil. This is why fossil fuels are called **non-renewable** energy sources; once they are used, they are gone forever. Not only that, burning fossil fuels has serious negative impacts on our environment by making air pollution, creating acid rain and causing global warming.

The good news is humans can harness energy from cleaner, **renewable** sources such as the sun, wind and ocean tides, which are provided over and over again by the earth's natural systems.

The sun's energy is free and abundant. The **radiant energy** or sunlight that shines on Earth in just one hour could create enough solar power to meet the world's energy demand for an entire year! Solar power can be used for just about anything. Many homes in the United States get heat and electricity from solar power. Around the world in places like South America, Africa and India, people are even using solar power to heat their food in solar cookers!

A solar cooker collects and traps the sun's energy, creating heat, much like a car parked on a sunny day creates heat. Instead of burning wood or fossil fuels, solar cookers rely on the sun's power to heat food without creating pollution. Not only are they good for the environment, solar cookers are easy to make and a fun way to cook foods like baked beans, nachos, muffins and dried fruit.

Vocabulary

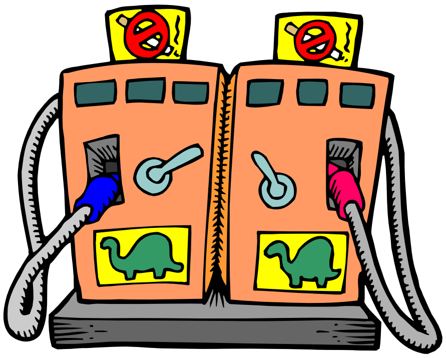
- Energy
- Renewable Energy
- Non-renewable Energy
- Global Warming
- Solar Energy
- Absorption
- Insulation
- Conduction
- Radiation

Materials

- *Energy - Our Powerful Future* Fact Sheet and Reading Comprehension Questions
- Raisins
- Student lab sheet
- Tape, scissors, rulers
- 4 Rubber bands
- Pieces of black, white, yellow, and dark blue construction paper
- 8 Small plastic tubs
- Thermometers
- Measuring cups
- Pizza boxes
- Newspaper
- Clear plastic wrap
- Aluminum foil
- Chocolate bars
- Marshmallows
- Graham crackers
- Potholders/oven mittens
- Glass baking dish w/lid

Preparation

1. Read *Energy – Our Powerful Future* Fact Sheet.
2. Gather items from the materials list.
3. Prepare solar collectors to be used in Part 1 of this lesson by doing the following:
    - Cut two circles each out of the black, white, yellow and blue construction paper to fit the bottom of the 8 plastic tubs.
    - Glue or tape each of the circles to the inside bottom of a plastic tub.



    - Cover one black, white, yellow and blue tub with clear plastic wrap across the top and hold in place with rubber bands. Puncture a tiny hole in middle of plastic wrap so that a thermometer can be inserted.
4. Organize students into eight working groups.
5. Give each group a copy of the *Energy - Our Powerful Future* fact sheet and comprehension questions. In their groups have students take turns reading the fact sheet aloud and answer the reading comprehension questions. Or, give this as a homework assignment.

Pre-Activity Questions

Ask students:

1. What is energy? (*Energy is the power to do work.)*
2. How can you tell if something is using energy? (*It lights up, it moves or grows, or it gets heated.)*

3. What are some things that use energy? (*Lights, computers, ovens, cars, bikes, plants and people use energy.)*
4. Where do we get most of the energy to run our cars, light our classroom, and heat our homes? (*From fossil fuels like gasoline, oil, coal, and natural gas.)*
5. Why are fossil fuels like oil and coal called non-renewable energy sources? (*Because nature has only made a certain amount of them; once they are used, they are gone forever.)*
6. Does burning fossil fuels harm the environment, and if so, how? (*Yes, burning fossil fuels makes air pollution, creates acid rain, and causes global warming.)*

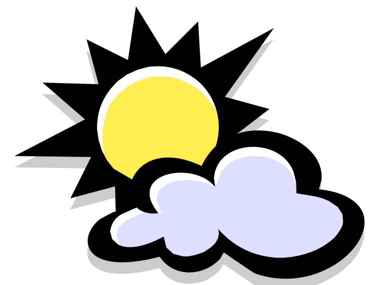
7. Why are the sun, wind and ocean tides called renewable energy sources? (*Because nature can provide these sources of energy again and again.)*

Activity Part 1: Hot & Cold Colors

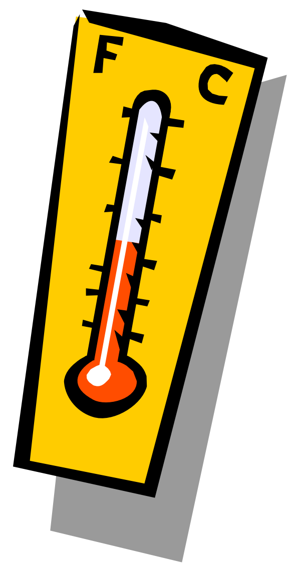
1. Give each student a handful of raisins for a snack.
2. Ask the class if they know what fruit a raisin comes from? (*grapes*)
3. Ask if they know how grapes become raisins? *(The sun's energy heats the grapes and evaporates or dries out the water inside to make raisins. This is true for all dried fruits including apples, apricots, cherries, and tomatoes.)*

4. Explain to students that the sun's energy heats things up all the time. When the sun's light falls on an object, like water or a car or the playground outside, that object takes in or *absorbs* the light and turns it into heat. So when objects absorb the sun's light, they become warmer.

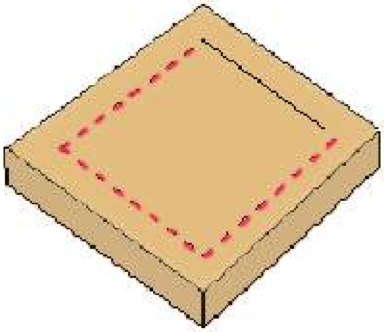
5. Ask students if they have ever sat in a sunny spot on the playground or in front of a window on a sunny day. What happened? Did their skin start to feel warm, or did they start to sweat? That was their body absorbing the sun's light and turning it into heat.
6. Divide students back into eight working groups, and tell them that they will work together to measure the amount of energy from the sun that different containers of water can absorb.
7. Give each group a thermometer, lab sheet and one of the solar collectors made from a plastic tub.



8. Instruct each group to use the measuring cups to fill their plastic tub with one cup of water and then to carefully carry their materials outside.
9. Once the class has gathered in a sunny place outside, tell each group to do the following:
    - Set their plastic tub down on the ground.
    - Place their thermometers in the tub of water.
    - Note the color of paper on the bottom of their tub and if their tub is covered with plastic wrap and find the corresponding column on their lab sheet. (Instruct groups with tubs covered by plastic wrap, to insert their thermometer through the small hole in the wrap.)
    - Read their thermometer and record the initial temperature of their water on their lab sheet.
    - Read their thermometer and record the temperature on their lab sheet every two minutes, stopping at ten minutes, for a total of 5 times. Calculate the change in temperature.

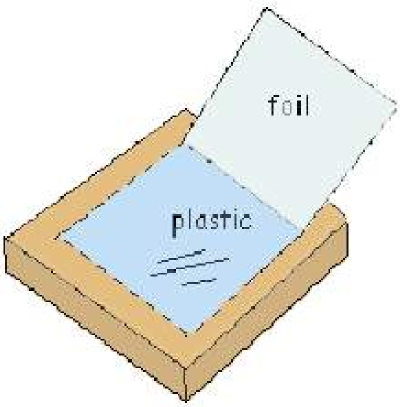


10. Back in the classroom, ask each group to share their results. Then chart the results using the lowest and highest temperature recorded by each group. Note on the chart the color of each tub and whether it was covered with plastic or not.
11. Lead the class in a discussion about the results. Sample questions might be:
    - Do you see any patterns? *(Dark colors absorbed more heat; light colors absorbed less heat, tubs covered in plastic got warmer)*
    - What color absorbed sunlight best? *(Black)*
    - What color absorbed sunlight the least? *(White)*
    - What effect did color have on temperature? (*Darker colors absorbed more sunlight, which turned into heat and caused a greater change in temperature.)*
    - Did the tubs covered with plastic wrap get warmer than those that weren't covered with plastic wrap? If so, why do



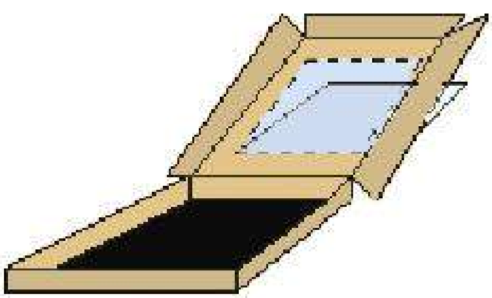
you think that happened? *(The tubs covered with plastic got warmer, because the wrap trapped heat and didn't let it escape. The wrap acted as insulation.)*

- Do you think time of day or time of year might affect the results of the experiment? Why or why not? If so, how could we find out? *(The sun is strongest at high noon, so temperatures in the tubs would probably be higher at that time. The Northern hemisphere gets more concentrated sunlight in the summer than in the winter, so this might affect temperatures in the tubs as well.)*
- What color t-shirt would you wear on a hot day to keep as cool as possible? *(White)*

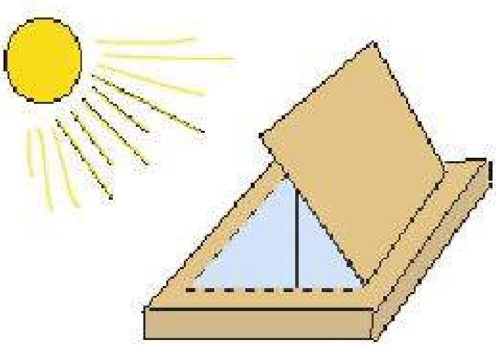


Activity Part 2: Building Solar Cookers

1. Tell students that they are going to use the results from their experiment to help them build a solar cooker.
2. Explain that solar cookers are ovens that don't burn any fossil fuel or wood. Instead, solar cookers catch and trap the sun's energy and use it to heat food. People in Africa, South America, and India use solar cookers, and many people in the United States use them at picnics and camping trips.
3. Break students up into groups and tell them that they are going to make solar cookers out of a pizza box.
4. Give each group a pizza box, scissors, tape, a sheet of black construction paper, 2 sheets of plastic wrap, a sheet of aluminum foil, newspaper and a ruler.
5. Instruct students to do the following:
    - Close the pizza box.
    - Draw a square with 9-inch sides on the top lid of the pizza box.
    - Carefully cut along 3 sides of the square and fold the flap back along the uncut edge to make an opening in the lid.
    - Cover the underside of the flap with a sheet of aluminum foil. Make sure to tape the edges of the foil down tightly. (Tell students that the foil will help to reflect sunlight into the box.)

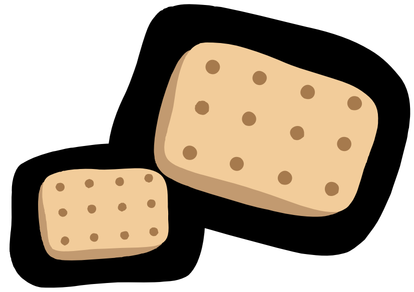


6. Tell students they are now going to line the inside bottom of the pizza box with a piece of construction paper, which will be used to absorb the sun's light. Based on their experiment, ask the students what color paper do they think will work best? *(Black)*
7. Instruct students to do the following:
    - Line the bottom inside of the box with a piece of black construction paper.
    - Roll sheets of newspaper into a 1-inch thick tube. Make 4 of these tubes and fit them around the edges of the bottom of the pizza box. Secure them in place with tape. (Explain that the newspaper will act as insulation.)



- Stretch one piece of plastic wrap tightly over the aluminum foil on the underside of the flap and secure the edges with tape.
- Stretch another piece of plastic wrap tightly across the opening in the lid and secure the edges with tape.
- Prop the flap open with a ruler.

8. Ask students why they think you asked them to tape plastic wrap across the opening in the lid and on the flap. *(The plastic wrap creates a layer of insulation that will trap or hold in heat created by sunlight shining into the pizza box.)*

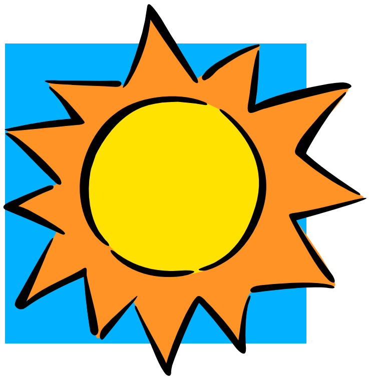


Activity Part 3: Making S'mores

1. On a sunny day, go outside to a flat surface and have students place their solar cookers on the ground in the sun. If it's cold outside, put a towel or blanket under the cookers so the bottom doesn't get cold.
2. Tell students they are going to make S'mores with the sun!
3. Give each group graham crackers, marshmallows, chocolate and either aluminum foil or a glass baking dish with a lid.
4. Have each student break a graham cracker in half, so they have 2 squares. Place 4 squares of chocolate on one graham square and one marshmallow on top of the chocolate. Place the other graham square on top of the marshmallow and press together.
5. Remind students that their solar cookers can get very hot. They should use oven mittens or potholders to touch the cooker and to place and remove contents from inside.
6. Instruct students to place their S'mores in the baking dish or on a piece of aluminum foil and then place them in their solar cookers by opening the pizza box lid and setting them inside. Students should close the pizza box and then prop open the flap of their solar cooker with a ruler and angle it so the aluminum foil on the inside of the flap is facing the sun. (Note: You may want to place an oven thermometer in each cooker, so students can see how hot the air temperature gets.)
7. Students should remove the S'mores from their solar cooker when they see that the chocolate has begun to melt. Have students check on their S'mores every five minutes.

Discussion Questions

1. Did students enjoy eating their S'mores?
2. How did the solar cooker heat the S'mores? *(The light energy from the sun enters the solar cooker and is absorbed by the construction paper, creating heat. The heat then transfers from the construction paper to the S'mores. This transfer of heat is called conduction. The warmed paper and food, give off heat waves into the air within the cooker. These heat waves or radiant energy then bounce off the aluminum foil and are*

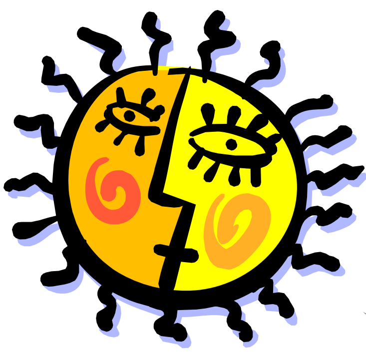


reflected back at the food. This cycle happens over and over again and heats the food.)

3. Did the solar cooker create any pollution that you could see? *(No)*
4. What type of energy source is the sun? Renewable or non-renewable? *(Renewable)*
5. Do you think there are other ways besides solar cookers that people can harness the sun's power? *(solar panels, solar cars, solar radios, drying clothes on a clothesline)*
6. Is this a better way to cook food than by burning fossil fuels? Why? *(Yes, because unlike burning fossil fuels, sunshine is free and it doesn't cause pollution, acid rain, or global warming.)*

Extensions

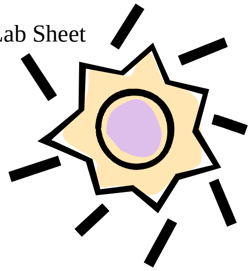
- Have students conduct another solar collector experiment and this time, have them take temperature readings during the morning and afternoon to see if the power of the sun changes with time of day.
- Solar cookers have been around since the 1830's when John Hershel used one to cook food during an African expedition. Have students research the history of solar cookers and create a timeline.
- Have students research the use of solar power and other renewable energy sources in California and then make a presentation to the class on their findings - write a report or create a renewable energy collage.



CA State Standards

Gr. 3 Science 1, 1a, 1b, 2, 2b, 5, 5b, 5c, 5e
Language Arts R2.2 • Math N1.1, N2.1
Gr. 6 Science 3c, 3d, 4, 4b, 6, 6a, 6b • Math N2.3

Solar Lab Sheet



Name____Date____________

Which Colors Absorb Heat Best?

The purpose of this lab is to: ____

____

What I think will happen is this: ____

____

Because: ____

	White With Cover	White No Cover	Yellow With Cover	Yellow No Cover	Blue With Cover	Blue No Cover	Black With Cover	Black No Cover
Original Temperature								
2 Minutes								
4 Minutes								
6 Minutes								
8 Minutes								
10 Minutes								
Change in Temperature								