WATT WATCHERS
4-H ENERGY PROJECT

NAME_____________________
CLUB_____________________
BIRTHDATE_________________
YEARS IN PROJECT_____
YEARS IN 4-H_____

Exploring Energy

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## Objectives

*In this project you will learn*

- about the energy contained within sunshine and how to use it to reduce energy demands on fossil fuels;
- how to take advantage of the sunshine to make your room more comfortable;
- about the chill factor of moving air;
- that the cooling effects of wind can be used to increase your comfort; and
- that color is a consideration in energy conservation.

*After you have completed this project, you are encouraged to take other projects in this series to learn more about energy conservation.*

## Project Requirements

*To complete this project you will*

- build a solar cooker and use it;
- build a solar collector;
- dry clothes and fruit with solar energy;
- write your name with sunshine;
- discover the temperature inside a closed car;
- make a draft detector and experiment with it;
- experiment with materials to determine their storage potential for solar energy;
- give a demonstration on energy conservation to your club; and
- teach at least two people to use renewable energy to replace some uses of nonrenewable energy sources.

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Exploring Energy

You are living at a time when the world is concerned about its energy sources and energy uses. Therefore, it is important to learn as much as you can about energy and how to use it wisely.

We use two kinds of energy sources in daily living: renewable and nonrenewable. Renewable sources of energy are not used up or destroyed; for example, sunshine, wind, and moving water. Nonrenewable energy sources cannot be replaced when they are used up. Nonrenewable energy sources include fossil fuels such as coal, petroleum, and natural gas.

In this project you will concentrate on making better use of renewable energy sources. By using our renewable energy sources we can save the nonrenewable sources of energy for future needs.

The problem with using renewable energy sources, such as sunshine and wind power, to replace the nonrenewable energy sources we now use is what to do when the sun does not shine or the wind stops blowing. Researchers are working to find ways to convert the energy from renewable sources into forms of energy that can be stored and used for everyday living. However, there are many ways we can now use these energy sources to conserve our nonrenewable energy. (In most instances we also save money by using renewable energy sources.)

Solar Energy and Sunshine

Sunshine is a "free" source of energy that has many practical uses. Florida is called the "Sunshine State" because of its abundance of sunshine. Since solar energy is renewable, we need to learn to use this source as effectively as possible. As you look at sunshine (never look directly at the sun) it is difficult to imagine its energy. To better understand sunshine and its concentration of energy, you will learn to write your name with sunshine.

ACTIVITY WRITING WITH SUNSHINE

Your challenge:
To learn about the energy contained in sunshine.

You will need:
Magnifying glass (or prescription glasses), light-colored piece of wood (e.g., pine), sunglasses, and a sunny day.

What to do:
1. This activity must be performed outdoors in the direct sunshine on a sunny day.
2. Put on sunglasses to protect your eyes.
3. Hold the magnifying glass over the wood at an angle to catch and focus the sun's rays. Move the magnifying glass up and down until there is a small, very bright spot of light. This small spot of light will burn the wood.
4. Move the magnifying glass slowly to form your initials or write your name. The heat from this focal point of the sun's rays will slowly burn the wood, turning it dark.
5. Do not hold the magnifying glass in one spot too long, because smoke will begin to appear and the wood will catch fire and burn.
6. Do not focus the magnifying glass on your skin; it will burn you.
7. If you have an electrical wood-burning set, use it to write your name.
8. Compare the lines made with the magnifying glass and the sun's rays to those drawn with the wood-burning set.
ACTIVITY BUILDING A SOLAR COOKER

Your challenge:
To use heat from the sun to cook a hotdog.

You will need:
Two heavy cardboard boxes, pencil, string, hotdog, aluminum foil, two long nails or a wire coat hanger, tape or glue, rule (or tape measure), thumbtack, and knife or scissors.

What to do:
1. To make the frame for your solar cooker, use a strong cardboard box that is at least 8 inches wide, 8 inches deep and 12 inches long. Remove the top from the box.

ACTIVITY TOASTING MARSHMALLOWS

Your challenge:
To learn about the energy contained in sunshine and in wood.

You will need:
Firewood, paper, pine cones or kindling wood, magnifying glass (or prescription glasses), sunglasses, marshmallows, a stick or straightened wire coat hanger (for toasting the marshmallows), and water hose (for safety in case the fire burns too fast).

What to do:
1. In a barbecue grill or on a clean, clear area, place a few sticks of dry wood and some newspaper or dry pine cones or kindling wood. (Be sure to place these in a location where it is safe to start a fire.) The paper or pine cones should be placed first with a small amount of wood over them.
2. Place the magnifying glass in the direct sunlight and direct the rays to the paper. Hold it in one location until the paper begins to burn. Then, place the magnifying glass in a safe place out of the sunlight.
3. Place the marshmallows on a stick or on a wire coat hanger that has been straightened. Hold marshmallows over the fire and toast them. You used sunlight to start the fire. The wood used for the fire is also a renewable energy source, because trees can be planted and will grow.

2. At each corner of the box place a mark that is 1½ inches from the bottom of the box. Draw a line connecting the two corner marks on the front side of the box. Do the same thing on the back side of the box.

3. Use a sharp knife to cut the front side away from the ends of the box. Cut down to the line. Then, cut along the line. Do the same thing to the back side of the box.
4. Use a piece of cardboard from another box. Cut two pieces that are the same size as the end of your box. Glue one extra piece of cardboard on each end of the box. (This reinforces the ends so they will be stronger.)

5. Measure the width of your box. Use this measurement for the diameter of the circle that you will draw. (Example: Suppose the box is 8 inches wide. The diameter of the circle will be 8 inches.)

6. Use a large piece of cardboard cut from another box to draw the circle. Make the diameter of this circle the same measurement as the width of your box. For example, if the width of the box is 8 inches, the diameter of the circle should be 8 inches. An easy way to draw a circle is to use the radius as a measurement. To find the radius, divide the diameter in half. If the diameter is 8 inches, the radius is 4 inches.

7. If you have a compass, use it to draw your circle. If you do not have a compass, you can draw a circle another way. Tie a string to a pencil. Be sure the string is longer than the circle's radius. Place a tack in the center of the cardboard. Wrap the string around the tack so that the length of the string from the tack to the pencil is the same measurement as the radius. Hold the tack securely so that the string does not slip. With the pencil erect, draw a circle.

8. The tack was located in the exact center of your circle. Use a ruler or straight edge to draw a line directly through the center of the circle and across the outer edges of the circle. Call this line "A." Now draw another line through the center of the circle, perpendicular to line A. The two lines should divide the circle into four equal parts. Label this second line "B."

9. On line A place a mark halfway between the center and the outside edge of the circle. Do this on both sides of the circle. These marks will be the focal points. (Example: If the diameter of a circle is 8 inches, the center will be 4 inches from the outside edge. The focal point would be 2 inches from the center and 2 inches from the edge of the circle.)

10. Cut the circle out of the cardboard. Then, cut the circle in half by cutting along line B.

11. Now, trim 1 inch off of the straight edge of each of the half circles.

12. Use these half circles as a pattern. Cut two more pieces just like them. Glue the new pieces onto the two half circles to make them stronger. These double-thick pieces will be the ends of your solar cooker.

13. You will need a piece of poster board or flexible cardboard to form the body of your solar cooker. To find
the size of the piece to be cut, you will need to make two measurements. First, use a tape measure to measure the distance around the curved part of one end piece. (This will be the length of the piece. In our example, this length will be 12.6 inches.) Second, measure the width of the frame (box) and subtract ½ inch. (In our example, this will be 11½ inches.) Cut the poster board the size of the measurements you have taken.

14. Tape the poster board to the ends of the cooker. (When taped, it has a cradle shape). Carefully cover the interior of the cradle with aluminum foil. Turn the shiny side up and keep the foil smooth. Mark the locations of the focal points.

15. About an inch directly beneath each focal point, mark a place to attach the cooker to the frame (box). Measure the distance from this mark to the straight edge of the cooker's end. Mark the same distance on the end pieces of the frame. Punch holes where you have made the marks.

16. Insert two long nails or a coat hanger through the focal points in the ends of the cooker.

17. Then connect the cooker to the frame with a bolt on each side. Put the bolts where you have made the holes beneath the focal points.

18. Fasten a hot dog on the nails. Place the cooker in the sun. Adjust the cooker so that the sun's rays are reflected by the foil and focused on the hotdog. Slowly turn the hot dog as it cooks.

- What generated the heat that cooked your hotdog?
- Why did the sunshine cook the hotdog in the cooker while it will not cook it without the cooker?
When the rays of the sun are focused they give off much heat. However, energy obtained from the sunshine can be used in many other ways that do not require they be focused. The sun can warm, dry, bleach, and tan. You can easily make tea, dry food, and dry your clothes with the heat from sunshine.

ACTIVITY  MAKING TEA WITH SOLAR ENERGY

Your challenge:
To use the energy from the sunshine to make tea.

You will need:
Two quart-size (clear) glass jars with lids and four regular-size tea bags or two large tea bags. You may use two tablespoons of loose tea, instead of the tea bags.

What to do:
1. Fill each of the glass jars with cold tap water. In each jar place two regular-size tea bags or one large tea bag. If you prefer you can use one tablespoon of loose tea in each jar. Be sure to put the same amount of tea in each jar. Screw the lids on the jars tightly.
2. Place one jar outdoors in the full sunshine and the other in the refrigerator or in a cool location in the house. Leave for 4 to 6 hours or until the tea in the jar in the sunshine reaches the desired strength.
3. Does the jar of tea sitting in the sunshine feel warm?

Where does the heat come from?

4. Which jar has stronger tea, the one in the sunshine or the jar located in the refrigerator or in a cool location?

Why?

Now you are ready for a treat. Sweeten the tea as desired and put it into ice-filled glasses.

- If the sunshine warmed the water in the jar enough to make tea, what happens to water left in other types of containers in the sun?

- If you have a pet that stays outdoors during the summer where should its water be placed?

- Why?

- If you have a garden hose that has been laying in the sunshine in the yard, lift the hose and feel the temperature of the water as it runs out of the end of the hose. Describe the temperature.

There are ways energy from the sunshine can be used effectively. Even the Indians used the sun to dry food so that it could be stored for later use. Early settlers relied heavily on dried foods to carry them through the winter.

Dried foods are still popular and are found in food stores. Dehydrators are used to dry foods. Although most dehydrators use fossil fuel, solar food dryers are attracting popularity. For your next activity, make a solar food dryer.
ACTIVITY  DRYING FRESH FRUIT WITH SOLAR ENERGY

Your challenge:
To use solar energy to dehydrate or dry fresh fruit so it can be stored for later use.

You will need:
An oven or barbecue rack, clean cheesecloth or an old sheet, safety pins, eight bricks or blocks, and fruit. (Several different types of fruit may be used; for example: apples, pears, peaches, grapes, and figs.)

What to do:
1. Prepare the fruit. If you are using apples, pears, or peaches, peel the fruit, core it, and cut it into slices 1/8-inch thick. Grapes and figs may be used whole.
2. Find a sunny location outdoors away from dust and dampness.
3. Use four bricks under the corner of the rack for legs.
4. Place half of the fabric over the rack and use safety pins to hold it in place.
5. Place fruit on the cloth-covered rack.
6. Put the other four bricks on the rack over the legs to hold it in place. Spread the other half of the cloth over the fruit and the second layer of the bricks. The cloth protects the fruit from dust and insects.
7. Turn the fruit once or twice each day. Bring the rack of fruit inside each night to prevent it from becoming damp from dew or rain.
8. When dry, the fruit will be tough, flexible, and not sticky.

- How long did it take to dry the fruit?
- Describe the taste and appearance of the dried fruit?
- List some other foods that can be successfully dried in the sunshine.
- How can farmers use the sun's energy to dry some of their crops for storage?
- What are some of the problems that can result from relying on sunshine for the energy needed for drying?
ACTIVITY  SOLAR DRYING CLOTHES

Your challenge:
Use energy from the sunshine to dry clothes.

You will need:
Two towels of the same size and same weight (they may be tea towels or bath towels).

What to do:
1. Take two identical towels which have been laundered or have been dipped in water and had the surplus water removed.
2. Hang one towel on the clothesline in the direct sunshine. Hang the other towel on the clothesline in the shade. Record the time that the towels were hung up.
3. Which towel dried first?
4. How long did it take for the towel in the sunshine to dry?
5. How long did it take for the towel hung in the shade to dry?

Why was there a difference in drying time? ____________

How can this information help you and your family save energy? ____________

The Greenhouse Effect

Everyone knows that light enters a room through windows and that the sun will shine through the window. Find a window with the sunshine coming through. Sit in the sunshine for a few minutes. Now move to another place in the room and sit there for a few minutes. In which location did you feel warmer?

Why? ____________

ACTIVITY  SOLAR HEAT FOR A ROOM

Your challenge:
To understand how energy from sunshine can be trapped in your home.

You will need:
Shoe box or another small box, thermometer, plastic wrap, tape, piece of cloth, sunshine, and window.

What to do:
1. Read the temperature on the thermometer and write it down.
2. Place the thermometer in the box. Place a piece of clear plastic wrap across the opening of the box. Be sure the plastic is smooth with no wrinkles and tape.
3. Put the box in the window with the taped side facing the sun. Watch the thermometer. What happens?
4. Leave the thermometer in the box facing the sun for 30 minutes. Record the temperature. ____________

Were the temperature readings different? ____________

What does this tell you about saving heat in your home?
How can you use this information to make your home more comfortable? Answer the questions below by placing the letter of the correct answer in the correct space.

Questions

____ On a cool morning, to help warm the room the curtains should be . . .

____ On a warm afternoon, to help keep the room cool the curtains should be . . .

Answers

(a) closed to keep out the sunshine.

(b) open to let in the sunshine.

When the rays of sunshine pass through glass, longer wave lengths are trapped inside, making the room warmer. This is called the greenhouse effect. Commercial growers and hobbyists rely on this principle by placing their plants in buildings made of transparent materials to keep them safe in the winter months.

Suppose you were going to build a small room or building for your mother to store her flowers during the cool months.

Describe what you would build.__________________________

__________________________

__________________________

Why?__________________________

__________________________

Color and Solar Energy

Did you know color can be important when using solar energy? It is also important to you in saving energy. Since we have so much sunshine in Florida, it's especially important to understand the effects of color. You know that you can reflect light with a mirror (almost everyone has at sometime used a mirror or a bright piece of metal to reflect sunlight into someone’s face). When you made the hotdog cooker, you used the bright side of the aluminum foil to reflect the sun's rays to a focal point so the meat would cook.

White and very light colors reflect light and heat energy. Black and dark colors absorb the sun's heat. On a bright sunny day, compare the temperature of the black asphalt street and your light-colored paved drive.

Which is hotter? ______________________

Why? ______________________

____________________
ACTIVITY  COLOR — REFLECTING AND ABSORBING THE SUN'S HEAT

Your challenge:
Learn the relationship of colors to heat absorption.

You will need:
Four ice cubes (all the same size), one stop watch or timer, four sheets of construction paper (fabric can be used if all pieces are the same size and the fabric is different only in color), and scotch tape.

What to do:
1. Find a sunny area outdoors.
2. Wrap each ice cube in a sheet of construction paper or fabric. Tape closed and place in the sunshine. Start the timer. After 3 minutes, open one cube of ice wrapped in black and one in white. Compare their size. Which is larger? ___________ Open the other ice cubes after 5 minutes and compare their sizes.
    (You may wish to repeat this activity two or three times and compare the results.)

- Which ice cube melted the fastest? ___________
  Why? ___________

- Which ice cube melted the slowest? ___________
  Why? ___________

- How long did it take each ice cube to melt?

3. Try this same activity again. This time conduct it in a shady area.

- Which ice cube melted the fastest? ___________
  Why? ___________

- Compare these results to the results of the sunny area. ___________

4. Relate the results of this activity to the color of clothing you wear. In the summer you would be cooler if you wore ___________. In the winter you would be warmer if your wore (color) ___________.

- What colors would you choose for a new automobile (interior and exterior)? ___________
  Why? ___________

- Does the color of the roof of your house have an effect on how comfortable you are in the summer or how much energy is required to cool your home? ___________
  Why? ___________

5. Ask your parents to park the car in the sunshine with all windows closed. Borrow your mother's oven thermometer and put it in the car. Leave it in the car for 4 hours in the middle of the day (preferably the summer). At the end of 4 hours, what is the temperature? ___________
  Why is it not safe to leave pets or small children in a car that is parked in the sunshine? ___________

The ability of colors to absorb heat is of benefit in developing solar collectors. You will notice that portions of the collector panel are often black or dark. If you have an opportunity, visit someone with a solar collector and inspect it. People that have solar hot water heaters or solar heat and air conditioning have solar collectors in their yards or on the roofs of their homes. To better understand this principle, build a simple solar collector.
ACTIVITY  CONSTRUCTING A SOLAR COLLECTOR

Your challenge:
Learn how to trap heat from sunlight.

You will need:
Cardboard box approximately 24 inches long, 24 inches wide, and 10 inches deep; plastic or glass to fit one side of the box; black paint or paper; and tape.

What to do:
1. Cut two holes, 3 inches square, in opposite ends of the box.
2. Paint the inside of the box black or line it with black paper.
3. Glue or tape the glass or plastic to the large open side and cover all edges.
4. Take the box outside and prop it up so the glass side faces the sun. Turn the box so that one hole is turned up and the other is turned down.
5. After about 15 minutes, place your hand over the hole that is on the top of the box. Do you feel the heat?

How could this heat be used in a home?

It is important to collect solar energy. An even bigger challenge is to store the energy collected for use at a later time. The color, density, and construction qualities of various materials are important considerations in storing solar energy. For your next activity, you will test some of these materials.

ACTIVITY  STORING SOLAR ENERGY

Your challenge:
To find out which materials store heat the best.

You will need:
Seven glass jars of the same size and color (with lids), water, sand, gravel, dirt, nails, wood shavings, a worksheet, and pencil.

What to do:
1. Fill each jar half full of a different material. One jar will be empty (it contains air).
2. Tightly cover each jar.
3. Place the jars in direct sunlight for 1 hour. Feel the sides of the jars. Rate the jars from coolest to hottest, numbering from 1 to 5 (1 being the coolest, 5 being the hottest). Record the results on the worksheet.
4. Place jars out of the direct sunlight to cool. Record results on worksheet at intervals of 1 hour, 2 hours, 3 hours, and the next morning.

Which material was the hottest after 1 hour in the direct sun?

Which material was the hottest after cooling for 1 hour?
2 hours?
3 hours?
the next morning?

Which material stores energy the best?

Solar collectors are used to collect the sun's energy for home heat. What materials do you think are used to store solar heat?

Why must heat energy be stored?
Wind Power

Wind power has been used as an energy source for a very long time. It was used to sail ships and to pump water long before fossil fuels came into general use. But there are problems associated with wind power. What happens when the wind stops or when there is too much? With today's need to replace fossil fuels with renewable energy sources, wind is again attracting attention. Maybe you are the person with enough creativity and imagination to invent more efficient ways of using wind power.

Movement of air generates energy. The stronger the wind, the greater the amount of energy involved. If it could be trapped and used, the energy expelled by one hurricane could supply the energy needs of the entire nation for a long time, but at this time science does not have the technology needed to do this. Maybe someday it will be possible. However, wind is being used. Windmills are being used to operate small electrical generators in some locations where there is a constant breeze.

ACTIVITY BUILDING A PINWHEEL OR WINDMILL TO GENERATE ENERGY

Your challenge:
To understand energy generated by air movement.

You will need:
One sheet of heavy paper, scissors, thumbtack, and a stick on which to attach the windmill.

What to do:
1. Cut the paper into a square.
2. Mark center of paper.
3. Cut lines diagonal from corner to within 1 inch of center.
4. Fold alternate corners to the center of paper and thumbtack the corners together in the center.
5. Blow on the pinwheel. Watch the blades turn. Notice that the more forceful the air movement, the faster the pinwheel turns.
6. Hold the pinwheel in a strong breeze. Observe the speed of the rotations.

Are there windmills in your community? ____________________________
If so, what are their uses? ____________________________
What are some of the things windmills can be used for? ____________________________

Moving air can help to keep you cool in warm weather. In cold weather, the wind blowing can make you feel even cooler. Many weather reports now list the chill factor along with temperatures when the weather is cold.

Moving air evaporates moisture from your skin, causing a feeling of coolness. For your next activity, you will conduct an experiment with moving air to better understand this process.
ACTIVITY  COOLING WITH MOVING AIR

Your challenge:
To learn about the cooling effects of moving air.

You will need:
A thermometer, a sock, and an electric fan.

What to do:
1. Wrap a damp sock around the base of a thermometer.
2. Read the thermometer. Write down the temperature.
3. Place the thermometer, still wrapped in the damp sock, directly in front of an electric fan which is operating.
4. Read the temperature on the thermometer again. Write it down.

Are there differences in the temperatures? 

Why do you think this happened?

5. Place your foot in a damp sock. How does it feel?
6. Put your foot, in the damp sock, directly in front of the blowing fan. How does it feel?

Does it feel cooler? Why?

7. Remove the sock and dry your foot. Now put your foot in front of the fan. Does it feel cooler with the fan blowing on it?

On warm days do you feel cooler if there is a breeze?

Why?

You can use the principle of moving air to help keep you comfortable. That is the reason you use an electric fan or a paddle fan to keep your home cool in warm weather. When days are warm and there is a breeze, a home is much cooler with the windows open. If windows can be opened across the room from each other, this increases the coolness.

ACTIVITY  MAKING A DRAFT DETECTOR

Your challenge:
Find air leaks around the windows and doors in your home.

You will need:
A ruler, a new pencil, tape, plastic wrap, and scissors.

What to do:
1. Make a draft detector by cutting a piece of plastic wrap 6 inches by 10 inches. Tape it to the edge of the pencil. Blow on it to see how it moves.
2. Hold the draft detector near the edges of closed doors and windows. Look for movement indicating drafts.

3. If drafts are located, discuss ways of fixing them with your parents. Cold air blowing into your home will waste heating energy.

Did you find drafts?
Your Project Report

You have learned that sunshine and wind generate energy which can be helpful if used wisely or wasteful if used incorrectly. You have learned how to use these energy sources to reduce demands for fossil fuels. As a member of 4-H, you can also teach others about energy conservation. You can share your knowledge and experiences with your family and friends. You can also give demonstrations and participate in judging events.

Briefly describe how this project has helped you to save nonrenewable energy through the use of renewable energy such as wind and sunshine.

What is the most helpful thing that you have learned from this project?