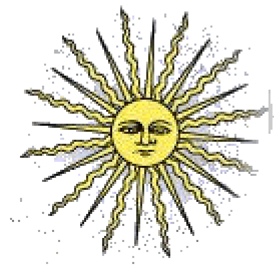
The Energy Story



When we hang our laundry outside to dry in the sun, we are using the sun's heat to do work—drying out clothes.

The sun has always been an energy source.

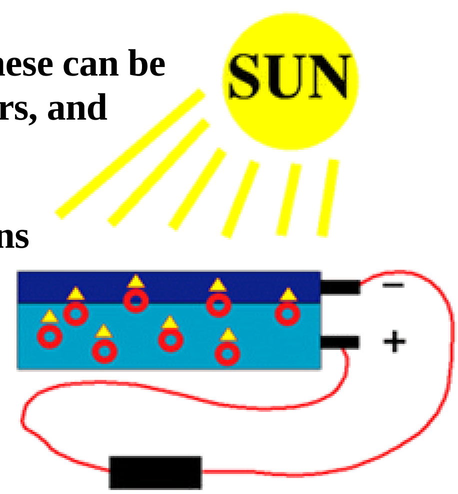
Plants use the sun's light to make food. Animals eat plants for food.

Decaying plants and animals millions of years ago produced the coal, oil, and natural gas that we use today. So, fossil fuels actually got their start as sunlight millions of years ago.

Solar energy can be used to make heat and electricity. In the 1830s, the British Astronomer John Herschel used a solar collector box to cook food during an expedition to Africa. (Some lunchbox!!!). Now people are trying to use the sun's energy to replace fossil fuels such as oil.

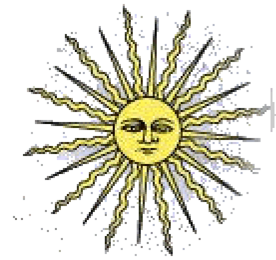
Electric companies are also trying the sun to produce electricity . This is done by capturing energy from sunlight. We can change the sunlight directly to electricity using solar cells.

Solar cells are also called photovolatic cells. These can be found on many small appliances , like calculators, and even the spacecraft.



When the sunlight strikes the solar cell, electrons (red circles) are knocked loose. They move toward the treated surface (dark blue color). An electron imbalance is created between the front and back. When the two surfaces are joined by a connector, like a wire, a current of electricity occurs between the positive and negative sides

Energy Education Lesson Plans



Solar and Photovoltaic Historical Background (5-8 grades)

While the various solar energy technologies in use today were developed primarily within the last 100 years, the use of the sun to provide energy for human needs actually dates back several centuries. As long ago as 100 A.D., people around the world recognized the usefulness of the sun for such diverse purposes as heating homes and setting fire to enemy ships.

The Swiss scientist Horace de Saussure is credited with inventing the world's first solar collector or "solar hot box" in 1767, and the French scientist Augustin Mouchot patented his solar engine in 1861. At that time, the primary uses of solar technologies ranged from cooking food and distilling water to pumping water for irrigation.

In the early 1880s, American engineer John Ericsson launched the solar energy industry in the United States. Ericsson developed several solar-driven engines to power steam generators for ships. But the man considered to be the father of solar energy in the United States was Clarence Kemp, who patented the first solar water heater in 1891. His invention was marketed in California, where in 1897 it became popular enough to heat the water of 30 percent of the houses in Pasadena.

In 1908, William J. Bailey of the Carnegie Steel Company invented the solar collectors that were to become the predecessors of those popularly used today. By the end of World War I, more than 4,000 rooftop solar water heaters had been sold, and more than 60,000 were in place by 1941. By the late 1940s, the demand for "solar homes" became so great that a large number of housing developments across the United States were built with both active and passive solar applications.

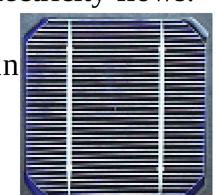
In 1954, Bell Telephone researchers discovered the sensitivity of a properly prepared silicon wafer to sunlight, and the "solar cell" was developed. Beginning in the late 1950s, photovoltaic cells were used to power U.S. space satellites, and they continue to be the prime power source for both manned and unmanned space projects today. The success of photovoltaics in space also spawned commercial applications for the technology that continue to be used and developed today.

The oil embargoes of 1973 and 1979, and the accompanying severe increases in the price of petroleum, created a new climate for the development of all renewable energy technologies, especially solar technologies. President Jimmy Carter stressed the importance of solar energy in reducing U.S. dependence on foreign oil, and he did everything from installing solar panels on the White House to promoting a wide range of incentives for solar energy systems to stimulate their use. By the early 1980s, the U.S. solar industry had grown to more than 100 national solar manufacturers and component suppliers producing solar water heating, solar thermal-electric, and photovoltaic equipment.

Photovoltaic Energy (5-8)

Photovoltaic energy is the conversion of sunlight into electricity through a photovoltaic (pv) cell, commonly called a solar cell. A pv cell is a solid state device (nonmechanical), usually made from silicon alloys.

Sunlight is composed of photons, or particles of solar energy. These photons contain various amounts of energy corresponding to the different wavelengths of the solar spectrum. When photons strike a pv cell, they may be reflected, pass right through, or be absorbed. Only the absorbed photons provide energy to generate electricity. When enough sunlight (energy) is absorbed by the material (a semiconductor) electrons are dislodged from the material's atoms. Special treatment of the material surface during manufacturing makes the front surface of the cell more receptive to free electrons, so the electrons naturally migrate to the surface. When the electron leaves its position it causes a hole to be formed. When many electrons, each carrying a negative charge, travel toward the front surface of the cell, the resulting imbalance of charge between the cell's front and back surfaces create a voltage potential like the negative and positive terminals of a battery. When the two surfaces are connected through an external load electricity flows.



The pv cell is the basic building block of a pv system. Individual cells can vary in size from about 1 cm (1/2 inch) to about 10 cm (4 inches) across. However, one cell only produces 1 or 2 watts, which isn't enough power for most applications. To increase power output cells are electricity connected into a packaged weather-tight module. Modules can be further connected to form an array. The term array refers to the entire generating plant, whether it is made up of one or several thousand modules. As many modules as needed can be connected to form the array size (power output) needed. The performance of a pv array is dependent upon sunlight. Climate conditions (e.g., clouds, fog) have a significant effect on the amount of solar energy received by a pv array and, in turn its performance. Most "current technology" pv modules are about 10 percent efficient in converting sunlight to electricity with further research being conducted to raise this efficiency to 15 percent.

The pv cell was discovered in 1954 by Bell Telephone researchers examining the sensitivity of a properly prepared silicon wafer to sunlight. Beginning in the late 1950s, pvs were used to power U.S. space satellites. The success of pvs in space generated commercial applications for pv technology. The simplest pv systems power many of the small calculators and wrist watches used everyday. More complicated systems provide electricity for pumping water, power communications equipment, and even provide electricity to our homes.

Photovoltaic conversion is useful for several reasons. Conversion from sunlight to electricity is direct, so that bulky mechanical generator systems are unnecessary. The modular characteristic of photovoltaic energy allows arrays to be installed quickly and in any size required or allowed. Also, the environmental impact of a pv system is minimal, requiring no water for system cooling and having no generation by-products. Photovoltaic cells, like batteries, generate direct current (DC) that is generally used for small loads (electronic equipment). When DC from photovoltaic cells is used for commercial applications or sold to electric utilities using the electric grid, it must be converted to alternating current (AC) using inverters, solid state devices that convert DC power to AC. Historically, pvs have been used at remote sites to provide electricity. However, a market for distributed generation that could be provided from pvs may be developing with the unbundling of transmission and distribution costs due to electric deregulation. The siting of numerous small-scale generators in electric distribution feeders could improve the economics and reliability of the distribution system.

Photovoltaics (3-5)

........................more commonly known as solar electricity

In 1839, Edmund Becquerel noticed that the sunlight absorbed by certain materials can produce, in addition to heat, small quantities of electricity. This curious phenomenon was limited to measuring light levels in photography until the 1950s. Then, improved purification techniques, advances in solid-state devices, and the needs of the emerging space program led to the development of photovoltaic cells.

Photovoltaic cells convert sunlight directly into electricity. When sunlight strikes a usually made of silicon that's been chemically treated, an electron is dislodged. (Silicon is the same stuff as sand at the beach and is found all over the world.) These loose electrons are gathered by wires attached to the cell, forming an electrical current. The more cells added, the higher the current and voltage. A number of PV cells laid side-by-side form a rectangular "module"; several modules together form an "array."

Most commonly known as "solar cells," PV systems are already an important part of our lives. The simplest systems power many of the small calculators and wrist watches in use every day. More complicated systems provide electricity for pumping water, powering communications equipment, and even lighting homes and running appliances. In a surprising number of cases, PV power is the cheapest form of electricity for performing these tasks.

Solar electricity is being used in schools around the country not only to generate electricity but to educate students in alternative forms of energy production and possibly guide the next generation to careers in the energy field.

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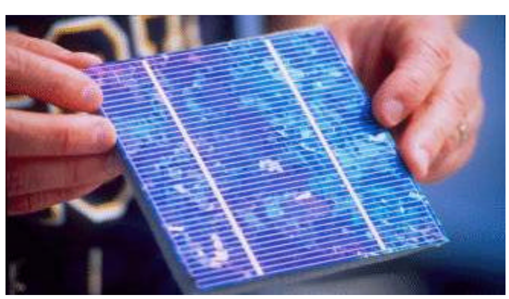

LITTER DETECTIVES
K-12

OBJECTIVES: The students will develop a positive attitude against littering. Students will develop solutions to help reduce littering.

RESOURCES: Chalkboard, litter collection bags, a map of the school building and grounds.

PROCEDURE:

1. Ask the class what "littering" is. Ask the class whether any of the members have littered. What was littered? Why? Do the students know of any areas in or around the school where litter can be found?

2. Divide the class into small groups. Using student suggestions, select a destination for each group to search for litter. The locations can be indoors or outdoors and must be as specific as possible. Identify the locations on the map. The goal of the exercise is to collect and analyze <u>all</u> litter located within the selected area. Allow 15 - 30 minutes for the litter collection.

3. After the litter collection, have each group examine the collected litter materials. Each group should categorize the litter and determine the most frequent litter components. Record the data on the chalkboard. Have each group relate its experience to the class. Each group should identify its litter search area on the map.

4. After the group presentations, discuss:

- Can any of the littered items be recycled or used in some other way?
- By examining the types of litter, can it be determined which age group may be most responsible for the problem?
- Does the school or community have rules or laws against littering? If so, are the rules or laws enforced? What penalties are involved?
- How is litter managed at your - Which locations yielded the most litter and why?
- school?
- Does the school provide refuse containers near the litter locations?
- How can the amount of littering be reduced?

5. As a follow-up activity, repeat the exercise after a week or month has passed and compare the findings.

Materials that Absorb Solar Energy

CONCEPTS

- Solar energy is the energy given off by the sun

FACTS

- Solar energy is often called "radiant energy"
- Solar energy is produced by nuclear fusion reactions on the sun
- Solar energy does not pollute

PRINCIPLES

- Some materials reflect solar energy
- Some materials absorb solar energy

SKILLS

- Making predictions
- Following directions
- Understanding cause-and-effect relationships
- Drawing conclusions

MATERIALS

Each experiment requires:

1. Shoebox deep enough to hold cans
2. Four (4) soup or other cans
3. Four (4) thermometers
4. Water
5. Salt
6. Sand or soil
7. Shredded paper
8. Masking tape, marker
9. Black paint
10. Paint brushes
11. Handout

ROOM PREPARATION

Elbow room and a place near a window to place black boxes.

SAFETY PRECAUTIONS

Handle thermometers with care.

PROCEDURES AND ACTIVITIES

INTRODUCTION

1. What is solar energy? Why should we try to tap and use solar energy? Discuss and find that energy from the sun is great because it does not pollute. Share the fact that most energy we use is fossil-related and costs a lot to harvest, can destroy the earth during harvesting, and is limited or exhaustible. Solar energy is limited only by cloud cover and the earth's rotation.
2. Today, we will begin an experiment to see what materials store and absorb sunlight. Why is this information useful? Share ideas on solar applications in our lives—cooking, heating, power for cars, etc.

ACTIVITY

1. Have students get in pairs or small groups.
2. Students paint their shoebox black--inside and out.
3. Students put a strip of masking tape on each can. Label with a marker the contents to be put in each: sand, salt, water, paper.
4. Fill up each can with its own material. Place cans inside the box. Put a thermometer in each can.
5. Put the top on the box. Place box on a windowsill or table in full sunlight for one (1) hour.
6. After one (1) hour, remove box top, take out cans, remove and read thermometer. Document temperature of each material on Handout #1.
7. Put cans back in box, cover, and leave in sunlight.
8. Retake temperatures of each material every ten (10) minutes for one (1) hour. Document temperatures on handout. Review the importance of observing, recording, and documenting findings for scientists.

CLOSING-ORIGINAL QUESTION

Ask again, "What kinds of materials store solar energy?"

EVALUATION

1. Students may orally share or write a simple research report about their experiment, observations and findings.
2. Students may demonstrate their knowledge about solar energy and materials by helping others conduct this experiment and learn about applications.

Solar S'Mores

CONCEPTS:

- Solar energy is the energy given off by the sun.
- When light energy is absorbed by objects it is changed to heat energy.
- Dark-colored objects absorb more light and store more heat from sunlight.

FACTS

- Solar energy is often called radiant energy.
- Solar energy is produced by nuclear fusion reactions within the sun.
- Solar energy does not pollute. Principles: * Dark-colored objects absorb more light and store more heat from sunlight than light-colored objects.
- Light-colored objects appear light to us because they are reflecting most of the light that hits them rather than absorbing it. Objects appear to be black when they absorb all wavelengths of light that hit them.

SKILLS
Making Observations € Making Comparisons Making Inferences
Drawing Conclusions

MATERIALS:
Every two people will need:

1. 4 graham crackers
2. 2. 16 mini marshmallows
3. 3. 2 plain milk chocolate candy bars
4. 4. 8 by 11 inch regular glass baking pan
5. 5. a clear glass lid for the baking pan
6. 6. 1 thermometer

ROOM PREPARATION:
This is an outdoors experiment. Need to have a place in direct sunlight (no shade) and where animals won¹t come by to eat the ingredients or disturb the pan! Use your thermometer to see what temperature it is outside. You need to do this experiment when it is at least 85 F. If it isn¹t hot enough outside, wait for a warmer day.

PROCEDURES AND ACTIVITIES

INTRODUCTION
Share the guiding questions:

1. Can you cook food outdoors?
2. What makes food cook or things melt outside?
3. How can and do we use the sun¹s energy to help us in our lives? Welcome a discussion about cooking outside. Think about how we melt marshmallows over a bonfire, heat up the inside of a hot dog on a stick over a fire, sear and cook the

inside of a hamburger on a grill. Then think about what makes the melting, warming and cooking happen- heat.

4. Talk about what happens when we are in sunlight and how the heat from the sun can be used for cooking, melting and warming food. May also share ideas and experiences with solar cooking, solar heating, and solar powered cars.

ACTIVITY

1. Put four graham crackers side by side in the bottom of the glass baking pan.
2. Place a chocolate bar on top of two of the graham crackers.
3. Put 8 mini marshmallows on top of the other two graham crackers.
4. Cover the baking pan with the clear glass lid.
5. Put the pan out in an area where it will get full sunlight....no shade!
6. Let the pan just sit there until the chocolate bars and marshmallows melt. To make a S'More, put one chocolate and one marshmallow graham cracker together to make a sandwich. You should have two sandwiches. Enjoy!

CLOSING-ORIGINAL QUESTION

Were we able to make S'Mores using sun energy instead of a bonfire? Talk about what really happened. Review how the sun gives off radiant energy. Share ideas about the ways in which objects absorb light energy and it is changed into heat energy. Talk about dark colors and objects and how they absorb and store more heat.

MORE IDEAS

1. Another Experiment and Option. You might repeat this experiment but this time try lining the glass baking pan with tin foil and black construction paper. See if the marshmallows and chocolate ingredients melt faster than they did in the plain glass pan. If our hunch is right, and dark paper absorbs more sunlight and heat. So, we should find out the S'Mores melt faster than in the plain glass pan.
2. Or try putting the two halves of the S'More sandwiches together before you put the dish out in the sun. See what happens. Does it take longer for the marshmallows and chocolate to melt? Why? It may be that the top graham cracker is sort of like a roof of a house. It shades the chocolate and marshmallow inside. This means that it will take longer for things to melt because the top graham cracker is absorbing much of the sun's heat.
3. Have you noticed how different the temperature can be on a hot day when you are standing right out in the direct sun instead of standing under the shade of a tree or awning? People who have houses that are under lots of shady trees will find that their homes stay cooler on hot days than those sitting out in the direct sun. Farmers are careful to be sure that their animals have shady areas

available, too, on hot summer days. Can you think of other times when we use what we know about the sun and shade to help us out

A Solar Heat Experiment

GUIDING QUESTIONS

1. Which colors absorb the most light and heat from the sun?
2. Is there a relationship between the color and the temperature of objects exposed to sunlight?

CONCEPTS:

- Solar energy is the energy given off by the sun.
- When light energy is absorbed by objects it is changed to heat energy.
- Dark-colored objects absorb more light and store more heat from sunlight.

FACTS:

- Solar energy is often called "radiant energy."
- Solar energy is produced by nuclear fusion reactions within the sun.
- Solar energy does not pollute.

PRINCIPLES:

- Dark-colored objects absorb more light and store more heat from sunlight than light-colored objects.
- Solar panels are usually painted black so that they will capture the most heat from the sun.
- Light-colored objects appear light to us because they are reflecting most of the light that hits them rather than absorbing it. Objects appear to be black when they absorb all wavelengths of light that hit them.

SKILLS

- Making Observations
- Making Comparisons
- Communicating Findings
- Making Inferences
- Drawing Conclusions

MATERIALS

- Tin cans (such as soup cans) of the same size per group
- Flat (not shiny) blue, yellow, white and black paint
- Paint brushes
- Newspaper
- Plastic wrap
- Thermometers

- Water
- Handout for recording data

ROOM PREPARATION

Painting can be messy. Put newspaper on the tabletops and/or the floor to catch any spills.

SAFETY PRECAUTIONS

Avoid getting paint in eyes.

PROCEDURES AND ACTIVITIES

INTRODUCTION

Share the guiding questions

- Which colors absorb the most light and heat from the sun?
- Is there a relationship between the color and the temperature of objects exposed to sunlight?

PRELAB DISCUSSION

Talk about solar energy and why we are trying to use it today for heating water and houses, and for powering cars and outdoor lighting. Bring out the point that solar energy is inexhaustible because it comes from the sun. The other fuels we use come from sources such as fossils and trees that can be used up.

Think about what solar panels look like. They are typically painted black underneath a clear glass or plastic cover. Why? Today's experiment will help us figure out why by illustrating the relationship between different colors and the ability to absorb and store solar energy.

ACTIVITY

1 Have students get into pairs or small groups.
2 Put newspaper on tabletop and underneath on the floor to catch any paint spills.
3 Give each pair or group 4 tin cans. Have them paint the inside of each can with a different color: white, yellow, blue and black.
4 Let the cans thoroughly dry.
5 Fill each can with the same amount of water.
6 Cover each can with a piece of plastic wrap. You may need to put a rubber band around the lip of the cans to hold your plastic wrap on.
7 Put the cans on a windowsill or tabletop where they will get lots of sunlight.
8 Shake down your thermometer to room temperature and then, every 30 minutes, take the temperature of the water in each of the cans—being careful to shake the thermometer down again between cans. (Alternatively, you could keep a can of water cool in the shade and put the thermometer into it to quickly return the temperature recorded to room temperature.) Record the temperatures of each can on your handout.

Note: this sort of observing, collecting and recording of data is very important for scientists.

9 Take the temperatures of the water in the cans every half hour for 3 hours

CLOSING-ORIGINAL QUESTION

Ask again:

- Is there a relationship between the color and the temperature of objects exposed to sunlight?
- Which colors absorb the most light and heat from the sun?

EVALUATION

1. Looking at data on charts, which can of water got the warmest?
2. Which can of water kept relatively cool?
3. What do you think the relationship is between color and heat absorption?
4. What is there about the color black that makes it absorb and store energy so well?
5. Can you relate what you know about colors and temperatures to everyday kinds of situations? For example, why do people recommend we wear light colors in the summer and dark colors during the winter? In hot places like Arizona, people use light colors of paint and materials on the exterior of their houses, why?

The Pizza Box Solar Oven

YOU WILL NEED:

- A medium size pizza box (Pizza Hut boxes work great)
- Black construction paper
- Extra-wide aluminum foil
- Plastic (plastic window covering from a hardware store works best)
- Glue
- Tape
- Scissors
- Ruler
- Magic marker
- String

PROCEDURE:

1. Tape foil to the inside bottom of the box.
   Cover the foil with black paper.
   Tape in place.
2. Put the box on the plastic.
   Draw the outline of the box on the plastic with the marker.
   Cut the plastic about 1/4 inch inside the marks.
3. On the top of the box, draw a line one inch from all sides.
   Cut along front and side lines **BUT NOT** along the back.
   This will be the hinge for the flap.
   Carefully fold open the flap.
4. Cut a piece of foil the size of the flap.
   Glue it to the side of the flap that faces **INTO** the box.
   Flatten out all the winkles.
   Wipe glue smears off with a damp towel before they dry.
5. Tape the plastic to the inside of the box.
   Tape one side first, then the opposite side.
   Make it tight so it looks like glass.
   Tape the other edges.
   Seal tight so no air can get in.
6. Cut a piece of string as long as the box.
   Tape one end to the top of the flap.
   Push a small nail into the back of the box so you have a place to tie the string.
7. Give it a try ... (English muffin pizzas, melting rate of chocolate "s-mores," etc....)
8. Can you improve your oven? (add insulation, add reflectors, etc...)
9. What else can you cook?

Using Solar Energy:
The Solar Apple Baker

GUIDING QUESTION
How can we harness the sun's energy to bake food?

CONCEPTS:
- Solar energy is the energy given off by the sun.
- Solar energy can be harnessed and used for many different things.

PRINCIPLES:
- Baking is the process of cooking and drying.
- Baking or cooking food involves a process of adding energy to it.
- Food changes in texture, size and taste when it is baked or cooked.

FACTS:
- Solar energy is often called radiant energy.
- Solar energy is produced by nuclear fusion reactions on the sun.
- Solar energy does not pollute.

SKILLS:
- Following Directions
- Cause and Effect Relationships
- Making Inferences

MATERIALS:
Each student will need:
- Two paper cups - 1 large, one smaller
- 12" X 18" black paper
- Aluminum foil
- Tape
- Food Wrap
- Newspaper
- Scissors
- Pre-cut Apple Slices or
- Apples and Knife or Apple Slicer
- Handout

ROOM PREPARATION:

Students need table space and elbow room to construct their apple bakers.

SAFETY PRECAUTIONS

Use care when handling scissors, knives or apple slicers.

PROCEDURES AND ACTIVITIES

INTRODUCTION

1. What is solar energy?
   Lead discussion to identify solar energy as trapping and utilizing the sun's power for practical purposes.
2. What are some different ways to use solar energy?
   Identify heating homes, heating water, power for solar cars, and electricity.
3. Today, we will build a solar apple baker to bake apple slices.

ACTIVITY

1. Pass out handout with illustration and directions for solar apple bakers.
2. Students construct their own solar apple baker, slice apples, and wrap and place slices in apple bakers.
3. Have students put bakers in a spot with lots of sunlight exposure.
4. Students observe, smell, and taste apple slices daily. They may take out apple slices whenever they are cooked to suit them.

CLOSING-ORIGINAL QUESTION

Ask again,
"How can we harness the sun's energy to bake food?"

EVALUATION

Let students share how they made their solar apple bakers, how the bakers harnessed solar energy, and how solar energy baked their apples. Listen to see evidence that they understand concept of solar energy and the principles of baking with their bakers. Students may illustrate and demonstrate making a solar apple baker with other students.

EXTENSION IDEAS

1. Try baking other fruit slices.
2. Try using red instead of black paper for the cone. In which color cone did the apple slices bake faster? Why? Which apple baker got hotter? Why?

What Stores Solar Energy Best?

MATERIALS:

- 1 cardboard box
- black paint
- 1 small metal containers
- 4 thermometers
- sand
- table salt
- water
- shredded paper

GETTING STARTED

Talk about the reasons and methods for keeping a home warm in winter and cool in summer as examples of energy storage. Introduce the concepts of materials that may help to cool or warm a home. Now generalize the concept that all materials can be categorized as to how they store energy or keep heat from leaking.

BEGIN YOUR EXPERIMENT

1. Paint the cardboard box black
2. Place the cans into the box
3. Fill one can with sand, one can with salt, one can with water and one can with shredded paper
4. Insert a thermometer in each can
5. Close the lids of the box and place in the sun for half an hour
6. Remove the cans and observe the temperature of each can
7. Stir the contents of each can occasionally and watch to see which temperature falls the slowest? The fastest? Which material stores the sun's heat best?

Alternative Energy Sources

SUMMARY
Parabolic Solar Collectors collect the light rays of the sun. The light rays reflect off the sides equal to the angle they came in at (the angle of reflection). Because the shape of the collector is parabolic, the light rays come together at a point above the collector. This point is called the hot spot. The location of the hot spot varies based on the location of the sun, but it can be located by moving your hand around the perimeter and across the inside of the solar cooker until you find the hottest area and then raise your hand slowly until you reach the hot spot. This is usually quite hot.

MATERIALS
1. Parabolic Solar Collectors (4-5 students can use one simultaneously)-an old umbrella lined with silver mylar works quite well.
2. Kraft flavored marshmallows (these come in different colors and are important in the assessment of knowledge).
3. Uncooked spaghetti noodles (as thick as possible) These are used as skewers. The kids eat them after they roast their marshmallows (no trash).

PROCEDURES
1. A clear, sunny day is a necessity for this activity. (It need not be a hot day but it must be sunny).
2. Around 11 a.m, place the cookers in an area where no shadows will be cast on them This will allow the cookers to heat up prior to use.
3. Review the angle of reflection concept with the students.
4. Explain the method of determining the hot spot on the cookers.
5. Place your hand about six inches above the rim of the cooker. With your eyes closed, slowly rotate your hand around the perimeter of the cooker. When you find the spot that is hottest, slowly raise your hand until the heat comes to a localized point. The hot spot is where you want to hold your marshmallow. (This also can be determined by using a piece of paper. Place the paper over the hottest area until the light comes to a point on the paper. I prefer having the children feel the heat however.)
6. Have the children choose the marshmallow they would like to roast and allow them to skewer them using the spaghetti noodles.

TIME TO COOK
1. Carefully listen to the children's observations related to the various cooking time of the different colors. Allow plenty of time to discover why some get finished before others. (White will never roast. Chocolate gets finished fastest, and the others vary based on how light the color is.)
2. Hold a classroom discussion based on the results. If you wanted to design a solar collector what color would you want it to be? Why?
3. At this point the children design different types of collectors that will hold water. These are placed outside in the sun (on a clear day) and tested at 15-minute intervals to determine which heat the fastest.

Solar Energy Experiment

GRADE LEVEL: 3-8
SUBJECT: Science

OBJECTIVES:

Students will recognize that light colors are less heat absorbent than dark ones.
Students will know that the sun is a source of energy.

PURPOSE:

The purpose of the following experiment is to demonstrate that energy from the sun can be collected and stored in many ways.

ACTIVITIES AND PROCEDURES:

GENERAL INFORMATION:
Our sun is an average sized star and it has been burning for about 4.5 billion years. Few people think of the sun as a nuclear furnace and fewer realize this is a source of nuclear energy that does not pollute. About four million tons of the sun's matter turns into energy every second and only one-billionth of the sun's light ever strikes the Earth.

At the equator the Earth receives about one kilowatt per square meter of solar energy. A kilowatt is 1000 watts or the amount of energy needed to light 10 one-hundred watt bulbs. If man could make full use of solar energy, almost every house in the world could be energy independent. Only a few households would have to be dependent on the electric company and this would reduce the pollution problem greatly. The consumption of gas, oil, or coal would be reduced and this would also help reduce the level of pollution. The automobile could be powered by the sunlight during the day and use battery power at night. This would also reduce pollution and help prevent global warming. Turning solar energy directly into electricity today is not very efficient; however, solar energy can be best collected as heat. The following experiment will teach young people how to collect and store the sun's energy in the form for heat.

The teacher will notice the experiment demonstrates a method to collect and store solar energy and has been designed for grade one through six. It is possible for young students to expand the concepts of these experiments into local science fair projects.

The Black and White Bottle Experiment

The experiment is performed with the two plastic bottles. The teacher will note one bottle is painted black and the other is painted white. Place the open end of one small balloon on the mouth of the white bottle and do the same for the black bottle. Make sure the balloon forms an air tight seal. Now place both bottles in bright sunlight.

Within a few minutes, the students will notice the balloon on the black bottle will start to expand. The balloon of the white bottle will remain limp. Have a student touch the black bottle to notice that it is warm. Then have the same student touch the white bottle to notice that it is much cooler than the black bottle.

QUESTIONS:
1. Why do you think the balloon on the black bottle expanded?
2. Does heat make air expand?
3. Does a black object get warmer in the sunlight than a white object?
4. What would be a good color to paint your car if you wanted to stay cool in the summer?

EXPLANATION:
The black bottle will absorb the sun's energy much better. The white bottle reflects away most of the sun's energy. As the bottle absorbs energy, the air inside the bottle warms up and expands making the balloon full with air.

MATERIALS:

one plastic bottle painted white, one plastic bottle painted black, several small balloons

Solar Hot Box

OVERVIEW:
This lesson is designed to explore different aspects of solar energy. The students have already been exposed to various forms of alternate energy sources and the reasons for their use. The students will build a solar hot box in order to test various colors and materials to find the maximum temperature that can be reached.

PURPOSE:
The purpose of this lesson is to demonstrate to students through discovery that different colors and materials create various temperatures.

OBJECTIVES:
- The student will review the basic needs for alternative energy sources.
- The students will be able to identify at least three different materials that will produce maximum heat.
- The students will be able to identify at least three different colors that will produce maximum heat.
- The students will be able to solve a design problem for a solar hot box.

CONTENT SEQUENCE:
- Teach basic alternative energy sources.
- Teach heat conductive and repelling materials.
- Teach heat conductive and repelling colors.
- Experiment with materials and colors for maximum heat.
- Teach designs for a solar hot box.

RESOURCES/MATERIAL:
- Shoe boxes
- different colored construction paper
- Cellophane different colors
- aluminum foil
- thermometers
- large sheet of paper

ACTIVITIES AND PROCEDURE:
This lesson will begin with a review of what alternate energy sources are. Each student will be required to brain storm as many energy sources as they can in a set time limit. At the end of the time limit the students will discuss which of the energy sources are used every day and which ones are alternative sources. Ask the students to discover for themselves why we consider some energy sources alternate and some not.
Explain to the students that today they will experiment with solar heating to decide if all energy needs in the U.S. can be met by solar energy.

TEACHING PROCEDURE:

1. Experiment with colors to determine which colors will absorb or reflect heat. Use colored cellophane when they build their boxes.
2. Experiment with materials to determine which materials will absorb or reflect heat. Use shoe boxes, foil, construction paper for the materials.
3. Define what a solar hot box is.
4. Define what a solar collector is.
5. Explain that a solar hot box differs from a solar collector only in the respect that the solar heat is collected and contained in the box is not purposely transferred. The heat from a solar collector is usually transferred from the collector by a heated air or water medium to another location.
6. Students will build their own hot box using the colors and materials they choose. Students can work in pairs or alone to build their box and conduct the experiment.
7. Explain that each hot box groups will go outside and complete a temperature experiment to determine the maximum temperature it will reach.
8. Have each group set their experiment up with a thermometer on the inside.
9. At one minute intervals have each group record the temperature of the hot box. Do this for ten (10) minutes.
10. Bring the results into the classroom and record the temperatures for each group on the board.
11. Ask the students which hot box achieved the highest temperature the fastest.

CLOSURE:

When the students have decided which box worked the best and which one didn't work ask them to brain storm conditions outside that would help or hinder the solar heating process. Make a list on a large sheet of paper and hang it the room.

EVALUATION:

For the next day ask the students to compose a paragraph addressing why solar energy might not be the answer to all the energy needs of the U.S.

Be "Sun"-sible About Heating Water

OBJECTIVES:
The student will do the following:
- Construct a simple solar water heater.
- Investigate color and heat.
- Investigate insulation and heat.

SUBJECT:
Science, Math

TIME:
120 minutes

MATERIALS:
- juice cans
- paint (white, black, green, red)
- very hot water
- food colors
- ice cubes
- thermometers
- construction paper (white, black, green, red, blue)
- watch
- quart jars
- cardboard boxes
- newspaper
- glue or rubber cement
- aluminum foil
- razor knife
- clear plastic wrap
- Towel
- duct tape
- tape
- 1-qt. Can
- flat black spray paint
- student sheets (included)

BACKGROUND INFORMATION
Heating water for use in the home is a major contributor to the home energy bill. One way to reduce energy use by the heater is to turn its thermostat back; settings of 120 to 140 degrees will save energy and still provide water hot enough for all the various purposes for which it is used. Another way to reduce energy consumption by the home water heater is to use less hot water. Cold or warm water performs satisfactorily for

typical laundry loads. One can take shorter showers or shallower baths. Repairing dripping hot water faucets can save a surprising amount of hot water.

Using the sun's energy is another way to reduce the hot water energy bill. The sun's energy is free, so the cost of solar heated water is less than that of conventionally heated water. Home solar water heaters usually consist of a solar collector, pipes through which water circulates from the collector to the water heater, and a highly efficient water heater similar to a conventional one. The collector, often mounted on the roof, is a dark-colored, glass-faced box in which the sun's heat is trapped. This trapped energy heats the water being pumped through the systems pipes, which pass through the collector. The heated water returns to the water heater, where it is perhaps heated further and is stored for use. The entire system is well insulated, so as to avoid losing heat. Solar water heaters can help lower the high cost of heating water.

Terms

Insulation: material that hinders the flow of heat energy.
solar collector: any device used to trap the sun's energy and change it into heat energy.

PROCEDURE

I. Setting the stage
- A. Have the students consider the energy used to heat Water for home use. Give each student a copy of the student sheet "JONES FAMILY ELECTRICITY USE" (included). Have the students examine the graph, and discuss with them the questions on the sheet.
- B. Share with the class the related information from the background information furnished.

II. Activity
- A. Have the students investigate color and heat.
    - 1. Have the students do the activity on the student sheet "WHICH COLOR HOLDS HEAT LONGEST?" (included).
        - a. Help the students make graphs and record data as they follow the instructions on the student sheet.
        - b. Discuss the results with the students.
    - 2. Have the students investigate color and the time required for ice to melt. (Do this yourself as a demonstration or have groups of students do it.)
        - a. Have squares of construction paper in the following colors—white, black, green, red, and blue. Place an ice cube on each square of colored paper.
        - b. Time how long it takes for each ice cube to melt.
        - c. Discuss with the students the results of the investigation.
- B. Have the students investigate insulation and solar water heating.
    - 1. Divide the students into groups of three or four each. Give each group a copy of the student sheet "INSULATION REALLY WORKS" (included), and have the groups complete the activity as instructed.
    - 2. Review the definition of the term "insulation" and relate it to water heating and storage.
- C. Have the students build model solar water heaters.
    - 1. Divide the students into groups of three or four each.

2. Distribute the student sheet "HOW TO MAKE A SOLAR WATER HEATER MODEL" (included) to each group and provide the materials they need.
3. Have them build the model solar water heater models according to the instructions on the sheet.
4. Have the students experiment with different colors or kinds of containers for the water.

III. Follow-up

A. Ask the students the following questions:
1. What are some ways energy is used in the home? (heating, water, air conditioning, appliances, and so on.)
2. What are some ways to reduce the amount of energy used to heat water? (turn water heater thermostat down; use less hot water; repair dripping hot water faucets)

B. Have the students complete the following:
1. Define solar energy.
2. Define insulation.
3. Describe how a solar water heater model works.

C. Ask the students the following questions:
1. How can we use the sun's energy to heat our homes and water? (Heat from the sun can be gathered by solar collectors and stored until needed.)
2. Which reach a higher temperature more quickly when placed in direct sunlight—light-colored or dark-colored objects? (dark)
3. How does a solar collector work? (A solar collector is a box-like device with a glass (or similar material) face and a black interior. It traps and absorbs the energy of the sun's rays. Water piped through the collector is heated and sent to a storage device.)

IV. Extension

A. Have interested students make posters or a bulletin board of warm and cool fabrics.

B. Have the students write to the U S. Department of Energy's Assistant Secretary for Conservation and Renewable Energy for further information on solar energy (Address: 1000 Independence Avenue, SW, Washington, DC 20585)

C. Invite someone to speak to the class about solar energy.

Garbage Pizza

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OBJECTIVES:

Students will be able to:

1. describe the composition of Municipal Solid Waste (MSW);
2. identify items within each waste category; and
3. visualize the amount of waste and categories of MSW.

METHOD:

Students will construct a garbage pizza (a three-dimensional pie chart) representing all of the waste thrown away in the United States, with a slice for each waste category.

MATERIALS

For pizza dough: mixing bowl, spoon, rolling pin, pizza pan, 2 cups flour, 2 cups salt, 1 cup water, oil or shortening.
For pizza "sauce" and toppings: school glue, red food coloring, small paint brush, waste items from these categories: paper, yard waste, wood, metals, glass, food waste, plastics, and other waste (e.g.. rubber, leather, textiles. misc. inorganic waste), polyurethane or lacquer (optional)

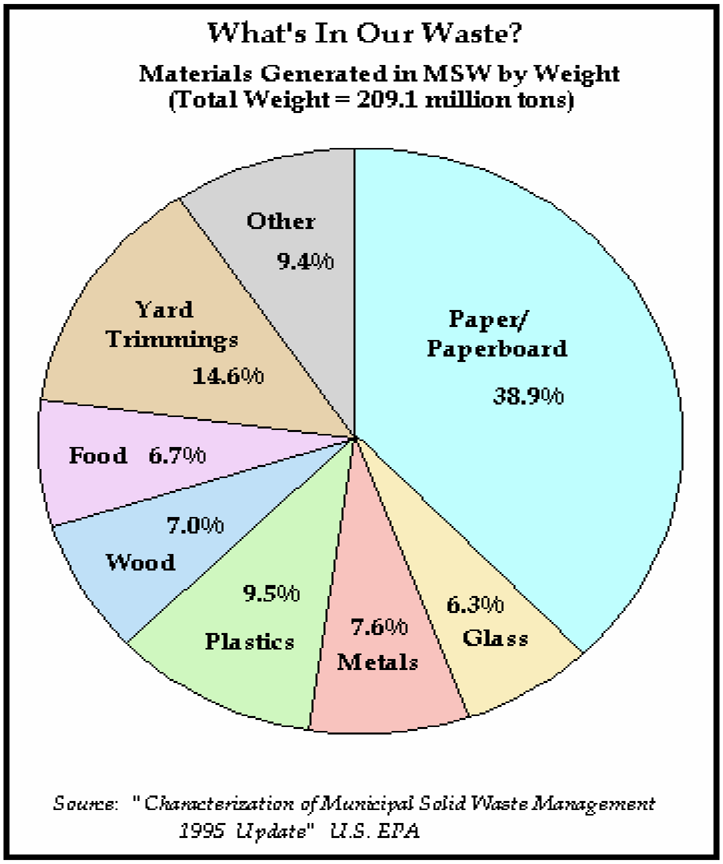
VOCABULARY

garbage, Municipal Solid Waste (MSW), trash, volume, weight

PROCEDURE

1. Before class, have prepared a "Garbage Pizza" crust, using the following recipe: Mix 2 cups of flour, 2 cups salt, and 1 cup water (adjusting water per altitude and/or humidity) until a stiff dough forms. Knead as you would a bread dough. Flatten the dough into a well greased round 12" deep dish pizza pan, pressing the edges up the inside of the pan. Flatten out slightly until it looks like a pizza pie. Cut the pizza into the same slices or sections to look like the Municipal Solid Waste by weight pie chart template included in this lesson. Using a fork or knife, puncture each slice several times before baking to avoid expanding air pockets. Bake at 350º F for 40-45 minutes, or until golden brown. Check the pizza every 10 minutes or so and re-cut the sections. (If you do not cut the pizza before cooking, you will need a chain saw after it is done!) Remove from the oven and let cool completely. Dough should be hard and dry. Mix approximately 4 oz. of white school glue with approximately 2 oz. of red food coloring (adding a drop of blue food coloring will darken the red, but is not necessary for a successful "sauce") until you achieve the desired red tomato sauce look. Apply sauce with a small paint brush (an apron is highly recommended). Allow to dry thoroughly. Label the underside of each slice with the correct type of waste and % it represents. A permanent marker works well. This makes it easier for students to glue the proper waste on the proper slice.

2. Ask the students to define the words GARBAGE and TRASH. Garbage refers to only the organic or food waste thrown away. Trash represents broken, discarded or worthless things (e.g.. rubbish and other forms of refuse which are not food). Brainstorm with students and list on the chalkboard



3. Determine all the waste items thrown away at home or school. Use the following categories: paper, yard waste, metals, glass, plastics, wood, food wastes, and other.
4. Introduce the concept of Municipal Solid Waste (MSW). MSW is made up of trash and garbage from household, commercial, and institutional sources in a community. Ask the class if the items listed on the board would also be found in a community's MSW.
5. Draw a circle on the board. Explain to students that we are going to pretend that all the waste thrown away in the United States will fit into this circle. This circle is filled with waste from all of the categories (paper, yard waste, metals, glass, plastic, wood, food waste, and other waste). Show students how much paper is thrown away by drawing a slice for paper (see chart included in this lesson). Repeat this demonstration for all eight categories. Reinforce the fact that the biggest slice, marked "paper" means that there is more paper than any other item in MSW. The next largest slice is yard waste, etc. Ask the students why it might be important to know the amount and kinds of waste thrown away. By knowing what kinds and amounts of things are in MSW, communities can plan better programs to reduce the amount of waste disposed (e.g., office paper recycling,

telephone book recycling, yard waste composting), and plan better waste handling options (e.g.. waste-to-energy incineration, sanitary landfilling).

6. Announce that the class is going to make a garbage pizza (with garbage and trash). Collect the items you need for the toppings, or have the students bring them from home. For example:
    - paper: newsprint, shredded paper, boxes, wrappers;
    - yard waste: grass, sticks, leaves, potpourri;
    - metals: paper clips, staples, can, small hardware:
    - glass: marbles, sea glass;
    - plastics: foam cup, plastic fork, bread clips, jug lids;
    - wood: tooth picks, building blocks;
    - food wastes: egg shells, pasta, pretzels, dry cereal;
    - other: rubber band, candle

    Show the students the "pie chart" pizza dough. Glue the waste items onto their corresponding pizza slices with uncolored glue or a hot glue gun. For an added touch after the glue has dried, spray the garbage pizza with polyurethane or lacquer, available at your local hardware store.

    Share the garbage pizza model with other classes or the entire school. Have students team-up and teach students in other grades about the MSW using the garbage pizza model.

ASSESSMENT

Set up a table with items from the eight categories of MSW: paper, yard waste, metals, glass, plastics, wood, food wastes, and other. Make signs for each category, and have students separate the waste items into the appropriate piles.

ENRICHMENT

Ask students to look through magazines for pictures of items from each MSW category. Have each student draw a garbage pizza on poster board and glue the pictures on the appropriate sections. Display the posters in the cafeteria.

Plan a classroom project to reduce the amount of paper in MSW. Discuss ways students could reduce paper use and waste at school (e.g.. don't waste paper, use both sides of paper, start a reuse box for all kinds of paper, start a paper recycling program, ask the principal if the school uses recycled paper, etc.).

Recycled Paper

GRADE LEVEL: Grades 2-6

DESCRIPTION:
Recycling is part of our everyday lives and this activity is a great way to show students that we can reuse paper even after it's already been written on.

GOAL:
To familiarize students with recycling paper.

OBJECTIVES:
- To make paper from paper we have already written on.
- To use the recycled paper for an assignment.

MATERIALS:
- Used paper
- blender water
- measuring cup
- 10x12 framed window screen newspaper

PROCEDURE:
- Take the recycled paper and rip it up into little pieces until you have about 2 cups.
- Place the pieces into the blender.
- Add 1cup of water and then blend until smooth.
- Pour mixture onto 10x12 screen while holding over the newspaper or a sink.
- Let dry overnight.
- Then you can write on it.

ASSESSMENT:
- Have the students use their paper to write an assignment on the next day.
- Ask students how this could be useful and explore some of their ideas.

Recycling

GRADE LEVEL: Appropriate for grades 5-8

TIME: 1-hour class period

OVERVIEW:
The current landfill in White County receives 40 tons of waste per day. Over 35% of this material could be recycled. The tipping fee at the landfill is $25 per ton. When the landfill closes in December 1996, all the garbage will have to go to a transfer station, where the fee will increase to $50 per ton.

The purpose of this class is to teach students the economic and ecological importance of recycling.

CONCEPTS:
- How materials break down in the environment
- Materials suitable for recycling
- Gathering and sorting of recyclable materials
- Environmental impact of recycling

OBJECTIVES:
- To help students identify garbage that can be recycled
- To acquaint students with the cost of handling garbage
- To illustrate the relationship between recycling and conservation of natural resources
- To teach students how to recycle

MATERIALS:

1. Posters:
   - Percent of different materials in household trash
   - Recycling symbol
   - Show cost to build a new landfill (this information can be obtained from local officials or from state EPD)
2. Bag of miscellaneous trash for sorting--gloves and aprons should also be provided for the students to ensure their safety while handling the garbage.

3. Pre-test/Post-test
4. Fact sheets (one per student)
5. Recycling containers (various styles)
6. Magnet
7. Markers
8. Poster board

PROCEDURE:

1. Start the activity by defining RECYCLING. Recycling is the collection of recyclable waste materials and the re-manufacture of the collected materials into new products.
2. Pass out fact sheets and discuss some of the information. Use examples to make numbers more dramatic.

FACT SHEET:

- 27 billion glass containers are thrown away each year
- 1 quart of motor oil can contaminate 1 million gallons of water
- Making new paper from recycled paper uses 45% less energy than making paper from trees

(Numerous examples of recycling facts can be found in recycling publications.)

3. Ask students to name some of the benefits of recycling:

-Saves resources
-Saves energy
-Reduces pollution
-Saves money

4.Use a bag of trash to show students some of the items we typically throw away. Dump this out on the (covered) floor.

5.Use a chart to illustrate the percentage of materials in household trash:

-40% paper
-10% metal
-8% glass
-8% plastic
-7% food scraps
-9% other

(These figures change from year to year, so check with the state EPD for current figures.)

6.Ask students where their trash goes. Use this opportunity to give facts about the current landfill. Provide information as to when the current landfill will close, and the cost of constructing a new landfill (total cost divided by total population). Tell students that recycling will reduce the amount of solid waste going to the landfill and thereby save everyone money. (Current figures can be obtained from local officials or the state EPD.)

7.Ask students to sort trash into appropriate piles; for example, paper, plastic, glass, metal, etc.

8.Present information about the different types of items in each pile; for example (paper)-newspaper, office paper, cardboard, etc. -Allow students to use a magnet to demonstrate how to separate aluminum cans from steel cans.

9.Select one or two examples of recyclables and give examples of new products that can be made from each. Use this opportunity to teach students the symbol that indicates a recycled product. Encourage them to buy recycled products when possible; show some examples.

10.Select one example (newspaper) and discuss how much raw material is needed to produce the Sunday newspaper (500,000 trees).
Show students that if recycled paper were used, these trees could be saved.

11.Inform the students that starting a recycling program at home is easy: place containers in a convenient location and you're ready to go. Show several examples of recycling containers.

12.Give students a list of locations that will accept recyclables. -At the end of the program, provide poster board and markers and ask students to design labels to place on their recycling containers at home.

ASSESSMENT:
Design a pre/post multiple-choice test to give students. Base the questions on the facts provided in the presentation.
Example: By weight, which accounts for the largest percentage of your trash?
a) glass
b) paper
c) plastic
Comparing pre-test and post-test scores will help assess how much students have learned.

School Energy Audit (Years 9-10)

1. Ask your teacher for copies of the school's past electricity bills. From the bills, list the following information:

- total electricity use per month
- total cost per three months
- total number of billing days

2. Ask your teacher what the total population of the school is. Once you have this information you can calculate the following:

- **Daily use** equals **Total use per quarter** divided by **Number of billing days** (kWh/day)
- **Personal daily use** equals **Daily use** divided by **Size of school population** (kWh/person/day)
- **Daily cost** equals **Total Cost per month** divided by **Number of billing days**
- Personal daily cost equals **Daily cost** divided by **Size of school population**

Why do you think different amounts of electricity are used at different times of the year?

3. Locate all the electricity meters in the school. Read the smallest units first (1/10kWh). Tip - if these are dial types, note that adjoining dials move in opposite directions.

Choose a specific meter to take an overnight reading. This is done by taking a reading of this meter at the end of a school day and then again as soon as you get to school the next morning. Record the results:

Reading at 3.30pm = _____kWh
Reading at 8.ooam = _____kWh

To record the amount of electricity consumed throughout the night simply subtract the morning reading from the overnight reading:

3.30pm reading (____kWh) - 8.00am reading (____kWh) = Consumption Overnight (____kWh)

4. Follow the same guidelines to work out hourly, daily, weekly and monthly readings.

5. Make a list of the different areas of your school. Some areas include classrooms, the library and the tuckshop. What are the other areas? Form teams with about 4 to 6 people in each and assign each team with an area of the school. For each area identify what kinds of energy are used there. This checklist may assist you:

- Fluorescent lights
- Incandescent lights
- Ceiling fans

- Air conditioners and heaters
- Computers, printers, photocopiers and office equipment
- Audiovisual equipment (slide projectors, TV, videos etc)
- Refrigerators
- Hot water heaters, urns
- Stoves, ovens, microwaves
- Kilns
- Science equipment
- Workshop machinery

Work out what times electricity is used in different areas of the school.

What recommendations can you make to help reduce the electricity used in each area?

6.

- Work out an approximate yearly electricity usage for your school by multiplying your school's monthly usage by 12. (Usage will change from month to month, but that's OK for this exercise).
- Work out how many tonnes of greenhouse gas your school could stop sending into the atmosphere, by joining Ergon Clean Energy. One tonne of greenhouse gas is released by every 1000 kilowatt hours of electricity from non-renewable sources. For example, if your school uses 120,000 kilowatt hours in a year, you could stop 120 tonnes of greenhouse gas from going into the atmosphere, by joining Ergon Clean Energy.

How to Plant A Tree

FIRST: CHOOSE THE PLANTING SITE AND ASK PERMISSION

This is an important first step. The reason why this step is first is because everything you do might depend on where you are going to plant your tree. For example, if you want to plant a tree in a park, you first need to find out who manages the park (is this a city park, state park, private, etc.) and ask their permission to plant a tree. They might say "yes, you can plant a tree but we can only plant certain kinds of trees" - for example some parks will only plant native trees (trees that have historically grown in the area) or they might have a tree planting plan that identifies historically grown in the area) or they might have a tree planting plan that identifies the type of trees to be planted. Or, you might be planting a tree near power and telephone wires so in selecting a tree you would want one that would not grow tall or fast (a dogwood tree for example). You might even want to replace a tree that has been destroyed by lightening or killed by disease. Replacing the tree with the same kind of a tree would be nice.

In selecting a site, remember, our communities and cities need and have an ongoing need - to have trees planted by people. That's because life is hard in the city for a tree: trees that might grow from seeds are cut by lawn mowers, sidewalks prevent water absorption by trees plus the added work of cleaning the air of auto emissions makes survival tough for trees. So the cities and town really need more trees!

Once you have identified where you would like to plant a tree, you need to ask permission from the owner or the manager of the property. This person might be a state forester, park ranger or the principal at your school. This rule even applies if you want to plant a tree in your yard at home - you still need to ask for permission of your parents.

SECOND: GET A TREE

You might be able to have a tree donated for your project or you might need to raise funds to purchase a tree. Check with your state or community forester to see if they have any programs where they give away trees for tree planting projects. Also, ask for their advice on the types of trees to plant in the area where you live - different trees are native to different states, and native trees will thrive better after planting.

If you are not able to get a tree donated, don't fret - you can raise the money you need to purchase a tree. Contact the manager at your local Wal-Mart or a business at busy intersection and ask permission to do a car wash or bake sale to raise money. Offer to clean litter for a fee from the parking lot after a football game. Collect aluminum cans in the classrooms and cash the cans in for money at the end of a month. Sell T-shirts. You might even be able to raise enough money to plant several trees!

THIRD: PLANT THE TREE

Use proper tree planting tree procedures!

No matter if you plant the tree by yourself or with your family, friends, club, class or scout members, you will want to use proper tree planting procedures - to make sure the tree has the best chance for a long life.

- Dig the hole as deep as the rootball and twice as wide.
- Check to see if the soil around the hole is too hard - if it is, loosen it up a bit with the shovel.
- Remove the container from the rootball. (The roots are like the tree's blood vessels and they work best if they are not all twisted and knotted up, so you might need to straighten them out if they are circling around after having grown in the container.)
- Place the tree in the hole, making sure the soil is at the same level on the tree as when the tree grew in the garden center. If your tree has burlap around the rootball, place the tree in the hole and then carefully untie the burlap. Leave the burlap lying in the bottom of the hole (this is Okay - the burlap will simply turn into organic matter over a period of time).
- Fill in around the rootball with soil and pack the soil with your hands and feet to make sure that there are no air pockets.
- Make a little dam around the base of the tree as wide as the hole with left over soil or grass clumps to hold in the water.
- Give your new tree a good soaking of water to help settle it into its new home.
- Name your tree, like Tara and her friends named the first tree they planted "Marcie the Marvelous Tree."

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Need more help? Contact your state or community forester listed in your telephone directory or call your local nursery for help and / or advice.

WHY NOT MAKE IT A SPECIAL DAY?

Organize a community tree planting event (Hey - More than 1 tree can be planted!) There may be people like community officials, other organizations like the Scouts and business representatives in your community who would love to be involved in your project - all you have to do is to ask. Once more people are part of your team, they can help you with other things like finding a planting site, purchasing a tree, helping to dig a hole. To help make the day a community event, try to involve the entire community - at least invite the entire community - and you can do that by making an announcement about the event through the media including the newspaper, radio, and television. (We can even help you if you need help on writing a press release).

FINALLY, AFTER THE PLANTING

Take care of the newly planted tree - and this means water and mulch around your tree. (The tree will be thirsty after it is planted, so deeply water it each week (2 to 3 gallons) for the first year. If mother nature happens to water your tree during the week, then don't worry about watering that week - Mother nature is the best source for water)
Give your tree a "mulch blanket." A mulch blanket is a 2- to 4-inch covering of rotten leaves, wood chips, pine straw or shredded bark that will insulate the growd, decrease the amount of weeds that will grow around your tree, keeps moisture around the roots and provides food for your tree. Make sure that the mulch blanket is not piled up on and touching the base of the tree but has a little space between the tree and where the mulch

begins - you simply might need to push some of the mulch back from the bottom of the tree.

AND WHEN ALL IS SAID AND DONE

Write Thank-You notes to people who helped with the project (and if Mom or Dad helped you with the project, write them a little thank-you note too!) Hint: One thing that Melissa does with her Thank-You notes is that she draws Thank-You Pictures! This is more fun and for her, says more than words ever say!

PRACTICE YOUR 3 R's:
Reduce, Reuse & Recycle

HELP SAVE OUR NATURAL RESOURCES

Our natural resources are the things that we take from the Earth to make all of the things that we need. When those things get worn out we throw them out, and they become garbage.

Did you know that we make 250 million tons of garbage each year! That's a lot of garbage!

People are helping to save our resources by practicing the 3 R's: reduce, reuse and recycle. You can help, too.

REDUCE

You can help by *PRECYCLING*. 1/3 of all garbage is packaging.

- Buy things that are in packages that can be recycled or are made of recycled materials.
- When you buy something small, say no thanks to a bag.

REUSE

Many things can be reused before you throw them out.

- Use coffee cans and cottage cheese containers for storage
- Use backs of paper or backs of used envelopes for jotting notes
- Put leftovers in resealable containers instead of using wraps and foil
- Use old clothes as rags for cleaning instead of paper towels
- Have a garage sale or donate clothes, books or toys that you don't use anymore

RECYCLE

Each year we use:

- 25 billion plastic containers
- 30 billion bottles & jars
- 65 billion aluminum cans

- 100 billion pounds of paper

Most communities recycle. Does yours?

INTRODUCTION

Dear Educator,

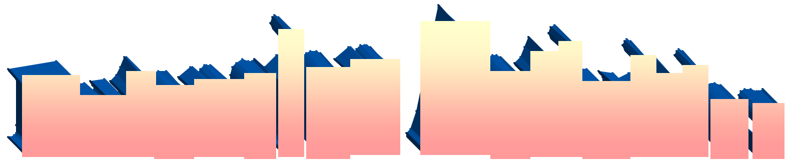
Welcome to the Department of Natural Resources's Guide to Energy Education! This packet of educational resources is intended as a supplemental tool for your classes investigation of solar energy and energy conservation. Our goal in distributing this material is to provide students with the awareness, appreciation, understanding, skills, and commitment to address environmental issues. Although the lesson plans have been categorized for different skill levels, many have the potential to be modified for any grade levels.

We hope that this packet proves to be a valuable asset in your class's energy studies. Happy learning!

Sincerely,

Paula Ridgeway
Manager, Energy Section

Guide to Energy Education



JOURNAL ACTIVITY
Bring the following items and have students journal on one to three ways that each of them could be reused: cardboard box, plastic milk carton, glass jar, wooden board, plastic bag, newspaper. After journal activity, conduct a group discussion where they are able to share their ideas.

ABC ORDER
Invite students to put the items above into ABC order. Teachers of older students might use a longer list, which students might help to brainstorm.

SEQUENCING
Students can draw a step-by-step diagram to show the ten steps involved in planting a tree. The information students will need to diagrams can be found on the following handout "How to Plant A Tree". Students might work in teams of 2, 5, or 10 to complete the project. They might bind their pages into book form to present other classes in the school with their "How to Plant A Tree" books.

ART
Each class in the school should select an Earth friendly slogan for Earth Day and create a colorful banner on computer print out paper. Classes can display their banners outside their classrooms and teachers can take their students on a banner tour.

MORE ART
Have students collect paper bags from the local grocery stores. In class, invite students to decorate them with Recycling, Energy Conservation, or Solar Energy Promotion themes. Once complete, have students return them to the grocery store for distribution. This activity could be extended in an ongoing center. Students could write conservation related poetry on the bags. Once several bags have been designed, they could be distributed to stores in larger quantities.

GRAPHING
Ask students to use the information on the Practice Your 3 R's:Reduce, Reuse, Recycle handout to create a graph that shows how much Americans recycle each year. The graph will show the number of containers made of

plastic, glass, and aluminum, and the number of pounds of paper recycled each year.

CLASSIFYING, GRAPHING, AND COMPARING/CONTRASTING
Make a checklist with ten columns. Head each column with a type of trash. (See the below chart for column headings). Then, count the number of litter items students collected in the “Litter Detectives” activity in each category. Graph the results to show which categories accounted for the most waste. Compare your results to the figures in the chart below, which represent nationwide trash composition.

PAPER	**XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 34%**
PLASTICS	**XXXXXXXXXXXXXXXXXXXX 20%**
METAL	**XXXXXXXXXXXX 12%**
YARD WASTE	**XXXXXXXXXX 10%**
RUBBER/LEATHER	**XXXXXX 6%**
TEXTILES	**XXXXX 5%**
MISC.	**XXXX 4%**
WOOD	**XXXX 4%**
FOOD WASTE	**XXX 3%**
GLASS	**XX 2%**