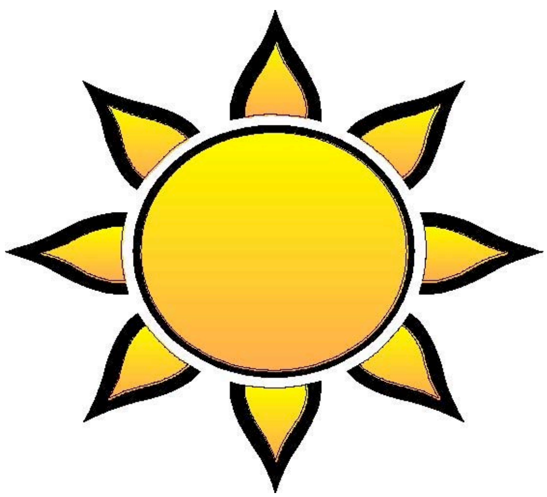
NATIONAL RENEWABLE ENERGY LABORATORY

GETTING ENERGIZED!

Teacher's Activity Guide for Elementary Grades 3-6



National Renewable Energy Laboratory
Education Programs
1617 Cole Blvd.
Golden CO 80401-3393
Tel: (303) 275-3044
Fax: (303) 275-3076
E-mail: linda_lung@nrel.gov
URL: http://www.nrel.gov/education.html

ACKNOWLEDGMENTS

The Education Programs Office at NREL would like to thank the following individuals for their commitment and hard work in the testing and revising of this activity kit. The expertise of these educators was invaluable in producing a final product that attempts to be "user friendly." Their open-mindedness and willingness to try these activities with their students generated productive feedback that will, we hope, continue as more teachers use these materials.

Cheryl Beckwith, *4th grade, Eiber Elementary, Jefferson County Schools*

Mary Edwards, *3rd grade, Governor's Ranch Elementary, Jefferson County Schools*

Rick Hanophy, *6th grade, Smiley Middle School, Denver Public Schools*

Ruby Wendling, *4th grade, Westgate Elementary, Jefferson County Schools*

A special thank you also is extended to **Professor James Schreck**, Department of Chemistry and Biochemistry at the University of Northern Colorado for his assistance in the development of these kits.

It is the goal of the Education Programs Office to make these kits accessible, easy to use, and fun. We want your students to gain, not only an understanding of renewable and nonrenewable energy resources, but a greater confidence in investigating, questioning, and experimenting with scientific ideas. Your feedback on the evaluation form found at the end of this packet is very important for us to continue to build and improve this kit.

STATE CONTENT STANDARDS

The activities in this kit address portions of the following guidelines from the Colorado Science Standards.

1. 1.0 Students understand the processes of scientific investigation, and design, conduct, communicate about, and evaluate such investigations.
2. 2.0 Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (Focus: Physics and Chemistry)
3. 2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).
4. 2.3 Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.
5. 3.2 Students know and understand interrelationships of matter and energy in living systems.
6. 5.0 Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

ASSESSMENTS/RUBRICS

A separate section on Task Assessments provides examples of methods to evaluate a student's grasp of major concepts presented in the activities. Teachers are encouraged to use these assessments as-is or to develop their own that will meet the individual needs of students. The assessments in this kit usually involve open-ended, problem-solving activities but some will require recall of content knowledge.

Included with the assessments is a standard, generic rubric. The rubric is established as *a guideline for performance*. It also is a useful form of self-evaluation because they let the student know what is expected for high quality work. Harriet Yustein, a teacher from Suffern, New York, states that, "Through experience I have found that the best rubrics come from the children themselves. You should model what you want them to do and then they will discuss exactly what you want from them. That will be their rubric."

CONCEPTS

This activity kit is designed for elementary grades 3-6, and is appropriate for discussion of energy concepts at these grade levels. The concepts developed through the activities in this kit include:

- energy sources (renewable and nonrenewable)
- conservation of energy
- uses and limits of energy
- future energy resources
- conversion of energy forms

TEACHING-LEARNING MODEL

Each activity follows a format developed by **the** National Center for the Improvement of Science Education. The model is based on the "Immersion Approach" where teachers actually complete research projects in a laboratory setting. Once teachers have experienced "real life" laboratory research, they are more familiar with how they solve scientific problems. The Teaching-Learning Model is the result of these lab experiences. Rather than taking a cookbook approach to doing activities, teachers have found that students learn content and process through these steps:

INVITE
Big Question, Present Problem
Uses Meaningful Context, Motivates Student/Investigator, Real-Life Situation

ù

EXPLORE, DISCOVER, CREATE
Gather Information, Brainstorm Solutions
Introduce New Vocabulary and New Concepts, Practice Techniques, "Need to Know"

ù

PROPOSE EXPLANATIONS AND SOLUTIONS
Analyze Data, Apply New Knowledge
Share Information, Conclude

ù

TAKE ACTION
Present Findings, Ask New Questions
Generate Ideas for Further Investigation, Present Findings to Classroom

ACTIVITY OUTLINE

The activities in this kit address energy concepts as follows:

Energy Sources	Activity 1 Activity 2 Activity 3	Learning About Energy Sources Energy Talk--Part I Energy Talk--Part II
Energy Uses/Limits	Activity 4 Activity 5 Activity 6	How Long Will It Last?--Part I How Long Will It Last?--Part II Now You're Cooking!
Energy Conversion	Activity 7 Activity 8	Leaf Relay Energy Conversions
Energy Conservation	Activity 9 Activity 10 Activity 11	Save or Waste? New Old Paper The Best Color
Energy for the Future	Activity 12	Rain Machine

Note: The following items will need to be provided by the teacher: SCISSORS, RULERS, CRAYONS, MARKERS, GLUE STICKS, BUTCHER PAPER, WATER, SINK (OR BUCKET).

RESOURCES

A Teacher's Background is included to help teachers with basic energy concepts, and to help them be more knowledgeable and comfortable in discussing these concepts with students. A Student Assessment is provided. Materials found in this curriculum packet were adapted from several sources including:

"Teach With Energy! FUNdamental Energy, Electricity and Science Lessons for Grades K-3," National Energy Foundation, Utah.

"Energy Conservation Activities for the Classroom K-12," Kentucky Department of Education.

"Science Activities in Energy," U.S. Department of Energy, Washington DC.

"Award Winning Energy Education Activities for Elementary and High School Teachers," U.S. Department of Energy, Washington DC.

"Iowa Developed Energy Activity Sampler K-12," Energy Division Iowa Department of Natural Resources.

"Energy Activities for the Primary Classroom," California Energy Extension Service.

TEACHER BACKGROUND

The following information is provided as a resource to the teacher. More specific notes are provided at the beginning of some activities and the kit contains a packet of FACT SHEETS relating to renewable energy topics. There are, of course, many other resources.

INTRODUCTION--WHAT IS ENERGY?

Energy gives us the ability to do things such as climb a mountain, play soccer, and even think. And there are many types of energy--some is stored in our muscles and brain cells, some is used to move around and play, while other types of energy are used to light a street lamp, heat or cool our homes, cook our food, and power buses, planes and cars.

Energy causes movement. Every time you see something move, energy is being used. A leaf moving in the wind, a pot of boiling water, and a school bus traveling to school are all evidence of energy being used. You know that energy exists because you can see or feel what it does. Energy moves cars, makes machines run, heats ovens, and lights our classrooms.

One form of energy can be changed into another form. When gasoline is burned in a school bus engine, the energy stored in gasoline is changed into heat energy. When we stand in the sun, light energy is changed into heat. When you turn on a flashlight, chemical energy stored in the battery is changed into light and heat.

To find energy, look for motion, heat, light, sound, chemical reactions, or electricity.

The sun is the source of all energy. The sun’s energy is stored in coal, petroleum, natural gas, food, water, and wind.

While there are two types of energy, ***renewable and nonrenewable***, most of the energy we use comes from burning nonrenewable fuels--coal, petroleum or oil, or natural gas. These supply the majority of our energy needs because we have designed ways to transform their energy on a large scale to meet consumer needs. Regardless of the energy source, the energy contained in them is changed into a more useful form electricity.

WHY DO WE MAKE ELECTRICITY?

We make electricity to provide energy for a lot of things. In fact, we often take electricity for granted because it is such an important part of our life style. It makes our everyday endeavors convenient and practical. For example, electricity makes alarm clocks ring in the morning to wake us for school, keeps food cool in the refrigerator so that cereal tastes good with milk, operates the blow dryer that styles hair, and runs the furnace that blows warm air throughout our homes in the winter to keep us warm while we get ready for school.

HOW DO WE MAKE ELECTRICITY?

One of the fossil fuels (usually coal) is burned in a power plant to heat water. The hot water turns into steam and forces a machine called a turbine to turn. The turbine powers a generator into electricity which is sent through power lines to provide energy for buildings of all types.

In summary, *coal 6hot water 6steam 6turbine 6generator 6electricity*.

Electricity can also be made from windmills or from water behind a dam. Falling water or rotating windmill blades will cause turbines to generate electricity.

WHY IS IT IMPORTANT NOT TO WASTE ENERGY?

In any energy conversion process, energy is *not* changed in *quality*. You can observe this by standing near an idling school bus engine. The engine gets very hot! Not all the chemical energy stored in the gasoline is converted into mechanical energy that moves the bus. Some energy is changed into heat energy that warms the air surrounding the engine. So, some of the energy stored in the gasoline is wasted. The *quality* of the original energy put into the process is not the same as the energy released.

The amount of fossil fuels is limited (no new reserves of these ancient fuels is being produced) and we will eventually run out of current supplies. It is important to conserve (save) these resources, while we experiment with the possibility of using renewable resources to meet our energy needs. Scientists at NREL are looking for ways to meet our energy needs using renewable energy sources. In the meantime, it is important that citizens not waste energy in any form. All of us need to be aware of things we can do to minimize the loss of energy. If the energy is lost, we don't have it available to use when we need it.

WHAT ELSE CAN WE USE FOR ENERGY?

Use of fossil fuels to make energy changes is complicated by the fact that they are the primary

causes of environmental pollution including smog, acid rain, and the Greenhouse Effect. Smog is formed when exhaust fumes of cars and buses mix with sunlight. The resulting thick, brown haze can be seen over some cities on occasion in winter. It can irritate eyes and lungs. Acid rain is caused by the sulfur present in coal. When coal is burned to generate electricity, the sulfur is changed into a gas that will dissolve in water and fall to ground as rain or snow. The acid formed in acid rain is like that in lemon juice or vinegar. Acid rain can damage buildings and statues made of stone, trees, and food crops. The greenhouse effect arises when too much carbon dioxide from burning fossil fuels is produced. Increased amounts cause a warming of the atmosphere surrounding the earth much like that in a greenhouse. Too much warming could alter earth's weather and cause the polar caps to melt resulting in flooding of coastal cities.
Because our reserves of fossil fuels are dwindling, scientists are exploring other energy sources. Energy sources of the future must be more plentiful, and less harmful to the environment. Scientists are exploring these forms of energy to generate electricity:

- Solar energy - using the sun
- Wind energy - using wind to turn a windmill
- Nuclear energy - splitting uranium atoms to create heat energy
- Geothermal energy - harnessing heat and steam generated below Earth's surface
- Waves and Tides - using the force of ocean waves and tides
- Biomass - producing fuels from living materials or decayed waste materials

HOW MANY WAYS ARE THERE TO SAVE ENERGY?

Energy saved is energy gained for another day! Saving energy will cut down on pollution and help our fossil fuels last longer, at least, until the renewable energy resources become more practical and affordable. Here are some energy saving tips that students should know:

- Turn off the radio and television when not in use.
- Turn off the lights when you are not using them.
- Use a solar powered calculator instead of a battery powdered calculator.
- Ride the bus to the Rockies or Broncos game instead to taking the car.
- Don't leave the refrigerator door open for a long time.
- Don't use an electric toothbrush.
- Use a hand operated can opener, not an electric one.
- Use a sweater to stay warm in the winter instead of turning up the thermostat.
- Recycle your pop cans, glass bottles and plastic containers.

- Use a fluorescent bulb instead of an incandescent one.
- Pass the clothes you've outgrown to a brother or sister or to someone who needs them.

Energy Sources

Activity 1: Learning About Energy

Activity 2: Energy Talk--Part 1

Activity 3: Energy Talk--Part 2

ACTIVITY 1 **LEARNING ABOUT ENERGY SOURCES**

CONCEPT Energy sources can be classified in different ways.

GOAL Students will be able to site five new energy facts and terms related to forms and sources.

MATERIALS **Items listed in bold type must be supplied by the teacher.** Coal (charcoal briquette), oil (Lamp oil), **Oil Lamp (optional),** Bic® butane lighter, small vial filled with just air--this can be "natural gas"--put a match beside it to illustrate that it is an odorless, colorless gas but it is flammable*, solar cell, buzzer, **glass of water**, small piece of wood, **food (apple, orange, banana, etc.), electrical appliance (food mixer, tooth brush, hair blower, etc.)**, pinwheel, a "radioactive" sticker, 7 Energy Source complete posters, 7 sets of Energy Source poster puzzle pieces, **butcher paper, regular paper.**

*Natural gas has an additive called "Mercaptan" that gives it its distinctive odor. The smell is not harmful but it alerts a person that natural gas, which is odorless, is leaking. **Contact Public Service Company of Colorado, Judy Corrigan at (303) 294-2060, or Kathy Worthington at (303) 294-2284 to ask about Mercaptan "scratch and sniff" cards for your students.**

BACKGROUND

ENERGY FORMS*

There are seven **forms** of energy. Just remember the name: MRS CHEN.

M Mechanical energy (kinetic energy); its counterpart is stored energy (potential energy)
R Radiant energy or sunlight or solar
S Sound energy
C Chemical energy
H Heat energy
E Electrical energy
N Nuclear energy

*Thanks to Rick Hanophy, Smiley Middle School, for the use of this model.

The **First Law of Thermodynamics** states that energy cannot be created or destroyed; it only changes form.

ENERGY SOURCES

Sources of energy, then, are materials or objects that produce energy by changing it from one form to another.

For example:

ENERGY SOURCE	**CHANGES FROM THIS FORM...**	**TO THIS FORM**
Solar Cell	Radiant	Electrical
Wind	Mechanical (kinetic--blades turning)	Electrical, Mechanical
Battery	Chemical (i.e. alkali battery)	Electrical
Space Heater	Electrical (outlet)	Heat, Mechanical (fan)
Gasoline	Chemical (combustion)	Mechanical, Heat, Sound
Oil, Coal, Nat'l Gas	Chemical (combustion)	Heat, Mechanical, Electrical
Food	Chemical (digestion)	Mechanical (muscles), Heat, Sound
Wood	Chemical (combustion)	Heat, Radiant, Sound

You can see that combustion (or burning) of an energy source gives us other forms of energy that our society uses every day. This is primarily why global warming has become an environmental problem in the last century. Combustion releases carbon dioxide which, in turn, traps heat in the lower atmosphere. Renewable energies such as solar cells and wind do not rely on combustion to produce the energy we use.

Oil, coal and natural gas are called *fossil fuels* because they come from plants and animals that have been buried for millions of years. The weight from mud and rock created pressure and heat that changed the plants and animals into fossil fuels. These energy sources are considered **nonrenewable** because once they are consumed, they are gone. It would take millions of years to produce more oil, gas, and coal.

Solar cells, wind turbines, biomass (plant material used to produce fuels), solar-thermal (sources that convert radiant to heat energy) are energy sources that can be reused because their primary source is the sun. Because the sun has an expected life span of 5 billion more years, these energies are considered **renewable**.

Since the sun has provided radiant light and heat to all living and nonliving things on the planet, it can be thought of as the primary source of both renewable and nonrenewable energies.

NOTE: Wind is not a *form* of energy so it's not found in MRS CHEN. Wind is a *source* of mechanical or motion energy.

FACTS ABOUT THE ENERGY EXAMPLES ON YOUR DEMO TABLE:

A. **COAL** (Charcoal briquette) Relate the use of this energy source to produce heat at a picnic or at home to cook hamburgers on a charcoal grill. Ask them if they have felt the heat energy released during the cooking. Point out that coal is a nonrenewable energy source. Once the charcoal is used up, no more hamburgers can be cooked.

B. **OIL** (Lamp oil and Bic® butane lighter) Some students may have experienced an oil furnace, but another way to illustrate oil as a source of energy is through the use of an oil lamp. Describe how they know this is an energy source - heat and light are produced during the burning process. Oil is also refined to produce gasoline (like butane). Point out that oil is a nonrenewable energy source because once the oil is used, the oil lamp will not provide any more light.

C. **RENEWABLE ENERGY**

Sunlight (Solar cell and buzzer) Introduce the term **solar energy**. Solar energy is energy derived from the sun. Show students the solar cell hooked to a buzzer. Shine a light (not fluorescent) on the cell to hear the buzzer. The sun is a renewable energy source.

Food (Apple or banana) Discuss why we take a break to eat lunch. (Food gives us energy to make it through the rest of the afternoon.) Point out that without adequate food we would be less active and eventually become weak or sick.

Water (Glass of water) Besides being used for a lot of other things, hydroelectric power plants use water to generate electricity. Falling water turns the plant's turbine generators. Water is also necessary to grow food and maintain all forms of life.

Wind (Pinwheel and blow dryer) Use the hair blower to make wind and observe the turning of the pinwheel. Point out that the moving air is the energy source. Does the wind have enough energy that it can push you around? Can the wind move a sailboat? Wind is a renewable energy source.

Wood or Biomass (Wood) Show the wood sample. Explain that when wood is burned in the fireplace, it warms the room. Point out that wastes are produced when this energy source is used - ash, smoke. Sometimes an energy source produces wastes.

D. **ELECTRICITY** (Hair blower, solar cell, lights) Electricity is a common form of energy. There are many sources of electricity--outlets, solar cells, batteries, etc. You can demonstrate that electricity is what makes the hair blower work. You can also demonstrate static electricity by scooting your feet on a carpet or combing someone's hair and watching it stand up.

E. **NATURAL GAS** (Empty bottle with match or Mercaptan card from Public Service) This form of energy is used a great deal in Colorado. Natural gas is formed under similar conditions as oil--from dead and decaying plant and animal life that lived millions of year ago in swampy, warm conditions. When drilling, gas is usually found in layers above oil since gas is lighter. Natural gas is piped to homes and is used to light stoves, heat water and run our furnaces. Some students may have gas fireplaces in their homes. Explain the additive, Mercaptan, that alerts people to the presence of harmful natural gas.

F. **NUCLEAR** (Radioactivity sticker) This energy comes from uranium fuel. Uranium ore occurs naturally underground and is mined and processed to remove Uranium 235. This is a radioactive material that is fissionable (its atoms can be split--a process that releases a lot of energy). Uranium 235 is processed into pellets and is loaded into a nuclear reactor of a nuclear power plant. The heat from fission is used to boil water. The steam turns a turbine which generates electricity. Nuclear power plants face environmental problems because of the difficulty in disposing of nuclear waste.

ACTIVITY

INVITE

1. Have a display of each energy source sample on a table. Ask "Why do we need energy?" and list student responses on board. Use examples as hints such as “How can we use wood as a source of energy?” or “Why do we need gasoline (butane)?”

EXPLORE, DISCOVER

2. Using the Background Information above, work from the Demo Table and have students observe and talk about various energy sources using senses. [Sniff the Mercaptan cards, use hair blower to illustrate wind turning the pinwheel, handle a briquette to see the carbon smudges, the teacher should demonstrate the lighter, etc.]

CREATE

3. Distribute a 2' X 3' piece of butcher paper and 1 set of Energy Source Jigsaw pieces to each group of 3 or 4 students. Challenge each work group to put their puzzles together.   You can put the complete set of posters up around the room to use as a guide.

4. Tape the pieces together onto the butcher paper.

APPLY NEW KNOWLEDGE

5. On a separate piece of paper, have each group come up with five (5) facts or 5 NEW vocabulary words from their poster.

TAKE ACTION

6. Give each student group about 3-4 minutes to share with the class their list of facts and words. Challenge them to make meaning of some of the words. Ask them to find something on the Demo Table that applies to their poster and list of facts.

FOLLOW UP/ASSESSMENT OPTION

1. Have students list all the energy forms and sources they have used that day (electricity to run the radio, light the lights, natural gas to heat the house and hot water, gas/oil in the bus to come to school, food to run and play, etc.) See who has used the greatest variety of energy sources (use the posters for help.)

2. Take away the Coal, Oil and Natural Gas Posters. Have students re-create their day without using these energy sources. Explain that this most likely will be the energy challenge in their future. (They can use the sun for heat, electricity (solar cell) and even for buses!)

LEAVE THE DEMO TABLE SET UP FOR ACTIVITY 2.

Activity 2 **ENERGY TALK -- PART I**

CONCEPT Each energy source (coal, sun, etc.) can be used in many ways.

GOAL Students will be able to identify energy sources as renewable or nonrenewable.

MATERIALS Items listed in bold type must be supplied by the teacher. Demo Table from Activity 1, energy source vocabulary words--**cut into strips**.

BACKGROUND
The following chart provides additional information on the classification of energy sources. You can use it to add to the Demo Table and to make a more challenging activity by having students consider other energy sources.

RENEWABLE ENERGY SOURCE USES				
SUN (Solar cell)	**WIND (Dryer)**	**WATER**	**FOOD**	**WOOD**
homes buildings plants heat light electricity	sailboats boats windmills electricity	waterwheels dams electricity	animals people plants	stoves factories electricity buildings heat light paper
NONRENEWABLE ENERGY SOURCE USES				
COAL	**OIL (Lamp oil)**	**NUCLEAR (Radioactive sticker)**	**NATURAL GAS**	**GASOLINE (Butane lighter)**
electricity trains	furnaces electricity grease for cars	heat buildings electricity	heat electricity	cars trucks boats lawnmowers

ACTIVITY
<u>*INVITE*</u>
1. Display the energy source samples again. Review the different sources of energy represented on the table: briquette = coal; solar cell = sun; lamp oil = oil; butane lighter = gasoline; pinwheel = wind, etc.

<u>*DISCOVER, INTRODUCE NEW VOCABULARY/CONCEPTS*</u>
2. Ask students what they do when they check out a book from the library but don't finish reading it. What can they do? [Answer: renew it.] Explain that some of the energy sources on the table can be used over and over again--they don't "run out"--they can be renewed like a library book.

3. Ask students to think about which items from the table could be reused. Explain that charcoal will burn to ashes, the oil lamp will burn up all the oil, that natural gas will be burned up. Once it's gone, it can't be used again for energy. Show them the solar cell and ask, "What does this need to work?" [sun] Then ask, "Can we reuse the sun? [Yes.] Will it run out? [No.]

> [Technically, yes. The sun will last about 5 billion more years before exploding to a red giant, then collapsing to a white dwarf. But, for our lifetimes, the sun is considered renewable.]

4. Put the following headings on the board. Have students look at the Demo Table and classify the energy sources. Challenge them to come us with additional examples.

RENEWABLE ENERGY	NONRENEWABLE ENERGY
[glass of water]	[charcoal]
[solar cell]	[lamp oil]
[wood]	[natural gas]
[food]	[radioactive-nuclear]
[hair blower/wind]	[butane lighter]

Note: The electricity that powers the hair blower is coming from a nonrenewable energy source--coal-fired power plants. However, a hair blower can be run from other electricity sources such as solar cells.

Additionally, you can make a wall chart with definitions of Renewable/Nonrenewable Energy. Put up the Energy Posters as well. Then have students fill in examples of advantages and disadvantages:

Energy Source	Advantages	Disadvantages

BRAINSTORM SOLUTIONS/APPLY NEW KNOWLEDGE

5. Tell students you are going to read part of an energy poem. Cut the stanzas apart and put in a cup. Have a student draw one out. Read it and let students identify the energy source. Then ask "Is it renewable or nonrenewable?" "How do you know?"

6. Read one or two more stanzas, however, read only one line at a time until students can guess the source. Be sure they can classify whether it is renewable or nonrenewable. [Use this as a way to check for understanding before moving on to #7.]

7. Divide students into pairs. Each pair should have a sheet of paper and a pencil. Fold the paper in half lengthwise and cut or tear in half. Have students draw an Energy Source Vocabulary strip. When each group has a strip, have them turn the strip face up and give them 1 minute to brainstorm as many clues about their energy source as they can. The clues must be written on one half sheet of paper. Challenge students to come up with clues that aren't "dead giveaways." [You may want to make copies of the poem "Helping Hand" for each pair.]

8. After 1 minute, collect strips, and give each pair a new word. Give them another minute. Have them write a new set of clues on the other half sheet of paper. Collect the vocabulary strips after 1 minute.

PRESENT FINDINGS TO CLASSROOM

9. Have student groups read their clues to the class. The class must guess the energy source and whether it is renewable or nonrenewable. Have them tape their papers to the board according to the correct category (renewable or nonrenewable). See how many clues it takes to identify each energy source.

10. Ask "Why are some sources identified quickly while others take more clues?" And "What clues are the same for more than one energy source?" ['I give heat and light' is a clue that can describe the sun, wood burning, oil burning, coal burning, etc.]

ASSESSMENT OPTIONS

11. Have each student write a 'Helping Hand' poem about energy sources that is at least 5 stanzas.

12. Have students design an "Imaginary Ultimate Energy Source" that is renewable and can light/heat our homes and schools, run our cars, can be eaten and won't pollute.

“Helping Hand”

I am used in cars.
I am a liquid.
I come from crude oil.
People pump me through a hose.
Cars and trucks need me to run.
People use too much of me.
Who am I?

I am black and shiny and hard.
I am burned for heat.
People mine for me deep in the ground.
I am very old!
I come from ancient plants.
Who am I?

I give heat and light.
I make the day warm.
I help plants to grow.
It is dark when I am not around.
Who am I?

I am very wet.
People use my energy through dams so I can make electricity.
I am good to drink.
I cool you in summer and help to keep you clean.
Who am I?

You like me!
I give you energy.
You can find me in the grocery store or in a garden.
You need me to grow.
Who am I?

I am so important!
I am used in many things.
People burn me in a fireplace to keep them warm.
I make lovely furniture, and I am used to build houses.
Who am I?

Light bulbs need me.
Without me, computers will not work.
I am a "powerful" thing!
I am a form of energy.
Who am I?

Gasoline is made from me.
Some people use me to heat their homes.
I can fix a squeaky door

Who am I?

[Answers: gasoline, coal, sunlight, water, food, wood, electricity, and oil.]

Activity 2
ENERGY TALK -- PART I
Vocabulary Cards

gasoline	**gasoline**	**gasoline**
coal	**coal**	**coal**
solar	**solar**	**solar**
water	**water**	**water**
food	**food**	**food**
wood	**wood**	**wood**
electricity	**electricity**	**electricity**
oil	**oil**	**oil**
natural gas	**natural gas**	**natural gas**
wind	**wind**	**wind**

ACTIVITY 3 **ENERGY TALK -- PART II**

CONCEPT Energy sources can be classified into two different categories: renewable and nonrenewable.

GOAL Students will color pictures of, read about, and classify energy sources.

MATERIALS **Items listed in bold type must be supplied by the teacher.** Energy Source Flash Cards, Flash Cards Factsheets, **crayons or colored pencils, glue sticks, scissors,** Demo Table from Activity 1, construction paper for booklet covers, string.

ACTIVITY

INVITE

1. Have students cut out all 10 Energy Source Flash Cards and color them.

2. Check for understanding by having a student match an energy source from the Demo Table to one of the cards. Again, have them classify the source as renewable or nonrenewable.

GATHER INFORMATION

3. Distribute a set of Flash Cards Factsheets to each student. Have them cut out each card.

4. Tell students to read the information on the factsheet (or read as a class). Have them match the factsheets to each of the pictures they have just colored. Check for accuracy.

5. Using a glue stick, glue the factsheet to the back of the correct picture. Let it dry.

ANALYZE DATA, APPLY NEW KNOWLEDGE

6. Pair students and have them face each other with their cards held out of sight.

ROUND ONE

7. One student shows the energy picture to his/her partner. The partner must identify whether the source is renewable or nonrenewable. If the student is correct, the card is placed aside and they switch. Play continues until both students have placed all cards aside.

ROUND TWO

8. One student shows the energy picture to his/her partner. The partner must give one energy fact relating to that energy source. If the student is correct, the card is placed aside and they switch. Play continues until both students have placed all cards aside.

ROUND THREE

9. One student verbally gives a clue about an energy source [use, advantages, disadvantages, etc] to his/her partner. The partner tries to guess what the energy source is.

TAKE ACTION

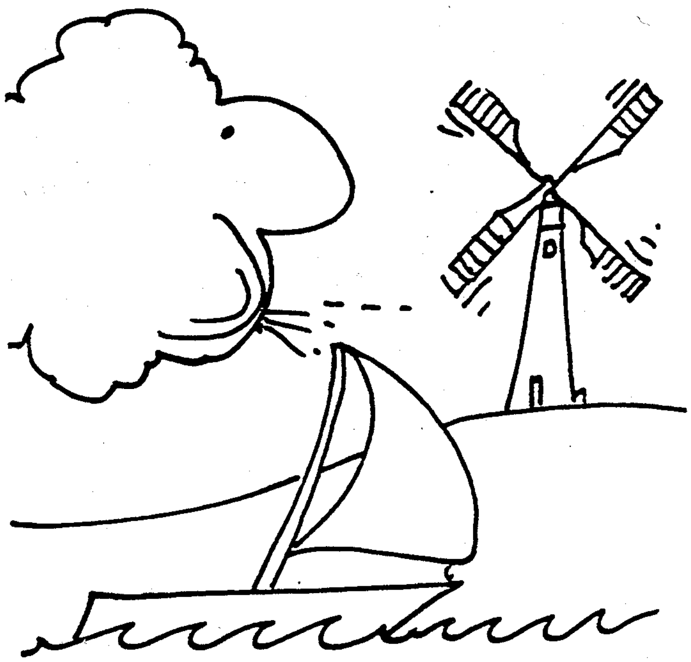
10. Make a book out of the 10 cards and classify them into renewable, nonrenewable energy sources. Create a cover for the book and include a title.

Note: Nuclear is sometimes considered to be renewable even though fuel pellets are nonrenewable. The supply of nuclear fuel is considered limitless. However, the environmental problems associated with nuclear energy [disposal of wastes, radiation leaks] make it more of a nonrenewable energy source. Electricity is really neither a renewable or nonrenewable energy source, but an energy form derived from either a renewable or nonrenewable energy source.

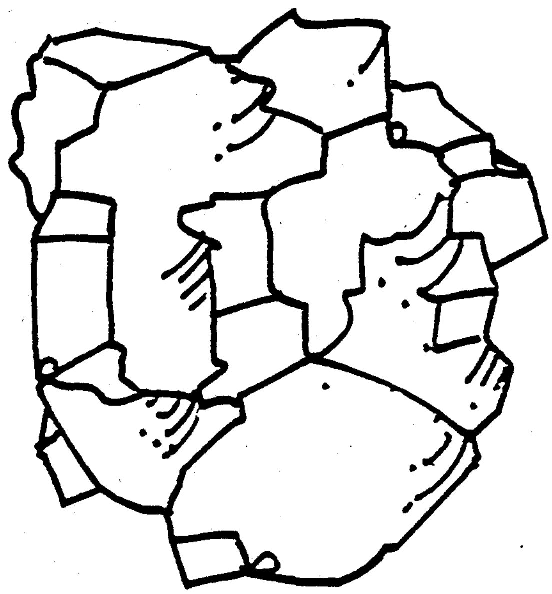
Energy Source Flashcards

Name ______________________

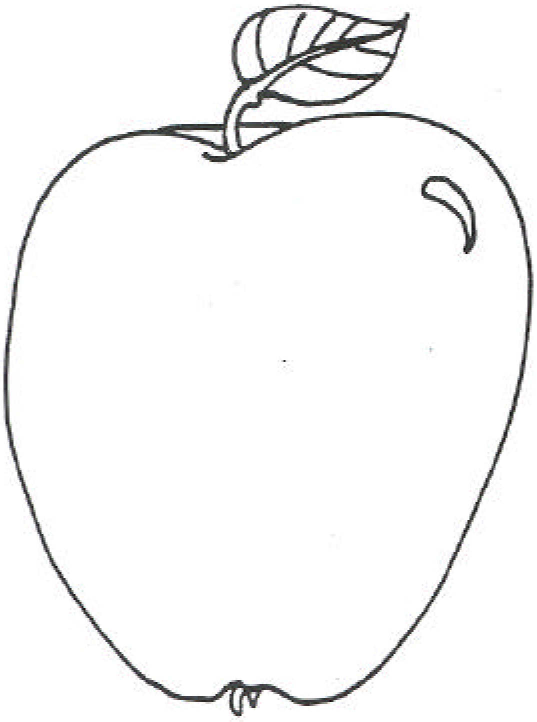
Date ______________________



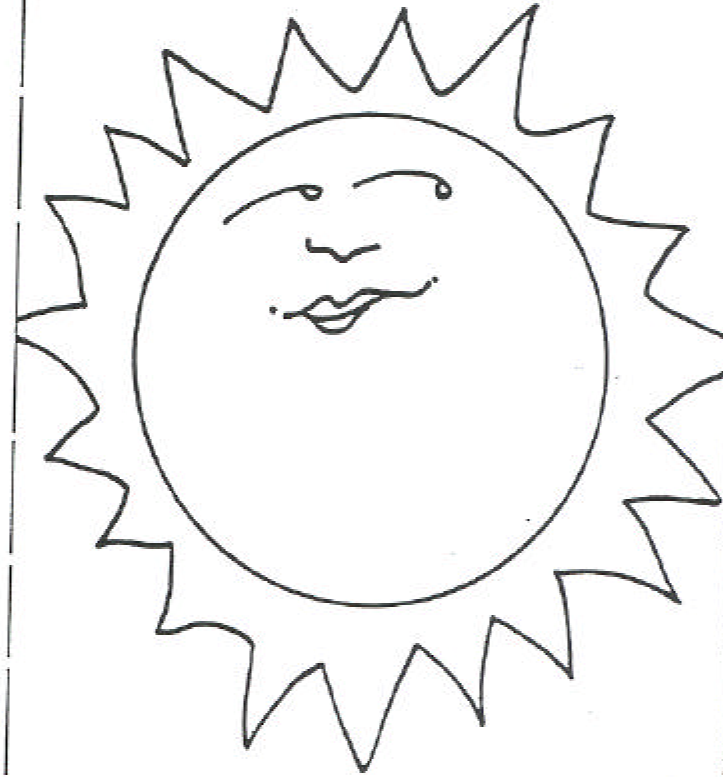
Wind



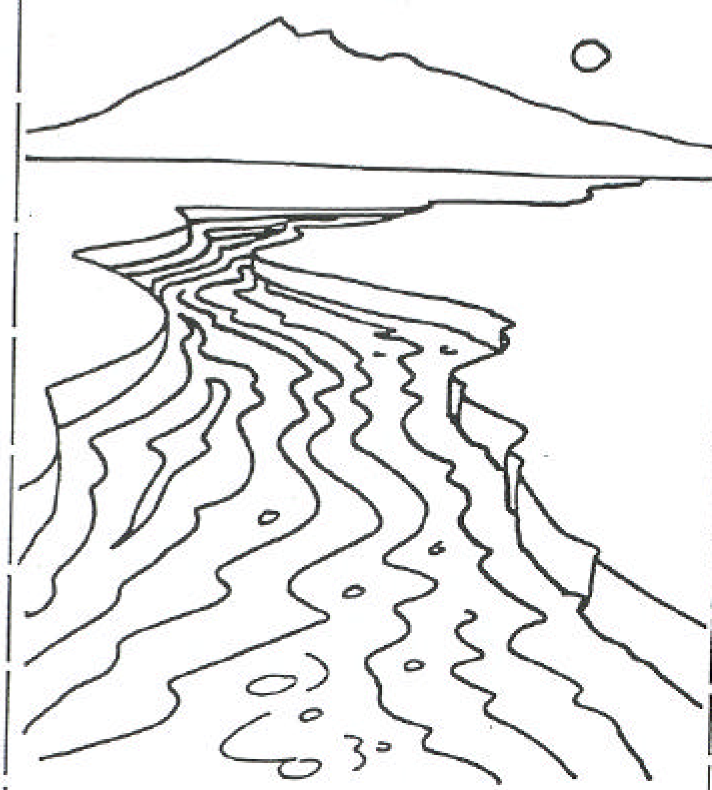
Coal



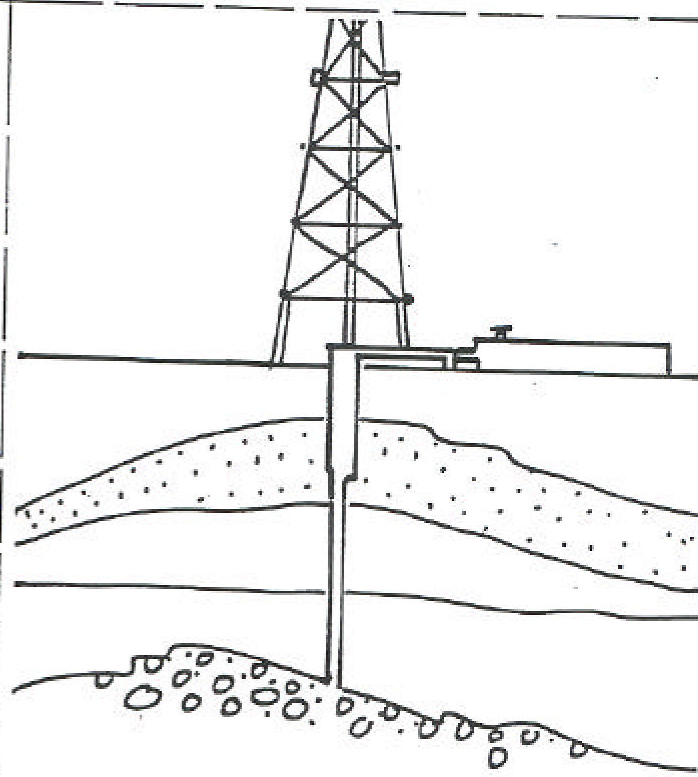
Food



Sun

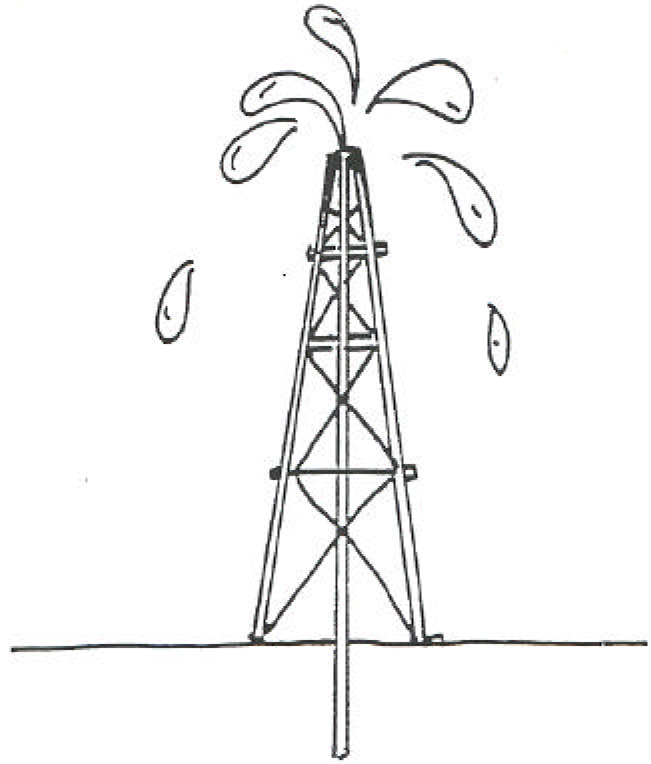


Moving Water



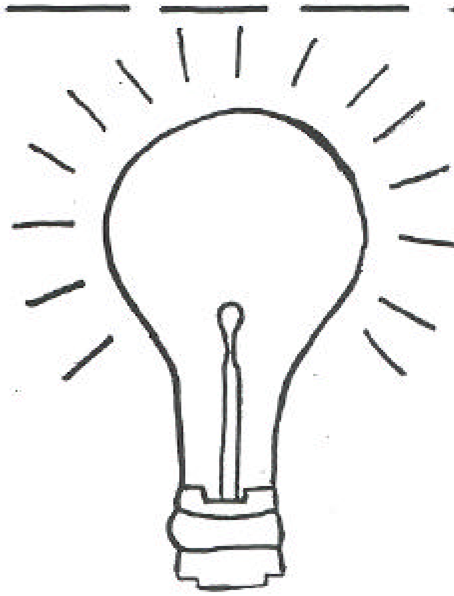
Natural Gas

Wood



Oil

Nuclear



Electrical

Activity 3 -- ENERGY TALK FACTSHEETS

Renewable Energy Source

- # moving air created when the sun heats the Earth unevenly
- # turns blades on wind-turbines to make electricity

Advantage

- # clean energy, no pollution

Disadvantage

- # you must wait for the wind to blow

Nonrenewable Energy Source

- # formed from animals and plants that died millions of years ago
- # the most commonly used energy source for electricity

Advantage

- # cheap, available now

Disadvantages

- # when burned, it pollutes air and water
- # leaves smudges when held
- # scars landscape when mined

Renewable Energy Source

- # necessary for living things
- # helps you to grow, move, think
- # requires clean water and air to grow properly

Advantages

- # tastes good, is good for you
- # can be grown fairly easily with proper soil, water, air

Disadvantages

- # too many sweets, fats can be harmful
- # can't be grown successfully everywhere on Earth

Renewable Energy Source

- # the only star in our solar system
- # maintains life on our planet
- # energy takes 8 minutes to reach our planet

Advantages

- # convenient source of energy
- # free

Disadvantages

- # it isn't available 24 hours a day
- # clouds, weather
- # skin cancer

Renewable Energy Source

- # falling water turns blades on turbines to make electricity
- # also called hydropower
- # supplies 8% of U.S. energy

Advantage

- # can supply electricity to large areas

Disadvantages

- # seasonal changes in water flow
- # disturbs life in rivers that are dammed
- # not many rivers left to use

Nonrenewable Energy Source

- # formed from animals and plants that died millions of years ago
- # gas forms above oil deposits deep in the Earth
- # also forms in landfills
- # can be used for fuel

Advantages

- # burns cleaner than coal or oil
- # large supply in the U.S.

Disadvantages

- # adds heat and carbon dioxide to the air
- # difficult to move long distances

Renewable Energy Source

- # used mostly for paper and building supplies
- # wood pulp from lumber mills is now recycled into cardboard and paper
- # along with other crops, it can be made into gasolines and fuels

Advantages

- # can be used for a large variety of things
- # convenient, easy to use
- # can take the place of today's gasoline

Disadvantages

- # forests are clear-cut
- # when burned, it adds heat and carbon dioxide to the air
- # pollutes the water when it is made into paper

Nonrenewable Energy Source

- # forms from animals and plants that died millions of years ago
- # is found deep in the Earth
- # drilling rigs are on land and out in the ocean

Advantages

- # there is a large source now available
- # it is easily moved from where it's drilled to where it's used
- # can be made into many kinds of fuels (lamp oil to diesel)

Disadvantages

- # drilling disturbs valuable wildlife habitat
- # oil spills
- # U.S. depends on foreign countries to sell us the oil
- # it pollutes the air when burned

Nuclear

uses uranium pellets in reactors
to make electricity
is used in the northeast and north-
west sections of the U.S.

Advantages

can produce a lot of electricity with a little bit of fuel
power plants don't pollute the air

Disadvantages

reactors have had accidents where radioactive materials get into the air, water and soil
the waste from a reactor takes millions of years to decompose to safe levels of radiation
there are few places to store the radioactive waste

Renewable and Nonrenewable Energy Form

the only one of these cards that is an energy FORM (not a source)
it is energy made of tiny moving particles called electrons
is one of the most common forms of energy that humans use

Advantages

convenient and easy to use
can be used for a lot of different things
can be moved over long distances
is clean energy if it is produced by solar cells or wind turbines

Disadvantages

if not used properly, it can kill
can pollute the air if electricity is produced by burning coal or oil

Energy Uses/Limits

Activity 4: How Long Will It Last?--Part I

Activity 5: How Long Will It Last?--Part II

Activity 6: Now You’re Cooking

Activity 4 **HOW LONG WILL IT LAST? - PART I**

CONCEPT Many energy resources are unevenly distributed and have limits to their usefulness.

GOAL Students will demonstrate through a simulation activity that coal is deposited unevenly between the earth's surface and underground, and will observe the limits of several energy sources.

MATERIALS Items listed in bold type must be supplied by the teacher. Per student: chocolate chip cookie, paper clip and napkin, another cookie (optional)

ACTIVITY

INVITE/PRESENT PROBLEM

1. Give each student a cookie, paper clip, and napkin. Be sure they don't begin to eat it!

2. Tell students that the cookie represents the state of Colorado. The tan area represents the earth's crust and the chocolate chips represent the coal deposits. They are going to "mine" the cookie.

EXPLORE/GATHER INFORMATION

3. Instruct students to count the number of visible chunks of coal in Colorado. Count only the coal deposits visible from the top. Record class data on the chalkboard.

4. Have students make a prediction as to how many coal deposits (chocolate chips) will exist in their mine. Record these predictions as well.

Student Name/Mine Name	Number of Surface Deposits	Predicted # of Total Deposits	Actual # of Deposits

5. Have students use their paper clip to begin "mining" their coal deposits. Place the coal deposits in one pile and the earth's crust in another pile. Have students count the coal deposits and record the class data on the chalkboard.

6. Compare and contrast the number of coal deposits visibly observed and actually in existence. How does the actual number of coal deposits compare to their predictions?

PROPOSE EXPLANATIONS

7. Discuss the following points with the class:

A. There were more "coal deposits" than could be seen on the surface.

B. Mining the deeper coal took more time, energy and was more trouble than mining the coal near the surface. This means that it often takes energy to get usable energy. Explain to students that the machinery and trucks used to mine coal use gasoline/diesel fuel to operate. Thus, we must *use* energy (gas) to get energy (coal).

C. Mining the coal disturbs the earth's crust. This means mining coal has environmental impacts. Have students look at the mess of crumbs on their napkin to illustrate this point.

D. Coal deposits were unevenly distributed. This means some students had more coal deposits than others.

APPLY NEW KNOWLEDGE

E. Show the students a Colorado map of coal deposits which illustrates that some areas have more coal deposits than others. Ask students to identify where the Rocky Mountains would be placed on the map. Do most of Colorado's coal deposits lie to the east or west of the mountain range? Are their coal deposits in the county in which you live? Use a colored marking pen to color areas where a lot of people live. What are some problems with this?

PRESENT FINDINGS, ASK NEW QUESTIONS

8. Summarize with students that energy sources are unevenly distributed, it takes energy to obtain energy, and securing an energy source affects the environment.

9. Have students do another cookie where they can eat the chips once they are mined but they must put back the rest of the cookie. This models reclamation efforts that are required once mining has been completed. You can discuss the replacement of vegetation and wildlife. (Where does the wildlife go while the area is being mined?)

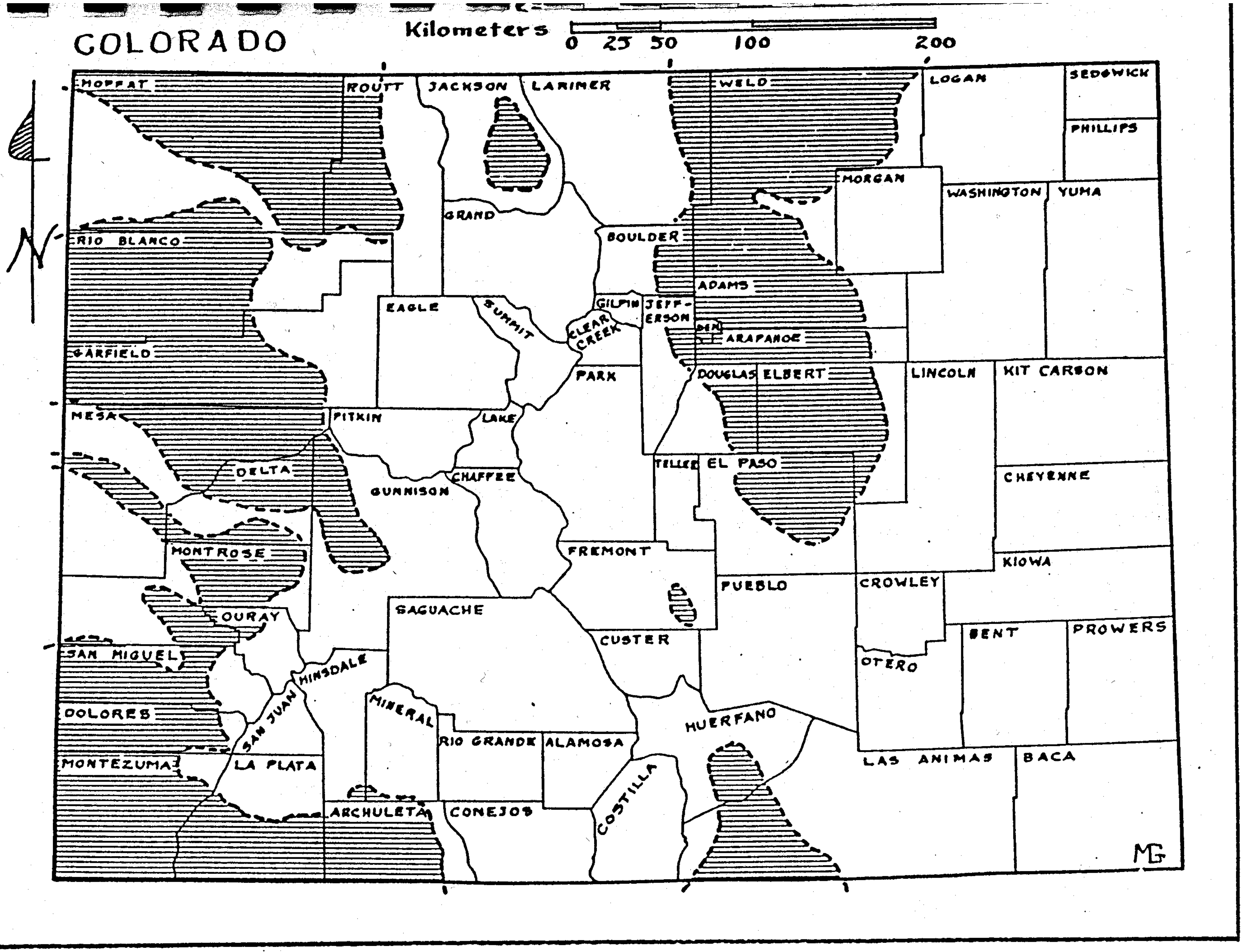


FIGURE 5.9. Areas underlaid by coal-bearing strata. No differentiation is made as to type of coal or depth of coal deposit below the surface. (Source: U.S. Geological Survey and Colorado Geological Survey, *Energy Resources Map of Colorado, 1977:1979,* Miscellaneous Investigations Series, map

Activity 5 **HOW LONG WILL IT LAST? - PART II**

CONCEPT All energy resources have limits to their usefulness.

GOAL Students will observe the limits of several energy sources.

MATERIALS Items listed in bold type must be supplied by the teacher. Flashlight, battery, birthday candles, matches, **candy packet for each student (Nerds)**

ACTIVITY

INVITE

1. Ask students to name some sources of energy (review).Get them started by suggesting the Sun. Other examples should include items that *make* energy: flashlight, candle, food, wood, etc.

EXPLORE

2. Put the following data chart on the board or overhead to use in the following activities:

Guess/Test/Tell

Item Being Tested	**Hours**			**Days**		
	Guess	*Test*	*Tell*	*Guess*	*Test*	*Tell*
Flashlight						
Candle						
Candy Packet						

3. **Flashlight Energy (Electricity)**. Turn the flashlight on and leave it on until the energy is used up (8-36 hours). Have students predict how long they think the energy in the batteries will last. Relate this study to the fact that the electrical energy in the battery will last only a certain amount of time. The energy is limited.

Extension: Test several brands of batteries. Be sure they have the same “expiration” date!

4. **Candle Energy**. Using a small birthday candle, have students predict how long the candle will burn, giving off heat and light energy. Again, relate this study to the idea that energy stored in the candle (chemical energy from oil) will last only a certain amount of time. The energy is limited.

5. **Food Energy**. Distribute the candy packets to each student. Tell them to eat them, but to conserve them as much as possible to make them last for several days. At certain times during the day, have students eat a few pieces. Relate this activity to the fact that food energy of the sugar is limited. It will last only so long. This is why we eat three meals each day - to extract the energy from food.

PROPOSE EXPLANATIONS/PRESENT FINDINGS

6. Have students go back and look at the data table. Ask “which energy source lasted the longest?” “What is the limit to the usefulness of a candle?” “Is there a limit to how much food you can eat?” “Which of these sources could ‘last forever?’”

7. Discuss the meaning of the word "limited" using the experiences the students have had with the activities. Related "limited" to energy resources, such as coal, oil, and natural gas. Also discuss what is a renewable resource, e.g., wood, water, sun, wind. In what ways **aren't they limited** like nonrenewable resources? In what ways **are they limited** like nonrenewable resources? For example, the sun’s energy is not very useful when the sun isn't shining.

Guess/Test/Tell

Item Tested	**Hours**			**Days**		
	Guess	Test	Tell	Guess	Test	Tell
Flashlight						
Candle						
Candy Packet						

Activity 6 **NOW YOU'RE COOKING! (*This activity works best in early fall or late spring. Have students bring in boxes and a coat hanger before beginning this activity.)**

CONCEPT Energy sources have limits to their usefulness.

GOAL Students will identify limits associated with these energy sources: candle, magnified sun energy, solar cookers.

MATERIALS Items listed in bold type must be supplied by the teacher. "Now You're Cooking" worksheet for each student or use the worksheet questions as a class discussion, magnifying glass, birthday candles mounted on aluminum pie plates, **clock with a second hand**, **regular sized marshmallows,** toothpicks. SOLAR OVEN: **boxes (paper, produce or book boxes work well), empty oatmeal containers,** "How to Make a Solar Cooker" packet for the teacher, **scissors, tape, glue,** aluminum foil, **knife (for teacher only), coat hanger.**

ACTIVITY *Conduct this activity on a warm sunny day.*
INVITE
1. Tell students they will be experimenting with using renewable and nonrenewable energy sources as they cook marshmallows.

2. Review the safety precautions when working with fire or do as a teacher demonstration.

3. Give each student their worksheet or use as a class discussion.

EXPLORE/DISCOVER
4. Put this chart on the board:

Energy Source	**Predicted Number of Marshmallows that will Cook in 3 Minutes**	**Actual Number of Marshmallows that Cooked in 3 Minutes**
Candle		
Magnifying Glass		
Solar Cooker		

5. Have students guess the number of marshmallows they think they can cook using the candle if only one marshmallow is cooked at a time. Have the students record their guesses on the worksheet (question 1).

6. Ask one student to be a timer and call out the time every 30 seconds.

7. Light the candle. Have students take turns holding a marshmallow on a toothpick near the flame. (Depending on the group and safety requirements, you may want to have more than one candle going so that students have a chance to observe and participate in cooking the marshmallows.) Cook as many marshmallows as possible in 3 minutes.

8. Have students answer questions 2-8 on the worksheet. Discuss their answers as a class.

9. Repeat the experiment using the magnifying glass and the sun to cook the marshmallows. Demonstrate how a magnifying glass can be used to concentrate the sun's rays. (Warn students about the dangers of looking directly at the sun, or of putting their hands under the magnifying glass). Have a student call time every 30 seconds.

10. Students can take turns cooking marshmallows under the magnifying glass. Have students answer questions 10-16 on the worksheet or discuss as a class.

BUILDING A PARABOLIC SOLAR COOKER

11. Divide students into groups of 3 to maximize use of materials. Hand out a copy of solar cooker instructions.

12. Follow directions to construct a solar cooker. When completed, continue the investigation by putting marshmallows on the skewer (coat hanger) and cooking for 3 minutes. TRY TO PICK A SUNNY DAY! Students can compare this type of energy to the candle and magnifier.

PROPOSE EXPLANATIONS

13. Ask students which of the energy sources was nonrenewable/renewable. Reinforce why.

14. Which energy source cooked the most marshmallows? What are advantages and disadvantages of using this energy source?

ASK NEW QUESTIONS

15. Ask students about other limits of other energy sources. What are other ways to cook marshmallows. Are these methods renewable or nonrenewable? What are the limits to using them?

Marshmallow Prediction Chart

Energy Source	Predicted Number of Marshmallow that Will Cook in 3 Minutes	Actual Number of Marshmallows that Cooked in 3 Minutes
Candle		
Magnifying Glass		
Solar Cooker		

Now You're Cooking!

Name ____________________

Date______________________

Using a Candle

1. How many pieces do you think could be cooked by the candle?

2. How many pieces were cooked by the candle?

3. Did the results surprise you? Why or Why not?

4. Can the candle be used again and again?

5. Do candles pollute the air?

6. Are candles quick to cook with?

7. Can you use candles to cook at any time of night or day?

8. Is the candle a renewable or nonrenewable source of energy?

Using the sun

9. How many pieces do you think could be cooked by the sun?

10. How many pieces were cooked by the sun?

11. Did the results surprise you? Why or why not?

12. Can the sun be used again and again?

13. Does the sun pollute the air?

14. Is the sun quick to cook with?

15. Can you use the sun to cook with at any time of day or night?

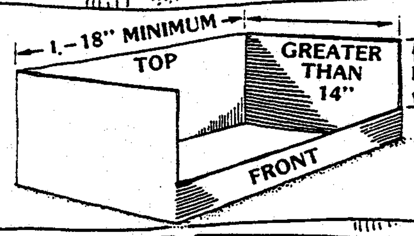
16. Is the sun a renewable or nonrenewable source of energy?

HOW TO MAKE A PARABOLIC SOLAR COOKER

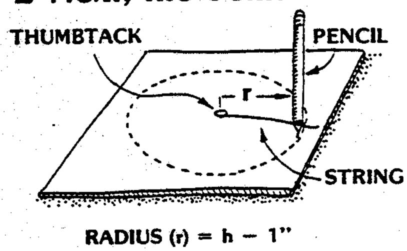
1 Begin with the Frame

You'll need a cardboard box that is strong and in good condition. A long, rectangular box will work better than a short, square one.

Cut the top and front out of the box as shown. The size of this box will determine the size of your cooker.

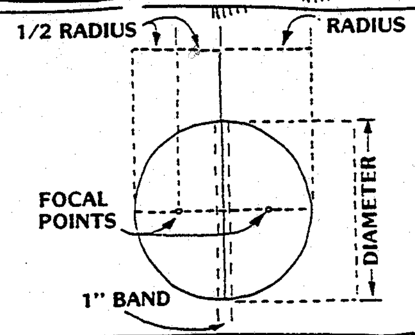


2 Next, the Semi-Circular Ends

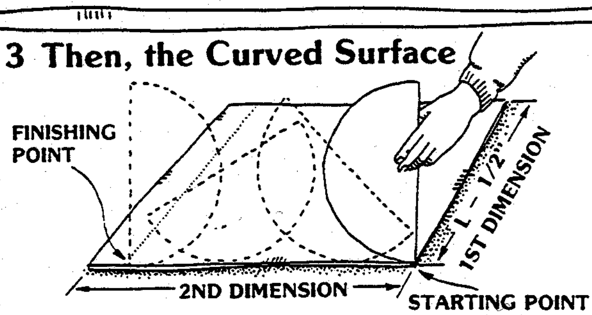


Cut a circle out of cardboard with a radius that is 1" less than the height of the front opening (h) of the frame box.

Locate the focal points as shown and cut out a 1" band, centered along the diameter.



3 Then, the Curved Surface



You'll need another piece of cardboard for this part.

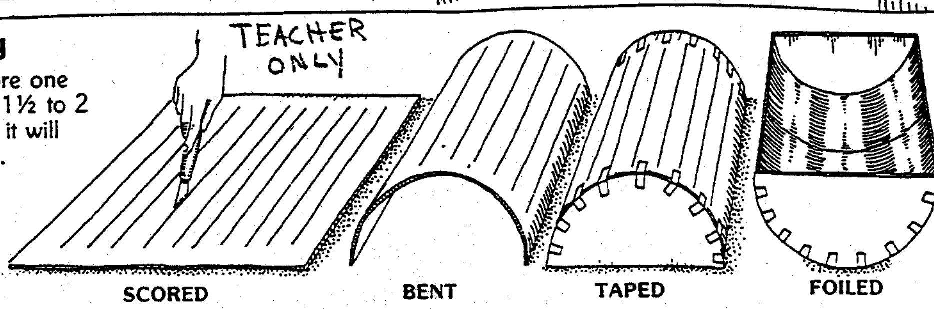
The first dimension you need is about 1/2" shorter than the length of the frame (L).

The second dimension is a little more difficult. Start the point of the semi-circular end piece as shown and roll the curved edge along the other unmeasured edge of the cardboard. Be careful not to slip or scoot it. Mark where the other point ends (and maybe add about 1/2"). This distance is your second dimension.

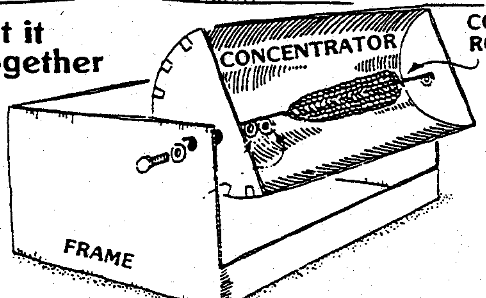
4 Scoring and Taping

After cutting this piece to size, score one side (but don't cut through) every 1½ to 2 inches with lines as shown so that it will bend easily around the end pieces. Tape the end pieces to the curved piece and cover the inside with aluminum foil. Rubber cement works well for htis, just be sure to read directions.

TEACHER ONLY



5 Put it Together



Take an unpainted thick wire and hold over a flame to burn off any excess oily substance, then push wire through the focal points of the curved concentrator to make the cooking rod.

HOW TO BUILD A SOLAR BOX COOKER

Supplies Needed:

2 Cardboard boxes (homemade, scavenged or bought).
- Inner box should be at least 15" x 15" (38 cm x 38 cm).
- Outer box should be larger all around, but it doesn't matter how much bigger as long as there is an inch (2.5 cm) or more of airspace between the two boxes. The distance between the two boxes does not have to be equal all the way around.

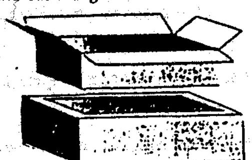
1 8 ounces of white glue or wheat paste
1 small jar of black tempera paint or 1 small black tray (paint it black with non-toxic paint)
1 small roll of aluminum foil
1 oven cooking bag (Reynolds is recommended
Newspaper

Building the Base

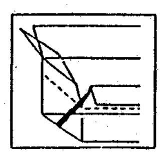
1. Fold the top flaps closed on the outer box and set the inner box on top.

2. Trace a line around it onto the top of the outer box.

3. Remove the inner box and cut along this line to form a hole in the top of the outer box (Figure 1).

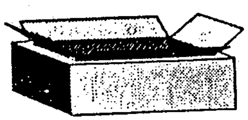


4. You can adjust how deep you want your oven to be by slitting the corners of the inner box down to that height. Fold each side down forming extended flaps (Figure 2). Folding is smoother if you first draw a firm line from the end of one cut to the other where the folds are to go.



5. Glue foil to the inside of both boxes and also to the inside of the remaining top flaps of the outer box. The inner box will be visible even after assembly, so you might want to take more time here. Glue the top flaps closed on the outer box.

6. Tear up newspaper sheets in fourths and crumple each piece into a lemon sized ball. Place some wads of crumpled newspaper into the outer box so that when you set the inner box down inside the hole in the outer box, the flaps on the inner box touch the top of the outer box (Figure 3). Glue these flaps onto the top of the outer box. Trim the excess flap length to be even with the perimeter of the outer box. The base is now finished.

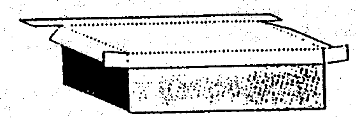


Building the Lid

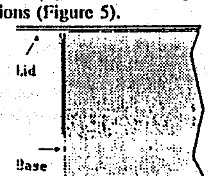
1. Take the large sheet of cardboard and lay it on top of the base.

2. Trace the outline and then cut and fold down the edges to form a lip of about 3" (7.5 cm).

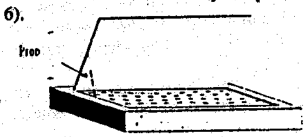
3. Fold the corners around and glue (Figure 4).



4. Orient the corrugations so that they go from left to right as you face the oven. Later the prop may be inserted into the corrugations (Figure 5).

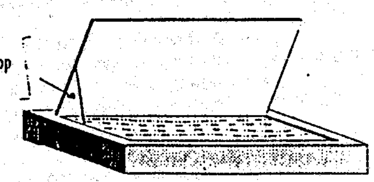


5. One trick you can use to make the lid fit well is to lay the pencil or pen against the side of the box when marking (Figure 6).



6. To make the reflector flap, draw a line on the lid, forming a rectangle the same size as the oven opening.

7. Cut around three sides and fold the resulting flap up framing the reflector (Figure 6) and apply foil to the flap on the inside.



8. To make the prop bend a 12" (30 cm) piece of hanger wire shown in Figure 6. This can then be inserted into the corrugations as shown.

9. Turn the lid upside-down and glue the oven bag in place, without opening it up. This makes a double layer of plastic. The two layers tend to separate form each other to form an airspace as the oven cooks. When using this method, it is important to also glue the bag closed on its open end. This stops water vapor from entering the bag and condensing. Alternately you can cut any size oven bag open to form a flat sheet large enough to cover the oven opening.

10. To make the drip pan, cut a piece of cardboard, the same size as the bottom of the interior of the oven and apply foil to one side.

11. Paint this foiled side black and allow it to dry.

12. Put this in the oven (black side up) and place your pots on it when cooking.

Improving Efficiency

The oven you have built should cook fine during most of the solar season. If you would like to improve the efficiency to be able to cook on more marginal days, you can modify your oven in any or all of the following ways:

1. Make pieces of foiled cardboard the same size as the oven sides and place these in the wall spaces.

2. Make a new reflector the size of the entire lid.

3. Make the drip pan using aluminum flashing and elevate this off the bottom of the oven slightly with small cardboard strips.

Instructions provided by:

Solar Box Cookers Northwest
7036 18th Ave. NE
Seattle, WA 98115 USA
(206) 525-1418

Ready to Cook!!!!

1. Put your food in covered black pots in the solar box cooker with the lid on.
   You can use any kind of cookware with solar energy, but dark, lightweight cookware heats up faster. Shiny steel or aluminum pans are less efficient because they reflect heat away from the food. Heavy pottery dishes take longer to heat up, but once hot, it holds the heat better.

2. Aim the box so the shiny side of the lid reflector faces where the sun will be in late morning (lunch) or early afternoon (supper). Tie the prop to hold the lid reflector where it shine the most sunlights into the box.

3. WARNING: Temperatures inside the cooker can reach 300 degrees Fahrenheit. Do not leave the cooker unattended in a place where it could be disturbed by others.

4. Food cooks better:
   - On a warm sunny day in late spring, summer or early fall
   - if you put it towards the back of the box
   - if you adjust the cooker often so that its shadow lies directly behind it
   - if you divide the food up into small pots

5. You need not stir the food while it is cooking. If you open the box during cooking, be careful of the high temperatures inside.

6. Most of all, put the food in early, and don't worry about overcooking, solar cookers seldom overcook.

7. Don't use aluminum foil around your meat or vegetables, or as a cover for a casserole. The aluminum foil will reflect the heat away from the food.

8. How to position the solar cooker. Locate the most sunny and wind-sheltered place in your yard or patio. When you get up in the morning and decide to cook with the sun, think not only of meal planning but also about what kind of solar day it is. If it's exceptionally clear and sunny. Go out and set up you oven and focus it so it will be hot and ready to go when you decide to cook.

9. Perhaps the biggest difference between your kitchen oven and your solar oven is that the heating element of the one in the kitchen stays still, while the sun, which heats your solar oven, is always moving. It moves slowly, but you'll have to remember to move the oven or reflector cooker occasionally to keep the heat where you want it.

10. The morning sun is very low in the sky, so aim your cooker low to catch its rays. The same is true in late afternoon, and sometime before sunset we are done with solar cooking because the sun it too low. Aiming the solar oven and reflector stove is done by watching shadows and is very easy. Observe the sun and see how fast the sun moves and how to adjust the oven for desired temperatures and best results. The oven is pointing directly at the sun.

11. With experience you will be able to aim the cooker to get the best results. If you have a sunny spot available, there can even be snow on the ground as long as the sun is shining brightly. The temperature of a solar cooker is determined more by the amount of sunshine then the outside air temperature.

12. Solar ovens reflect a lot of heat and a great deal of light. You should always wear sunglasses when cooking because of the light intensity. The glasses protect your eyes and make it easier to see inside the oven.

Energy Conversion

Activity 7: Leaf Relay

Activity 8: Energy Conversions

Activity 7 **LEAF RELAY**

CONCEPT Energy moves through food chains.

GOAL Students will learn how energy is “lost” when transferred from one system to another.

MATERIALS **Items listed in bold type must be supplied by the teacher.** Enough **dry leaves or popcorn** for each group of five to have an armful, handful. (You can also use handfuls of sand, beans or Styrofoam® packing peanuts, or anything else you can find in quantity,) **an open, fairly flat area.**

ACTIVITY

INVITE

1. Introduce students to a simple food chain by putting an example on the chalkboard. Example: sun-grass-sheep; explain that the sun provides energy for grass to grow and the grass provides energy [food] for sheep. OR, sun --> plants --> herbivores --> carnivores --> humans (unless vegetarian!)

DISCOVER/INTRODUCE NEW CONCEPTS

2. Discuss the following points:

- # the sun gives off energy that is used by plants
- # however, the plants don’t use all the energy the sun produces (only 2% is used by plants)
- # animals eat plants to get their energy
- # however, not all of the energy that was captured by the plant is still in the plant since it had to use some for its own growth and reproduction
- # with each transfer of energy, some is “lost” to the process of staying alive

It takes energy to get energy!

CREATE (a food chain) AND APPLY NEW KNOWLEDGE

3. Place the pile of leaves at one end of the site in a pile. Form teams of five students.

4. Have each team line up in a parallel line, with 2 to 3 feet separating each person, and several yards separating each group. The teams should be lined up about 100 yards away from the “energy pile.” Having groups in a large circle surrounding the “pile” of energy allows everyone to see what is happening, but it has to be big!

5. Assign one of the following roles to each student: The first person in line will be the sun; the second, a plant; the third, a herbivore; fourth, a carnivore; and fifth, a human.

6. Have each player, except the sun, mark their spots. Have the suns stand behind the “energy pile” facing their group.

7. Explain that the sun provides the energy needed in each of the food chains. Have the suns scoop up as many leaves as they can hold in their arms.

8. At the “go” signal, the suns race to the plants who (gently) grab as much of the suns’ energy as they can.

9. The plants pivot (they do not run), and the herbivores race up to grab as much energy as they can hold. The herbivores return to their spot. As soon as the herbivores return to their spot, the carnivores run up

and capture the energy from the herbivores. Continue with the humans. When the humans return to their spot, have them raise the remaining energy above their heads to signal that they are through.

GENERATE IDEAS FOR FURTHER INVESTIGATIONS

10. Look on the ground. What happened to the energy during transport and transfer? Compare the amount held by the first and last person. If there were fewer transfers, how much energy would the last person have? How could we make fewer transfers in obtaining energy in our lives? Take out the carnivore stage and compare the amount of energy left over.

11. Introduce environmental disasters like pesticides, floods, or oil spills at one stage. Have the students immediately drop half the leaves they are carrying. This represents the damage and the lessened energy taken up or transferred. Discuss the effects of having less energy for the food chain and survival problems.

Activity 8 **ENERGY CONVERSIONS**

CONCEPT Energy cannot be created or destroyed. It can only change forms.

GOAL Students will use sensory experiences to create an energy conversion grid.

MATERIALS **Items listed in bold type must be supplied by the teacher.** Solar cell, radiometer, light bulb, battery, electric motor, **Wintergreen Lifesavers™**.

ACTIVITY

INVITE

1. Begin by asking students to name some examples of energy forms. Remind them about MRS CHEN: mechanical, radiant, sound, chemical, heat, electrical, and nuclear.

2. Explain that energy is useful to people when we can "turn it into" some other kind of energy. For example, electricity is useful when we can use it to light a bulb. Food energy, like a candy bar, is useful when we eat it and let our stomach digest it so we can move.

BRAINSTORM IDEAS, PRACTICE TECHNIQUES

3. Hand out "Energy Changes" worksheet.

4. Point out that the worksheet has three of the energy forms that were just talked about. Tell them that you are going to demonstrate some ways that energy changes into a different kind of energy. Students are to figure out into which box the demonstration belongs. The chart, when completed, will look something like the one below:

LIGHT	ELECTRICITY	MOTION
	SOLAR CELL	RADIOMETER; PUPILS DILATING WHEN LIGHTS ARE TURNED ON; PLANTS MOVING WITH THE SUN (CALLED PHOTOTROPISM)
LIGHT BULB		ELECTRIC MOTOR HOOKED TO BATTERY
LIFE SAVERS	STATIC (SPARKS)	

APPLY NEW KNOWLEDGE

5. Go in any order using the following steps as guidelines:

SOLAR CELL: Explain that the sunlight strikes the solar panel which creates electricity.

BULB: Electricity flows to the filaments in the bulb causing them to glow.

ELECTRIC MOTOR: When hooked to a battery, the electricity causes the shaft to spin.

LIFESAVERS SPARKS: Give each student a lifesaver. Turn out the lights. The darker the room the better. As students crunch down on the lifesaver (motion), it makes a spark, (light).

STATIC ELECTRICITY: If your room has a rug, you can demonstrate this more easily. Have a student take off his/her shoes and scoot his/her feet across the rug. Have him/her touch a metal object like a desk or pencil sharpener to illustrate static charge.

RADIOMETER: When light strikes the wings of the radiometer, it transfers heat to each one--but not to the same degree. The lighter wing reflects the rays, and the dark wing absorbs the rays. When freely moving particles of air inside the radiometer strike the light colored wings, they take on very little energy and do not bounce off very fast. (Remind students that black t-shirts on a hot day are warmer than a white t-shirt. The hotter something is, the more the particles that make up the object move around.) But, when particles strike the dark wings, they take on a great deal of energy and "kick" away at terrific speed. The result is the movement of the wings in a circle from black to white.

PHOTOTROPISM: Plants move throughout the day to receive light energy. Observe a flowering plant in the morning as it sits in a windowsill. Observe it again in the afternoon and notice how the plant has changed position relative to the sun. Another example is to turn out the lights in the classroom. Have students form pairs and ask them to look at the pupils of the eyes of their partner. Let the room remain dark for 2 or 3 minutes. Then, count to 3 and turn the lights on. Students should see a shrinking of the pupil in their partner's eyes. This is a more abstract example of light energy creating motion (in the eye).

GENERATE IDEAS FOR FURTHER INVESTIGATION

6. Challenge students to come up with ideas of their own using the second table on their worksheet.

NAME____

ENERGY CHANGES

	LIGHT	ELECTRICITY	MOTION

HERE ARE SOME OF MY OWN ENERGY CHANGES. . .

Energy Conservation

Activity 9: Save or Waste?

Activity 10: New Old Paper

Activity 11: The Best Color

Activity 9 **SAVE OR WASTE? (This can also be used as a task assessment**.)

CONCEPT Energy can be conserved in various ways.

GOAL Students will list some ways to save energy. They will also identify activities that waste energy and practices that save (conserve) energy. Recycling is another way to save energy.

MATERIALS Items listed in bold type must be supplied by the teacher. "Save or Waste?" cut-up strips (CUT STRIPS AHEAD OF TIME), “Should You Shower or Bathe?” worksheet, **scissors, poster paper, markers**.

ACTIVITY

INVITE

1. Tell students there are many things we can do at home to stop wasting energy. Examples: it wastes energy to leave lights on in an empty room; it saves energy to turn off lights before leaving a room. Students can discuss other examples of conservation and wasting.

DISCOVER

2. Scramble up the energy-related behavior statements.

3. Distribute the statements among your students. Challenge the students with "wasting behavior” strips to match with the students who have the "saving behavior” strips, and visa versa.

4. Once students have found partners with the correct strips, have each pair read their strips to the rest of the class.

ANALYZE DATA

5. Be sure students understand how each corrective measure saves energy. Ask students what would happen if we didn't try to save energy. Lead them to understand that conservation extends energy resources, saves money, and protects the environment. These measures are particularly important until scientists and engineers can have renewable energy sources available on the scale to meet consumer needs.

TAKE ACTION

6. Have students complete “Should You Shower or Bathe?” at home. As you hand it out, be sure to have them make predictions before taking it home.

7 Have students report their findings to the class and keep a record on the board of which saved more water. Point out that not only can we conserve energy by heating smaller amounts of water, you are also saving a renewable resource - water.

8. Discuss one way to heat water--solar energy. What are the advantages? Disadvantages?

9. Create a class poster illustrating examples of saving/wasting energy. Glue or tape onto construction paper and hang in the room. Students can add to it as you continue with the unit.

SAVE OR WASTE?

SAVE	WASTE

Save or Waste?

It saves energy when you...

It wastes energy when you...

Use a pan the size of the burner on the stove.	Put a little pan on a big burner on the stove.
Cook many items in oven at the same time.	Cook only one item in oven.
Put lid on pan when cooking. It keeps heat in.	Leave lid off pan when cooking.
Keep oven door closed. Use a clock to tell when food is ready	Peek in oven while food is cooking.
Toast bread in toaster, not in oven.	Toast bread in oven, rather than in a toaster.
Stop cooking when food is tender.	Cook food longer than needed.
Run the washing machine with a full load.	Run the washing machine without many clothes in it.
Wash clothes in cold water when possible.	Wash clothes with more hot water than needed.
Take a shower, instead of a bath.	Fill bath tub to the top.
Wash and rinse dishes in two pans.	Wash dishes under a running faucet.
Fix the leaking faucet.	Have a leaking faucet.
Iron clothes all at the same time.	Iron clothes one or two items at a time.
Turn off TV or radio when noboby is watching or listening.	The TV or radio plays to an empty room.
Turn off lights that you don’t need.	Lights are on in empty room.
Close the curtains in the room you’re cooling.	The sun shines into the room you’re trying to cool.

Open and close the refrigerator door quickly.	Keep the refrigerator door open longer than needed.
When it is cold, wear warm clothes in several layers.	When it is cold, wear thin clothes.
When it is cold, close outside doors quickly.	When it is cold, leave outside doors open longer than needed.
Stuff rags, paper or rug in crack under outside door.	Have a crack under the outside door.
Have good insulation in outside walls and roof.	Have poor insulation in outside walls and roof.
Combine errands so that only one trip in the car is needed.	Take many trips in the car.

Name___________________________________

Should You Shower or Bathe?

Remember: It takes energy to heat the water in your bath or shower.

Purpose: When do you use more water: showering or bathing?

Prediction:
____

Procedure:
1. Take a bath. Fill your tub with water as usual. Before you step into the tub, measure the depth of the water with a ruler. The depth of the bath water is ____________ inches.

2. Take a shower (on another day). Before you begin, close the bathtub drain so the shower water will collect in the tub. When you have finished with your shower, measure the depth of the water that has collected. The depth of the shower water is _____________ inches.

Results:
3. What is the difference in inches in the amount of water you used?
____________ inches

Conclusion:

If people took _______________________ instead of _____________________

a lot of energy would be saved.

It's not only good sense to save energy, but you are also saving another renewable resource--water.

Activity 10 **NEW OLD PAPER**

CONCEPT Newspapers can be recycled and can save energy.

GOAL Students will learn recycling and conservation techniques by reusing paper as another way of conserving resources.

MATERIALS Items listed in bold type must be supplied by the teacher. Office paper--about 100 sheets, 2-gallon buckets or pans per group, embroidery screens, magnifying glass, **blender, water,** diapers, sponge, “Recyling Newspaper” diagram.

ACTIVITY (Note: This is a two-day activity.)

INVITE

Day One

1. Discuss with students where paper comes from. Discuss the cutting down of trees, transport to lumber mills, transport to the pulp mill, transport to the paper mill, and then to the people who are going to use it.

2. Discuss ways to conserve trees and energy, i.e., using the front and back of pieces of paper.

3. Making new paper from old paper uses half the amount of energy as making new paper from trees. It also saves trees. Saving trees helps clean up industrial pollution since trees absorb carbon from the atmosphere--not to mention all the animals’ homes provided by trees and how nice they are to look at!

CREATE/APPLY NEW KNOWLEDGE

4. Divide students into groups of 3 or 4. Give them a some old office paper. Tell them to shred the paper into quarter-sized pieces.

5. Fill the blender 3/4 full of water. Add a handful of shredded paper and blend. Repeat, adding handfuls at a time until the mixture resembles oatmeal. (If you wish to let each child make his/her own piece of paper, use smaller amounts.) This mixture is called **pulp.**

6. Fill the buckets or pans (or a janitor’s sink) with water.

7. Have a student take an embroidery screen and set it in the pan of water.

8. Pour the pulp from the blender into the pan so that it is on top of the screen.

9. Tell the student to carefully pull the screen upward making sure the screen stays parallel to the bottom of the pan. As the screen is pulled up, the pulp will stick to it. Pull it straight out of the water and let it drain.

10. Place the screen upside-down on a diaper. Use a damp sponge on the back of the screen to loosen the pulp from the screen and to push it onto the diaper. Carefully loosen and remove the embroidery screen and let the paper dry on the diaper. Give the screen to the next member of the group.

Day Two

11. Once the paper has dried, have each student carefully remove it from the diaper. Re-use the diapers! Students can write an advantage to recycling paper on this sheet. What are some disadvantages to this paper?

TAKE ACTION

1. Hand out “Recycling Newspaper.” Review the origins of paper and discuss logging practices.

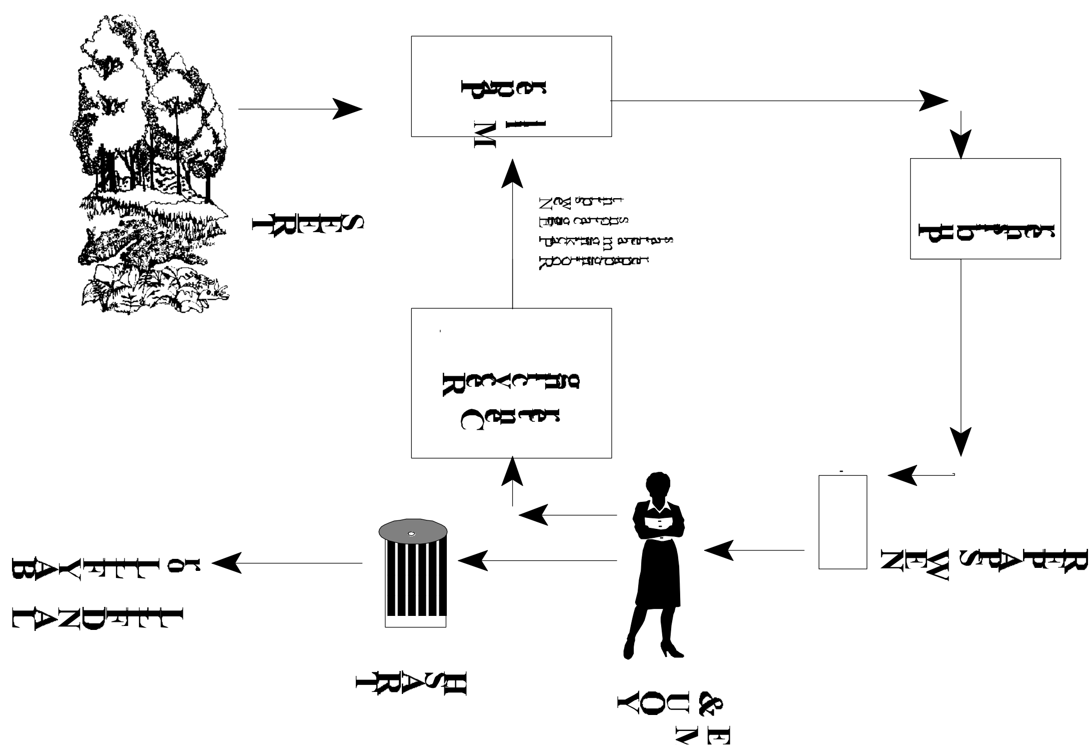
2. Where does paper go if we don’t reuse it? [To the landfill, which is costly. Also, space for landfills is becoming scarce.]

3. What happens if we all take our paper to the recycling center, but no one buys recycled paper products?

4. Talk about some of the problems of cutting down too many trees (e.g., increase global warming, loss of habitat, loss of scenic beauty).

5. Make an “accordian book” illustrating the steps on “Recycling Newspaper.”[An accordian book is made of square pieces of paper cut or folded with the right hand sides attached so that the sequence of recycling paper can read from left to right. The book is folded alternately along the right-hand side, leaving the first square (page) on top.]

Recycling Newspaper



Activity 11 **THE BEST COLOR**

CONCEPT There are many ways to conserve energy.

GOAL Students will explain that color can affect the absorption of heat energy.

MATERIALS Items listed in bold type must be supplied by the teacher. Ask students to bring in a clean soup can with the label removed and the top cut out. (You'll need one can per pair of students.) Flat enamel paints, thermometers, plastic wrap, rubber bands, Data Collection sheets, transparency of thermometers, transparency of Class Data Sheet.

ACTIVITY

INVITE

1. Discuss how color can be "hot" or "cold." What color of t-shirt would you wear on a hot day to stay cool?

2. Tell students they will be conducting an experiment to see which colors absorb the most heat energy. Students will need to work in pairs. Students choose one color to paint their soup can. Distribute paints, brushes, cans of water. (If students have difficulty with the term "absorb," use a sponge absorbing water as an example.)

EXPLORE, DISCOVER

3. Give each group a Data Collection Sheet.

4. Reteach/review how to read a thermometer. Use the transparency and explain that measuring temperature in Celsius (right hand side) or Fahrenheit (left hand side) will require they count by 2's. Have them turn to the second page of their Data Collection Sheet and explain how to mark the beginning and ending temperatures when they do the lab.

5. Put a thermometer in each empty can. Have them predict the final temperature for their color. Then place the cans in a sunny area with no drafts. Record the temperature every minute for 8 minutes.

ANALYZE DATA, PROPOSE EXPLANATIONS

6. Students record 1-minute and final temperatures, then complete the questions on page 2. The teacher records their results on the Class Data Sheet transparency. Students copy this data on page 3. Sequence the colors and their temperatures from lowest to highest.

7. Have students answer questions on the fourth page. Discuss the impact of color on heating. Where are there patterns? For example, did the dark colors result in higher temperatures? What effect did light colors have on temperatures? Have students classify colors into groups of high temperature and low.

PRESENT FINDINGS, GENERATE IDEAS FOR FURTHER INVESTIGATION

8. Repeat the same experiment but fasten plastic wrap tightly across the top of the can. Cut a small slit for the thermometer. Record temperatures for 8 minutes.

9. Discuss the "Greenhouse Effect" as a process where the Earth's atmosphere traps heat on the Earth's surface. The plastic cover represents air and clouds and increasing amounts of carbon dioxide. Carbon dioxide is a by-product of combustion, which is the process of burning fossil fuels. This is another reason

for pursuing renewable energy technologies as an alternative to fossil fuels since the greenhouse gases are increasing globally.

10. Experiment with different kinds of insulation. Use three cans and insulate one can with felt, one with aluminum foil, and place another can in a slightly larger glass jar. Repeat the activity above.

11. Test the inside of teachers' cars and see which colors make the inside hottest.

12. Place ice cubes on teachers' cars and see which colors cause the ice cubes to melt fastest.

13. Ask students the color of concrete [white or light colored]; asphalt [black]. Give them the following situation: their parents are getting ready to put in a driveway that will come up next to the side of the house that faces south. There are lots of windows facing south. Which kind of driveway should their parents put in--concrete or asphalt? Ask about the temperature inside the house on a hot summer day. Have students draw a conclusion about color and absorption of heat.

Name ____________________
Date ____________________

Data Collection Sheet

COLOR OF CAN:_______________________

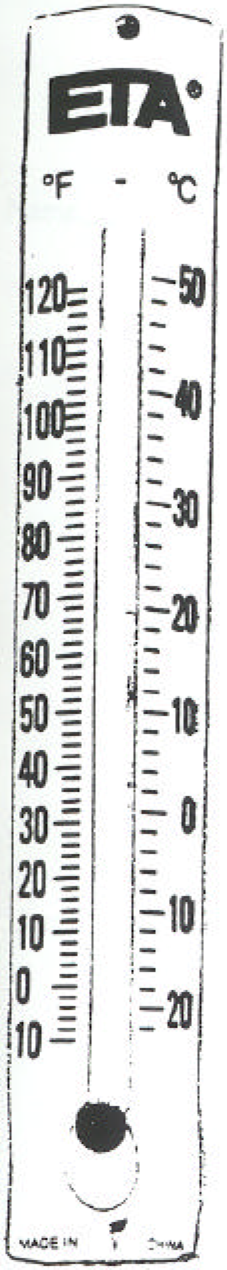
I predict that the temperature in the can will _________________________________

____.

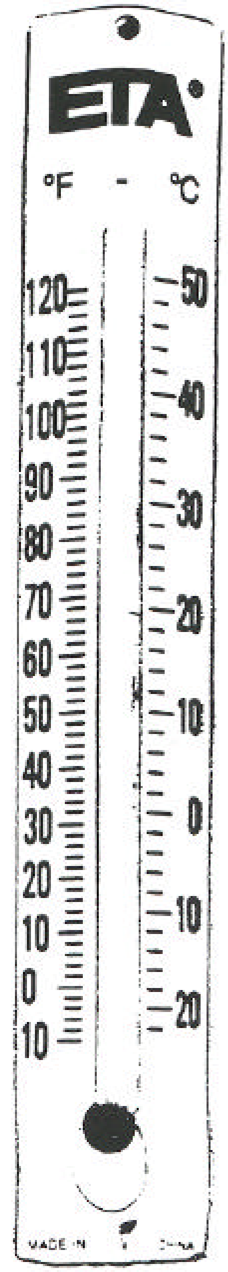
I predict that different colored cans will ____

____

Time	F	C
Start		
1 min.		
2 min.		
3 min.		
4 min.		
5 min.		
6 min.		
7 min.		
8 min.		



1 min.



8 min.

____
Color of Can

What happened with the temperature in my____________________can?
(color)

____

____

____

What happened with the temperature in my can compared to the temperature in different colored cans?

____

____

____

Name_________________________

Class Data Sheet

Color	High Temperature
White	
Red	
Yellow	
Blue	
Black	
Purple	
Orange	
Brown	
Green	
Turquoise	
Unpainted	

Sequence the colors and their temperatures from lowest to highest.

Name____________________

The Best Color

1. Which colors would be best for painting homes, schools, and other buildings to keep them warm in winter? Why?

____

____

2. Which color clothes would be warmer in the winter? Why?

____

____

3. Which color clothes would be cooler in the summer? Why?

____

____

4. How can choosing the best color save energy?

____

____

5. "The color of paint can affect the absorption of heat energy." Tell what this means in your own words, or explain how you know this is true.

____

____

Energy for the Future

Activity 12: Rain Machine

Activity 12 **RAIN MACHINE**

CONCEPT Solar energy can help purify water.

GOAL Students will see how impure water can be made clean using solar energy.

MATERIALS **Items listed in bold type must be supplied by the teacher.** 1 large plastic cup, 1 smaller paper cup, clear plastic food wrap, **small rock**, **salty water** (you may want the students to prepare the salty water)

ACTIVITY

INVITE

1. Ask students if they have ever taken a drink of seawater. As the human population continues to grow, the available fresh water supply becomes smaller. If the fresh water supply gets smaller, is there a way we can make seawater drinkable? Present students with a problem: if they were lost in a desert with no fuel or water, and the only water was in a salty pond, how could they survive?

2. Ask them if they know of a way to change saltwater into fresh water. Is there a renewable energy source that could be used? [solar energy] This may be an abstract question, but present it to them as "food for thought." (The process involves evaporation.)

EXPLORE, DISCOVER

3. Have students work in pairs. Have them fill a large plastic cup to a depth of 2 cm (about 1 inch) with salty water. Place the empty small paper cup inside the large cup. It will float.

4. Cover the plastic cup with clear plastic. Secure it tightly with a rubber band.

5. Put a small rock on the plastic wrap to make it sag in the middle, but don't let the rock touch the salt water or tear the plastic wrap.

6. Place the cup on a tray and put the tray in the sun (or outside if possible. As the water evaporates, notice the tiny droplets that condense on the cool plastic wrap and run down into the cup.)

ANALYZE DATA

7. After 3-5 days, check the cups by removing the plastic wrap. You can let students drink the water in the inner, small cup.

8. Discuss what happened. Write the word **evaporation** on the board. Ask them what happens to rain on a sidewalk after the sun comes back out. It doesn't "disappear" but it goes into the air as **water vapor**. This water vapor is the pure form of water. When water evaporates, it doesn't take any of the salts or minerals with it--just plain water. The salt is left behind.

ASK NEW QUESTIONS

9. How has renewable energy been used in this experiment? Where might you apply this "technology" on a big scale? Refer back to the problem asked in question #1.

10. Why does this water taste differently from tap water? What is in tap water? Have a student contact the city government to get the phone number of a supervisor of the water plant. Ask what minerals are in tap water.

Getting Energized

Assessments

GETTING ENERGIZED

STUDENT ASSESSMENTS

The following assessments are designed to be used at the end of the renewable energy activity unit. However, these activities are provided as *guidelines* for the teacher to use in developing appropriate measurement packages. Assessments can range from daily, weekly or final activities; they may be oral, written, multiple-choice, true-false, task-oriented, cumulative, diagnostic, etc. Please use these ideas and add or delete according to your needs.

A sample rubric is included on page 85. Again, it is important for teachers to adapt scoring guides to suit the needs of their students.

On page 86, a "pledge certificate" also has been included. NREL encourages teachers to promote the continuation of energy saving practices by their students.

GETTING ENERGIZED
STUDENT ASSESSMENTS

ASSESSMENT #1
QUIZ: ENERGY - WHAT IN THE WORLD IS IT?

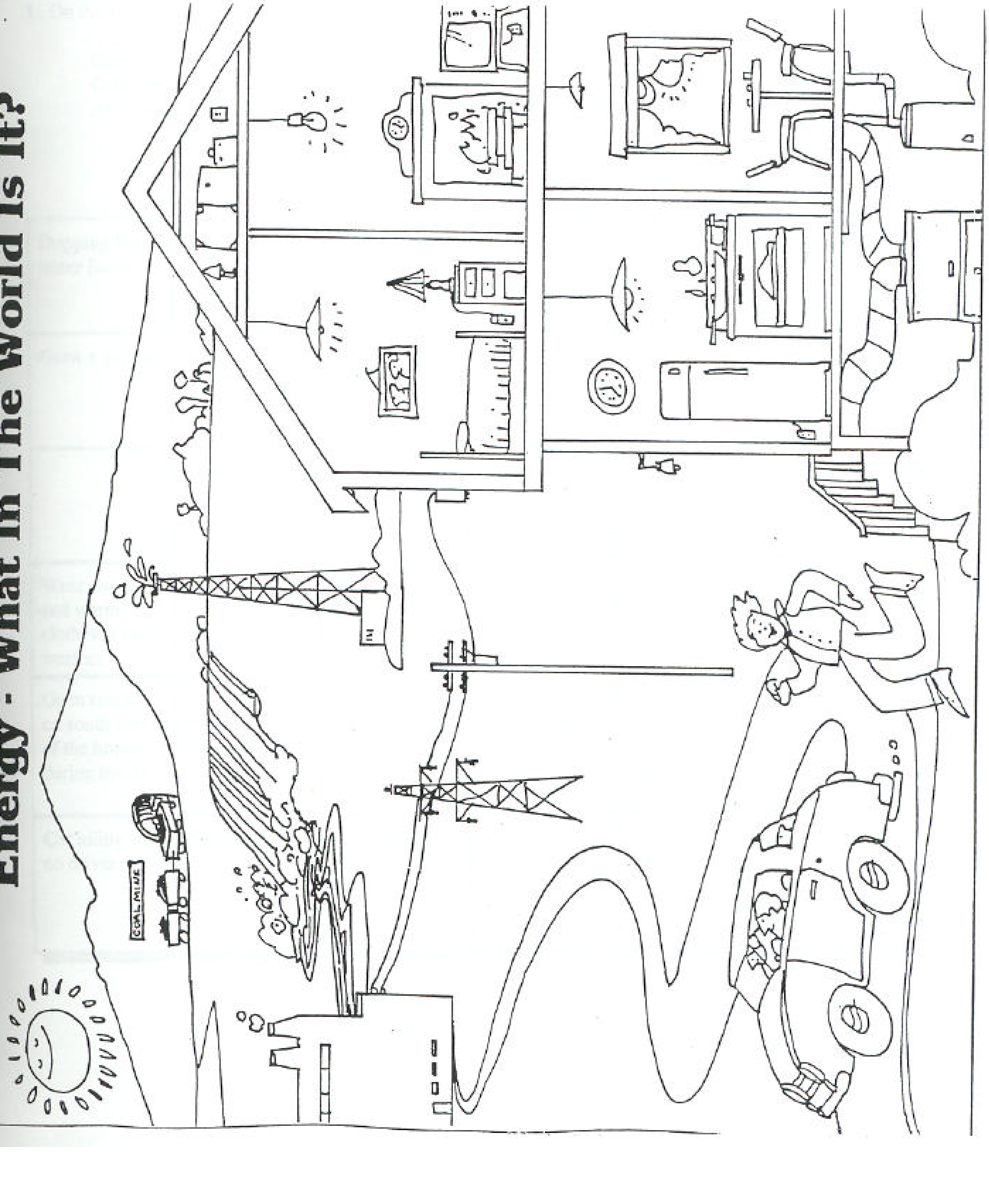
1. Students have learned about various energy sources. Additionally they have learned to distinguish nonrenewable and renewable energy sources. They have learned that one form of energy can be transformed into another form. They have learned that energy is the power to make things move; energy creates light; and energy makes heat. Energy is the ability to do work.

Have students color the picture using the following key:

Color the source of all energy (the appropriate color).

a. Color GREEN the things that move
b. Color YELLOW the things that light.
c. Color RED the things that give off heat.
d. Put a BLUE CIRCLE around all renewable energy sources.
e. Put a BROWN CIRCLE around all nonrenewable energy sources.
f. Put a PURPLE "F"where food energy is being transformed into the energy to run.
g. Put a BLACK "G" where the energy in gasoline is causing the object to move.
h. Color ORANGE where taking the energy source causes landscape changes.
I. Mark three places with "EE" where electrical energy is being converted into light energy.
j. Put an "N" where natural gas energy is being changed into heat energy.

Energy - What In The World Is It?



ASSESSMENT #2
CONSERVATION QUIZ

1. On the grid below, have students color boxes according to the following guidelines.

   Color the blocks RED which show a waste of energy.
   Color the blocks YELLOW which show saving energy.
   Add ideas of your own to the empty boxes and color them correctly.

Dripping hot water faucet	Room with thermostat set at 68ºF or lower		Lights on in an empty room	Car making a quick stop or start	
Grow a garden	Electric blanket	TV off when no one is watching		Car pool	Electric can opener
	Fluorescent lights	Lamps with 150 watt bulbs	Car with only one passenger		Take showers instead of baths
Wear sweaters and warm clothes in cold weather		Ride your bike instead of taking the car	Electric toothbrush	Cars speeding over 55 mph	Outside lights left on during the day
Open curtains on south side of the house during the day	Full loads in the washing machine		Use both sides of a piece of paper	Close windows and doors with heat or air conditioner on	
Car idling with no driver	Electric knife	Hang clothes outside to dry		Recycle paper, glass and metal	

ASSESSMENT #3
QUIZ: WHO'S THE COOLEST?

1. Give each student the picture and some crayons.

2. Explain that the picture is an experiment. The squares on the sidewalk are pieces of construction paper of different colors. The thermometers have been sitting on each one for 15 minutes in the hot sun. The two students have recorded the temperature on each square of paper. Using this information, color the squares according to this key:

2 squares are white
1 square is black
1 square is yellow
1 square is blue

OR

TASK: WHO'S THE COOLEST?

1. Use this as an experiment your students can do. Pick a sunny day!

2. Ask students to answer: WHICH COLOR WILL STAY THE COOLEST?

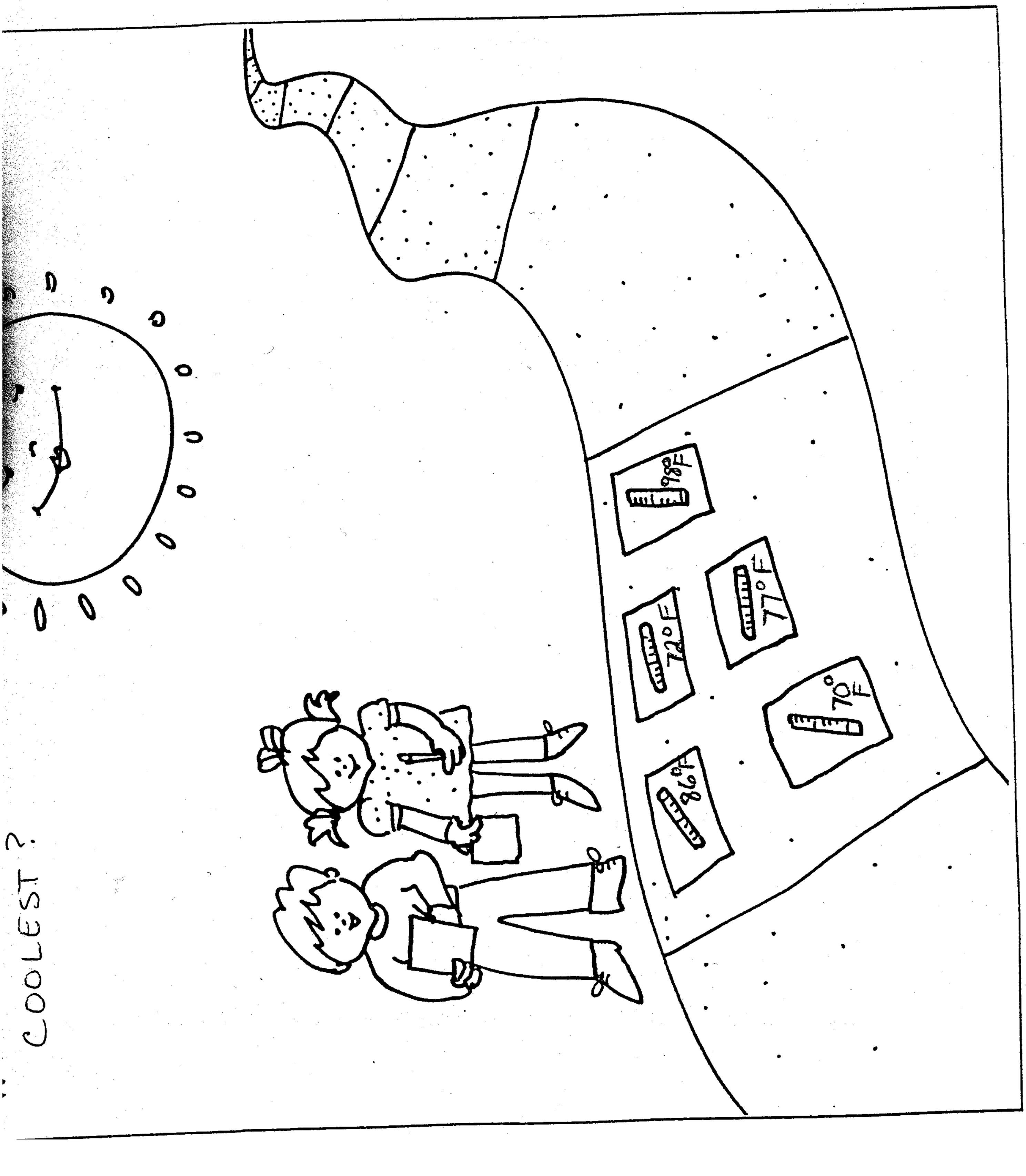
3. Give each student a thermometer. Have them work in groups of 3-5.

4. Let them choose 3-5 colors of construction paper to test for their group. [Paper can be cut to one size, i.e., 4" x 5" or you can purposely give them different sizes. See #6 below.]

5. Hand out the Task Lab Sheet. Students must complete all parts including the graph and conclusion.

6. Explain that this is a **controlled experiment** where one variable is manipulated while all other variables are controlled or kept the same. [For example, the color of the construction paper is a variable that will be manipulated whereas location, time of day, amount of sun, size of paper, orientation of paper, type of thermometer, etc. are all kept the same.]

7. Conclusions should identify the lighter colored paper as being the coolest.


COOLEST ?
98°F
72°F
77°F
70°F
86°F

Name____

TASK: LAB SHEET

TITLE: ____

PURPOSE: TO FIND OUT "WHICH COLOR WILL STAY THE COOLEST?"

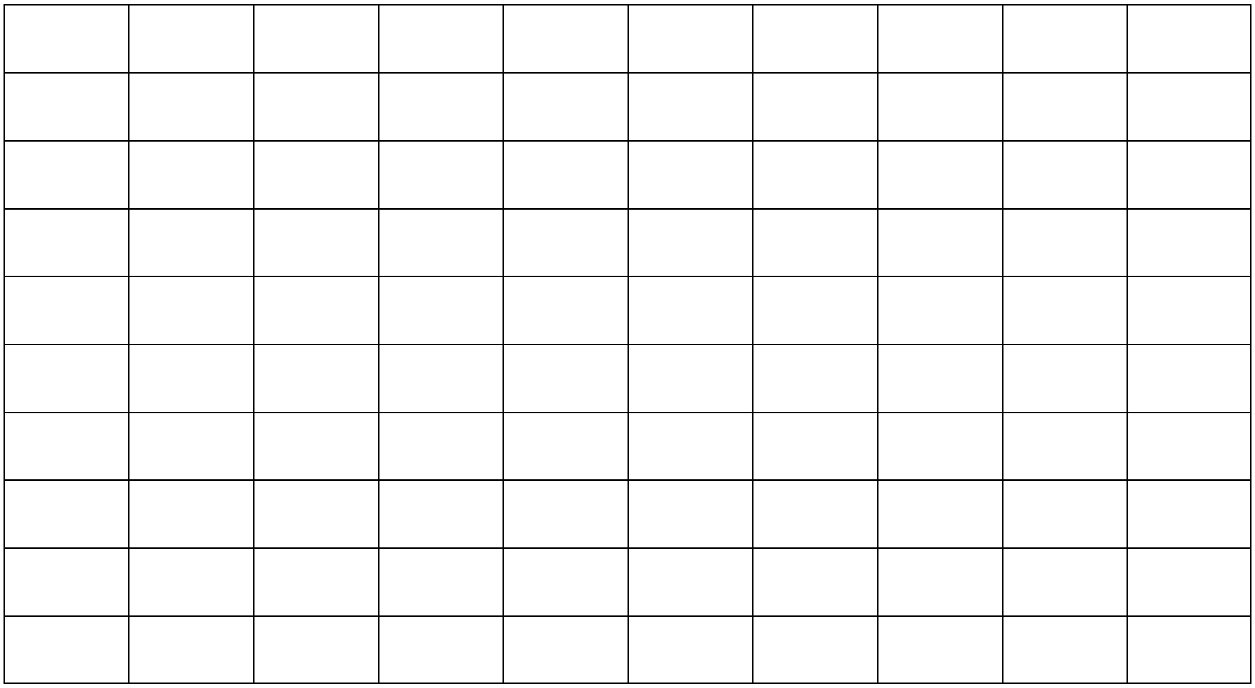
HYPOTHESIS: I THINK ____

____

DATA TABLE

Graph and Conclusion (over)

GRAPH



0

Time

CONCLUSION:

THE COOLEST COLOR IS ____

BECAUSE ____

____.

ASSESSMENT #4
TASK: KEEP IT COOL

1. Challenge students to design an insulation system that will keep an ice cube for 2 hours.

2. Students can try Styrofoam®, black cloth, white cloth, yellow wrapping paper, packing peanuts, newspaper, paper towel, tape, aluminum foil, etc. The insulated ice cube will then be placed in a plastic cup with the student's name on it and left for 2 hours in a place *chosen by the teacher*.

3. Controlled experiment: Students will vary the kind and amount of insulation. The teacher will control the size of ice cube (1 per student--try to get them the same size), size of cups (from Activity #12), location of cups, and length of time (2 hours).

4. Bring in a measure up or teaspoons to record the amount of water in the plastic cup after 2 hours. Share the results with the class--however, no names need to be used. Indicate each cup by a number followed by the amount of water that melted.

5. Students need to complete the accompanying lab form.

Name____

LAB: KEEP IT COOL

PURPOSE: TO FIND OUT WHAT MAKES THE BEST INSULATOR

HYPOTHESIS: I THINK ____

____

DATA TABLE

CONCLUSION:

IN MY EXPERIMENT, ______________ TEASPOONS OF WATER MELTED.

THE BEST KIND OF INSULATION WAS _________________________________

_________________________________ BECAUSE ______________________________

____

.

Rubric for Task Assessments

Getting Energized
Activities for Elementary Grades 3-6

General Scale for Scoring Student Performance

SCORE	DESCRIPTION
5	Beyond expectations--quality of work is unusually high and beyond expectations
4	Meets expectation--skill is mastered to the level of expectation
3	Almost there--skill is almost mastered but with minor problems
2	The skill is present but with errors and omissions
1	The skill is absent

I, ________________________

do solemnly pledge to

conserve________________

by________________________

____

____

starting on this__day of 19____.

____________ ____________

Signature Witness

Getting Energized

Activities for Elementary Grades 3-6

Evaluation

In our continuing effort to improve our education programs, the Center for Science and Education at NREL would appreciate your taking a few minutes to complete the following evaluation. **Please return this form with the box of unused materials. Thank you.**

School ______________________________ School District_______________________________

Approximate Ethnic Distribution of your Class:

_____% African American _____% Hispanic _____% Asian

_____% Native American _____% Caucasian _____% Other

Gender Distribution of your Class: _____% Girls _____% Boys

1. With what grade level did you use this material? 3 4 5 6 Other (specify)_____

2. What was the length of time you needed to teach the entire kit? ___________ days

Please circle the number that is the most appropriate response to the question.

	Strongly Agree				**Strongly Disagree**	
3. The Teacher's Activity Guide was organized and easy to follow.	5	4	3	2	1	n/a
4. Background information was clearly written and was useful in understanding the content area.	5	4	3	2	1	n/a
5. Key terms were explained, understandable and useful.	5	4	3	2	1	n/a
6. The activities, overall, were useful in motivating students.	5	4	3	2	1	n/a
7. The activities were appropriate for 3-6 grade level.	5	4	3	2	1	n/a
8. The assessments, overall, provided useful feedback on student progress.	5	4	3	2	1	n/a
9. The kit of materials was well supplied and helped in the teaching of the activities.	5	4	3	2	1	n/a

Over, please. . .

Please rate each of the activities according to your overall sense of the ease of implementation, appropriate level of content, and student motivation.

	Excellent		Fair		Poor	
11. Activity 1: Learning About Enery	5	4	3	2	1	n/a
12. Activity 2: Energy Talk -- Part 1	5	4	3	2	1	n/a
13. Activity 3: Energy Talk -- Part 2	5	4	3	2	1	n/a
14. Activity 4: How Long Will It Last? -- Part I	5	4	3	2	1	n/a
15. Activity 5: How Long Will It Last? -- Part II n/a		5	4	3	2	1
16. Activity 6: Now You’re Cooking!	5	4	3	2	1	n/a
17. Activity 7: Leaf Relay	5	4	3	2	1	n/a
18. Activity 8: Energy Conversion	5	4	3	2	1	n/a
19. Activity 9: Save or Waste	5	4	3	2	1	n/a
20. Activity 10: New Old Paper	5	4	3	2	1	n/a
21. Activity 11: The Best Color	5	4	3	2	1	n/a
22. Activity 12: Rain Machine	5	4	3	2	1	n/a
23. Student Assessment #1	5	4	3	2	1	n/a
24. Student Assessment #2	5	4	3	2	1	n/a
25. Student Assessment #3	5	4	3	2	1	n/a
26. Student Assessment #4	5	4	3	2	1	n/a

Please add any additional comments below. (If you have changed the format of any activity or if you have developed your own assessments/rubrics, please include a copy with this evaluation. We will include it in the next edition of the **Getting Energized Activity Kit**.)