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ABSTRACT

This publication contains descriptions of the winning entries to the National Science Teachers Association (NSTA) Teacher Participation Contest conducted in 1976. This was a nationwide contest for the design of activities around energy themes at any grade level, K-12. The ten winning entries described here are: (1) Energy Units for Primary Grades; (2) Aluminum Recycling Experiment; (3) Energy in Art and Energy is All Around Us; (4) Black Gold; (5) Energy, Economy, Education; (6) Local Investigation in Container Use; (7) Kill A Watt; (8) Idea: Designing an Energy-Efficiency House; (9) Solar Heating and Cooling; and (10) Living with Wind Power. Many of these winners are designed for the senior high school. Each one has included a brief summary of what the activity teaches, what the students do, and how the activity might fit into the existing curriculum. (MR)

ERHQ-0011

Award Winning Energy Education Activities

For Elementary and High School Teachers

Energy Research & Development Administration

NOTICE

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Award Winning Energy Education Activities

Edited by Helen H. Carey

This booklet contains brief descriptions of the winning entries to the NSTA Teacher Participation Contest conducted in Spring 1976. This contest was part of a project in energy education sponsoted by the Education Programs Branch, Office of Public Affairs, U.S. Energy Research and Development Administration. The material is the responsibility of the authors and the National Science Teachers Association.

1977

National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, D.C. 20009

An important part of NSTA's Project to Develop Classroom Materials (K-12) on Energy Education Themes, which was supported by the Education Programs Branch of the Energy Research and Development Administration (ERDA), was the announcement in the Spring of 1976 of a nationwide teachers' contest for the design of student activities around energy themes. The contest was open to any teacher, in any discipline, and at any grade level.

What NSTA was looking for were ideas for activities which would fit easily into standard courses of study, and would, at the same time, further student understanding of important energy issues.

This booklet provides a brief description of each of the 10 winning entries which a panel of judges selected. We would like to pass these teaching ideas along, with the hope that they will stimulate other classroom activities. We encourage you to try out these teachers' ideas in your own classroom, and pass the word to your teaching colleagues.

Panel of Judges

Gentry Ann Brady (Elementary)
Greenville, North Carolina

Phyllis Brock (High School)
Conyers, Georgia

Helen Carey (Jr. High School)
Adelphi, Maryland

Gaye Chappel (High School)
Chesapeake City, Virginia

Phillip Gay (Jr. High School)
San Diego, California

Vance A. Criswell (Elementary)
Timonium, Maryland

Edith Gladden (Elementary)
Philadelphia, Pennsylvania

Alma Jean Harder (High School)
Wilmington, Delaware

John Layman (High School)
College Park, Maryland

Barbara McClure (High School)
Columbia, Missouri

Carolyn Clark Newsom (High School)
Wilmington, Delaware

Patricia Sommerkamp (Jr. High School)
Ft. Mitchell, Kentucky

Award Winners	Energy Idea	Grades	Page
Gracia Brown	Energy Units for Primary Grades	2-3	1
Ronald G. Crampton	Aluminum Recycling Experiment	9-12	4
Kathy B. Erickson	Energy in Art	10-12	6
	Energy is All Around Us	2	10
Rosanne Fortner	Black Gold	7-12	18
George R. Gross	Energy, Economy, Education	7-12	19
Gary W. Laird	Local Investigation in Container Use	7-12	21
Diane Margotto	Kill A Watt	8	24
Dale Raths	Idea: Designing an Energy-Efficiency House	10-12	30
Paul Sniffin	Solar Heating and Cooling	7-12	32
Elizabeth Wooten	Living With Wind Power	3-5	35

ENERGY UNIT FOR PRIMARY GRADES

Second and third graders learn about energy and its uses, with a series of hands-on experiences. Students make pinwheels, kites, and murals showing the geothermal action of volcanoes. The unit correlates science, reading, vocabulary-building, language arts, and geography.

by Gracia Brown
Lone Pine School, Medford Oregon

WHAT IS ENERGY?

Try these ideas with your students:

GETTING STARTED

1. For one class period make a list of the ways people used energy during a school day 100 years ago. (Use pictures of old school houses and of recess games around the school yard, etc.) Have students make statements about differences between then and now.

2. Make a list of the ways muscle energy is used each day. Ask: Do we use less muscle energy today than children of 100 years ago? Can you think of machines that now do the work people once did by lifting, hauling, pulling and dragging things?

3. Decorate a shoe box using an energy theme and lettering. Have your students find and cut out pictures related to energy. Pictures of electrical appliances, cars, large machines, etc. should go into the box. Have them make a statement about what energy does. "It makes things go" may be considered a sufficient definition for young children.

4. There are many films available that describe the nature of energy. After viewing, have each student write one fact about energy on an index card. Put the cards in the Energy Box. Later, have students use these cards as captions for some of the pictures and show these on an energy bulletin board.

WHAT ARE OUR MAIN SOURCES OF ENERGY?

W is for WATER POWER

Think of a question beginning with the letter W about water power. This should be a question that you are really curious about or would enjoy finding the answer to.

1. Show pictures of rivers and dams. Ask your students to make statements about what would happen in a very dry season. What was on the land before the dam was built? Why can't water power be used by people everywhere? Consider other limits of water power. Make wide use of maps and pictures.

FOSSIL FUELS

2. Begin a mini-book of the sources of energy with pictures and vocabulary words about water power. Make this Chapter One. Chapter Two will take up fossil fuels.

OIL

Put the word How on the chalkboard. Ask students to think of a question that begins with this word about the subject of oil. Point out the letter "o" in How - o for oil.

1. Hold up a picture of a power plant. Ask: How is oil used to make electricity? Take students outside to the parking lot. Ask questions about oil in making asphalt. Discuss heating oil for homes. Help students discover that gasoline is made from oil.

NATURAL GAS

2. Introduce the topic of natural gas by looking at cooking gas burners in the school cafeteria.

3. Use the bulletin board to illustrate the other wide uses of oil products, especially in making plastics.

COAL

4. Bring in a piece of coal and have students list many facts about coal. Where it is found, how it got in the ground, how it is gathered (mined), its main uses, and its effects on the environment.

5. Discuss the limited amounts of fossil fuels.

CONVERTED ENERGY

Hold up the picture of the power plant again. Have the class discuss why an electrician or an electrical engineer might work in this place. Discuss electricity as converted energy. At this point, introduce household appliances as a topic and discuss what would happen if all of a sudden there was no oil, natural gas, or coal. What would make electricity?

WHAT ARE THE ENERGY SOURCES FOR THE FUTURE?

What are some of the ways we use the sun's energy? Have students make a cardboard model of a solar cooker or a solar motor. Have them describe to the class how the sun makes these work. With some kits available, it is possible for a small group of students to make a solar-powered battery that will turn the wheel.

SUN

1. Show one of the many films available on solar energy. After the film, have your students make lists of the limits and problems of solar energy.

2. Use science kits and books to gather information about heat from the sun. Have students give oral reports on some things they learned about the sun's energy.

WIND

3. Patterns for making kites and pinwheels are available everywhere. Have students demonstrate the advantages, limits, and problems associated with wind power by making and using models: kites, pinwheels, tinkertoy windmills, etc.

4. Read some poems about wind. There are some good choral readings

that can be used with this topic, as well as some interesting articles in science magazines.

GEOTHERMAL STEAM

5. Energy in steam can be introduced by the topic of hot springs. Where and how have we used them in the past? Have students draw pictures of geysers, or make a large mural showing geothermal activity for the classroom. Have students make statements about the limits and problems of geothermal energy and place these in written form on the mural.

NUCLEAR

6. Nuclear energy can be introduced through a discussion of the kinds of electrical appliances it will help run. Try to help the students draw the inference that nuclear energy will be converted to electrical energy.

HOW CAN WE HELP SAVE ENERGY?

ENERGY CONSERVATION

7. Design and make a poster on the topic of Energy Conservation. Decide on a simple theme such as Save Electricity and illustrate your poster with drawings or magazine pictures. Write your slogan in large, easy-to-read letters. Other ideas to use as themes are: We All Need The Sun's Energy, Save Energy, Turn It Off, etc.

8. Take an energy tour of the school. Have pencils and paper handy to make lists of the ways energy can be saved in the school building.

NOTE: The NSTA Fact Sheets on Alternative Energy Technologies, a set of 19 four-page fact sheets ranging over a full list of technological options for the future is now available at low cost to teachers. Write to NSTA for information about these and other energy materials for teachers.

ALUMINUM RECYCLING EXPERIMENT

This experiment in recycling aluminum to foster energy awareness is designed for a high school chemistry class. It can easily be adapted for junior high school physical science or earth science classes.

by Ronald G. Crampton
Westside High School, Omaha, Nebraska

Is recycling just the matter of starting a recycling center and collecting a lot of cans, papar, and old bottles? Perhaps not. Perhaps commendable enthusiasms are not often coupled with a realistic understanding of the aspect of high energy use in recycling. In this experiment students consider whether conserving energy may have higher priority than the few pounds of material that can be salvaged from recycling. The first part of the experiment asks the students to consider, informally, the topic of recycling waste aluminum, and sets the stage for the second part where students compare the energy consumption in recycling with the savings in the amount of aluminum at the end of the process.

A procedure for this chemistry activity follows. (If it would suit your purposes to have the complete experiment, you can receive it by sending 75¢ to NSTA for a xerox copy.) However, this is just a brief outline of the experiment in recycling aluminum. At the conclusion of the experiment, you can expect most of the following goals will have been met.

General goals introduced and stimulated in the activity are to:

1. Provide the student with an opportunity to relate the recycling process to energy consumption, cost considerations, design feasibilities, and environmental advantages.

2. Provide an opportunity to observe a chemical change and to distinguish between a chemical change and a physical one.

3. Provide a method to synthesize the aluminum compound $KAl(SO_4)_2 \cdot 12\ H_2O_{(s)}$, from a piece of scrap aluminum foil.

4. Introduce chemical formulas and relate them to observations and events.

5. Familiarize students with laboratory equipment.

6. Introduce the metric system.

CHEMICAL REACTION OBSERVED: (summary)

$$2\ Al_{(s)} + 2\ KOH_{(aq)} + 6\ H_2O_{(l)} \longrightarrow 2\ KAl(OH)_{4(aq)} + 3\ H_{2(g)}$$

$$2\ KAl(OH)_{4(aq)} + H_2SO_4 \longrightarrow \underset{\text{white precipitate}}{2\ Al(OH)_{3(s)}} + K_2SO_{4(aq)} + 2\ H_2O$$

Rx-3 $2Al(OH)_{3(s)} + 3\ H_2SO_{4(aq)} \longrightarrow Al_2(SO_4)_{3(aq)} + 3\ H_2O_{(l)}$

After standing overnight, alum crystals should be present as shown in the following reaction:

Rx-4 $K^+_{(aq)} + Al^{+3}_{(aq)} + 2SO_{4(aq)}^{-2} + 12\ H_2O_{(l)} \longrightarrow KAl(SO_4)_2 \cdot 12H_2O_{(s)}$

<u>Note</u>: The appearance of the beautiful alum crystals will will interest the students and is an ideal opportunity to introduce some students to crystal grouping.

CHEMICALS:

$Al_{(s)}$ — 1. Piece of scrap aluminum foil (ask students to bring their own aluminum foil from home). Reagent

$KOH_{(aq)}$ — 2. Bottle of 1.5M potassium hydroxide solution. It requires 50 ml. for each studnet. The solution is prepared by adding <u>84</u> grams of KOH per liter of solution.

$H_2SO_{4(aq)}$ — 3. Reagent Bottle of 3M sulfuric acid solution. It requires 25 ml. for each student. The solution is prepared by adding <u>168</u> ml. of concentrated H_2SO_4 per liter of solution.

$Ca(OH)_{2(s)}$ — 4. Small jar of solid calcium hydroxide

5. Bottle of dirty water

6. Ice

EQUIPMENT:

- 250 ml beaker
- glass stirring rod
- 100 ml graduated cylinder
- hot plate
- mortar and pestle
- filter paper to fit
- the filtering apparatus
- spatula
- small ruler
- wire gauze
- 400 ml beaker

ENERGY IN ART

> This unit of learning experiences focuses on the impact that energy will have on our architectural structures in the future. Secondary school art students (grades 10,11,12) learn to correlate design and energy efficiency.

by Kathy Erickson
Richmond, Virginia

The unit <u>Energy in Art</u> helps students explore architectural changes, examine building materials, recycle discarded objects, and compute energy efficiency in household appliances. The teacher uses easily obtained materials and needs very little outside preparation in implementing <u>Energy in Art</u> into intermediate art classes, grades 10-12. By this time, students should have had some contact with energy and the sources of energy in science classes. Most will have acquired some competence in basic drawing, composition, perception of space, color values, and some understanding of architectural styles. They probably have learned the elements of 3-D sculpture in beginning art classes. This unit provides for the further development and maintenance of these skills.

It will be helpful to the teacher using the unit to examine carefully the overall organization of the unit before starting to use it. There are five lessons, but each could be taught separately if the teacher wishes. At the conclusion of the entire unit students should be able to:

1. explain the importance of energy in art.
2. explain some of the effects energy use will have on architectural styles in the future.
3. define an energy efficient building.
4. compute wattages of appliances and equipment in use in classroom, and use this information when the time comes to purchase home appliances.
5. recycle junk into art sculptures.

Possible conclusions can take the form of student drawings of future homes and office buildings. In these drawings students must consider the concepts of mass, space, plane, texture, and proportion. They should be prepared to explain how the design is energy efficient and what effects the design may have on life style and on the environment.

Junk sculpture projects must be undertaken without the aid of power tools. A display of the sculptures affords a graphic presentation of the key concepts of Energy in Art.

Lesson 1. <u>Energy</u>

Objective: Students should be able to develop original ideas about communicating energy through art.

Materials: Record player, record albums, water colors, paint brushes, pans, water color paper (four sheets per student.)

<u>Getting Started.</u> Ask: What is energy? What are some energy sources? What are some ways we use energy in the classroom? Is energy used whenever we create a work of art?

<u>Activity</u> Play four different beats or tempos using suitable recordings. Have students watercolor to the beat using the following art elements: form, color, line, and texture to create a picture. Each picture should reflect a different tempo and style.

<u>Follow-Up</u> Does music release energy?

Do wave lengths have anything to do with energy?

If so, how? How did music affect the aesthetic value of each painting?

Can you tell from the painting that it reflects a specific beat of music?

Lesson 2. <u>Future Architecture</u>

Objective: Students should be able to determine how energy availability has been reflected in architectural styles.

Materials: Pictures of solar houses, underground schools, picture of a module; drawing paper and pencils.

<u>Getting Started.</u> Ask: What ways has architecture changed over the last years? Look at the type of structures that presently exist and look at the construction devices that governed the form, and of the impact technology has had on the design of buildings. Ask: How have building materials changed from then to now?

<u>Developing the Lesson:</u>

What does it mean to have an energy-efficient building? How can a home be made more efficient?

How will solar energy devices affect styles of architecture? (Show pictures of solar heated/cooled homes.)

How aesthetically pleasing are they? (Show a pleasant-appearing underground school building.) What effect on energy efficiency would you gain by building a school this way? Does this kind of building affect visual pollution? (Explain this term.)

In what ways do you think new products such as plastics, new steels, urethane foam will affect future architecture styles? How will modules change the style of architecture? (Show picture of a module.)

Activity Draw a future home. Consider what sources of energy will most likely be used in 2000 A.D., and new building materials. Plan your home for maximum attractiveness and liveability. Consider concepts of mass, space, plane, texture, and proportion.

Lesson 3. Energy in Architecture (Continued)

Complete drawings of futuristic home. At the end of the class period, each student will explain his drawing and list the energy source. Explain how the designs show a consideration of energy efficiency and protects the environment.

Lesson 4. Appliance Efficiency

Objective: Students should be able to determine energy efficiency and discuss its importance in class and at home.

Getting Started. Ask: What does it mean if you say an appliance is an energy-efficient one? How is efficiency rated? (Appliances are rated on a scale from one to twelve, with rating number twelve being the highest or the most efficient rating.)

Ask: How many of you use energy efficient appliances. Show students how to find the wattage of an appliance or equipment by locating a label on the appliance indicating the volts and amps (ampere) and then multiplying it as follows:

______ x ______ = ______
Volts Amps Watts

Activity-Part 1 Ask students to locate various pieces of equipment in the classroom and to compute their wattage.

Chart the wattage figures for each piece of equipment on the blackboard.

Discuss ways that each piece of equipment can be replaced by either using hand-powered models or whether it would be better to purchase new pieces of energy-efficient equipment.

Activity-Part 2 Students will design a three-dimensional sculpture project with the following specifications:

1. The sculpture should consist of space, form, and texture using found junk objects. These objects should be recycled into a very aesthetic piece of sculpture.
2. It should be constructed without the aid of using powered tools that use electrical energy.

3. Sketches for the junk project will be due by the next class period. A description on the method of creating the sculpture and the type of materials to be used must be listed on the back of the sketch. Students should bring in junk objects for the next lesson.

Lesson 5. Junk Sculpture

Check with the instructor to see if the materials used for the sculpture is junk and will not need additional energy to reproduce. The only other means of energy to be used is that of the student.

Students will be permitted to start their 3-D sculptures and to work on these for 10-45 minute sessions. At the completion of the sculpture, each student will be required to list the various pieces of junk used in the sculpture. Then they will be asked to list the sources of energy needed to make that piece of junk sculpture. The list of junk with the sources of energy and a title of the piece of art will be placed beside the sculpture in a special exhibit on energy in the school display case.

About Evaluation

Watercolors should be evaluated on the student's ability to react to the music and the energy activity. The student will also be evaluated on his facility to handle a paint brush, his sensitivity to ranges of color value, his understanding of composition, and his perception of space. The student will also be evaluated on his ability to follow directions.

Energy efficient house drawings will be evaluated on imagination, line, form, their perception to space, and the student's facility in handling drawing instruments.

The sculpture will be evaluated on originality to use junk objects and to make them into an interesting piece of 3-dimensional sculpture using good skill performance.

Resources

The Futurist, October 1975 Magazine

Creating Energy Choices for the Future, U.S. Energy Research and Development Administration.

ENERGY IS ALL AROUND

This series of five lessons introduces advanced second graders to the primary sources of energy and their main uses, as well as alternate sources--wind, nuclear, tidal, and geothermal. The activities encourage children to "get involved" with energy--feel it, see it, draw it, conserve it.

by Kathy Erickson
Richmond, Virginia

Lesson 1. What is Energy?

What will you need?

1. piece of coal
2. plastic toy
3. chalkboard, overhead; redrawn pix
4. hand-out #1

What Will Students Do?

Answer these:

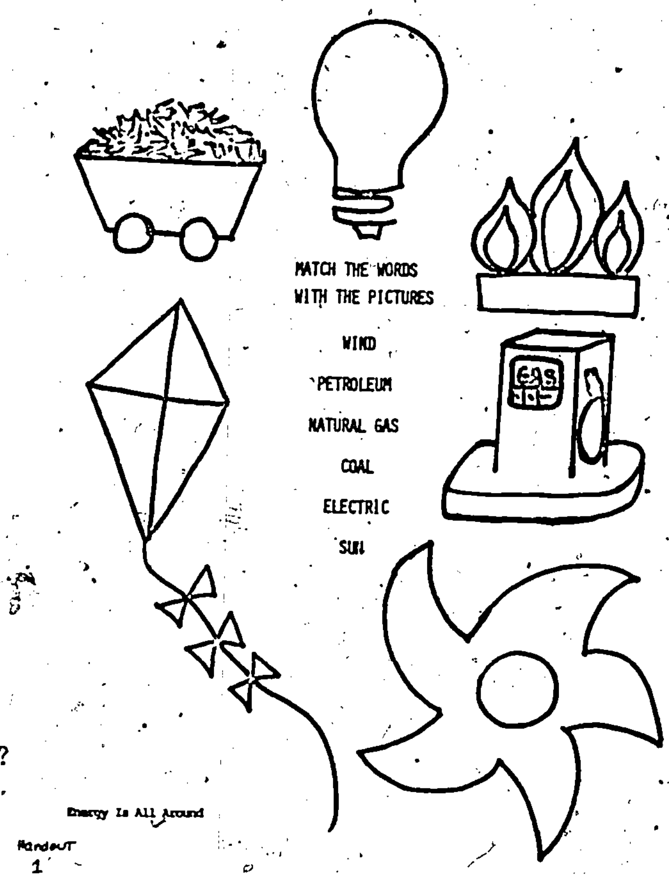
1. What is energy?
2. Do we use energy? In what ways?
3. How do we get our energy?
4. Where is our energy stored?

Ready for a fun way to learn?

Stand and Do: Hopping
Clapping
Sway back and forth

Can we think of other ways to use energy?
(Class suggestions are acted out)

Activity



Match the words with the picture.

Another Energy Activity

Guess Who? ? ?
Who uses energy?
Who uses coal? What do we use coal for?
Who uses natural gas? What for?
Who uses toys like these? (plastic toy; oil based)

Lesson 1. What is Energy? (Continued)

What are our main sources of energy? Let's see if we can remember.

- Sun (Solar energy)
- Coal (Show piece of coal)
- Natural gas (It is odorless, colorless)
- Oil (Show can or container of sample. Talk about gas stations.)

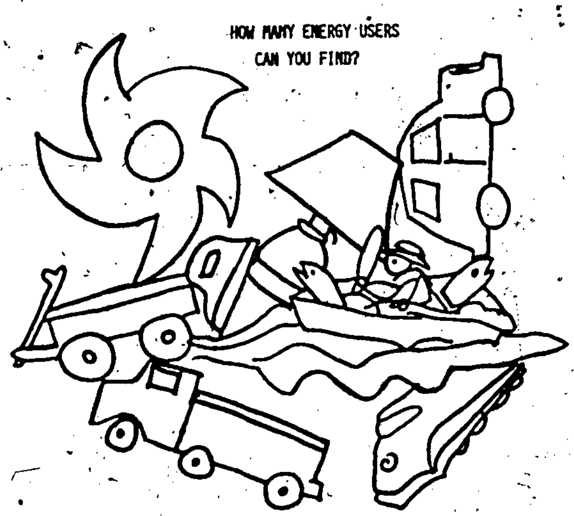
We also have alternative sources. They are: Wind, Nuclear, Tidal, Geothermal

How does the body use food for energy? Let us see how?

Lesson 2. Conserving Energy

What will you need?

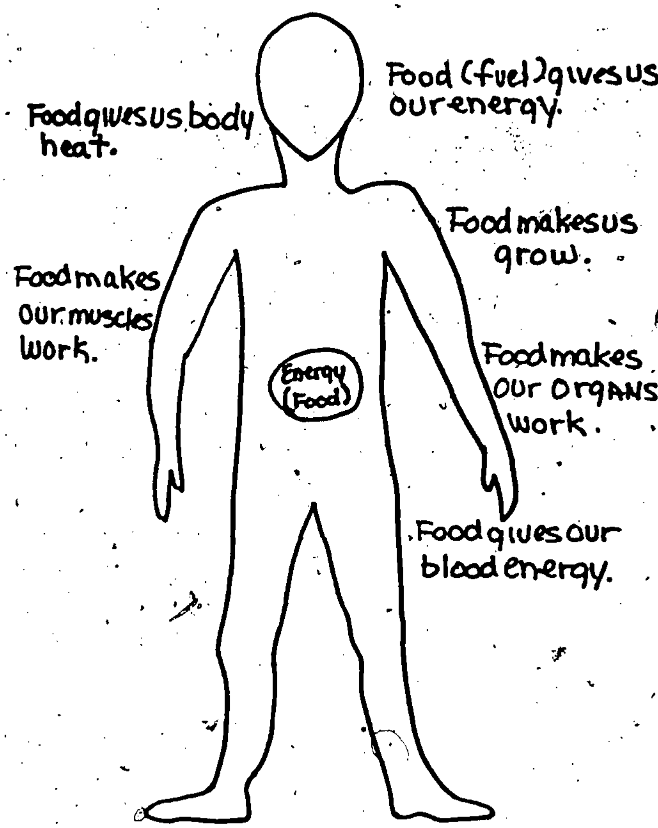
1. Class set of Handout #2 (see below)
2. Pictures or slides that show energy being conserved. (see ideas next page)
3. Find energy users. Use some of pictures next page.



FILL IN THE BLANK AND NAME THE SOURCE OF ENERGY.

1. B _ A T
2. T R _ C K
3. I _ O N
4. _ U N
5. L A _ P
6. T R A _ N
7. C _ R
8. W _ G O N

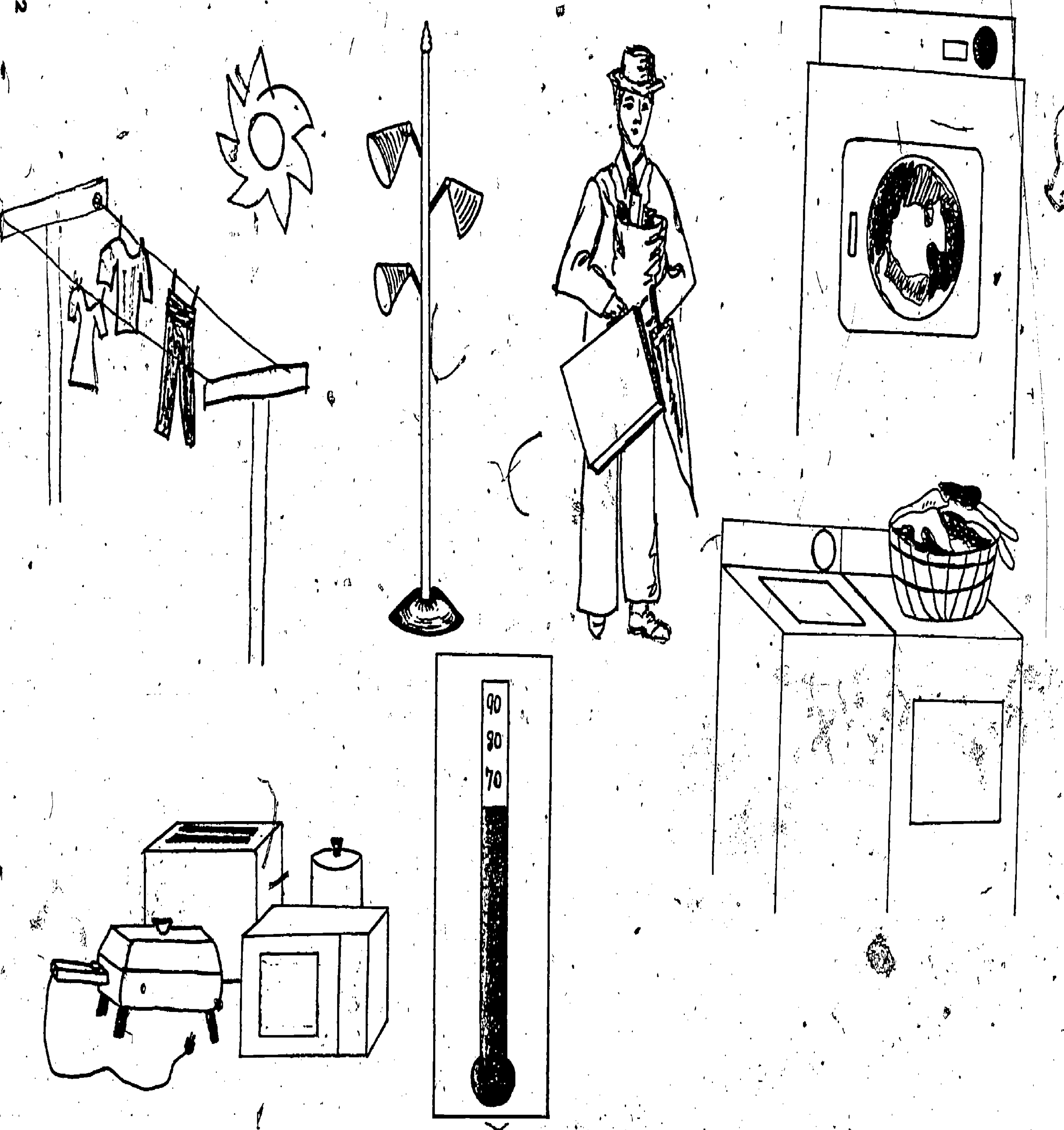
Handout 2



FILL IN THE BLANKS. FIND ENERGY USERS.

Another Energy Activity

Talk about ways to save energy.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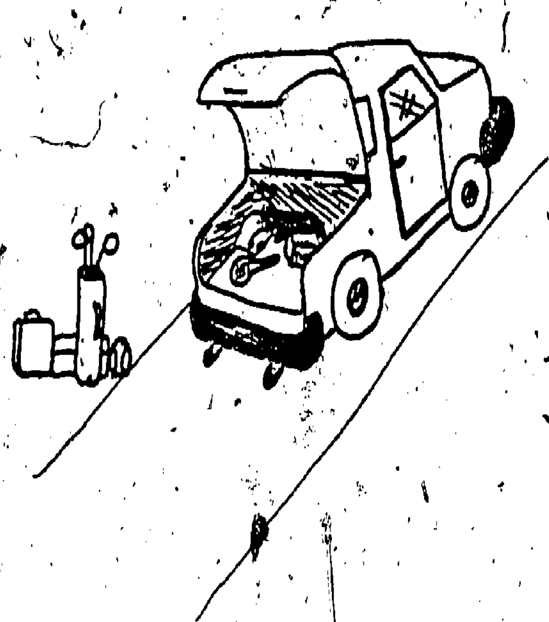

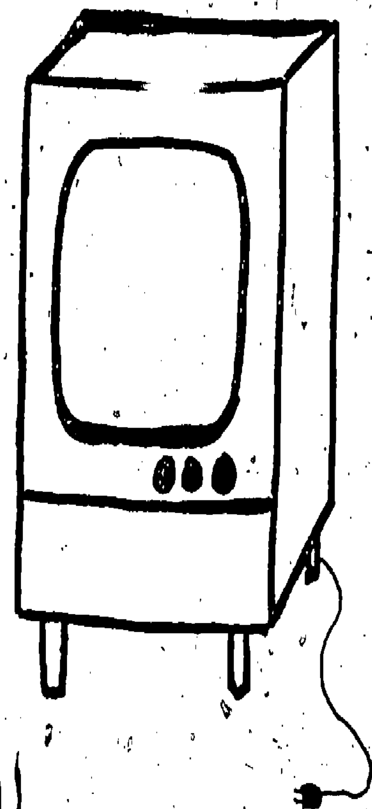

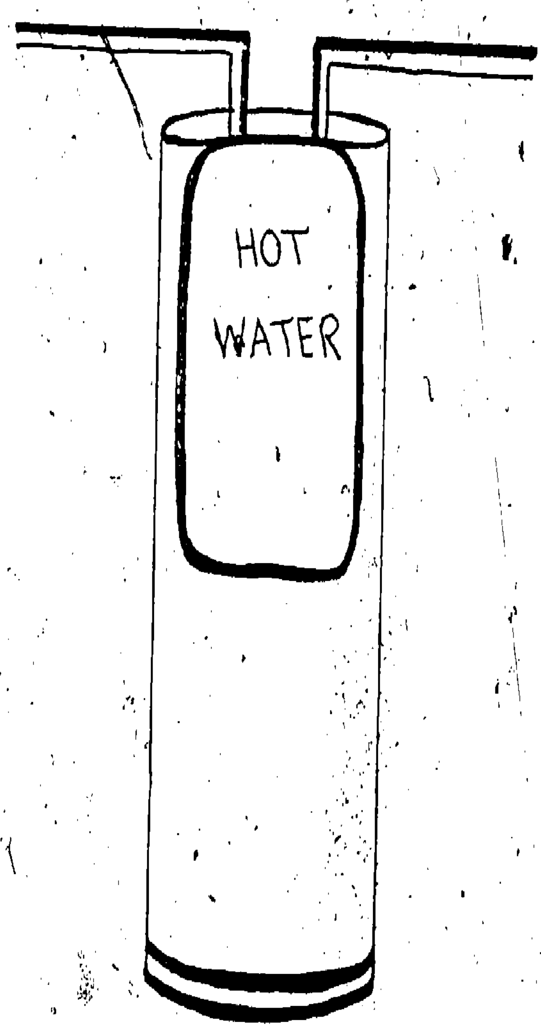
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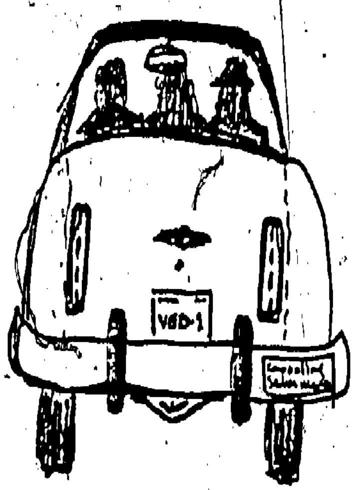
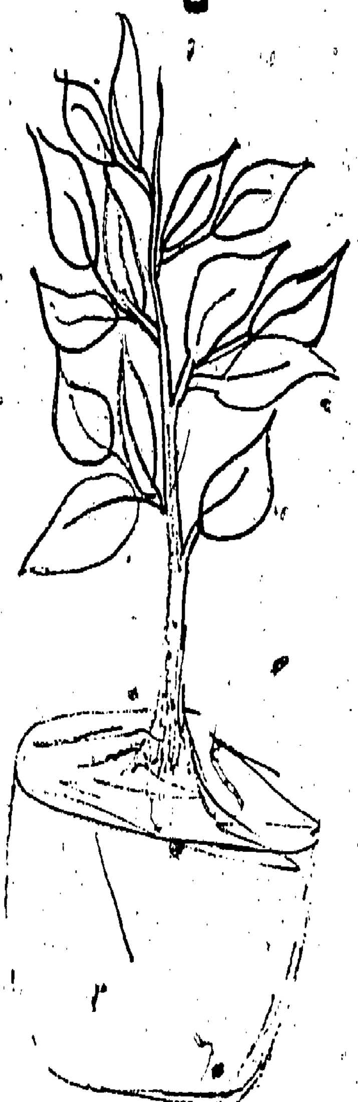
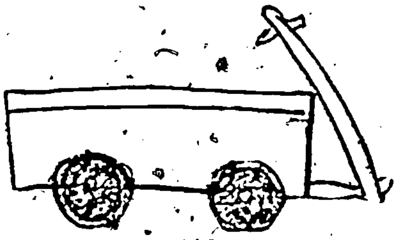
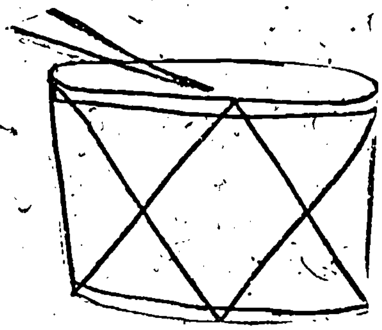
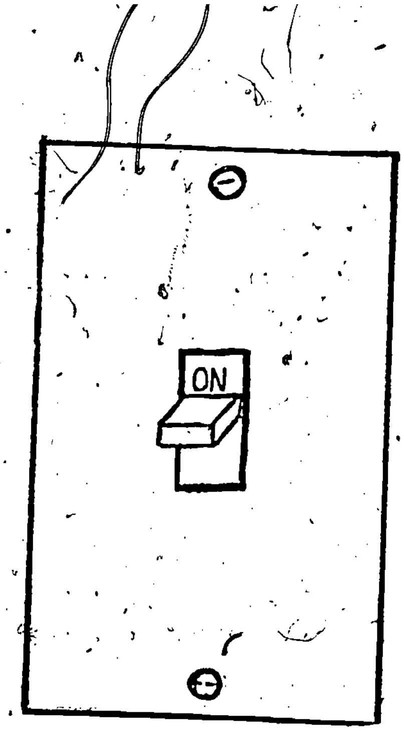
WATER







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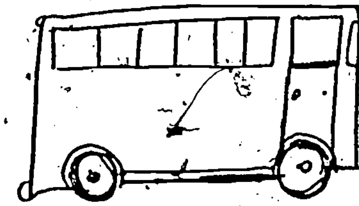

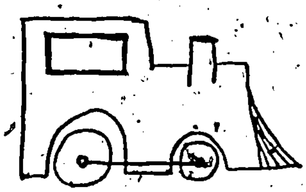

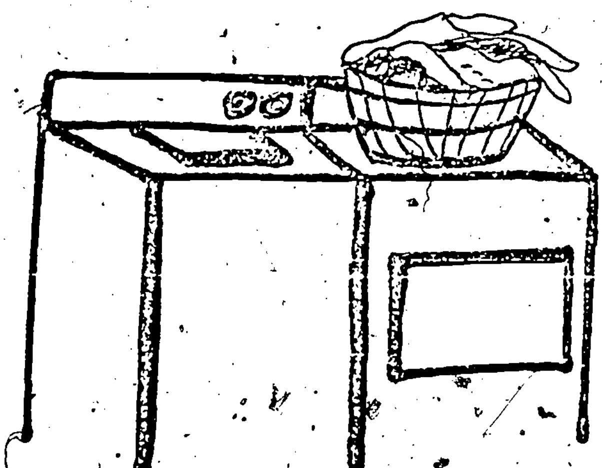

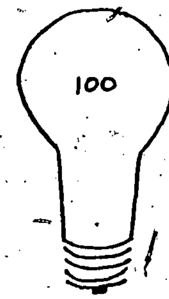
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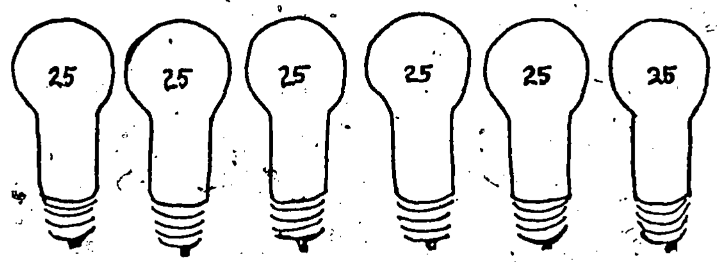
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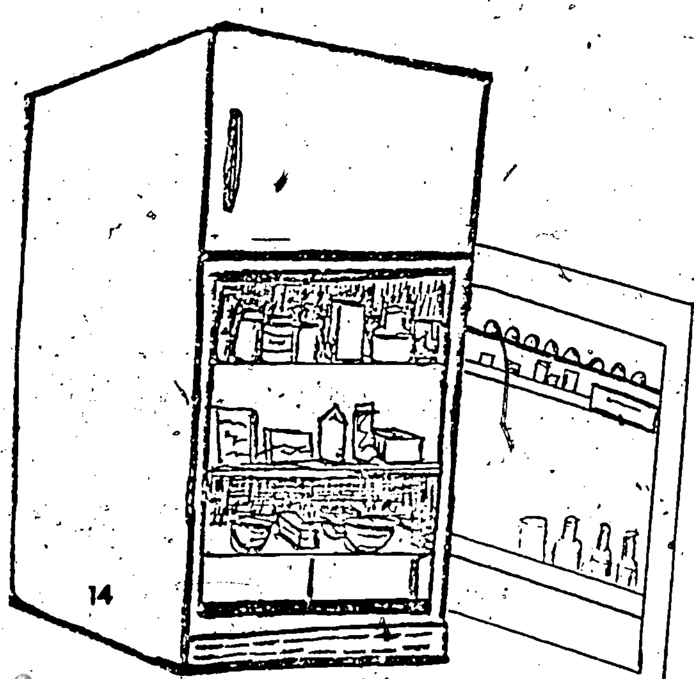
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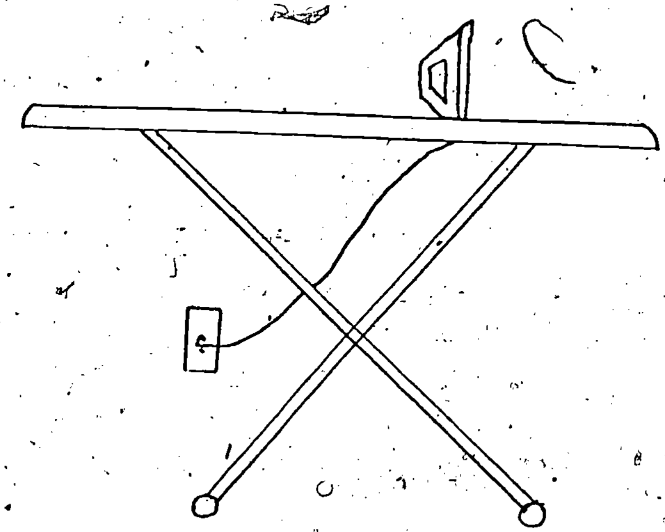
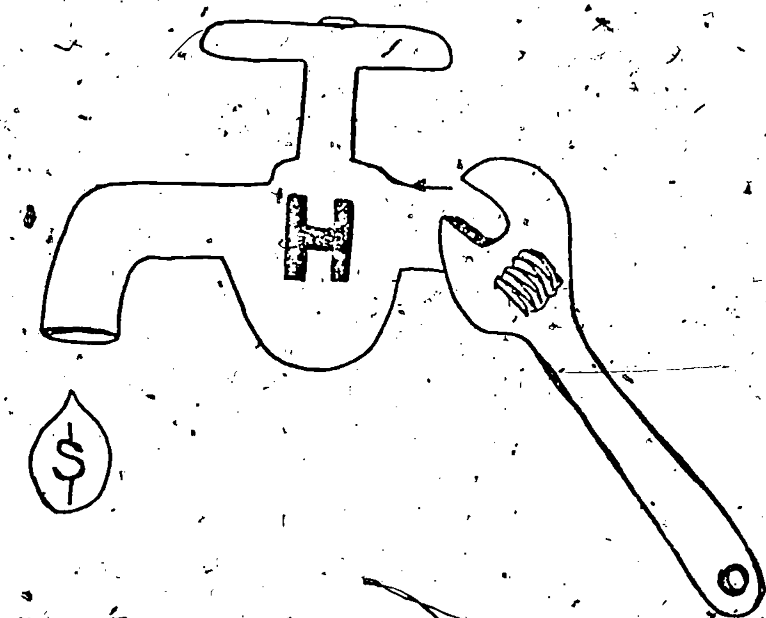
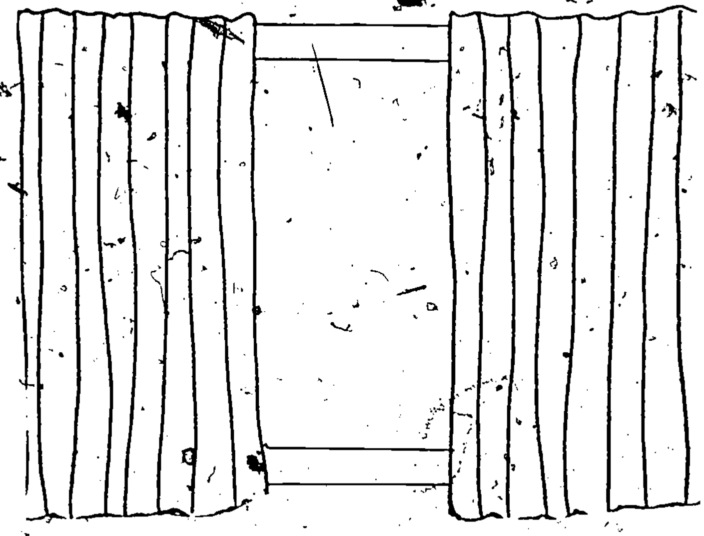
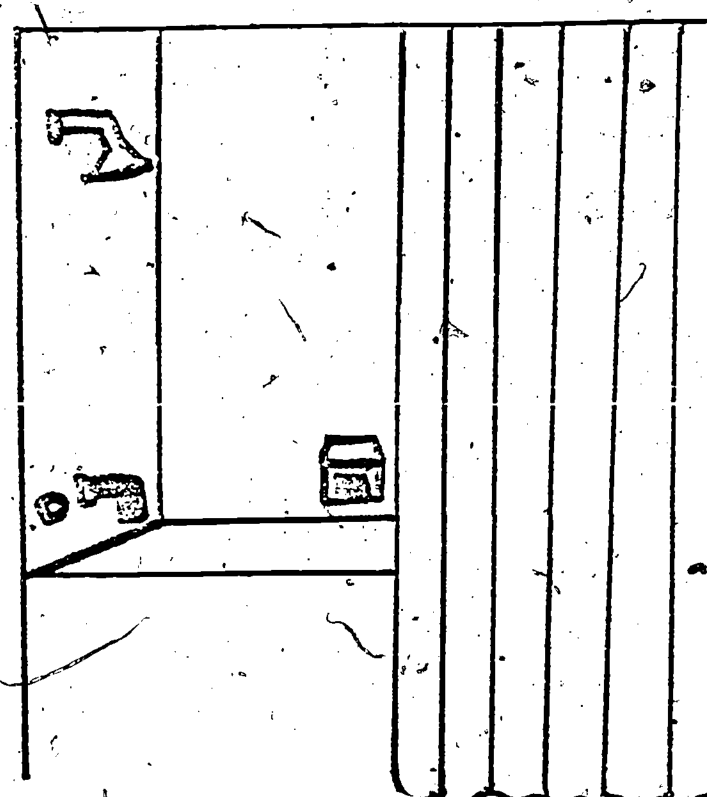
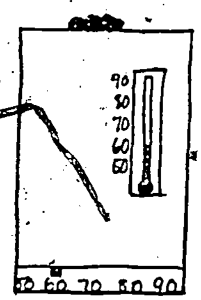
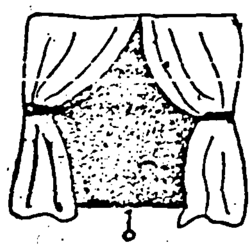


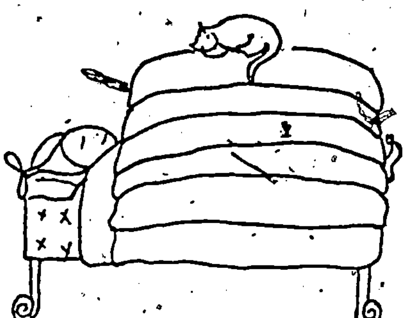


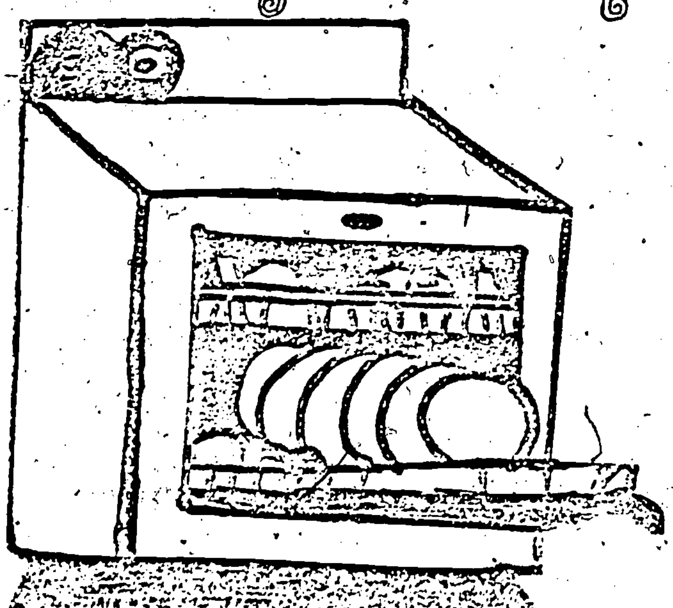





90
80
70
60
50
50 60 70 80 90







Lesson 3. Energy Sources and Conservation

What will you need?

Class sets of Energy Flash Cards. Use any or all of the pictures on previous pages...

What Will Students Do?

1. Discuss ways to conserve (save) energy.
2. Play a Flash Card Game. Directions: Students divide into groups of two. One student will hold up each card for the other to explain the source of energy pictured and mention one way to conserve energy coming from this source.

ACTIVITY

Another Energy Activity

Color the energy Flash Cards.

Try to find groups for the pictures to belong to.

Lesson 4. Energy With Art

What will you need?

1. watercolor paper
2. brushes
3. watercolors and pans

What Will Students Do?

1. Paint a picture about "Saving Energy At Home".
2. Explain their pictures orally.
3. Display the picture to help their classmates with ideas.

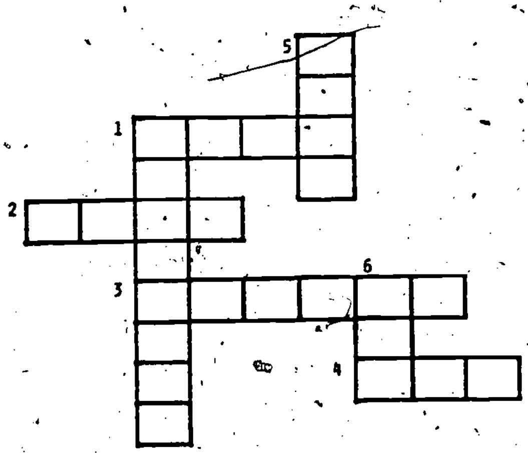
Lesson 5. Energy Puppets

What will you need?

1. Copies of Hand-Out #5 for evaluation. (And for speedy students to begin when their puppets have been made.)
2. Art supplies: crayons, scissors, pencils, tape.

What Will Students Do?

1. Design, color, and stuff a puppet with tissue.
2. Divide into groups of three or four and make up a puppet play. Decide on the energy things to say.
3. Share your 5-minute puppet show with the class.



ACROSS

1. C______ IS USED TO HEAT OUR HOMES.
2. W______ IS NEEDED TO FLY A KITE.
3. WE SHOULD TRY TO CONSERVE OUR E______.
4. THE S____ IS OUR ORIGINAL SOURCE OF ENERGY.

DOWN

1. TRY TO C__________ OUR ENERGY.
5. A LIGHT B____ GIVES US LIGHT.
6. WE USE G______ TO RUN OUR CARS.

Energy Evaluation Activity

Fill in the crossword with energy words. Complete the energy sentences.

BLACK GOLD

Black Gold is a role-playing simulation to acquaint students in grades 7-12 social studies or science classes with the problems of securing new oil supplies. This simulation involves students in a debate over offshore drilling vs. direct imports of oil.

by Rosanne Fortner
Hidden Valley Intermediate School, Roanoke, Virginia

Modification of existing teaching materials in any subject can allow for exposure of basic energy information. Whether the unit under consideration deals specifically with an energy problem, or uses energy facts as a vehicle for teaching other material, the significance of the information will usually be obvious. Students are generally aware of the energy crisis, and any unit which involves all class members can provide many teachable moments.

In developing a unit on "The Ocean in Danger," I used a role-playing activity to dramatize the problem of securing new oil supplies. Students considered the growth and variety of oil related products, the rising costs of these products, and the location and richness of known oil reserves. They also considered whether other resources could be substituted for oil products, and how some costs could be lowered. They debated ways to reduce their use of oil. Students used the newspapers as a resource and found much information in the publications of Shell and Exxon Oil Companies. Reprints from the Social Issues Resources series and written informational packets from the Environmental Protection Agency and Energy Offices in may states were other valuable supplementary resource outlets.

The games could easily take two weeks of class time if it is preceeded by in-group discussions and individual to group research. The class might spend several days researching and discussing the effects of oil spills and performing experiments in removing oil from water. However, the duration of the active participation in the role-playing activity requires only three days.

Becoming a part of a decision-making process can pep up a class atmosphere. In this game, the players become aware of the gentle and not-so-gentle means of persuasion that comes into play when such things as politics, personal concerns, and environmental preferences become enjoined. The Coastal Problems Committee is called to consider the Petro Oil Company's request to drill for oil on the continental shelf. Company representatives come to the meeting prepared to offer alternatives to drilling, including the offer to construct onshore refineries and deepwater ports to serve super-tankers.

Consultants in energy and marine scientists testify and offer opinions in opposition to the Oil Company. After hearing the questioning of all witnesses, the Committee must make a decision to (1) allow the oil company to begin its search for oil, or (2) permit super-tankers to bring overseas' oil to onshore refineries, or (3) seek other sources of energy and deny requests.

Students with leadership qualities will undoubtedly claim the six witnesses' roles. Other class members take the roles of Committee members, but do not have specific roles assigned. In reaching a decision, students become interested in a common problem and see the need for evaluating all aspects of the issue at hand. They take from the simulation the idea of establishing priorities, which is a valuable step in their becoming active, informed citizens in the future.

ENERGY, ECONOMY, EDUCATION

This unit for junior and senior high school students in general science, physics, and environmental science encourages students to explore the energy use in their own school building -- to look at the sources of energy and make suggestions for its better use of possible alternatives.

by George R. Gross
Union High School, Millburn, New Jersey

The main thrust of much recent information has been largely concentrated in two major areas: (1) the sources of energy, and (2) the conservation of energy. This last has mostly covered the heavy use of energy by the home-owner and automobile user. Less attention has been paid to the economic implications of energy conservation. It is toward this lack that I have aimed my unit, choosing the school building as a focus.

Any visitor to modern schools is struck by the number of hall lights burning during the school day. Often banks of lights glow brightly beside sunny window walls. The building is more often than not, either insufferably hot or as cold as an igloo. A close look shows that these buildings are poorly insulated, and lacking in storm windows and controllable classroom lighting. I propose the following outline for a unit of study that could serve as an educational tool for both students and administrators in teaching economically and environmentally sound energy conservation. The unit can be developed as a classroom activity, or it can be expanded into a system-wide investigation ino energy conservation.

I. Energy

   A. Flow -- glass, wood, metals, concrete

   B. Uses -- lighting, heating, incineration, cooling, hot water

   C. Sources -- what fuels are used

   D. Conservation measures

      1. Use

      2. Insulation (costs, installation, effectiveness, types)

      3. Costs (reduced rates, etc.)

      4. Measurement (meters, lab measurement)

II. Energy Use Practices

   A. Time (hours of lighting use, heating, and cooling)

B. Mean temperature (day, night, halls, classrooms, etc.)

C. Mean lighting intensity (in halls, classrooms)

D. Insulation (Where? Rf values, weatherstripping, storm windows, etc.)

E. Methods of heating and cooling (specific types)

III. Survey of Energy Use

A. Electricity (lighting)

1. Kw used per fixture

2. Number of fixtures

3. Cost of electricity (calculated from rate applicable)

B. Heating/Cooling

1. Btu's used per room, hall, etc.

2. Total consumption per year

3. Cost of heating/cooling (calculated from rates applicable)

IV. Determination of Energy Use

A. What is the amount of lost energy and the estimated cost of energy losses over a period of time (month, day, or year).

B. Estimate heating/cooling losses through windows, walls, ceilings, doorways, floors.

V. Recommendations

A. Lighting (intensities, removal of fixtures, new switching patterns, automatice shut-offs, etc.)

B. Heating/Cooling (changing mean temperatures, insulation, methods)

VI. Presentation of Dollar Savings to Board of Education

A. Attendance at Board Meeting

B. Publicity (report, posters, letters, etc.)

ENERGY CONSUMPTION/CONSERVATION IN CONTAINER USE AND TRANSPORTATION
Investigations Into Local Container Use

This activity investigates energy use in the packaging of goods, using local litter as the focus. In a one to three week unit of study, students trace the energy flow in the manufacturing, distribution, and use of one discarded container. For Junior and Senior High School.

by Gary W. Laird
Douglas Anderson Junior High
Jacksonville, Florida

How will your students likely see the purpose in studying the energy used in ordinary containers? For starters, they will soon realize that energy affects their daily life. As it is, students use containers of every size and shape every day, but do not realize how much energy they represent. Part of each activity in this unit supports the growing realization that energy is spent at each stage of a container's cycle. Learning how to estimate the energy used at each stage is a key goal in each of the four activities, but this goal ought to be developed by tapping the resources offered by the school. Visits to local manufacturing plants, talks by guest speakers, and surveys taken in the home and community are only a few of a wide variety of sources that can advance the other goals of this energy project.

The scientific stress in this unit is placed on the energy used in the production and transportation of containers. The social stress is placed on the personal decisions involved in their use. The over-all learning objective is to have each student acquire a working knowledge of the energy demand placed on all members of the community by the use, storage, and transport of containers, with the accent on the amounts of net energy before and after use.

GETTING STARTED

At the beginning of the unit I suggested that the students write to various manufacturers of containers, or visit a bottling or canning plant. Students should obtain some basic information about durability of the containers, costs of manufacturing and distributing containers, and estimates of recycling (or washing) costs, and storage charges. In addition, I encouraged reading and research in books and current periodicals and the collection of direct energy data. These notes become part of the necessary background information, and were drawn on in developing basic understandings, skills, and attitudes when the full project got underway.

Activity 1: Litter Distribution

Each student was asked to make a survey of the kinds of containers they might find at a street corner, an intersection or roadside. (In order to keep the sample random and uniform, I asked the students to survey a sixteen square meter area only, and to take surveys in representative parts of the community.)

One week later the information was compiled on an Energy Board. Each type of container was given a Btu or calorie energy use factor, basing determination on the previous research information. We made a line graph to show the number of containers in each catefory: glass, paper, plastic, or metal. We plotted the net energy used in each type of container. If a container was reuseable or recyclable, we subtracted an energy constant and plotted these containers against the non-returnables.

We concluded Activity 1 by summarizing the total energy amounts of all the litter, and put the tables aside for later reference. We also projected the total energy (estimated) demands for a year in both returnable and non-returnable containers. And we estimated the total energy use if only returnable containers were used for a year in the community.

Activity 2: Returnable vs. Using Once-Only Containers

Students formed committee groups to gather information on local recycling efforts. They made an Energy Board comparing costs and energy use of recycling litter with non-reuseable litter. Space on the Energy Board was allotted for suggestions for more efficient use of energy in containers.

Group 1. Visit a bottling plant, or invite an expert in this field to come to the class to talk about energy use in the container business.

Group 2. Visit food processing companies to find out specific costs of food containers.

Group 3. Talk to local government officials who have responsibilities in litter collection. Ask about recycling efforts and their costs.

Group 4. Collect information to support arguments for alternative manufacturing and food distributing networks.

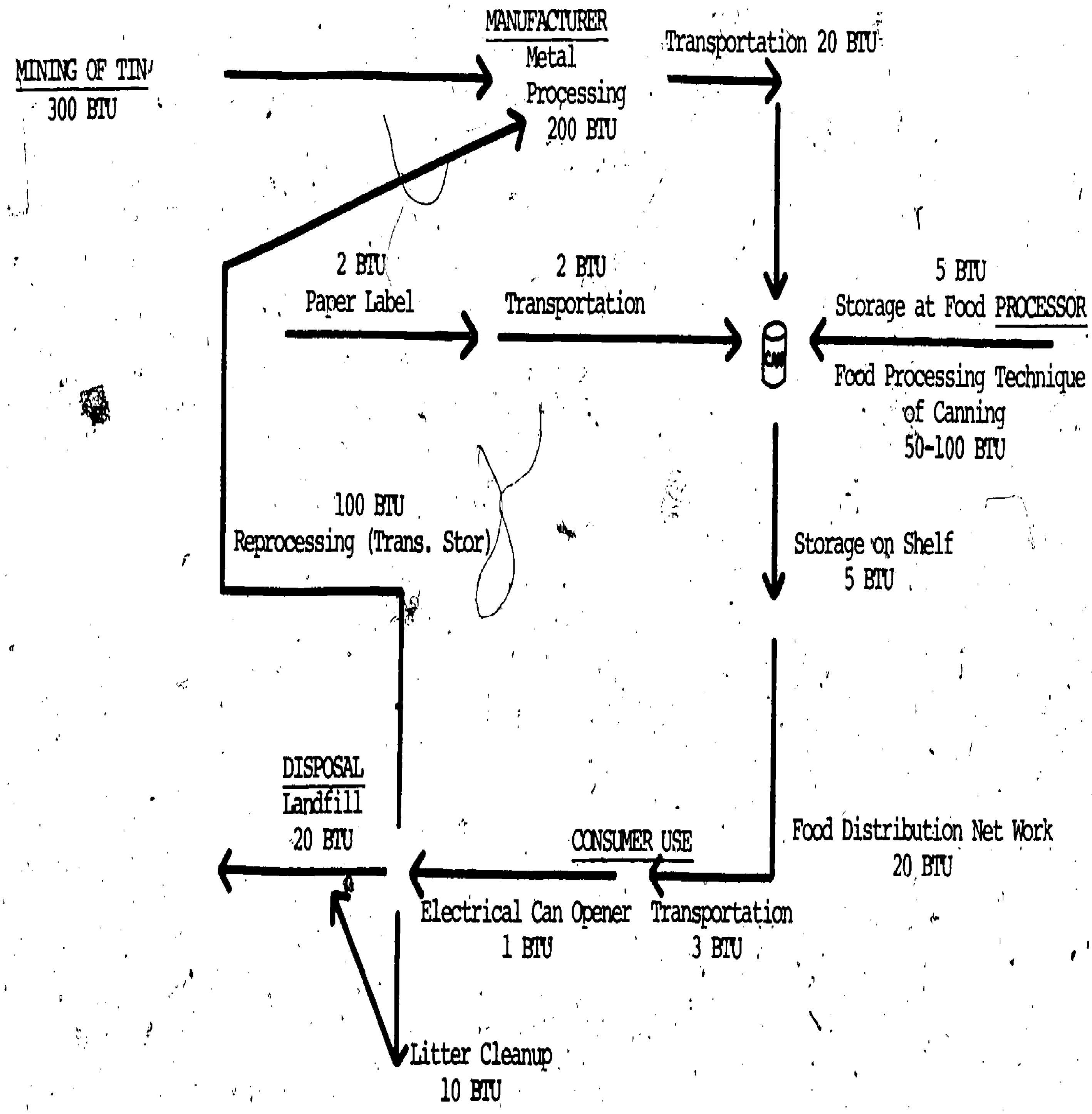
Activity 3: Calculating the Net Energy Use in Manufacturing

Students were assigned project in survey-taking. First, they looked at the trash and litter at home for the type and amount of containers. Next, they surveyed local food outlets inquiring into the costs of food in specific containers. They compared these findings with the statistics compiled in Activity 1, and revised their energy estimates when necessary.

Activity 4: Charting the Energy Flow

Each student traced the energy use of the container cycle with one specific container. (The flow starts with the energy use in mining the metal and ends its cycle as litter.) The estimation of the Btu's is made from Energy Board figures and by using the background notes. A sample diagram follows.

NOTE: Most teachers will want students to identify alternative technologies at the end of this unit. For example, they should think of new ways of shopping, improved transportation methods, refrigeration by solar energy, methane energy from waste, and consider organic farming, and to take some personal responsibility toward conservation.



SOUP TIN CAN CONTAINER: ENERGY CYCLE

Eighth grade mathematics students are introduced to a series of activities that encourage energy conservation. Students assess their present household energy usage and propose practical ways to make significant savings.

by Diana Margotto
Washington Junior High School
Green Bay, Wisconsin

Why Energy Education?

To combat the energy crisis we must realize we do not need as much electricity as we think we do. We have been wasteful users of electricity and of nonrenewable resources which produce electricity. The time is here to reevaluate our electrical needs and to attempt an individual kilowatt cutback. Even though an individual's contribution may seem small, the combined efforts of many individuals can greatly reduce total electricity energy requirements.

Energy education will enlighten the young student about what the past has been, what the present energy crisis represents, and what the options and priorities are for the future. Each young person's individual acts of conserving energy in the home can have an impact on the family, then the community, the state, and finally on the entire nation, so that ideally there would be no more energy crisis.

General Procedures for Teaching

Kill A Watt was designed for eighth grade mathematics students to enable them to recognize the need to develop conservative habits and attitudes concerning the consumption of electricity. Although this learning package was developed to be used as supplementary work for eighth grade mathematics classes, it can be utilized in grades 6 through 9 with an integrated, interdisciplinary approach.

Students see the reasons why they are learning about energy conservation through behavorial objectives for each energy-related concept stated from a consumer point of view. An accompanying bibliograpy indicates sources of information used in the writing of this energy conservation learning package.

Organization of Learning Package

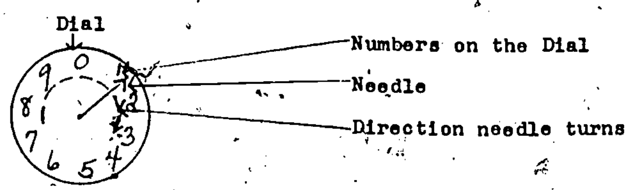
As the title indicates, Kill A Watt has a major concept of conservation of electricity. The eight sub-concepts related to this major concept are: (1) Meaning of the Energy Crisis, (2) Finding Energy Solutions, (3) Energy and Your Life Style, (4) Reading Electric Meters, (5) Computing Electric Bills, (6) Use of Household Appliances, (7) The Household Energy Game, and (8) Kilowatt Counter.

The teacher can be either a director or a facilitator of learning about electrical energy conservation as students involve themselves in the various learning activities by reading reference materials, viewing films, planning panel discussions, collecting data, solving mathematical problems, interviewing resource people. developing a bulletin display, and contributing to class discussions.

Timing depends on the usage of Kill A Watt. Suggestions are: (a) four to six weeks of intentive study, (b) one day a week for a semester, or (c) one day every two weeks for the entire school year.

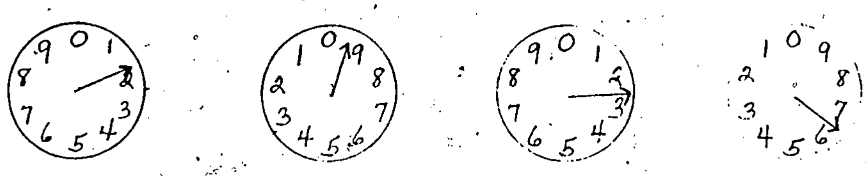
LEARNING ACTIVITY ON METER READING

The amount of electricity you use is measured by a METER attached to your house or apartment. An electricity meter has dials on which one or more needles will point to the number of kilowatt-hours of electricity that you have used since the meter was installed. One of the dials on the meter will look like this:



STUDY THE ILLUSTRATION BELOW.

This Dial counts units of 1000 kilowatt-hours each.	This Dial counts units of 100 kilowatt-hours each.	This Dial counts units of 10 kilowatt-hours each.	This Dial counts single kilowatt-hours.



Dial A Dial B Dial C Dial D

Dial A. The needle turns in a clockwise direction.

Dial B. The needle turns in a counterclockwise direction.

Dial C. The needle turns in a clockwise direction.

Dial D. The needle turns in a counterclockwise direction.

As the needle turns in a clockwise or counterclockwise direction, it counts one unit of electricity used. The number of units counted is THE LAST NUMBER PASSED BY THE NEEDLE.

The diagram on the preceding page of the single dial shows that one unit of electricity has been counted.

STUDY THE second illustration carefully to notice that several dials are needed to count the total number of units of electricity used in a home. The reason for the four dials is that each dial can count only ten units, so each dial as explained will count a unit of a different size.

Notice that the needle on Dial A has just passed the number 1. Therefore, this needle has just counted one unit that measures ______ (1, 10, 1000) kilowatt-hours. Dial A measures ______ kilowatt-hours.

The needle on Dial B has just counted the number 9. This needle has just counted 9 units, each measuring ______ (9, 100, 900) kilowatt-hours. Dial B reads ______ (9, 100, 900) kilowatt-hours.

The needle on Dial C has just counted the number 2. Dial C reads ______ (2, 10, 20) kilowatt-hours.

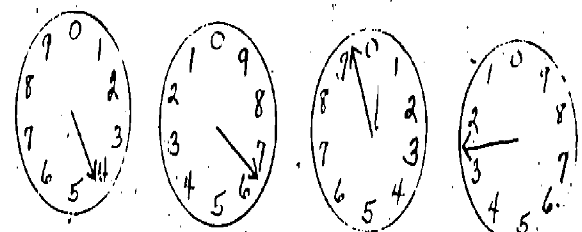
The needle on Dial D has just counted the number 6. Dial D reads ______ (6, 60, 1) kilowatt-hours.

The correct choices for the blanks above are 1000, 1000, 100 900, 20, 6.

In order to get the total reading of the electricity meter shown above, we must add together the readings on Dials A, B, C, and D. In other words, we must add 1000, 900, 20, and 6 to get a total of 1926 kilowatt-hours.

Study the meter below. Fill in the blanks beneath each dial.

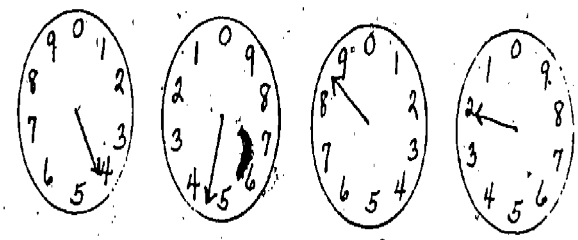
1000 100 10 1



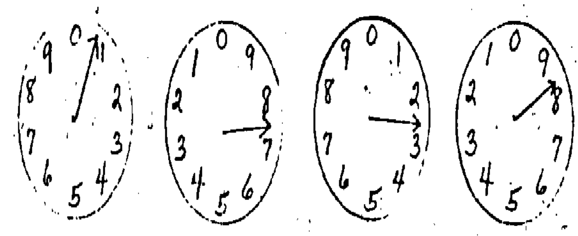
means ______ kilowatt-hours | means ______ kilowatt-hours | means ______ kilowatt-hours | means ______ kilowatt-hours

According to your calculations, this meter shows that a total of ______ kilowatt-hours have been used.

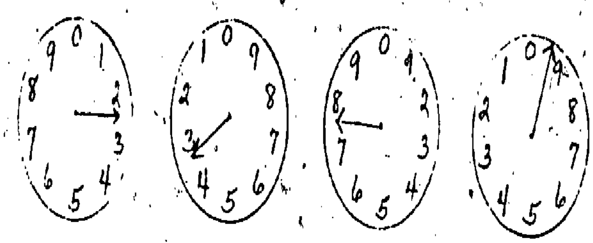
The meter shown below reads ______ kilowatt-hours.



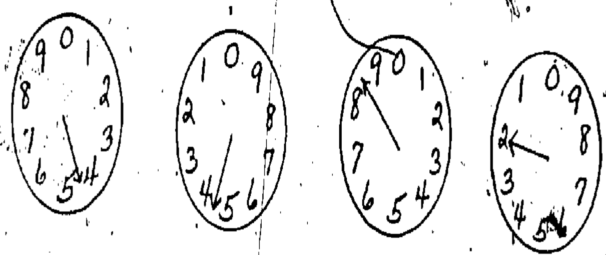
This meter reads ______ kilowatt-hours.



This meter reads ______ kilowatt-hours.

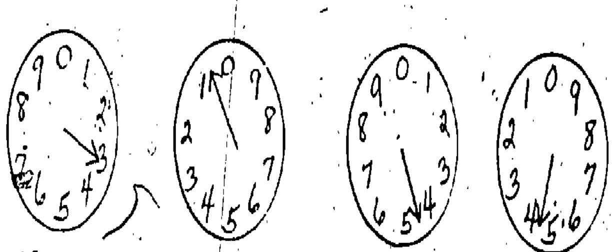


Each month a man from the power company is sent to your home to read your electricity meter. His job is to determine how much electricity you used during the month. For example, suppose your meter looked like this in the month of April:



According to the meter, you have used to date ________ kilowatt-hours of electricity.

In May, the person from the power company makes another reading.



He finds that your electricity meter now reads ________ kilowatt-hours. Since the April reading, you have used ________ kilowatt-hours. You find this by subtracting the April reading from the May reading.

YOU SHOULD NOW BE ABLE TO FIND AND READ THE METER FOR ELECTRICITY IN YOUR OWN HOME.

DAILY USE OF ELECTRICITY IN MY HOME

DATE	TIME	ELECTRIC METER READING (kwh)	KILOWATT-HOURS USED DAILY	$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				

ELECTRICITY RATE SCHEDULE FOR GREEN BAY (May, 1975)

ENERGY CHARGE

First 200 Kwh at	$ .0430
Next 1300 Kwh at	.0260
Over 1500 Kwh at	.0215
Total Kwh at (Fuel Clause)	.00215

SAMPLE BILL COMPUTATION: Suppose that your total electricity consumption for the month amounted to 500 Kwh. The charge for this monthly consumption would be figured out in this way.

First 200 Kwh at $.0430........$8.60
Next 300 Kwh at $.0260.........$7.80
Total of 500 Kwh at $.00215....$1.08 (Fuel Clause)
Total..$17.48

WORK SPACE FOR ABOVE COMPUTATIONS:

200
x.0430
6000
800
8.6000

300
x.0260
18000
600
7.8000

.00215
x 500.
1.07500 ≐ 1.08

$ 8.60
7.80
+ 1.08
17.48

COMPUTING ELECTRIC BILLS

Work all problems on this paper showing the calculations for each. Use the Green Bay rate schedule to do these.

1. Mr. Collins read his meter at the beginning of May It read 4335 Kwh. When he subtracted the April reading of 3916, he found the number of kilowatt-hours he used in one month. What would his electric bill amount to in Green Bay ?

2. Can you find an error in this bill ?

Mr. J. J. Jones
111 Energy Blvd.
Antsville, Indiana 60761

Previous meter reading	Present meter reading	No. Kwh. Used	Amount to be paid
3569	4129	560	$20.16

3. The Wisconsin Public Service Corporation decided to drop its fuel charge for the next three months. How would this reduce the electricity bill in problem 1.

WHAT IS A KILOWATT-HOUR ?

Take a look at an ordinary light bulb and you will notice that its wattage is indicated. For example, the bulb might read 100 watts, 60 watts, 40 watts, and so on. The wattage marked on a bulb indicates the amount of electricity that bulb will use in one hour.

For example, a 100-watt bulb will use 100 watt-hours of electricity in 1 hour. Similarly, a 60-watt bulb will use 60 watt-hours of electricity in 1 hour. How many watt-hours electricity will a 40-watt bulb use in one hour ?

__________ watt-hours.

****

Will a 15-watt bulb use 30 watt-hours of electricity in 1 hour ? ___

Since a 40-watt bulb will use ________ watt-hours of electricity in 1 hour, then the same bulb will use _____ watt-hours of electricity in 2 hours. How many watt-hours of electricity will a 40-watt bulb use in four hours ? __________

To answer this question, you must multiply the number _____ by the number ______. You find that a 40-watt bulb will use 160 watt-hours of electricity in four hours.

****

Answer the following:

1. A 100-watt bulb will use 100 ____________ of electricity in 1 hour.

2. Two 100-watt bulbs will use ________________ of electricity in 1 hour.

3. How many watt-hours of electricity will 3 60-watt bulbs use in 1 hour ? in three hours ?

The average family will use many 100-watt bulbs, many other bulbs of varying wattage, and a number of electrical appliances as well. It is for this reason that the typical home will probably use during one month several thousand watt-hours of electricity.

Because the average home will use several thousand watt-hours of electricity in one mont, it is more convenient to measure the amount of electricity in a unit larger than the watt-hour. One kilowatt-hour is equal to 1000 watt-hours. REMEMBER that a kilowatt-hour is larger than a watt-hour.

Two kilowatt-hours equal ________ watt-hours.

500 watt-hours equal _______ of a kilowatt-hour.

How many watt-hours equal 5 kilowatt-hours. __________

If five 200-watt bulbs were used for one hour, they would use a total of 5 times 200 watt-hours or 1000 watt-hours or 1 kilowatt-hour.

****

ANSWER THE FOLLOWING:

1. If each fluorescent tube in the lighting fixtures in your classroom is labeled 40 watts, how many watt-hours of electricity is being used in 1 hour ? How many kilowatt-hours in 1 hour ?

2. How many kilowatt-hours is being used today if the lights in this classroom are turned on for 8 hours ?

3. In what other ways besides the overhead lighting is electricity used in the classroom ?

DESIGNING AN ENERGY-EFFICIENT HOUSE

Designing an energy-efficient house and making people aware of the simple design factors which affect household energy consumption is the focus of this unit, called simply, IDEA, for architectural drafting students in high school.

by Dale Raths
Arvada West High School
Arvada, California

Ever since the stone age, man has been continually modifying his physical surroundings for protection and comfort. We have traditionally attempted to dominate the environment rather than to harmonize with it. Now after many years of enjoying the luxury of abundant energy and fuel supplies, we have come to the realization that these resources are finite. In order to survive we must control the factors for which we are responsible; namely, the demand for energy. As teachers, we can help our students accept this responsibility.

We will need to help students redefine the relationship of the planned environment and the natural environment. However, it must be a team effort. As social studies teachers we can help develop these attitudes: how energy resources affected out past, and how they will determine our future. As science teachers we can provide the understanding of energy concepts, and how they are used. With both the attitudinal changes and the scientific understanding in hand, the student can begin to design a house that is in harmony with the environment.

Conservation of present energy sources is of immediate concern as it will be several years before alternate sources will have even a negligible effect on present resources. It is for this reason that I have elected to integrate a simple unit on energy conservation into my traditional architectural drafting curriculum. Traditionally, the course requires the students to design a simple house in the first semester of the course. With the inclusion of the energy unit, I ask the students to design an energy-efficient house. Each student selects at least one topic relating to energy conservation in home building. After some research he then reports his findings to the class, becoming the resident consultant in the particular speciality of his research. As the design of the house progresses, the individual consultant offers his educated opinion. Hint: Don't be surprised if some students wish to use the benefits of their research in another class as a report topic. The students get caught up in the fascination of their own research.

Following is the unit: An Energy-Efficient House, presented in outline form. Keep in mind that this is not a separate unit, but one that is integrated within a traditional unit in architectural drafting.

Designing An Energy-Efficient House

This unit will provide an understanding of energy concepts as they relate to building construction, and how energy can be conserved by more appropriate design. At the conclusion of this unit students should be able to:

1. Identify most cost efficient design features of a house, i.e. those

features that are cost efficient due to their energy conserving qualities.

2. design or draw a plan of an energy-saving component that could be part of a house.

Major Concepts or Topics for Research:

SITE

Existing Vegetation
Landscape
Topography (Shape)
Exposure Variations
Sun, Wind
Water
Soil

CLIMATE

Sun
Wind
Ventilation
Heating
Cooling

STRUCTURE

Style
Climate Control
Lighting
Fireplaces
Insulation
Windows
Doors
Other Openings
Materials:
- wood
- masonry
- metals
- plastics

Appliances

Evaluation Suggestions:

As evaluation some students might wish to build a cutaway model of an energy-efficient house. This project could be used for a school exhibit or a home show in the community.

Resource materials on this subject are available.

Books:

Adams, Anthony, Your Energy Efficient House: Building and Remodeling Ideas, Garden Way Publishing, Charlotte, Virginia, 1975.

Eccli, Eugene, editor, Low-Cost, Energy Efficient Shelter for the Owner and the Builder, Rodale Press, Inc., Emmaus, Pennsylvania, 1976.

Pamphlets:

"The Energy Challenge. What Can We Do?", ~~Shell Oil Company, Box 2643, Houston, Texas 77001.~~

ERDA Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

SOLAR HEATING AND COOLING

Experiments in this activity involve students in calculating solar heating and cooling temperatures, such as testing the effect of paint on glass for the absorption and reflection of sun heat. (For grades 7-12, with adaptions by the teacher.)

by Paul Shiffen
Matawan Regional High School
Matawan, New Jersey

Since we are all consumers of energy, it is the responsibility of all of us to learn more about energy sources and the ways we can use energy more efficiently. Energy conservation projects such as the ones I have developed apply to the home as well as the school. Students should be encouraged to use resources at home to perform experiments similar to the ones in these lessons.

Pupil-teacher planning should involve the assignment of specific projects. Some of the projects can best be done by the class as a whole. Some can best be done by committee. Some projects are most effectively completed by individuals. Whatever the arrangements, it is hoped that students will develop, from participation in the projects on solar energy and energy efficient design, attitudes consistent with conservation of natural resources.

Skills in critical thinking as well as specific skills in gathering data are major goals of these projects. The teacher will find in each of the projects many opportunities to introduce and develop math, graph construction, use of basic tools, and vocabulary building skills.

SOLAR ENERGY

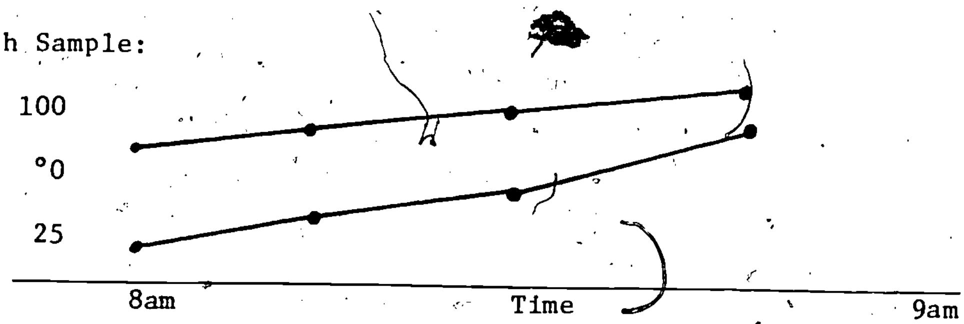
This activity requires a classroom with windows facing the east, west, or south side. The sunlight must enter at least in the morning or afternoon, while the students are in attendance. Students should collect metal containers of every shape and size they can find. They should paint the outside of these flat black. Then the containers should be filled nearly full of water and placed in the sunlight.

Every 15 minutes someone in the class should take the temperature of the air in the room and the water temperature in the cans. (It is recommended that the kind of thermometer that can best fit these needs is one that is calibrated up to 100 degrees centigrade.) Students should record the information in both table and graph form.

Sample Reading:

Time	Air	Water (in ° Centigrade)
8:00	24	50
8:15	26	60
8:30	28	75
8:45	30	100

Graph Sample:



Students were motivated and stimulated by these methods of collecting and recording data. They observed the relationship between air and water temperature and made some generalizations about collecting and storing solar energy on the basis of evidence collected from the experiment.

AN ENERGY CONSERVING HOME

Primarily designed for students in grades 7-12, this activity provides an opportunity for students to design and construct homes of various shapes and sizes and required them to consider volume, cost, strength, and ease of construction, as well as energy efficiency.

We began the study with a discussion of the homes of the North American Indian. These were traditionally conical, sperical, or triangular shapes. Then we examined the shapes of these homes in terms of strength and conservation of energy. At this point we compared the typical rectangular home with an A-frame home of the same floor space. Most math students knew that the area of a triangle is ½ base x height, and that the volume of a triangular home is one-half that of a rectangular one.

The A-frame uses fewer but heavier members, and is stronger. Since the members are larger, more insulation can be used. In this type of construction there would be one-half the volume to heat and cool. Fifty percent more insulation, greater strength, less construction time and cost, and less exterior maintenance are only a few of the advantages offered by this home. In addition, the sloping roof is well designed for adding devices for solar heating and cooling.

SOLAR HEATING AND COOLING

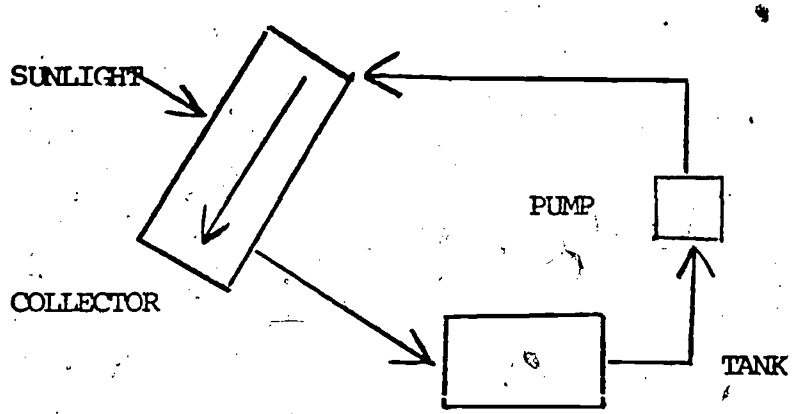
Either venetial blinds or shades can be used for this activity, which may be more appropriate for teachers or principals to use than students since it involves a greater time span than the activity with the water cans.

Most venetian blinds are painted a light color and are therefore suitable for reflecting the energy of the summer sun and reducing the air conditioning costs of the office. In winter one side of the blind should be painted black for this experiment. (Flat black will help absorb the energy from the sun and reduce heat costs.) The total effect of this activity should be measurable in reduced energy costs over the school year. Students can help keep a record of the heat and air conditioning costs, and compute the savings.

A similar activity to the venetian blinds calls for the use of different colored drapes, dark cloth for winter, and white for summer to absorb or reflect the solar energy. Reversible drapes may be the best answer. The approximate energy absorbed and reflected can be estimated by multiplying 300 times the number of square feet of window area to get the energy gain or loss in Btu's which is about what is needed to heat or cool the average classroom. Data collected by students, teachers, and administrators might be forwarded to appropriate county or state officials.

SOLAR HEATING

This project is suitable for students in grades 7-12. It consists of a water storage container, a water pump and a solar energy collector.



The collector should be made of metal, painted black, and covered with polyethylene. The pump should be selected according to the relative size of the collector and storage tank. A fish tank and pump would be suitable for a small model. In either case, the water is pumped over the solar collector while it is exposed to the sun.

Students can record indoor and outdoor air temperature as well as water and collector temperature. By observing these data, they can be determined whether increased collector or storage capacity is needed.

LIVING WITH WIND POWER

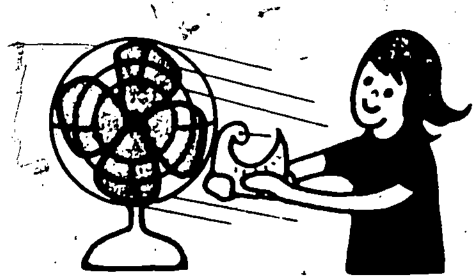
In this activity, students learn about energy through a series of "unipacs". Each unipac emphasizes the inquiry approach to learning and encourages students to make decisions about alternate sources of energy and conservation. This unipac can be used in grades 3-5, and in junior high.

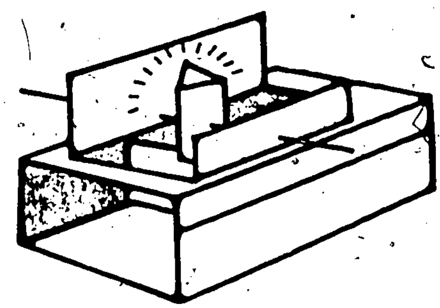
by Elizabeth Wooten
West Boron Elementary School

Students should become aware of the value of energy, what it does for us, and why it is important. They should also learn about alternative energy sources which are ecologically sound, especially wind and water power and solar energy. This unipac about wind power emphasizes the advantages of home-generated electricity. At the end of the unit the students will be able to:

1. list four uses of wind power.
2. describe the wind currents.
3. describe the effect obstructions have on wind currents.
4. tell why wind plants may be used as a major source of energy.

We start the unit on wind power by examining the statement that wind has always been and will always be free. Some of the initial activities were drawing pictures of sailing ships and windmills. To focus attention on the study of wind power, I asked students to participate in a series of hands-on activities which are outlined for you:





Energy in Wind

A. Make your own version of a propeller for a windmill to test in the wind. Compare it with a well-balanced model.

B. Make a string gauge, a tunnel gauge, and a helix gauge. (See patterns for these at the end of this outline.)

C. Make pinwheels for spinning in the wind.

D. Make model windmill towers using soaked (overnight) garbanzo beans and tooth picks. (Garbanzo beans are similar to chick peas.)

Calibrating and Recording Data

A. Read wind speed using cardboard gauges.

B. Read wind speed by hand anemometers.

C. Check appliances at home for amounts of kilowatt hours of electricity used in the home over a short period of time. Compare this usage with estimated kilowatt hours of electricity from a wind plant. Choose which appliances you would eliminate, if you had to.

Playing Activities

A. Bring to class assorted sizes of nickel-cadmium rechargeable batteries, fully charged. Bring a favorite battery-operated toy and experiment with an ammeter to determine the energy drain on the batteries when the toy is used. Make a list of the class toys and record the amperage drain of each energy user. Which is the least?

B. Read wind speed by using a hand anemometer to determine when you should recharge your batteries. A low charge battery cannot operate a toy. Students make the connection between this observation and conclude that a drained wind plant battery system will not operate household appliances. They also learn that variability is wind power's biggest drawback.

Understanding Wind Currents

Use a hand anemometer and check:

A. wind speed facing the direct wind;

B. wind speed between buildings;

C. wind speed at the corners of buildings.

D. Find the places where the wind blows strongest and where the wind is weakest.

E. Make a statement about wind currents.

Use handmade wind propellers and aim them:

A. into the direct wind;

B. around the corners of buildings;

C. between buildings, facing the strongest wind.

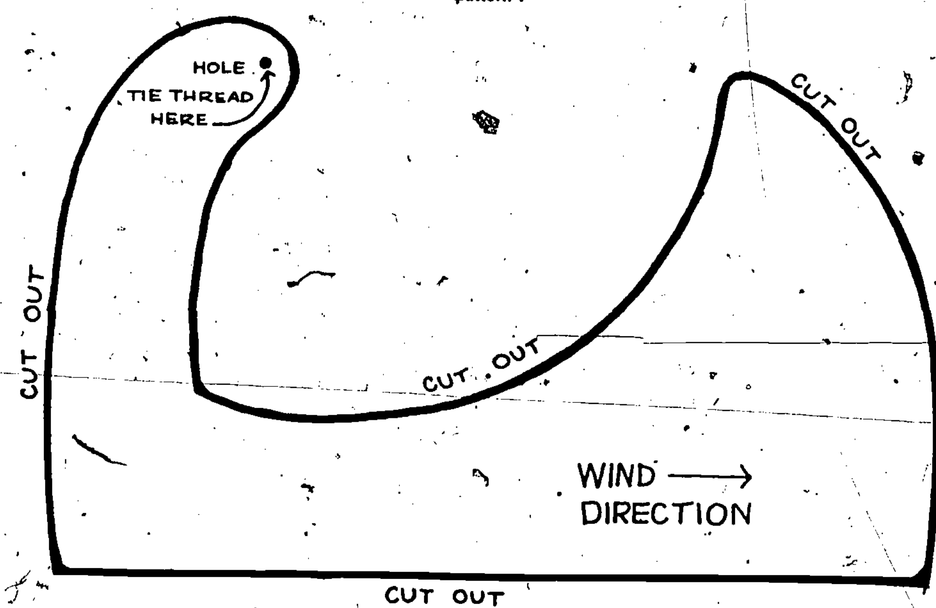
D. Tell why swift winds in different locations propel the blades faster. Tell why the direction in which you aim the propeller makes a difference in the speed by which it turns.

Experiment With a Bicycle Generator

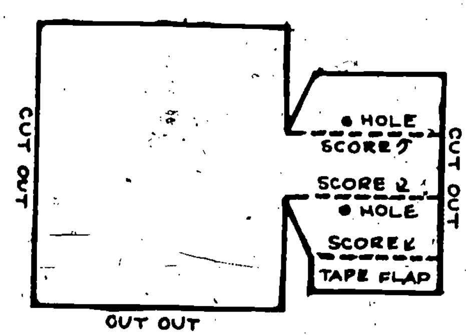
A. With a classmate peddling and providing the energy source, and another holding positive and negative generator leads, try to feel the electric current.

B. Attempt to hook up the generator leads to a small light bulb.

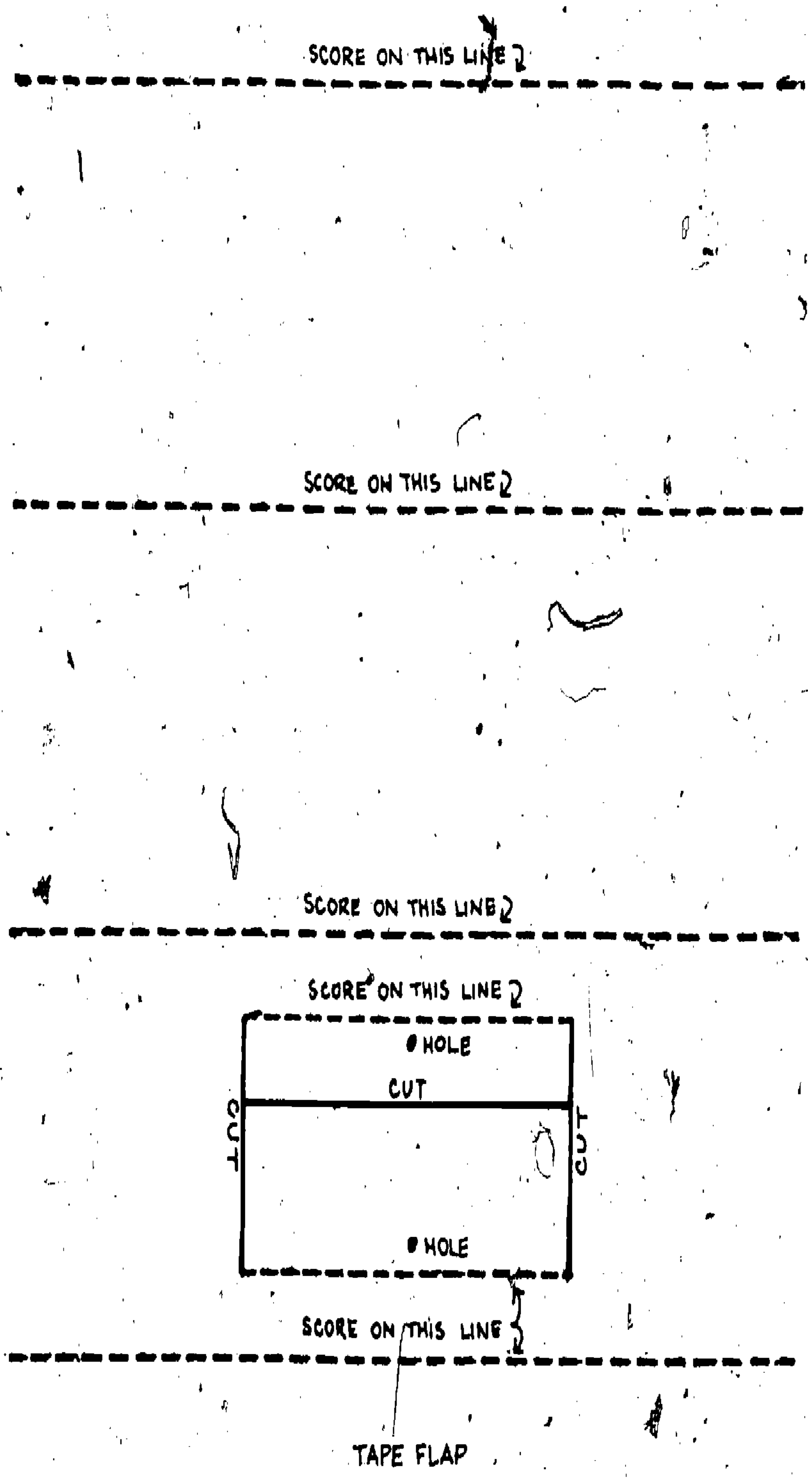
STRING GAUGE
pattern 1



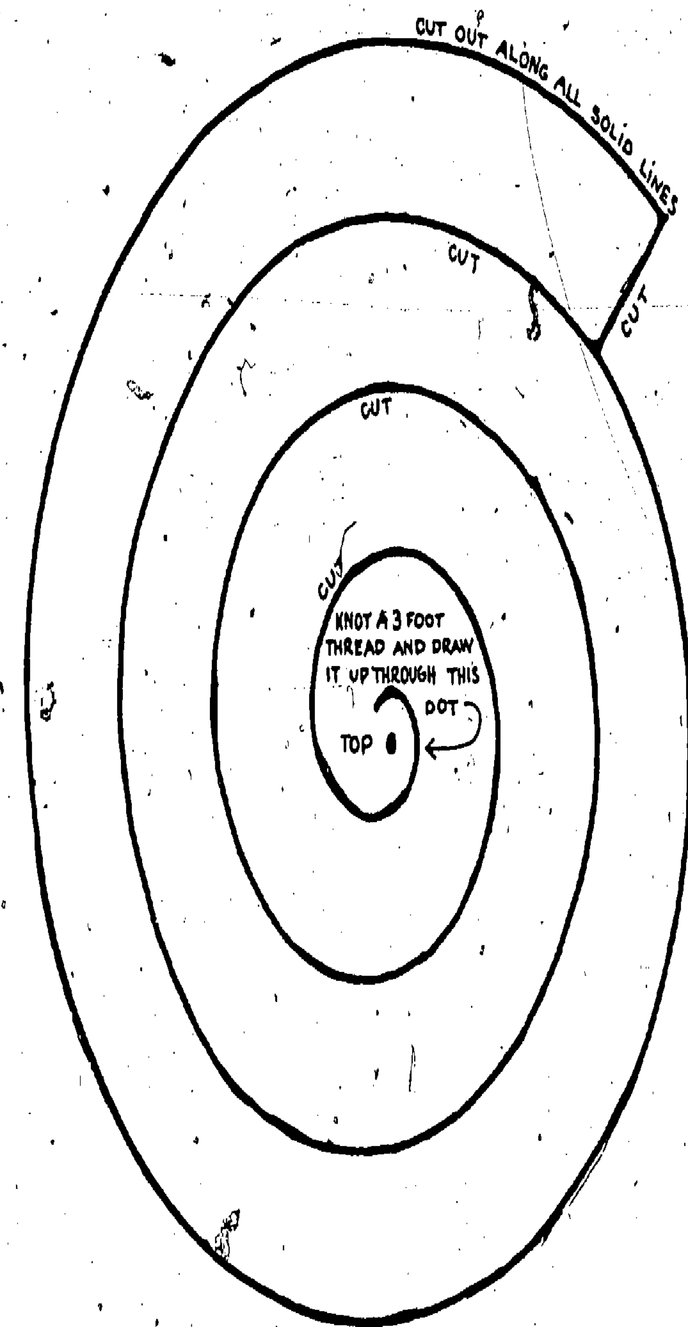
VANE PATTERN for tunnel gauge
pattern 2



TUNNEL GAUGE
pattern 2



HELIX GAUGE*
pattern 3



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