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ABSTRACT

Sixteen teaching units of activities were prepared for students in grades 4-12 to increase their awareness, knowledge, and skills of energy and energy related issues by examining topics such as energy conservation on the farm, foreign oil, U.S. energy consumption, energy efficient houses, alternative energy sources, personal energy use, conservation, automobiles and geography. The activities draw upon social studies, mathematics, language arts, science, art and architecture, and use a variety of teaching methods including films, discussion, role playing, readings, question and answers, map and graph reading, interviewing, speeches, lecture and group work. While the organizational format for each unit is not standardized, most indicate grade level, subject, objectives, new vocabulary, materials needed, skills, evaluation, and resource materials. In the beginning of the book, a Florida Governor's Energy Award Program, comparable to the Presidential Physical Fitness Program, is proposed. It is suggested that local areas implement this award program with their own award certificates. (DC)

LEARNING ABOUT ENERGY IN SECONDARY SCHOOLS
SOME EXEMPLARY LESSONS FOR STUDENTS

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SOUTHEASTERN LEADERSHIP INSTITUTE IN ENERGY EDUCATION
Florida State University, Tallahassee
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FINAL REPORT VOLUME II

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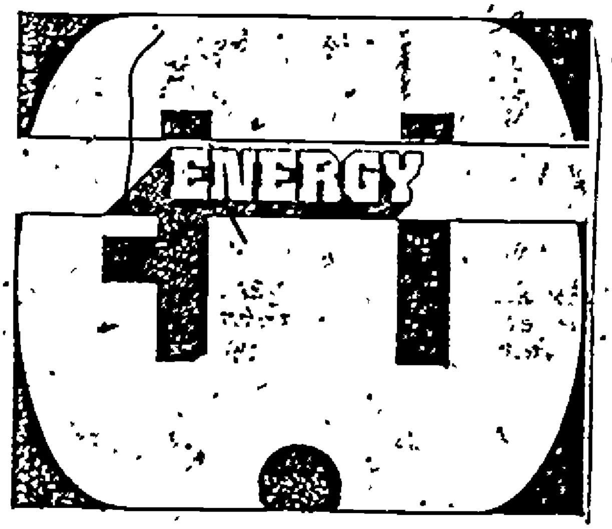

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FLORIDA GOVERNOR'S ENERGY AWARD

Patricia A. Temple   Alicia G. Barrionuevo

GRADE LEVELS: All Florida students in grades 4 to 9

GENERAL OBJECTIVES. To make aware of the energy situation a generation of students in an active, participatory manner with a reward for their knowledge gain and conservation efforts of a badge from their governor.

RATIONALE. For many years, all elementary and junior high school students in the United States have participated in the Presidental Physical Fitness program.

A Card for record keeping are issued to all students and their push-ups, running time, etc., are kept. After all exercise activities are recorded, students meeting established standards receive a Presidential award.

What has the student proved in earning this award? The student has used human energy to reach desired physical applications and has become more aware of health and healthful exercise.

We propose the establishment on the state level (to be extended nationally if successful) of an energy award in order to generate interest, awareness, and participation on a scale comparable to that of the Physical Fitness program.

Living in the latter part of the 20th Century will mean ma[illegible] involvement with the energy situation. This means knowledge of source[illegible]d different forms of energy (not only human) but, also, energy that relates to everyday life.

For this reason, we are designing a program of awareness, involvement, and understanding of the energy necessary for survival and calling it, the "Florida Governor's Energy Award" program. Those students who earn the required points will receive a badge from their governor.

This program has been designed to be interdisplinary with involvement of English, Social Studies, Mathematics, Science, art classes and the principal. Awards can be presented at an end-of-the-year assembly.

We have presented this idea to the Governor's Energy office. If the idea is not approved by that office, each county and/or school and/or individual teacher can implement the program and award its own certificate or badge.

ACTIVITIES: See card sample

RESOURCES. Cards, badges, faculty involvement in an interdisplinary task to be interjected into the curriculum

EVALUATION PROCEDURES: See card sample

NOTE. If we are not successful in obtaining a badge award, please duplicate the card and implement the program in your school/class/county and award your own certificates. If you do so, we would like to know of the responses to the program in order to use the information for obtaining some source of revenue at either a state or federal level in order to provide funding.

Please write:

Alicia Barrionuevo
3240 S. W. 57 Avenue
Miami, Florida 33146

Patricia Temple
4700 Alhambra Circle
Coral Gables Florida
33146

GOVERNOR'S ENERGY AWARD

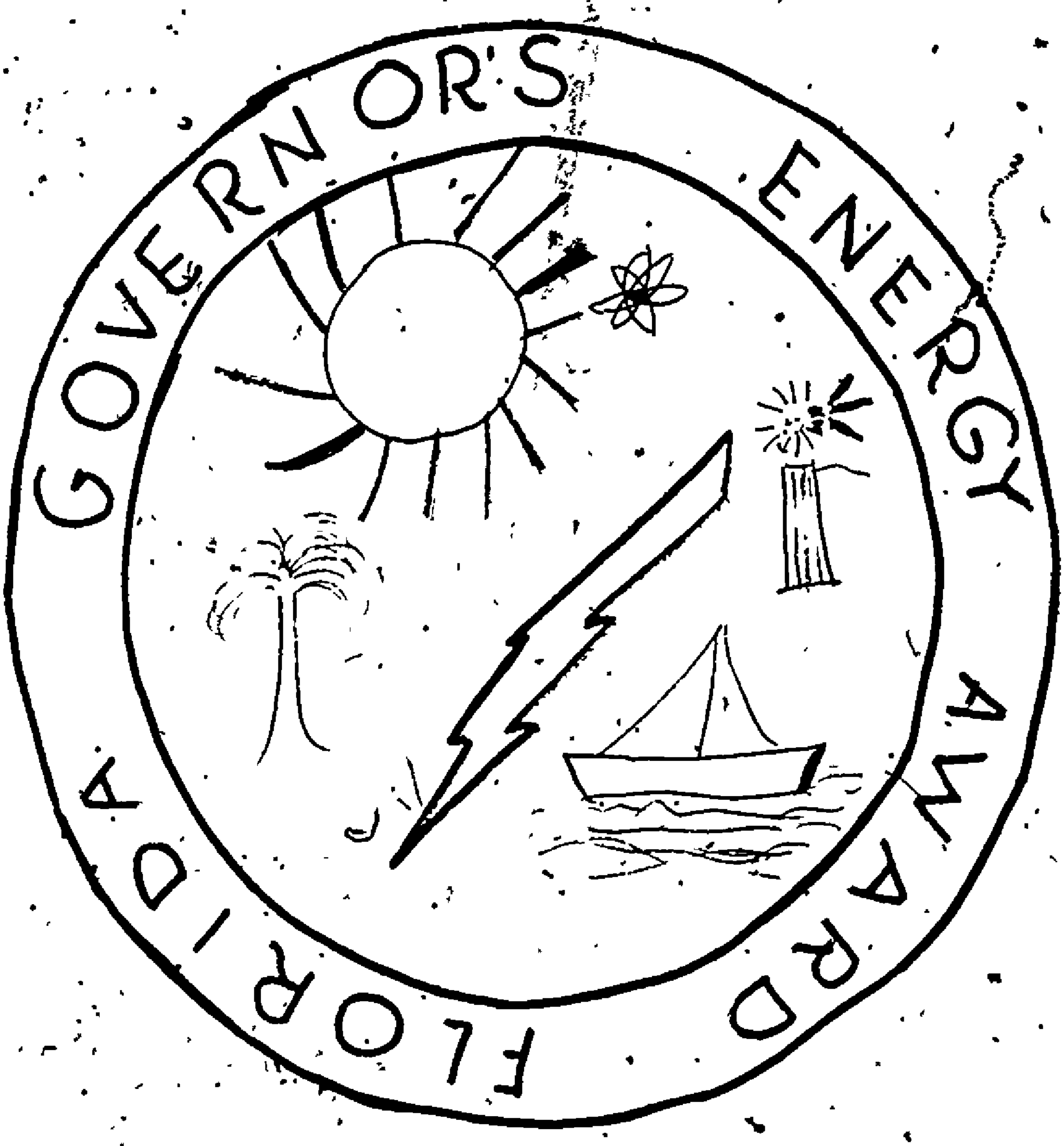
Name of the student		School			City		Points	
Science projects and /or reports (2)	1 A 4	B 3	C 2	D 1	A 4	B 3	C 2	D 1
Social Studies projects and/or reports	1 A 4	B 3	C 2	D 1	A 4	B 3	C 2	D 1
ENERGY CONSERVATION MONITOR (1 week)	A 4	B 3	C 2	D 1				
Implementation of ideas to conserve energy	A 4	B 3	C 2	D 1				
Prepare and solve ten factual energy related problems in Math class		A 4	B 3	C 2	D 1			
Book report on energy (English class)	A 4	B 3	C 2	D 1				
One original poster on energy. Display in the school (graded by Art Teacher)		A 4	B 3	C 2	D 1			
5 newspaper and/or magazine articles with student comment to English, Social Studies, or Science Teacher		A 4	B 3	C 2	D 1			
Other (i.e., Energy Day, assemblies, etc.)		1	2	3	4	5		

Points needed for the award = 32

TOTAL

Certified by The School Principal

Date



BADGE

Sample badge for "FLORIDA GOVERNOR'S ENERGY AWARD"
submitted by Patricia Temple and Alicia Barrionuevo

THE SCHOOL LIBRARY: THE ENERGY INFORMATION CENTER

Patricia A Temple Alicia G Barrionuev

Suggested activities for energy awareness

1) Special energy section
2) Energy displays
3) Book fair on energy
4) Posters
5) Display of student art work on energy theme
6) Use energy topic during library orientation
7) Energy Career Day
8) Special films on energy with follow-up by classroom teacher
9) Displays for Energy Day
10) Energy resource information to subject area teachers giving
    a) printed materials
    b) films-film strips
    c) posters
    d) pamphlets
    e) prepared units of instruction
11) Suggestion box for energy-saving activities
12) Photography contest with energy topic
13) Resource speakers
14) Pen Pal sponsorship with basic theme of correspondence to be energy
15) Bi-monthly energy information bulletin to faculty
16) Display of science energy-related projects
17) Annotated energy bibliography
18) Place school library on mailing list of energy information suppliers
19) Decorate Christmas tree with energy symbols
20) Work with art/graphics department to create bookmarks decorated with energy themes and distribute these in the library
21) Exhibition-demonstration of FPL Watt counter
22) Have selected energy sources readily available at Science Fair time
23) Sponsor recycling centers (i.e., newspaper, aluminum cans, etc)
24) Up-dates via PA system of on-going energy-related activities (i e., television, specials, magazine articles, etc.)
25) Honor noted energy contributors (past or present) with displays, bibliographical information, etc.)

CONSERVING ENERGY ON THE FARM

John E. Brown Cathy Osborne

GRADE: 8th and 9th

GENERAL OBJECTIVE: To discover and explore energy and ways to conserve energy on the farm

KEY VOCABULARY:

<u>Ampere</u> A unit of measure for electric current.
<u>Appliance</u> A device which does a special job, usually electric.
<u>Barrel</u> A liquid measure of oil, usually crude oil, equal to 42 gallons or 306 pounds.
<u>Chemical energy</u> Energy stored in the structure of atoms and molecules, which can be released by a chemical reaction.
<u>Conserve</u> To keep from being lost, wasted, or damaged.
<u>Efficiency</u> The ratio of work or energy output to the energy input to do the work.
<u>Electric current</u> A flow of charged particles, usually electrons.
<u>Energy</u> The ability to do work, to move a force a certain distance.
<u>Fuel</u> A substance that can be burned to produce heat.
<u>Fusion</u> The joining together of atoms to release energy.
<u>Gasoline</u> A fuel composed primarily of light hydrocarbons, produced by "cracking" crude oil in a refinery.
<u>Geothermal Energy</u> Heat energy within the earth which produces steam when it comes in contact with air.
<u>Kilowatt</u> A unit of electric power equal to 1000 watts.
<u>Kilowatt-hour</u> A unit of energy or work equal to the use of one kilowatt of energy for one hour.
<u>Nuclear Energy</u> Atomic energy, the energy released by changes in the nucleus of an atom in a reactor.
<u>Volt</u> The electromotive force which will cause a current of one ampere to flow through a resistance of one ohm.
<u>Watt</u> A metric unit of power used in electric measurements of the rate at which work is done or energy used.

SEQUENCE OF ACTIVITIES: (13) days

Introduction:

"Each of us is concerned with the rapid rising cost of gasoline, electricity and other energy resources. The threat of shortage in some and someday all of these hangs over our heads every day.

"While over the long term, the United States will be able to develop and put into production one or more alternative sources of energy, the day when these can offer a significant substitute to the more conventional kinds of energy is some years off."[1]

Until that day comes, we as farmers can take steps today to reduce the ever increasing cost of energy and to ease the threat of energy shortages. At the conclusion of this lesson you will be able to save yourself some money and all of us some vital energy.

ACTIVITIES:

1. Ask student: What is energy? Energy Conservation?
2. Have students explore the meaning of energy as it relates to Agriculture.
3. Show the film "Energy Conservation."
4. Ask student: How energy is lost?
5. Conduct discussion on how energy is lost in the farmhouse. (Weatherizing, Electricity, etc.)
6. Have students express opinion of Ways they can save energy mentioned above.
7. Show the film "How to Keep the Heat in Your House."
8. Read and discuss pamphlets on energy conservation.
9. Ask students how can they conserve energy in and around the farmhouse?
10. Show the film "Wood Heat."
11. Discuss the film (cost efficiency and etc.)
12. Have students design a model energy efficient farm.
13. Show film "Opening your Home to Solar Energy." Discuss film.
14. Show film "Organic Gardening Composting."
15. Ask students: Is Gasohol the answer to the farmers' fuel shortage?
16. Examine and discuss what our oil refineries get from a barrel of crude oil.
17. Discuss some alternative for our fuel shortage.
18. Ask student to survey gas stations and compare costs of diesel, regular, premium, unleaded and gasohol.
19. Ask students where does the electricity comes from that is used on the farm and what relationship does it have to fuel?

SKILLS (COMPETENCIES) TO BE DEVELOPED:

1. Students will develop a knowledge of energy and the different forms of energy.
2. Students will develop a knowledge of how energy is lost, (What is energy? - page 27).
3. Students will develop and explore ways energy is wasted in the farmhouse.
4. Students will develop and explore ways to conserve energy within the farmhouse.
5. Students will construct a model energy efficient farmhouse.
6. Students will develop a knowledge of how they can save fuel on the farm.
7. Students will discover and explore alternative energy resources for fuel on the farm.

RESOURCES NEEDED:

Textbook, Filmstrip, projector, screen, pencil and paper, pamphlets.

Films
Bullfrog Films Inc.
Oley, Pa. 19547

"Getting the most from your garden"
"Home energy conservation series"
"Conserving energy"
"Organic gardening (Composting)"
"Opening your home to solar energy"

Other Resources:

"Fuel from plants," fact sheet, National Science Teachers Association.
"Energy and my Environment," Governor's Energy Office.
"Energy conservation packet," Tennessee Valley Authority.
"Some useful facts on energy," Gulf Oil Corporation, 1981.
"What is Energy," U.S. Department of Energy, May 1980.

Pamphlets:

"A theological view of nuclear energy," Nuclear News, February, 1970.
"Facts about oil," American Petroleum Institute.
"Two energy futures," American Petroleum Institute.
"Energy wise home buying," Tennessee Valley Authority"
"Energy-saving checklist for home builders, buyers, and owners," U.S. Department of Energy.
"Electric saving," Tennessee Valley Authority.
"Home Weathering Check List," Tennessee Valley Authority.
"Where do we put it," James Phillips, Department of Education.
"Alternative Energy Sources," Ronald Benrey and Robert Schultz, 1978.
"Solar Energy for Agriculture," U.S. Department of Energy.
"Alternate Fuels," Gulf Oil Corporation.
"The Solar Powdered Irrigation Pump," U.S. Department of Energy.

EVALUATION PROCEDURE: Observation

Quiz

GRAPH U.S. DEPENDENCE ON FOREIGN OIL AND
U.S. USE OF GASOLINE IN CARS

Margorie Congdon

GRADE LEVEL: Fifth grade (math unit)

GENERAL OBJECTIVES: To follow basic math unit on charts/graphs. Learn to read and construct graphs. Use charts and graphs to solve problems.

VOCABULARY: pictograph, bar graph, broken-line graph.

MATERIALS: pencil, paper, straight edge, graph paper (optional).

ACTIVITY 1: Construct a pictograph using the following chart which gives you the average cost of imported oil.

AMOUNTS PAID FOR CRUDE OIL BY THE UNITED STATES[1]
(Dollars per barrel)

Year	Price per barrel
1969	$2.80
1970	2.96
1971	3.17
1972	3.22
1973	4.08
1974	12.52
1975	13.93
1976	13.48
1977	14.53
1978	14.57
1979	21.00

ACTIVITY 2: American dependence on imported oil has changed over the years. Construct a bar graph illustrating this.

UNITED STATES DEPENDENCE ON PETROLEUM IMPORTS[2]
(Millions of barrels per day)

Year	Oil Imports
1969	3.2
1970	3.4
1971	3.9
1972	4.7
1973	6.3
1974	6.1
1975	6.1
1976	7.3
1977	8.8
1978	8.2
1979	8.3

ACTIVITY 3. Over the years the mileage (miles per gallon) of U.S. cars has varied. Construct a broken-line graph showing this change. (Hint: Use 13.0 as the starting point of your vertical axis.)

U.S. AUTOMOBILE AVERAGE MILES PER GALLON[3]

Year	Miles per gallon
1967	13.93
1968	13.97
1969	13.63
1970	13.57
1971	13.57
1972	13.49
1973	13.10
1974	13.43
1975	13.53
1976	13.76
1977	13.94

ACTIVITY 4. Below is a chart showing the average number of miles driven by U.S. drivers. Use the information to make a broken-line graph. (Hint: Round to the nearest hundred).

AVERAGE NUMBER OF MILES DRIVEN BY U.S. CARS[4]

Year	Average miles per car
1967	9,531
1968	9,627
1969	9,782
1970	9,978
1971	10,121
1972	10,184
1973	9,992
1974	9,448
1975	9,634
1976	9,763
1977	9,839

ACTIVITY 5 Use the graphs you have made and the information given you in chart form to answer these questions.

1. How much money do the United States pay for imported oil in 1970? ($3,673,360,000)
2. How much money do the United States pay for imported oil in 1973? ($9,382,960,000)
3. How much did imported oil cost the United States in 1974? ($27,875,780)
4. Why was there such a jump between the years 1973-74? (OPEC embargo)
5. How much did imported oil cost the United States in the most recent year for which information is availiable? (63,619,500,000)
6. There are about 100 million cars in the United States. About how many gallons of gasoline were used by the American automobile in 1977? (70,6000,000,000)

7. During which year did American cars get the poorest gas mileage? (1973)
8. During which year did American gasoline consumption fall off? (1974)

ON THE AVERAGE AMERICAN CARS ARE DRIVEN ABOUT 10,000 MILES PER YEAR.

9. Based on 10,000 miles per year, how many gallons of gasoline does car A, that gets 13 miles per gallon, use in a year? (769)
10. How much does the owner of car A pay for gasoline, at $1.30 per gallon, in a year? ($999.70)
11. Based on 10,000 miles per year, how many gallons of gasoline does car B, that gets 15 miles per gallon, use in a year? ($666.66)
12. How much does the owner of car B pay for gas, at $1.30 per gallon, in a year? ($866.66)
13. Based on 10,000 per year, how many gallons of gasoline does car C, that gets 24 miles per gallon, use in a year? (417)
14. How much does the owner of car C pay for gas, at $1.30 per gallon, in a year? ($542.10)
15. How much money is saved by driving car B rather than car A? (133.04)
16. How much money is saved by driving car C instead of car A? ($457,60)
*17. Find out how many miles per gallon your family cars get and approximately how many miles each is driven in a year. Calculate the cost of gas (for a year) for each car.
*18. How much money and gasoline could be saved by trading one of these cars for a smaller one that gets 30 mpg?
*19. List several ways to improve gas mileage.
*20. List the things you learned while working with this unit.

*You may ask an adult to help you with starred questions.

EVALUATION. The evaluation of this unit could consist of observing the graphs produced by the children.

FOOTNOTES:

1. "Energy for Today and Tomorrow" Energy Conservation Research, Malvern, Pa. 19355. page 2
2. Ibid. page 1
3. Ibid. page 7
4. Ibid. page 7

POST SCRIPT. Activity 5 is good not only for reading and using graphs but is good as an activity in problem solving.

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MIDDLE EAST OIL

Patricia Stradley

GRADE LEVEL: Sixth Grade (social studies unit).

GENERAL OBJECTIVES: To follow unit in basal text. The student will become aware of the role the Middle East plays in the supply of oil for the United States. Map skills, reading skills, research skills, and role playing will be involved.

VOCABULARY: Crude oil, refinery, OPEC, tanker, import, export, consumer, petroleum, LTC

MATERIALS NEEDED:
1. World outline map
2. Crayons
3. Social studies book that is appropriate for sixth grade and includes Middle Eastern unit.
4. "Tips for Energy Savers." Consumer Information, Pueblo, Colorado 81009.
5. Fact Sheet #9, 10, and 11. "Energy Conservation," by John Fowler. c/o National Science Teachers Association, Washington, D.C.
6. "Some Useful Facts on Energy," Gulf Oil Corp., January, 1981.
7. "The ABC's of Oil," Public Affairs, Gulf Oil Corp., P.O. Box 1563, Houston, TX 77001.
8. "Facts About Oil." American Petroleum Institute.
9. Atlas

ACTIVITY 1: On a world outline map name the following:
- a. Saudi Arabia and its capital
- b. Iraq and its capital
- c. Kuwait and its capital
- d. Oman and its capital
- e. U.S.A. and its capital
- f. U.S.S.R. and its capital
- g. Afganistan and its capital
- h. Qatar and its capital
- i. Israel and its capital
- j. Mediterranean Sea
- k. Persian Gulf
- l. Atlantic Ocean
- m. Pacific Ocean
- n. Gulf of Mexico
- o. Strait of Hormuz
- p. Indian Ocean

ACTIVITY 2:
- a. Draw in on the map, using a dotted line, the transportation routes on Middle Eastern oil to United States ports.
- b. Color red the country that is the world's largest oil producer.
- c. Color green the country that is the world's largest consumer of oil.
- d. Label three ports at which oil tankers arrive in the United States.

e. Make a key for your map that includes capitals, transportation routes, colors, and ports.

ACTIVITY 3: Answer the following questions using social studies books, graphs, and booklets for information.

a. Does the U.S. consume more energy that it produces? (yes)
b. What area of the world provides the U.S. with most of its imported oil? (Middle East)
c. What means of transportation must Middle East oil use to reach the U.S.? (tanker)
d. List the bodies of water a tanker would travel from Saudi Arabia to New Orleans. (Persian Gulf, Strait of Hormuz, Indian Ocean, Atlantic Ocean, and Gulf of Mexico)
e. Why is control of the Strait of Hormuz important? (Controls transportation)
f. Does U.S.S.R. have access to the Persian Gulf? (no)
g. Why would they like to have control? (control oil shipment)
h. Would the U.S. like this? (no)
i. Why or why not? (would be at the mercy of U.S.S.R. for oil)
j. What religion is predominant in the Middle East? (Islam)
k. What is the U.S.S.R. stance on religion? (oppose)
l. How would this affect the feelings of Middle Eastern countries toward being ruled by U.S.S.R.? (resistance)
m. What would happen if the U.S. could no longer buy Middle East oil? (not enough energy)
n. What can the U.S. do to solve our problem about using more petroleum than we produce? (answers will vary)
o. Using the lists provided choose products you consider important in your life? Why? (answers will vary)
p. Which 5 of these 15 would you least like to give up? Why? (answers will vary)
q. Which 5 of these 15 could you most easily give up? (Answers will vary)
r. What is the chief product of the Middle East? (oil)
s. Do you think the Middle East people want to sell their oil as fast as they can? Why or why not?
t. What does OPEC stand for? (Organization of Petroleum Exporting Countries)
u. Name the OPEC countries. (Indonesia, Ecuador, Venezuela, Libya, Algeria, Nigeria, Gabon, Saudi Arabia, Iran, Qatar, Kuwait, United Arab Emirates, and Neutral Zone)

ACTIVITY 4: Role playing - Press Interview (directions for teacher)

As a culminating activity the students will role play a press interview. The class will be divided into small groups with each group member assigned a character to depict.

The roles can be Ali Rodi, an Arab oilman; Simon Jones, a Texas oilman, Tillie Lind, mayor, Brooke Dorsey, and Steve Robertson, reporters for The Oak Ridger.

In preparing for the role playing, the teacher must discuss and review with individual students the attitudes, opinions, and facts gleaned from the study. After roles are assigned time must be provided for each student to plan his role. Groups should have time to discuss their plans for dialogue and costumes.

Since students often have difficulty initiating an oral activity, the teacher should be prepared to begin the interview. An example might be, "Ladies and gentlemen of the press, I would like to present the mayor, Tillie Lind, who will introduce you our visitor, Sheik Ali Rodi."

As each group finishes its presentation, a time for audience and teacher reaction is provided before the next groups give their version of the interview. A final critique will evaluate the entire activity and will cover attitudes and opinions developed by the class members.

(The following activity sheets should be given to the child playing each character). Objectives for the roles-play characters:

Arab oilman - against intervention in Arab affairs by foreign interests
wants a high price for his oil
willing to make deals for products he may need
wants to make sure that his oil is not depleted (used up)

Texas oilman - fears that Middle East oil may be controlled by unfriendly government or interests
wants lowest price possible from Arabs

Mayor - wants business from both Arab and Texan; friendly

Reporters - wants to know what prices are being charged
wants to know what deals were made (weapons, food, defense, nuclear, power plants)
are we getting enough for American demands?
is the Arab government stable
how do Arabs feel about Russia?
how do Arabs feel about Israel?
how do Arabs feel about the United States?

EVALUATION

Answer the following questions in complete sentences.
1. Compare the consumption and production of oil in the Middle East and the United States.
2. Why is the U.S. concerned about the governments of the Middle Eastern countries?
3. What can you do to conserve energy?

APPENDIX - handouts

from - Energy in the Global Marketplace, November, 1978. National Science Teachers Association, Washington, D.C.
"Petro-dollars: The Problem of Too Much Money" (article)
"From Those Who Have to Those Who Want" (map)
"World Energy Consumption" (graph)
"Average U.S. Daily Imports of Crude Oil by Country of Orgin" (chart)

from - Tom Walker, Gulf Oil, Atlanta Office
"OPEC" (chart)
"1980 World Crude Supply" (chart)
"World Consumption and Reserves of Petroleum" (chart & graph)

from - Energy Transitions in U.S. History, June 1979-grades 8 - 9. U.S. Department of Energy, Office of Education, Business and Labor Affairs, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830
"U.S. Crude Oil Production and Total Consumption of Petroleum" (graph)
"Oil: Bright Promise" (List of products made from oil)

[redacted]

Student Hand-out: **PETRODOLLARS: THE PROBLEM OF TOO MUCH MONEY**

Imagine having a product to sell that has a value of: the entire U.S. farm crop; all the steel produced in the United States for four and a half years; 10,000 fighter aircraft; 3,200,000 private homes; or all the cars and trucks produced in the U.S. for three and a half years.

The members of the Organization of Petroleum Exporting Countries (OPEC) are in this unique position. OPEC is composed of the thirteen oil producing nations of the Middle East, Africa, Central America, and South America who together control over half of the world's oil reserves. The sale of oil brings in more than $125 billion a year to OPEC nations. The cost of producing oil in the Middle East countries in particular, is low, and therefore much of this income is clear profit.

This enormous wealth is new to most of the OPEC nations. Until the 1960's, the large, multinational oil companies controlled the production and sale of oil. Because there was an abundance of oil and little competition, the multinational corporations were able to keep the price of oil low and reap a great profit.

In 1960 the oil producing nations decided they wanted to obtain more money from the sale of their oil. At first OPEC was successful only in keeping the price of oil from dropping. In 1973, however, Arab OPEC nations embargoed the sale of oil to some industrial nations. When the embargo was lifted, OPEC, convinced now of its power, raised the price of oil from $2 a barrel to $13 per barrel. Although there has been some internal disagreement about the wisdom of this high price, OPEC has managed to keep the price of oil high.

OVER

With the increase in the price of oil, there has been a huge increase in the amount of money in OPEC nations. This income is being used to help OPEC nations develop. OPEC countries must import most of their manufactured goods, and some of their food. It is the profit they collect from the sale of their oil which pays for these goods. Many OPEC governments have directed the money to badly-needed programs in housing, health care, education and industrialization.

For many Middle East OPEC members, a large part of their oil profit is used for defense. Weapons and armies are expensive, yet the situation in the Middle East has prompted the OPEC nations to buy planes and weapons. They purchase these from the industrialized countries such as the United States, West Germany and the Soviet Union.

Even with developing programs underway and high defense spending, the OPEC countries still have enormous amounts of money. Increasingly, they invest this money in other nations around the world such as Great Britain and the United States. Among the companies partially owned by Arab and other OPEC nations are: Daimler Benz, manufacturers of Mercedes Benz automobiles; Arizona Land and Cattle Company of Phoenix; Kiaweh Island, South Carolina; Krupp Steel Works of West Germany; Security National Bank of San Jose, California.

Money that the oil producing nations earn from the sale of oil and then reinvest in other nations is referred to as "petrodollars." Some people are afraid that this investment in American industries by foreign nations is dangerous. It may give too much power to these foreign nations. Other people point out that the petrodollar investments have helped to support American industry. These investments also mean that some of the money the United States spends on oil is brought back to the country.

Student Handout

Oil-Based Products

antenna cable
credit cards
permanent-press clothes
heart valves
crayons
disposable diapers
parachutes
telephones
enamel
transparent tape
vinyl siding
safety flares
bubble bath
bookends
deodorant
panty hose
bedspreads
plastic tubs
shag rugs
lunch boxes
jerseys
windshield wipers
phonographs
car sound insulation
garment bags
fences
kitchen counter tops
pillows
dune buggy bodies
checkers
soap dishes
syringes
shoes
volley balls
sleeping bags
electrician's tape
mascara
flags
oxygen masks
ink
hair spray
steering wheels
food wraps
rubber duckies
seed tape
card tables
ping pong paddles
purses
weed killers
football pads
puzzles
carbon paper
dishdrainers
puppets
upholstery
hearing aids
earphones
whistles
clothesline
carpet sweepers
chess boards
yardsticks
slip covers
patio screens
mats
refrigerator linings
floor wax
panelling
earrings
false eyelashes
no-wax floors
golf balls
lighter fluid
attache cases
wet suits
laxatives
trash cans
brassieres
acrylic paints
vacuum bottles
bearing grease
rafts
sockets
tiles
air-conditioners
wallets
backpacks
rubbing alcohol
epoxy glue
oil filters

OVER

- mailboxes
- uniforms
- pacifers
- cassette tapes
- luggage
- antifreeze
- flashlights
- motorcycle helmets
- antibiotics
- shower doors
- sugar bowls
- decoys
- tobacco pouches
- pencils
- model cars
- garden hoses
- lawn sprinklers
- playing cards
- dolls
- bubble gum
- coasters
- straps
- tires
- rulers
- boat covers
- unbreakable dishes
- toothpaste
- tents
- finger paints
- glycerin
- foot pads
- lamps
- ice cube trays
- swimming pool liners
- cough syrup
- hair dryers
- styrofoam coolers
- brake fluid
- draperies
- car battery cases
- hockey pucks
- fertilizers
- knitting yarn
- sandwich bags
- tablecloths
- toothbrushes
- notebooks
- darts
- flea collars
- stadium cushions
- hang gliders
- sandals
- lipstick
- electric blankets
- lamp shades
- skateboard wheels
- guitar strings
- jugs
- eyeglasses
- vinyl tops
- TV cabinets
- measuring tape
- water softeners
- microfilm
- tennis balls
- measuring cups
- dishwashing liquid
- extension cords
- combs
- plastic varnish
- badminton birdies
- bird feeders
- hair curlers
- laminates
- visors
- tennis rackets
- canisters
- computer tape
- ammonia
- gaskets
- monkey bars
- venetian blinds
- digital clocks
- life jackets
- model planes
- insect repellent
- fishing net
- hair coloring
- rubber cement

21

Student Handout

OPEC

Number Of Countries	13
Very Diverse Group	Ethnic, Religious, Racial Per Capita Income, Language, Type Of Government, Geography
Most Common Denominators	Muslim, Arab
Total World Oil Reserves	675 Billion BBLS
OPEC Reserves	470 Billion BBLS
% Of World	70%
Arab OPEC Reserves	367 Billion BBLS
% Of World	47%
% Of Free World	62%
Total World Population	4.4 Billion People
Arab OPEC Population	44 Million People
% Of World	1%
% Of Free World	1 - ½%

Student Handout.

1980 WORLD CRUDE SUPPLY
MMB/D

OPEC	
Saudi Arabia	9.50
Iraq	3.50
Venezuela	2.05
Nigeria	2.10
Libya	1.82
U.A.E.	1.65
Kuwait	1.50
Iran	1.45
Indonesia	1.50
Algeria	1.00
Qatar	.48
Neutral Zone	.53
Gabon	.20
Ecuador	.22
TOTAL	27.50

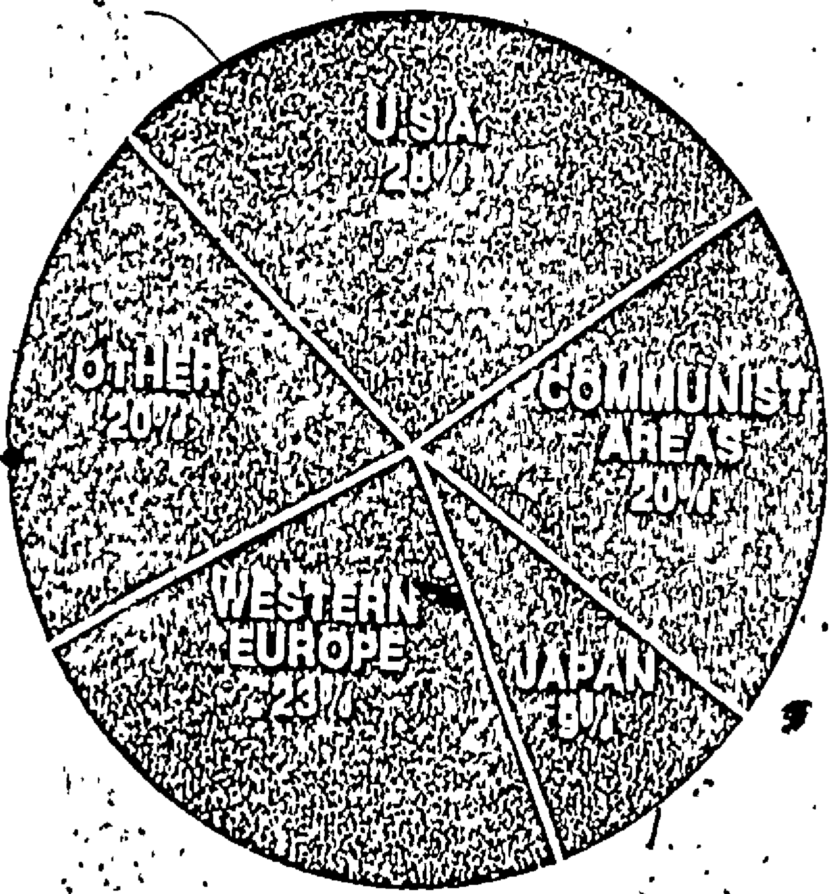
NON-OPEC	
U.S.S.R	11.70
U.S.	8.64
North Sea	2.27
China	2.20
Mexico	2.04
Canada	1.45
Egypt	.62
Malaysia/Brunei	.55
Argentina	.49
Australia	.40
Oman	.29
India	.26
Trinidad	.22
Other	1.63
TOTAL	[illegible]2.76

Student Handout

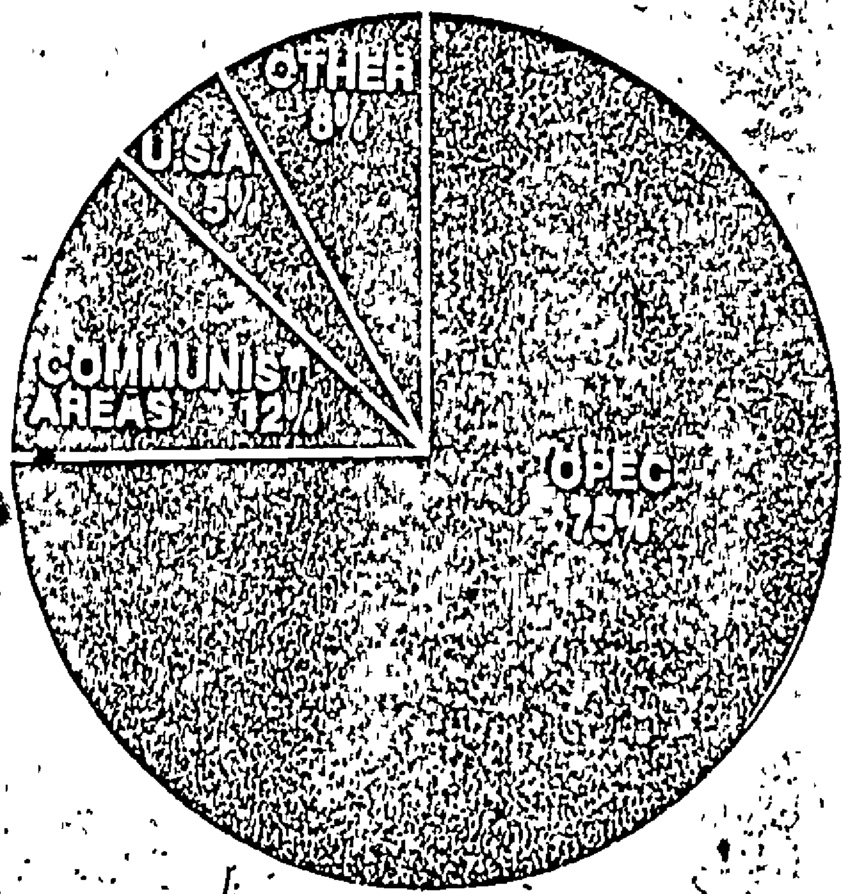
WORLD CONSUMPTION AND RESERVES OF PETROLEUM

1979

CONSUMPTION
64.5 MMB/D

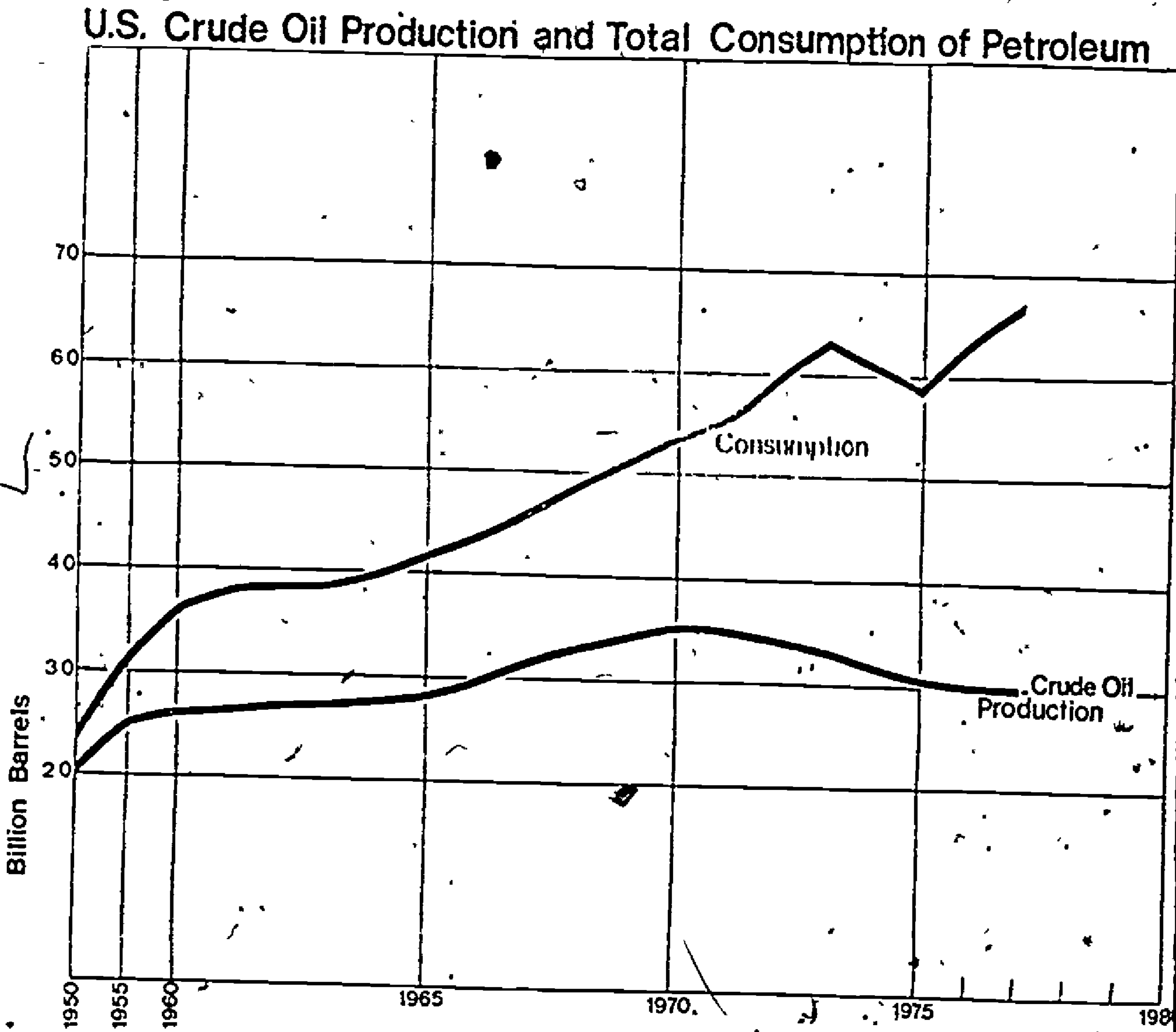


RESERVES
650 Billion Barrels



Student Handout

~~Graph 1~~



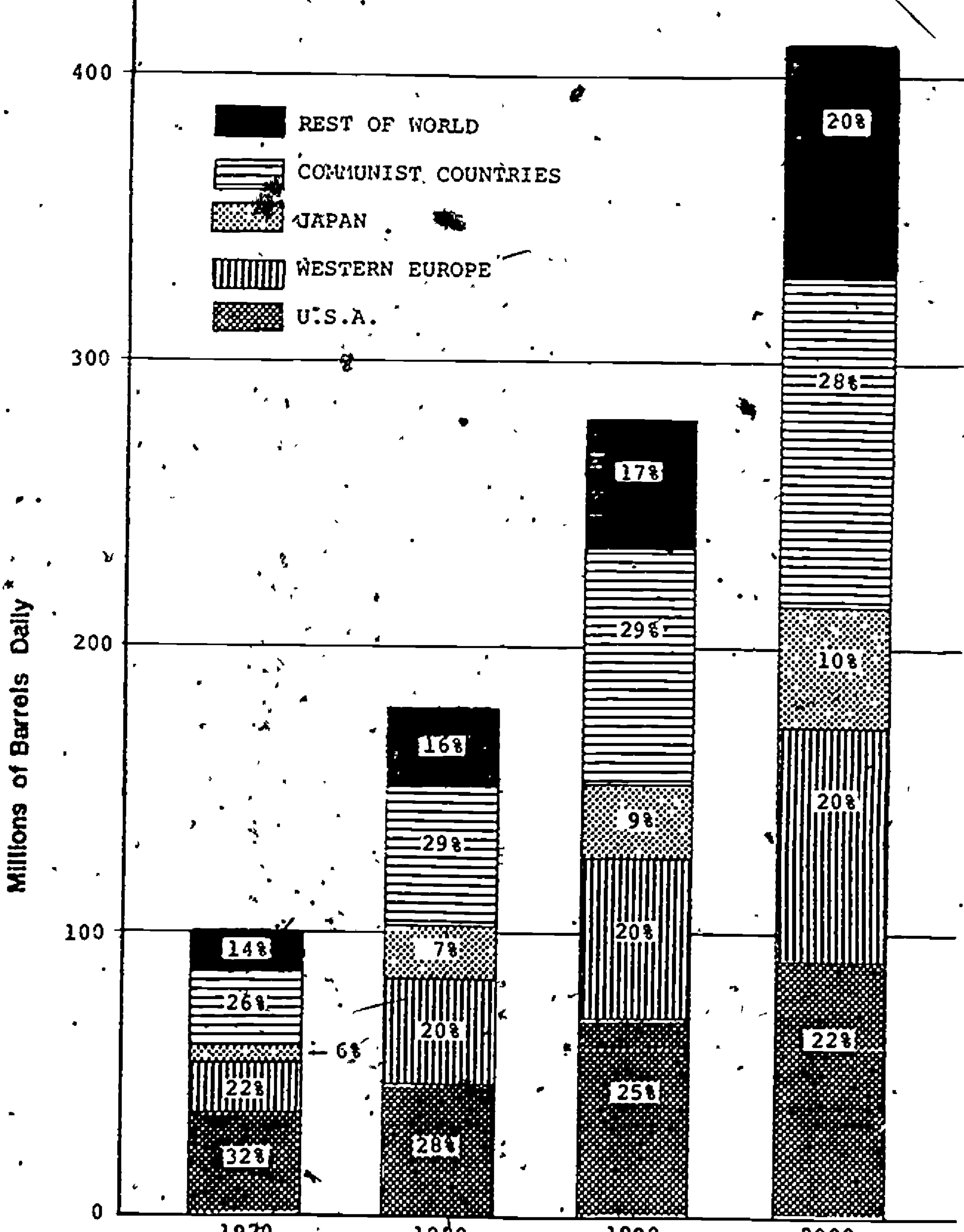
Data from <u>Energy in Focus Basic Data</u> (Washington, DC Federal Energy Administration) 1977

<u>Monthly Energy Review</u> (Washington, DC Department of Energy) 1978

Student Handout

World Energy Consumption

Graph 1



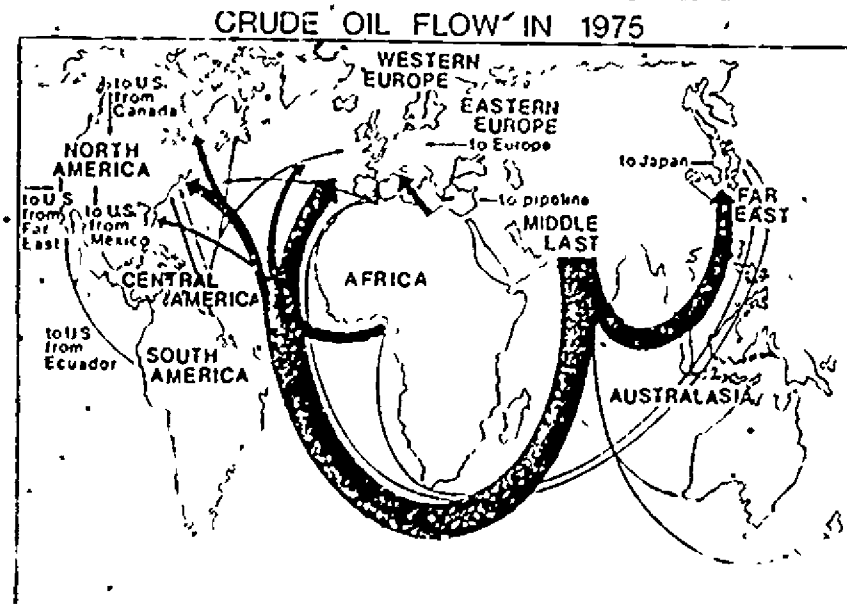
*All sources of energy expressed as equivalent to crude oil.

Student Handout

~~Lesson 2~~

~~Student Worksheet~~: FROM THOSE WHO HAVE TO THOSE WHO WANT

CRUDE OIL FLOW IN 1975



Adapted from Bureau of Mines, Division of Petroleum and Natural Gas.

Student Handout

Student Worksheet: AVERAGE U.S. DAILY IMPORTS OF CRUDE OIL BY COUNTRY OF ORIGIN

Table I

Read the table on this page. As you read keep in mind the question: *How important is Middle Eastern oil to the United States?* Th[illegible] ~~the questions on the next page.~~

Average U.S. Daily Imports of Crude Oil by Country of Origin

Source	1973	1975	1977 (Jan.-July)
Total Imports as % of Daily U.S. Needs	35.8%	37.0%	47.6%
Arab Oil	25.6%	29.4%	47.4%
Saudi Arabia	9.5	14.1	21.2
Kuwait	2.6	.5	1.0
Libya	5.6	5.5	9.8
Iraq	.8	.2	.8
United Arab Emirates	2.6	2.8	5.0
Algeria	2.3	4.8	9.6
Others	2.3	1.5	.6
Non-Arab Oil	74.4%	70.6%	52.6%
Iran	6.8	8.3	7.7
Venezuela	29.7	17.2	3.4
Indonesia	4.0	7.5	7.2
Canada	17.7	13.3	4.6
Nigeria	8.9	13.6	18.6
Others	7.3	10.8	11.1
Domestic Supply	64.2%	63.0%	52.4%

International Economic Report of the President, Table 4, Pages 65 and 71, 1973.
International Economic Report of the President, Table 74, Pages 182, 1975.
Oil and Gas Journal, Volume 75, No. 30, page 141, 1977.

ENERGY ACTIVITY

Gail Delicio

OBJECTIVE: This student will become aware of design elements which promote energy conservation in the home.

PERFORMANCE OBJECTIVES:
1. Using pencil, ruler, and graph paper, create a floor plan for an energy conscious home. (Scale 1" = 1/4")
2. Using pencil and paper create a site map for placement of the house, taking advantage of passive solar heating and cooling and natural breezes.

EVALUATION: Class Critiqué

ARCHITECTURE: Part I, the student will design a floor plan for an energy efficient home.

ACTIVITY: Design an Energy Conscious Home

TARGET GROUP: 8th and 9th grade Art, Science

MATERIALS: Graph paper, pencil, ruler, compass, protractor, "Planning Packet"

TIME REQUIRED FOR ACTIVITY: Part I - one week ("Design on Energy Conscious Home")
Part II - one day ("Selecting Site for House")

VISUAL AIDS: Planning Packet - one per group, xeroxed info sheets, 50 floor plans from "Homefinder" section of Sentinel Star, and sample blueprints donated by local architects.
FILMS - "Landscape Architecture," "Spaces To Live IN," and "All Kinds of Houses."

STEP I - Read planning packet. Discuss in class using transparencies illustrating key designs, etc.

STEP II - Create a floor plan illustrating design concepts which promote energy conservation in a house.

STEP III - Create a site map for house placement. Make use of passive solar and heating and natural breezes.

PLANNING PACKET
What type of house saves energy?

A. <u>One story square or rectangular floor plan.</u>
   1. Trades wall area for roof area.
   2. Reduces window area.
   3. Inside rooms are not exposed to exterior.

B. <u>Circular Floor Plan.</u>
   1. Best because the smallest area with the greatest use of space is a circle.
   2. Easy placement of windows to capture natural breezes.
   3. Easy placement of windows for passive solar heating and cooling.

C. Hexagonal Floor Plan
   1. Reduces wall area, but is not awkward as circle.
D. Square Plan With Atrium
   1. Windows face inner atrium opening.
   2. Can reduce heat gain if shading devices are used.
   3. Can provide placement of garden or pool.

Factsheet.

A. Reducing window and wall areas can save energy.
B. A house with a high wall casts, a long shadow for most of the winter.
C. A house with an overhang for the south wall protects it from the summer sun and allows exposure to the winter sun.
D. Face windows to the south, southeast, or southwest. On the east, west, and especially north, keep window areas small.
E. Scale: 1" = 1/4"
F. Airlock - An entry which had two doors, one of which is open at one time. Greenhouse - An airlock may be used as a greenhouse for plants. Outside wall temperatures are increased in cold weather and decreased in warm weather.

"You Must Use" List

1. Use solar energy naturally.
2. Maximum use of natural ventilation.
3. Maximum use of shade.
4. One of (or a combination) of four house types:
   a. Square or rectangular
   b. Square w/atrium
   c. Circular
   d. Hexagonal

   All are one-story houses

"You Can Use" List

1. Shutter
2. Solar Collectors
3. Greenhouse
4. Airlocks (entry)

ACTIVITY: Part II

Create a site map for placement of house, taking advantage of passive solar heating and cooling and natural breezes.

MATERIALS: paper, pencil, and ruler

RESOURCES:

1. Passive Design Ideas For the Energy Conscious Consumer, National Solar Heating and Cooling Information Center, Rockville, Md.
2. Energy - Saving Checklist for Home Builders, Buyers, and Owners, U.S. Department of Energy, 1979, Washinton, D.C.
3. Solar Modular Homes, Tennessee Valley Authority, Division of Energy Conservation and Rates, Solar Applications Branch.

4. The Passive Solar Energy Book, Mazria, Edward 1979, Rodule Press, pg. 88.
5. Jim Phillips' Passive Solar Energy House Site Map.
6. Jim Phillips' Where Do We Put It?
7. Eric Hostetler's example drawing:

ART AS A FUNCTIONAL TOOL. CREATIVE DESIGN FOR AN ENERGY EFFICIENT HOME.
Cathy Wilson Osborne

GRADE LEVEL: 8-9

GENERAL OBJECTIVES:

1. Student will develop knowledge and awareness in relation to energy issues and environmental conservation.
2. Students will design and develop creative plans for an energy efficient home or dwelling using knowledge (previously learned) in architectural design.
3. Student will transfer two-dimensional design idea to three-dimensional media in creating a model of the energy efficient design.
4. Student will participate in class critique and will appropriately display their work in the school library.

KEY VOCABULARY:

Passive Design - use of solar energy naturally with the use of little mechanical hardware
Berming - use of earth in insulate or moderate temperature changes
Greenhouse Effect - design using solar radiation through glass areas to maintain levels of heat during the winter months
Hydroelectric - electrical power by the extraction of energy from the force of moving water.
Life Cycle Costs - total cost of an item including initial purchase price as well as cost of operation, maintenance, etc., over the life of the item
Solar Energy - the electromagnetic radiation emitted by the sun

SEQUENCE OF ACTIVITIES:

DAY ONE Introduction of Unit. "Factual" discussion developing concepts relating to
a. energy issues (nation wide)
b. energy resources (nation and state wide)
c. energy conservation and environmental effects
d. the present and future status (where do we go from here, learning from the past)
e. what is "our" role in functional architectural design

Discussion will touch on architectural design tools such as air flows, solar design, hydro power, wind power, etc. Resources also include booklets of factual information provided by government (national and state) energy services. A list of these publication sources is provided in the back of this unit lesson.

DAY TWO Film, "Living the Good Life," produced by Bullfrog productions. Source for this film is also provided on back of unit lesson. Discussion relating to information in the film. Discussion of Florida "poineer" existance, how early Floridians used passive design in the construction of their dwellings. How we can use this knowledge and apply or improve their methods in conjunction with modern technology.

DAY THREE Film, "Log House," also produced by Bullfrog Productions. Introductions. Introduction to project. Introduce and inform students of project requirements such as materials and tools use, time, use, development of research needed for design, development of design, and drafting and drawing requirements.

DAY FOUR "Where do we put it?" activity. This is an activity which helps students investigate the numerous factors surrounding siting and building their homes and how energy conservation can be affected by the type building constructed. Information and materials are listed on the source pages at the back of this unit lesson. The activity is teacher guided and directed.

DAY FIVE Development of research and beginning design. Students may wish to work and research in the library where documents and resources are readily available and aware of students' needs in guidance and suggestions relating to the research project. Suggestions and design "hints" are helpful to the students at this stage of the drafting.

DAY SIX Individual work on the design drawings. Paper and pencils, rulers and erasers provided by the instructor. Instructor guidance during class time is essential.

DAY SEVEN Continued drawing on an individual basis.

DAY EIGHT Finish work on design drawings. Class critique and discussion of finished works. Objective suggestions and criticism from both instructor and fellow students. Design flaws and drawing skills could or should be pointed out--helpful suggestions should be discussed. Various ideas and designs should be discussed, technical discussion may aid in transfer of 2-D drawing to 3-D media. Teacher evaluation should be withheld until completion of the unit.

DAY NINE Introduction and requirements for 3-Dimensional project. Includes suggestions of media use (paper mache', cardboard, paints, found objects, etc.) Students should be limited as to the size of the project; not too small a scale and not excessive size. Size will also vary according to the type of design the student may have chosen. Students may wish to compare and combine their drawing designs and depending on the size of the class and availability of materials, may wish to work in groups of two or three to produce a 3-D model. Teacher demonstration may be helpful if students are not familiar with the media of paper mache'. Students should be encouraged to use materials and media "new" to them and to use ther in a new or creative ways. Suggestions or motivation by the instructor as to new methods and media use may stimulate several varied manipulation of the materials. "Anything goes" in the development of creative ideas in media use. "Found" objects may include chicken wire, bamboo, popsicle sticks, twigs and branches, clay or ceramics, paper products, seeds, nuts or berries, scrap metal, mechanical parts, machinery scraps, and other varied or multiple ideas or items.

DAY TEN Beginnings of 3-D project; Individual work under the guidance of instructor. Materials provided by instructor.

DAY ELEVEN Continued individual work.

DAY TWELVE, THIRTEEN, AND FOURTEEN Continued individual work on project. During these "lab" periods the instructor should be available to the student for guidance and suggestions concerning both technical and manipulative problems encountered by the student.

DAY FIFTEEN At the completion of project the student will be expected to display his/her work in the school library or suitable location. Class critique and discussion will take place at this time. Project evaluation will take place. Project wrap-up and discussion concerning project worth and knowledge gained from the experience will prove valuable to both student and instructor.

SKILLS (COMPETENCIES DEVELOPED)

1. Development in knowledge of energy conscious issues
2. Development in knowledge of creative artistic design in architecture
3. Development in knowledge of art as a functional tool of society
4. Development of drawing and design skills
5. Development of knowledge in 3-Dimensional Media
6. Development of technical and manipulative skills

RESOURCES NEEDED (MATERIALS)

Resources for research material, filmstrips, projector, screen, paper for each student, rulers, pencils, pen and ink, colored inks, brushes, water containers, paper towels, storage areas for drawings, cardboard, scissors, exacto blades and knives, paper mache', glue cement, "found objects" (gathered by students), paints, finishing items, display areas for finished work.

EVALUATION

Evaluation will be based upon finished products produced by the student. Evaluation will also be based on process, what and how the student learned, determined from the teacher observations. Evaluation of display, participation in project, participation in clean-up at the close of each class period. Evaluation of use and application of knowledge concerning tools and materials. Application of prior knowledge in design. There will be not structured examination, primary evalutation is based on observation of the students' progress on a daily basis.

SOURCE OF RESOURCES AND MATERIALS TO BE USED FOR LESSON UNIT

Bullfrog Films
"Living the Good Life," "Log House"

National Solar Heating and Cooling Information Center
P.O. Box 1607
Rockville, MD 20850
(Passive Design Ideas)

United State Department of Energy
Washington, D.C. 20585
(assorted materials provided free of charge)

The Rockefeller Foundation
1133 Avenue of the Americas
New York, NY 10036
(World Energy Survey, Ruth Sivard)

Florida Solar Energy Center
300 State Road 401
Cape Canaveral, FL 32920
("Design Notes, Concepts in Passive Design")

WHERE DO WE PUT IT?

This is an energy education activity which helps teachers and students investigate the numerous factors surrounding siting and building their own personal home and how energy conservation can be affected by the type building and the siting plan.

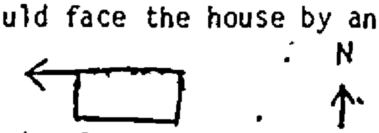
Introduce the activity by displaying a large (28" x 33") drawing of the 40-acre plot on which the home is to be built. (Attached drawing.) Point out the various places on the drawing that might affect an individual's decision as to where the home should be built, such as the lake, hill, paved road, trees, and open spaces. On this first part do not mention the idea of energy conservation. Ask the group to decide three things on this first part of the activity:

(1) What type house will be built given three choices:

Conventional | Stilt | Earth Sheltered

(2) Where they would build the house by placing the above symbols in the chosen spot.

(3) In what direction they would face the house by an arrow attached to the symbol.



(In this example a conventional house would be facing WEST.)

After all participants have placed their choices on the small drawing of the larger display, ask for individuals to give you their decisions and mark them on the large display in pencil. Ask for discussion as to why these spots were chosen.

In the second part of the activity, point out the need for energy conservation in home building in this time of energy shortages and high cost. Ask the group to make the same three choices again with the prime consideration being energy conservation. Plot these second choices on the large display in green or black ink or marker. Discuss the changes, if any, and why they were made.

In the third activity pass out the information on siting, passive cooling, and earth sheltered building. (Attached information sheets.) Point out the various factors that might affect energy conservation in the displayed plot such as:

(1) Prevailing wind (give to participants)

(2) Shading by trees; deciduous/conifer

(3) Elevation of home

(4) Direction home faces

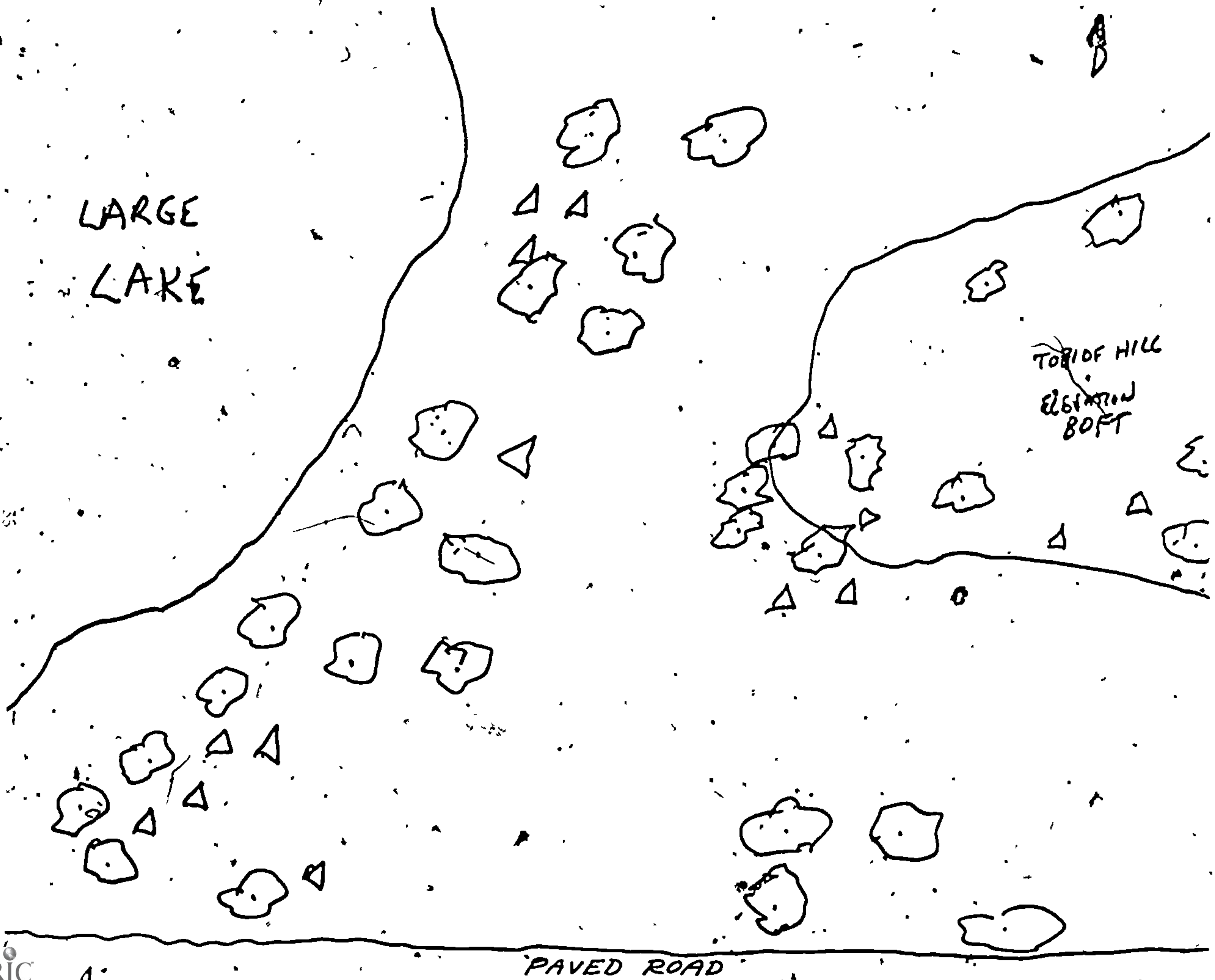
(5) Cooling/warming by lake

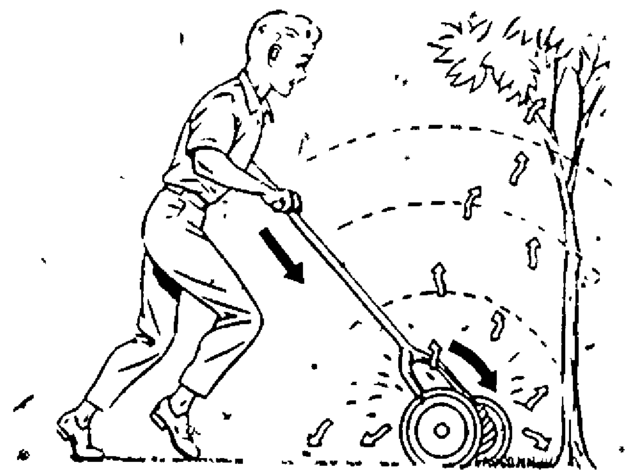
(6) Use of earth shelter to eliminate the extremes of temperature changes.

(7) Type of construction

(8) Materials used to build home

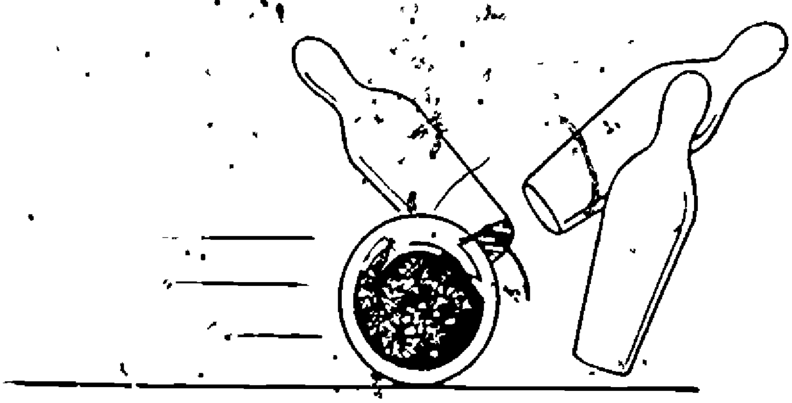
Pass out the information sheets on siting, passive cooling/heating and earth sheltered building to participants and ask them to review the materials so that they can make a final decision on "Where do we put it?" After giving them time to review materials, ask for their final decision on where they would put their home, what type home they would build and which direction they would face the home. Display these final decisions in green on the large display. This activity could then lead to a discussion about the factors that affect siting and building.


LARGE LAKE
TOP OF HILL
ELEVATION 80FT
PAVED ROAD



A boy pushing a lawn mower puts into it muscular energy which does the mechanical work of cutting the grass, and through friction is changed into heat which warms the grass the mower, and the surroundings

Figure 1 Mechanical Energy Changes to Heat and Sound



The mechanical energy of a rolling bowling ball is changed into heat and sound energy when it strikes the pins

Figure 2 Relative Amounts of Stored Energy

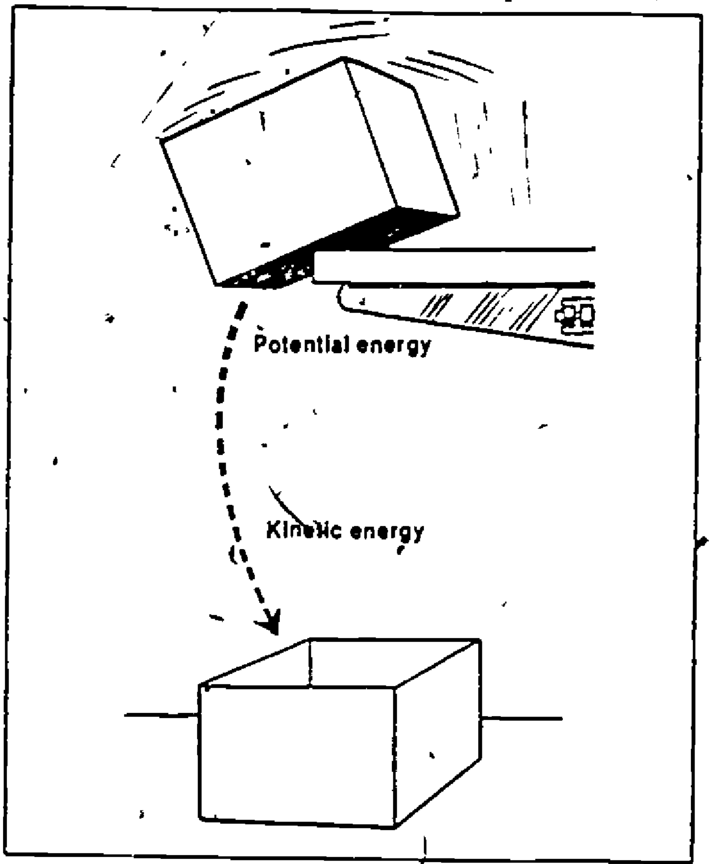


Figure 2 Transforming Potential Energy to Kinetic Energy

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PROPAGANDA TECHNIQUES IN ENERGY EDUCATION

Gail Foster

GRADE LEVELS: Junior High and above

OBJECTIVES: To identify and to give examples of progapanda techniques for the purpose of building rational decision-making skills.

SEQUENCE OF ACTIVITIES:

1. Teacher will review the rationale and revise hand-outs, if necessary.
2. Students will bring in examples of advertising.
3. Propaganda techniques will be introduced and hand-outs distributed.
4. Students will find examples of each propaganda technique in advertising. Radio & T.V. commercials may be used. Role playing maybe valuable.
5. Students will bring in articles on energy.
6. Students will identify specific propaganda techniques within the articles.
7. Group discussion may involve changing values and how they are affected by propaganda.
8. Groups may plan advertising campaigns or write energy articles using propaganda to encourage conservation. Videotape productions could be planned and performed.

SPECIFIC SKILLS:

1. Students will be able to identify specific propaganda techniques in advertisements and commercials.
2. Students will be able to identify specific propaganda techniques in articles based on energy.
3. Students will be able to utilize propaganda to encourage conservation.

RESOURCES:

Advertisements
Energy--related articles
Hand-outs
The Propaganda Game (wff'n Proof, optional)

EDUCATION PROCEDURES: Rationale

The energy crisis is alarming. In ancient Chinese the word "crisis" was written with two characters. The first meant "danger," but this danger does not automatically endow educators with license to indoctrinate. Rather than yield to this tendency, recall that the Greek root of the word crisis means "decision." Thus decision making skills should be a primary objective in energy education.

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In order for students to build skills in making decisions, propaganda techniques should be identified and studied. The word "propaganda" comes from the Latin word for propagation, Propaganda, as a method of dessiminating information, influencing opinions and encouraging specific courses of action, is not always negative. However, in our society, it is increasingly important that students be able to evaluate information and distinguish between emotional issues and actual content of an idea. To promote skills in the process of decision - making, students should have opportunities to identify and analyze propaganda techniques.

The following hand-outs identify and give examples of propaganda techniques.

Propaganda Techniques - I

The Institute for Propaganda Analysis lists seven common propaganda techniques.

1 Name Calling - Applying some label that people generally dislike or fear to a person, organization or idea Such words as "racist" or "communist" may be used to discredit rather than describe accurately.

Example - "Only an idiot would believe nuclear power can solve our nation's energy problems."

2 Glittering Generality - Connecting positive - sounding words to an idea, so that you will accept the idea without examining it.

Example - "Farmers are the life blood of our country, harvesting energy from the sun to feed America. They can help solve our energy problems through gasohol."

3 Transfer - Using the reputation of some respected organization in connection with an idea.

Example - "The Union of Concerned Scientists estimate that 10 to 17 percent of our uranium miners will die of cancer."

4 Testimonial - Quoting some well-known person in favor of a given product or policy.

Example - "Energy Analyst Charles Kormanoff recently published an exhaustive study that shows electricity from nuclear plants will cost 20 to 25 percent more than power from modern coal plants with advanced pollution - removing scrublers."

5 Plain Folks - Winning confidence on the basis that an idea is good because it is related to the common people.

Example - "Ladies and gentlemen of the jury... the defendant cannot possibly be guilty of tampering with his electric meter to defraud the utility company, for he comes from a long, long line of hard-working, God-fearing, liberty-loving, and patriotic people just like yourselves."

6 Card Stacking - Selecting and using facts to give a false or misleading idea

Example - "Nuclear plants in the U S. run at only 5 percent of their capacity."

7 Band Wagon - Urging you to follow the crowd and accept the idea because "everybody's doing it"

Example - " meeting the nation's energy needs should be a great national cooperative effort that enlists the imagination and talents of all Americans "

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Propaganda Techniques - II

1. Appeal to Pity - Seeks to produce sympathy and pity to influence your opinion

   Example - "America's poor, already trapped by rapidly rising prices for food and housing, are expected to be hardest hit by a 50¢ a gallon tax on gasoline."

2. Appeal to Prestige - Urging the acceptance of an idea as a means of raising your status.

3. Appeal to Ridicule - Attempting to make fun of someone or something in order to influence your opinion.

   Example - "Conservation is ignored in the President's energy budget. Obviously, conservation is not good business for the oil companies that donated $280,000 to redecorate Ronald Reagan's White House living quarters."

4. Bargain Appeal - Attempting to get you to buy an item by appealing to your desire to save money

   Example - "This is your last chance to buy a brand new Opex automobile at 1981 prices"

5. Appeal to Flattery - Attempting to persuade by flattering a person in an area inwhich he would like to excel

   Example - "Physically fit students tend to use bikes for transportation in order to conserve our valuable natural resource."

6. Slogan Appeal - Promotes a favorable response or positive action through short, catchy phrases.

   Example - "Save It, Florida." "Extinct Is Forever."

7. Technical Jargon Appeal - Impresses with the use of technical language or unfamiliar words

   Example - "Durawear tires contain durium, the bonding material that makes these tires wear for years"

8. Danger/Survival Appeal - Refusing to act in a certain manner will result in harmful consequences.

   Example - "The Union of Concerned Scientists predicts a one-in-five chance of a catastrophe for one of our current reactors during their 30 to 40 year lifespan."

Sources - Some examples were based up an article in the Tallahassee Democrat entitled "We Don't Need Nuclear Power" by Ira Scorr, June 21, 1981

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OIL ENERGY: FACTS AND FAIRNESS

Debra A. Summers   Kelvin Reddick   Bob Stevens   Roger W. Robison Jr.

GRADE LEVEL: 9 & 10 grade average or regular class of science or social studies. Class time is approximately 45 minutes long.

GENERAL OBJECTIVES:
1. To learn how oil is consumed.
2. To learn how much oil is consumed.
3. To learn how much oil we use as individuals.
4. To find out if oil is distributed equitably.

KEY VOCABULARY: (See Attached Sheet)

SEQUENCE OF ACTIVITIES:
1. Homework assignment - check mileage on family car.
2. Role Playing - a classroom debate on "Energy."
3. Lecture on the Facts about Energy.
4. Home energy audit.
5. Newspaper article discussion.

SKILLS TO BE DEVELOPED (COMPETENCIES):
1. Math Skills
2. Reading Skills
3. Understanding of the use of the Environmental Protection Agency
4. Thinking & Discussion Skills

RESOURCES NEEDED:
1. Environmental Protection Agency Guide Booklet.
2. "Tips for Energy Savers."
3. Index cards.

EVALUATION PROCEDURES: (See Attached Sheet)

ACTIVITY I

OBJECTIVE: To show students their families gas usage and to compare their families' gas usage.

SKILLS DEVELOPED:
1. Math skills of addition and subtraction.
2. Students learn to read Environmental Protection Agency (EPA) chart.
3. Students develop an understanding of individual energy use.

TIME: This activity will take approximately 5 - 10 minutes of class time. This assignment is to be assigned at the first class meeting of the unit on Oil Energy and completed at end of the week. The end of week activity will take about 45 minutes or an entire class period.

MATERIALS NEEDED: EPA guide for car mileage .

ACTIVITY: At first meeting, students will be given homework assignment. Each student will check the mileage of their family car(s). At the end of the week, students will check the mileage again and bring figures to class.

In class, students will subtract the first mileage reading from the second mileage reading:

EXAMPLE: 08550 - second reading
05425 - first reading
125 = miles driven

The student will then divide the total number of miles driven by the E.P.A. rating for their particular car.

EXAMPLE: E.P.A. rating for Ford Pinto, 25 mpg.

$$25 \overline{)125}^{\,5}$$

There are 5 gallons of gas used by the child's family. Each student will then compare gas usage.

QUESTIONS TO BE ADDRESSED:
1. Is there a difference in how much gas is used?
2. Who uses the most? The least? Why? (i.e. occupation, distance from city, number of family members).

NOTE. If a students family does not have a car, the student could be involved by using the teachers or principals' mileage or the school buses. This activity can be altered from 1 day to several days.

FURTHER DISCUSSION. Have students consider "If just 1 gallon of gasoline were saved each week for every auto in the country, we'd save about 5.6 billon gallons of gas in a year or about 8% of the demand." (From: Tips for Energy Savers)

REFERENCE. 1. E.P.A. Mileage Guide. E.P.A., Washington, D.C. 20545
2. Tips For Energy Savers, U.S. Department of Energy, TIC P.O. Box 62, Oak Ridge, TN 37830 .

ACTIVITY II: Lesson Plan

OBJECTIVES. 1. The student should be able to understand the importance of conserving energy.
2. The students will learn about individual consumption.

SKILLS DEVELOPMENTS: Social Studies

TIME: 3 days

MATERIALS: index cards, fact sheets

ACTIVITY. 1. A lecture will be given on energy consumption. (Teacher)
2. Classroom discussion on energy.
3. Choose a career occupation and on an index card write down the duties of that particular role.
4. Choose one of the debate propositions. Each debate will be discussed in class.

A classroom debate on "Energy."

Preparation: Pass out cards to student and let them choose a role from the following:

Lower class people	Higher class people
farm laborer	bank executive
store worker	President of Corporation
maid	owner of Store
garbage collectors	gas station owner
bus driver	doctor
taxi driver	lawyer
bank teller	judge
waitress	big time contractors
cashier	big time farmers
custodian	architecture
	engineer
	college professor.
	pilots
	politician

2. In one paragraph describe the role.
3. Choose one of the following preposition for debate in class.
   a. close down gas station on the weekend or cut down on the consumption of gasoline.
   b. cut down on electricity or raise the rates.
   c. cut down the bus operation by two hours in the evening inorder to conserve energy for the bus corporation.
   d. raise the electricity rates to build a power plant.

ACTIVITY III: Tips for Energy Savers

FACTS:
1. Most of the energy we use the U.S. come from petroleum. (Crude oil)
2. U.S. imports half of it, at a high cost. Where does it go?
   a. Industry 36%
   b. Commerce 11%
   c. Residence 26% (offices, schools, hospitals)
   d. Transportation 27%
3. If we continue using energy as we have become accustomed to, we could run out of domestic oil supplies before the year 2007 and natural gas even sooner.

OVERALL SITUATION IN THE U.S.

Energy demand keeps rising; energy prices keep going up. the availability and future costs of supplies remains uncertain.

WHAT CAN WE DO ABOUT IT?

1. Conserve energy. This will help us extend our supplies and reduce our import burdens.
2. We could easily cut our energy use by an estimated 30% or more.
3. The energy we use for our homes and automobiles--gas, oil, electricity--draws on all of our energy resources. Cutting back on these uses is the simplest, most effective way to make our resources last longer.
4. Draft - proof windows and doors. If every household wer caulked and weather stripped, 580,000 barrels of home heating fuel could be saved each winter.

5. Install a heat pump -- costs; $2000 -- $425. It can cut the use of electricity for heating by 30 to 40%.
6. By removing one bulb out of three and replace it with a burned out bulb for safety; replace others with bulbs of the next lower wattage. This should save about 4% in electricity costs in the average home.
7. By not buying a car air conditioner one can reduce fuel consumption on an average of 10 percent.

ACTIVITY IV: Home Energy Audit

OBJECTIVES: 1. To increase the students awareness of how his family consumes energy.
2. To make students aware of actions they might take to conserve their family's consumption of energy.

ACTIVITIES: 1. Creation of Home Energy Audit Check List (1 day).
a. The class will be divided into small groups and instructed to discuss items for inclusion on a Home Energy Audit Check List. (group work)
b. Each group will report on its work to the class, and the work of the various group will be refined in class discussions.
c. A committee of these students will be appointed to edit the work of the class and to established a final form for the audit check list. (writing skills)
2. Conducting Home Energy Audit: (1 day). Students will use the Home Energy Audit Checklist developed by the class to examine the ways their family use energy, and to establish methods for future consumption.
3. Students will be required to write a two page essay in which they report their findings and make recommendations for specific actions their family might take to conserve its use of energy. This material should be attached to their copy of the Home Energy Audit Checklist and submitted to the teacher.

ACTIVITY V

OBJECTIVE. To investigate the equitability of energy policy on the individual in regard to gasoline consumption.

SKILLS NEEDED. Reading newspaper article, classroom discussion skills, and problem solving.

TIME: One class period (50 minutes).

MATERIAL NEEDED: Copy of news account for each student.

ACTIVITY: 1. Students will read the article.
2. Teacher will ask if any vocabulary or concepts are not understood. This can be done through question and discussion lead by the teacher.
3. The students will be asked to discuss the values expressed in the article.

EXAMPLE:
1. Railroads are efficient for all.
2. Tax will affect all equally. (remember how much your family drives)
3. How will tax money be used? Is it equitable?
4. Will this make people conserve?

DATELINE: Washington, D.C. -- Congressman Bill Board (D - Delaware) today proposed a 50¢ per-gallon gasoline tax. This tax would generate funds for refurbishing the nation's railroads. Board stated, "This is both a plan to promote conservation now and a low cost energy efficient means of transportation for the future." This tax will affect all Americans equally for everyone buying gasoline. The Appropriations Committee will consider this proposal next week.

VOCABULARY:

1. Energy - A quantity having the dimensions of a force times a distance. It exists in many forms and can be converted from one form to another. Common units are: calories, joules, BTU's, and kilowatt-hours.
2. Gasoline - A petroleum product consisting primarily of light hydrocarbons. Most gasoline is formed by "cracking" and refining crude oil.
3. Equitable - Fairness - not equal but a fair distribution of resources.
4. E.P.A. - Environmental Protection Agency.
5. Crude oil - A mixture of hydrocarbon in liquid form found in natural underground petroleum reservoirs.
6. M.P.G. - miles per gallon.

OIL ENERGY: FACTS & FAIRNESS EVALUATION

True/False

__T__ 1. Most of the energy we use in the U.S. comes from petroleum.

__T__ 2. If we continue to use energy as we have in the past, our supplies will run out before the year 2007.

__F__ 3. Our energy demand is constantly going down.

__F__ 4. It is a very good idea to use as much electricity as one lies in the early morning hours.

__T__ 5. Cutting back on the use of energy resources is the most effective way to make our resources last longer.

Short Answer

1. What does the letters E.P.A. stand for? (Environmental Protection Agency)
2. List some ways in which one could inexpensively repair their homes inorder to save energy. (insulate hot water heater, turn down thermostat, use weather stripping around doors and windows)
3. What does the word "equitable" mean? (Fairness - not equal but a fair distribution of resources)
4. What is "ENERGY?" (a quantity having the dimensions of a force times a distance. It exists in many forms and can be converted from 1 form to another. Common units are calories, joules, BTU's and kilowatt-hours).
5. What are you willing to do as an individual to help conserve energy?

GEOGRAPHY AND ENERGY: RESOURCES AND ISSUES

Charles R. Larnest Martha L. Woodward Genevieve Snell

GRADE LEVEL: - 12

GENERAL OBJECTIVES. For the student to discover the types of energy: their availability, users, problems and whether they contribute to the chemical or electrical pool.

KEY VOCABULARY ITEMS:

energy	synfuels	cartel
fossil fuels	ecology	balance of payments
Biomass	pollution	nuclear reactor
geo-thermal	conservation	breeder reactor
exponential growth	co-generation	energy efficient
renewable fuels	OPEC	

ACTIVITIES:

(1) As an introduction to this unit of study show a film on energy and elicit from the students' comments concerning the problems, their ideas etc. For the films see: DOE Film Library, P.O. Box 62, Oak Ridge, TN 37830.

(2) Vocabulary study. Define the key words and write a paragraph which uses at least 10 of the energy words.

(3) Letter Writing Activity - See sample letters:

(a) At the beginning of this unit each student will rewrite a letter requesting information on some aspect of energy to an oil company, utility company, environmental or energy agency. Some suggestions are:

Rosalyn Tillis
Governor's Energy Office
The Capitol
Tallahassee, FL 32301

Dr. Dave LaHart
300 State Road 401
Florida Solar Energy Center
Cape Canaveral, FL 32920

Tom Watson
Gulf Oil Corporation
P.O. Box 7245
Station C
Atlanta, GA 30357

Technical Information Center
Department of Energy
P.O. Box 62
Oak Ridge, TN 37830

(b) At the end of the unit, each student will write a letter expressing his opinion on some aspect of energy based on the information gained from this study. These letters could be written to the local newspaper, city, county, state, or federal officials. Appropriate officials include:

Governor D. Robert Graham
State Capitol
Tallahassee, FL 32301

Senator Lawton Chiles
Room 437
Russell Senate Office Bldg.
Washington, D.C. 20515

Senator Dempsey Barron
Senate Office Bldg.
Tallahassee, FL 32304

Senator Paula Hawkins
Senate Office Bldg.
Washington D.C. 20510

Senator Pat Thomas
Room 332, Senate Office
Building
Tallahassee, FL 32304

Rep. James H. Thompson
House Office Bldg. Rm. 208
Tallahassee, FL 32304

Rep. Don Fuqua
Rm. 2268 Rayburn House Bldg.
Washington, D.C. 20515

A letter to a newspaper expressing an opinion

1981 Planet Road
Super City, Florida
June 20, 1981

Dear Sirs,

I am concerned about the closing of the City-Dial-a Ride program for the aged.

It is true that some of our fuel supply will be used to provide a volunteer program to transport the disabled and aged to doctor's appointments and other necessary meetings.

So many of these persons have no transportation and are unable to use public conveyances.

It would seem to me to be an act of generosity and mercy to continue this program - to fund it, if volunteer drivers cannot be found.

Yours truly,

A letter to an oil company requesting information

1981 Environment Street
New Energy City, Florida
June 20, 1981

Dear Sirs,

The students of the 7th grade of Conserve Junior High are studying a unit on Energy.

I am interested in off-shore drilling. Are there any pamplets, maps, etc. on this subject, published by your Oil Company that I may have.

I would appreciate any help in this matter. Thank you.

Yours truly,

(4) Energy Studying Sheet - These can be used by individuals or small groups. Duplicate and distribute to each student. Consult the following resources.

- "Energy, National Geographic, February, 1981.
- "Energy," World Book Encyclopedia - Field Enterprises (also consult specific energy resources)
- Sivord, Ruth L. World Energy Survey: World Priorities Leesburg, VA 1979

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Cutting Energy Costs, 1980 Yearbook of Agriculture - USDA
"Energy '80," Christian Science Monitor, 1980
"Some Useful Facts on Energy," Gulf Oil Corp., January, 1981
The World Almanac

WORK-STUDY SHEET ON ENERGY

OBJECTIVES:
1. To do a concentrated study on one (or more) fuel(s)/energy source(s).
2. To learn about the supply and demand of the fuel/energy source.
3. To learn about the cost of the fuel/energy source.
4. To discover the government policy on the use of this fuel/energy source.
5. To learn what is the appropriate use of the fuel/energy source.

1. Select one fuel/energy source for study from this group:

Fossil fuels (coal, petroleum, natural gas)

Water Power	Tidal Energy
Nuclear Energy	Geo-Thermal Power
Solar Energy	Fuel Cells
Wind Energy	Solid Wastes
Hydrogen	Wood

1a. This study will be on: ______________________

2. What are the various forms fo this fuel/energy source?
A. __________ B. __________ C. __________ D. __________

3. Does this contribute to:
A. The chemical pool fo energy B. the electrical pool of energy
C. Both

4. In what type quantities can this fuel/energy source be purchased?
____

5. List 5 - 10 ways in which this fuel/energy source can be used.

__________	__________
__________	__________
__________	__________
__________	__________
__________	__________

6. What is the current cost per unit of this fuel/energy source?
____

7. What was the cost 5 to 10 years ago?
Year __________ Cost __________

8. Discuss the known available quantity or supply of this fuel/energy source in the U.S. (Use separate page).

9. Discuss the known available quantity or supply of this fuel/energy source in the world. (Use separate page).

10. List and discuss the major problems related to obtaining and using this fuel/energy source in the U.S. (Use separate page).

11. List and discuss the major problems related to obtaining and using this fuel/energy source in the world. (Use separate page).

12. Discuss the historical development of this fuel/energy source. (Use separate page).

13. Discuss the place of government (local, state, national) as related to this fuel/energy source. (Use separate page).

14. Describe and discuss the conservation and appropriate utilization of this fuel/energy source. (Use separate page).

15. Discuss the ethics of using this fuel/energy source. (Use separate page).

RENEWABLE FUELS - FUELWOOD

GRADE LEVEL: 7th grade

GENERAL OBJECTIVE: To discover the uses of fuelwood as an energy source.

KEY VOCABULARY ITEMS: Energy, nuclear reactor, fossil fuel, foresters, wood, heat equivalent, wood alcohol, cellulose, lignin, charcoal, resource, developing nations, World Bank, Table of Coefficients, thermal equivalent, metric ton, BTU, quadrillion

ACTIVITIES:
1. What energy mass produces more than one half as much energy as that produced by the nations nuclear reactor?
   Answer: wood
2. Compare the energy content of wood to fossil fuel.
   Answer: lower
3. Compare the cost of power from the use of wood to that of fossil fuels.
   Answer: more expensive
4. Although there is a great demand for firewood in many areas, why cannot the demand be met?
   Answer: Not enough foresters to supply the wood.
5. How is the cost of wood heat being reduced in many areas?
   Answer: trees are chipped and compressed into pellets with a heat equivalent of coal.

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6. Where did the Department of Energy fund an "energy plantation" to grow trees like an agriculture crop?
Answer: South Carolina
7. How is wood converted into alcohol?
Answer: First, the wood is separated into cellulose and a woody substance called lignin. It is the cellulose that can be converted to alcohol.
8. Name 2 traditional forms of energy upon which the developing nations are dependent.
9. Where is 90% of the reported firewood production?
Answer: developing nations
10. What part of all energy consumed in South America and South Asia is fuelwood?
Answer: 1/3
11. What part of all energy consumed in Africa is fuelwood?
Answer: 2/3
12. Wood is considered what kind of resources?
Answer: self-generating
13. Name 3 reasons why wood is cut.
(1) to clear land for grazing and farmland. (2) building material. (3) industrial products
14. Global forests are disappearing at what rate?
Answer: ½ in the past 25 years.
15. Give 2 reasons for increased demand for wood.
(1) population explosion (2) jump in commercial energy prices
16. Give 2 serious consequences of scarcity of wood in the developing nations.
Answer: (1) diversion of animal dung from agriculture to heating and cooking purposes. (2) reduced soil fertility and crop production.
17. Name 3 countries pioneering in the development of fuelwood plantations.
Answer: (1) Sweden (2) South Korea (3) China
18. Without a replenishment programs, when does the World Bank estimate that the current stock of wood will be consumed?
Answer: less than 40 years.
19. There is no universally agreed upon system for making conversion from one unit of energy to another, but what tables is used for conversion whenever possible?
Answer: U.N. Tables of Coefficients
20. In the U.N. Tables of Coefficients, to the thermal equivalent of what energy quantity are basic units of other energy quantities compared?
Answer: The thermal equivalent of hard coal.
21. One cubic meter of fuelwood is equivalent to how many metric tons of hard coal?
Answer: 0.33
22. One metric ton of coal is equivalent to how many cubic meters of fuelwood?
Answer: 3.03
23. Give 1 BTU in joules and gram calories.
Answer: 1,055 joules, and 252 gram calories

24. If 1,000,000 BTU's = 0.0036 metric tons of coal equivalent, how many BTU are in a cubic meter of fuelwood?
Answer: 10 million.
25. The U.S. total energy need is how many BTU?
Answer: 75 quadrillion (quads) BTU/year
26. How much wood is in a quad?
Answer: 50 million cords of wood.
27. At the rate of 50 million cords of wood per year, how long would our forests last?
Answer: less than 7 years.
28. Wise management of forests for energy would concentrate wood energy use in what communities:
Answer: rural and agricultural
29. How much of the total rural and agricultural energy requirements could be wood?
Answer: 25%
30. For every quad of wood grown, harvested, and delivered, approximately .046 quads are used how?
Answer: harvesting and transporting
31. Besides fuel why should the U.S. maintain forest areas?
Answer: clean air and water, noise, wildlife, recreation
32. How is energy released from fuelwood?
Answer: burning
33. Methanol or wood alcohol can be used to fuel automobiles. What is the major problem to be overcome in converting a car from the use of gasoline to methanol?
Answer: corrosion of emission and starting systems, filters, seals, and fuel tanks.

Useful Conversion Factor Table

1 BTU = 1,055 joules = 252 gram calories
1 metric ton = 1.102 short tons
1 metric ton = 1.47 metric ton coal equivalent
1,000,000 BTU = 0.036 metric tons coal equivalent
1 cubic meter of fuelwood = 0.33 metric ton coal equivalent
1 metric ton coal equivalent = 3.03 cubic meters of fuelwood.

RESOURCES:

Reprint from Christian Science Monitor, February, 1980, pg. 7.
The 1980 Yearbook of Agriculture, Cutting Energy Costs, pg. 107.
World Energy Survey, Ruth Leger Sivard. Rockefeller Foundation, 1979, pg. 25.
Science Activities in Energy, U.S. Department of Energy by Oak Ridge Associated Universities, 1981.

CONSERVATIONS ACTIVITIES

ACTIVITY 1 "Thanking About Your Energy Use."

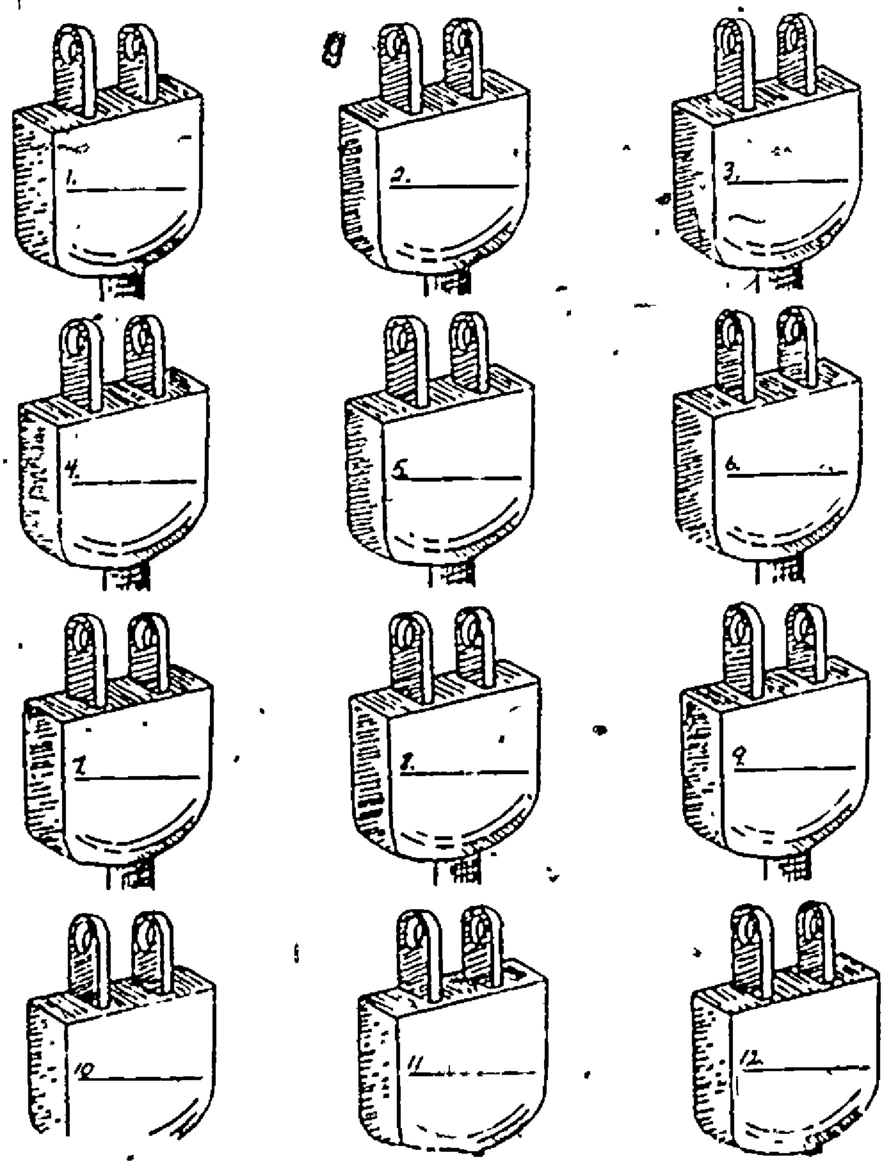
ACTIVITY 2 "Learning About Your Water heater and Your Family's Hot Water Needs."

The two handouts above are from:
"Energy guide for Secondary Home Economic Classes" May 1980.
Energy, Environment, and Resource Center, University of Tennessee, Knoxville, Tennessee, 37916.

ACTIVITY 1

Thinking About Your Energy Use

1. In the spaces provided below, list 12 major appliances used in your home regularly.



2. If there were a law that said you had to use less electricity, draw a pencil line through the three items in the picture you could do without.

3. Circle in pencil the three that really mean the most to you and that you would hold on to until the very end.

4. Now look back over your list and your decisions and consider:

   a. Why did you decide to do without the three items?

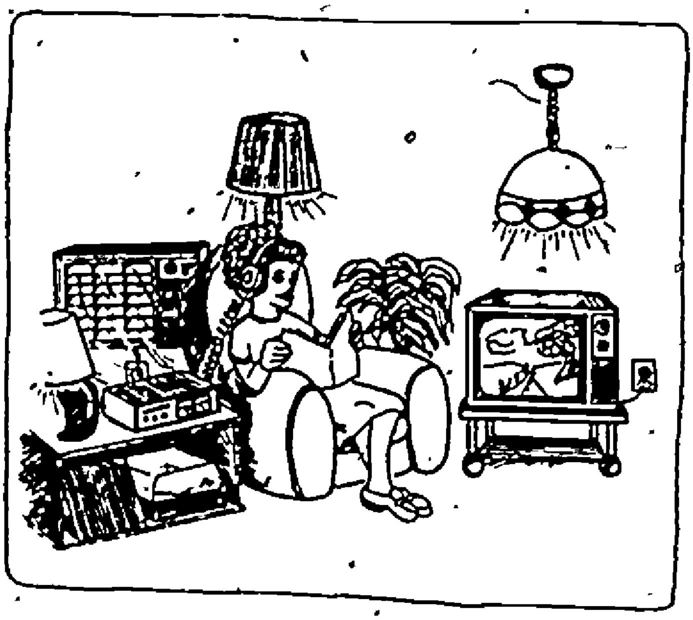
   b. Why did you want to keep the other three?

5. List below some efficiency steps you can take to reduce the energy and money consumed by each of the three appliances you chose in Question 3.

a. ____
____
____

b ____
____
____

c. ____
____
____



ACTIVITY

Learning About Your Water Heater and Your Family's Hot Water Needs.

1. The first thing you need to learn about your family's water heater is. What do you have now?: To learn this, find out:

   ★ What type of water heater is it—gas, electric, or oil?

   ★ How old is it?

   ★ Is it insulated?

   ★ What is its capacity? (In other words, how much water can it hold?)

   ★ At what temperature is it's thermostat set? What is the *actual* temperature of the water in the heater? (To find this out, draw water from the heater through a faucet near the bottom and check it with a thermometer.) . And, remember, the water when it comes out of your kitchen faucet, etc , will not be the same temperature as it is in the heater. The further it travels through pipes, the cooler it gets.

2 Too small a water heater will not give your family enough hot water, too big a water heater will be operating inefficiently by heating unused water. So the next thing you need to discover is how much hot water your family uses To do this, find out:

   ★ How many loads of clothes are washed each week?

   ★ How many loads of dishes are washed each week?

   ★ During each week, how many showers or baths are taken and for how long?

   This information is then converted to daily hot water usage with the following factors

Task	Average Hot Water Consumed per Load or Bath	
Clothes Washing	(Hot water wash)	24 Gallons
	(Warm water wash)	12 Gallons
Dish Washing		10 Gallons
Bathing	(Short shower or bath)	20 Gallons

   Total your family's weekly use of hot water and then divide by seven to get daily hot water use.

3 How does your family's daily hot water use compare with your water heater's capacity—Is the heater's capacity too small—unnecessarily large?

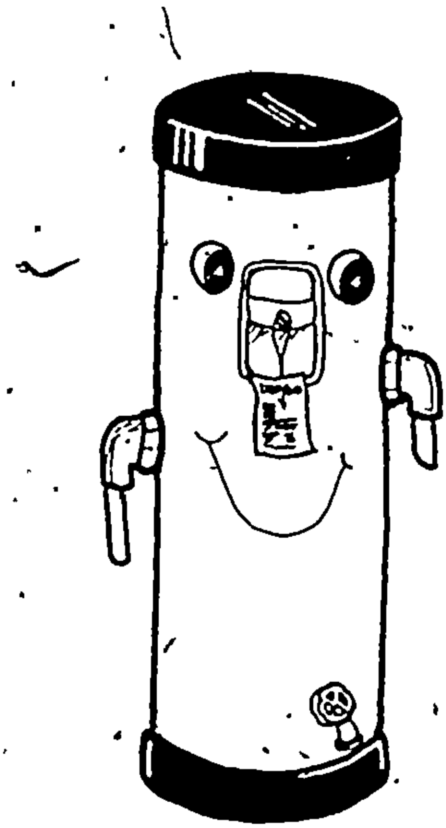
4 The table below gives the national average daily hot water requirement for different sized families.

Family Size	Gallons of Hot Water Used Daily
2	23
3	32
4	40
5	48
6	57
7	65

How does your family compare?—Does it use less?—Does it use more? Why?

5 Why might you run out of hot water on one day during the week but not on other days?

6 What are some ways to cut down on your family's hot water use?



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ACTIVITY 3 Gasoline Mileage Cost Chart

Mileage Cost Chart

Yearly Cost For 10,000 Miles of Driving

	$1.25@gal	$1.50@gal	$2.00@gal	$3.00gal
10 mpg				
15 mpg				
20 mpg				
25 mpg				
30 mpg				
40 mpg				

Monthly Cost For 1,000 Miles of Driving

	$1.25 gal	$1.50 gal	$2.00 gal	$3.00 gal
10 mpg				
15 mpg				
20 mpg				
25 mpg				
30 mpg				
40 mpg				

Savings

1. Money in one year saved at 30 mpg with 1.50 gal. as compared with 15 mpg at $1.50 gal. is ________________.

2. Gas saved in same period is ________________.

3. Money saved in one month at 30 mpg with $1.50 gal. as compared with 15 mpg at $1.50 gal is ________________.

4. Gas saved in same period is ________________.

ETHICS ON ENERGY

Martin Bielicki

GRADE LEVEL: Middle School, High School

OBJECTIVE: To have the students become aware of the sensitive issues concerning energy.

SKILLS: Value clarification, discussion, and writing.

SEQUENCE OF ACTIVITIES: Read the case studies. The student can write position papers and participate in class discussions.

RESOURCES: Reading could give the students an insight into the issues: "Bill would raise interstate speed limit," from the Tallahassee Democrat, February 21, 1981. 'The Nuclear Dilemma' by F.H. Schmidt from the American Educator, Spring, 1981.

EVALUATION: Position paper and discussion.

CASE #1 Current law says that drivers shall drive 55 mph. You have probably noticed that some people drive 70 mph and others follow the 55 mph law.

1. Why is there a 55 mph law?
2. Why would someone want to drive faster than 55 mph?
3. Why would someone want to follow 55 mph?
4. How are you going to drive? Why?

CASE #2 The United States consumes 33% of the World's Natural Resources, but only has 6% of the population.

1. Why does the U.S.A. consume a third of the Natural Resources?
2. Why must the U.S. be concerned about consuming a third of the world's resources.
3. How would your life-style change if there imported natural resources should be totally halted?

CASE #3 France has lent technicians to the Middle East to build a Nuclear Breeder Reactor. The reactor will help supply poorer nations with energy. The nuclear wastes, however, could easily be developed into atomic bombs.

1. What issue can you see from nations giving nuclear knowledge to poorer nations?
2. Should the technology of Nuclear Reactors be controlled by a few nations?

CASE #4 If oil is found on the shelf of South America, it would provide that continent with much needed energy.

1. Who should control the drilling and exporting of that oil?
2. If minerals and new energies are found in any ocean, who should have the right to ownership?

READING ON THE FLORIDA ENVIRONMENT

Martin Bielicki

GRADE LEVEL: High School

OBJECTIVES: To have the student become aware of the crisis in Florida's environment.

SKILLS: Reading comprehension

Fact Questions:

1. What has been the growth of Florida?
2. List some of Florida's problems.
3. What is an "acquifer?"
4. How has our water resource been threatened?
5. How has development changed the ecological/ecosystem of Florida?
6. In what ways have rivers and lakes been polluted?
7. What is the South Florida Water Management District?
8. How has the Ecosystem of the Everglades been altered?

Though Questions:

1. What do you think Florida will be like in 20 years?
2. Why must people think about Ecosystem?
3. In what ways could our environment be protected?
4. What are some of the advantages and disadvantages of increasing population?
5. Why could a class-five hurricane teach developers a lesson?
6. How can you actively protect the environment?

RESOURCES. There is an excellent article in Sports Illustrated, February 9, 1981, by Robert Boule and Rose Mary Mechem, "Florida's Booming to some, but it's Bombing to others."

EVALUATION. Discussion and writing assignments could be developed from the article in Sports Illustrated. The following is a list of questions that could be asked from that article.

Also, a teacher can include the reading, "For The Future of Florida, Repair The Everglades," published by the Friends of the Everglades. Films on ecology and ecosystems can be seen in conjuction with Florida. Guest speakers from Water Management, Audubon Society and City Commissions could be invited to speak. Florida maps could be given to show where endangered areas are located. Field trips could be arranged, especially to the Everglades National Park. Environmental Centers can also aid in developing a unit on Florida ecology.

IMPROVE YOUR ENERGY QUOTIENT

(Mathematics, Science, Social Studies)

Carolyn Campbell
Gail Foster
Jean Foster

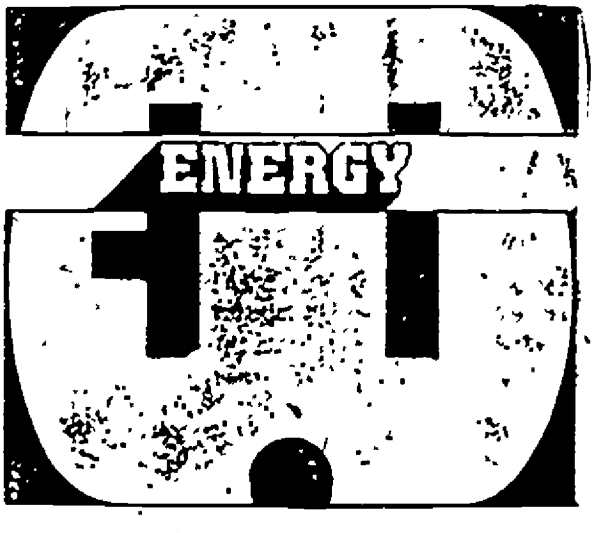
ACTIVITY I: ELECTRICITY--HOW TIMES HAVE CHANGED

GRADE LEVEL: 9 - 12

OBJECTIVES. Students will learn interviewing techniques and ways in which their uses of electricity differ from those of their grandparents.

ACTIVITY: Use handout entitled "The Good Old Days"

SKILLS: Interpret results from interview.



The Good Old Days?

Interview someone who is old enough to remember what life was like before the days of great usage of oil and natural gas Ask him or her the questions that follow and others that you think of yourself.

1. What kind of lights did you use in your home? ______ How was it heated? ______
2. What fabrics were clothes made of? Was clothing harder or easier to take care of? ______
3. What sort of washing machine did you have? ______
4. What kind of stove (and what kind of fuel) did your family use for cooking? ______
5. Did you have a refrigerator? How did you keep your food fresh? ______
6. How was food packaged when it came from the store? ______ What did milk come in? ______ Was your milk delivered? ______ How? ______
7. What sort of soap did you use? Did it clean as well as the cleaners we have now? ______
8. How was your water heated for bathing and laundry? ______
9. Did your family have a car? ______ If not, how did you travel? How did you get to school? ______
10. Did you have a radio? What did it look like? ______ Did you go to the movies? ______ What kinds of entertainment did you enjoy? ______

(Think up as many more questions of your own as you can Ask them during the interview. Put the answers on the back of this paper)

To close the interview, ask these questions and write the answers on the back of this paper.

In what ways is life for you more enjoyable now that we have electricity, plastics, detergents, and other oil and natural gas products?

In what ways did you like the "good old days" better?

Activity 2. Improve Your Appliance E.Q.*

GRADE LEVEL: 9 - 12

OBJECTIVES The student will be able to determine the energy efficiency of specified appliances.

VOCABULARY: Ampere, Voltage, and Watts.

ACTIVITY: Have each student complete the table below.

Chart A

APPLIANCE	BRAND NAME	WATTS REQUIRED
Black and White TV		
Blowdryer		
Color Television		
Dryer		
Electric Alarm Clock		
Hot Water Heater		
Microwave Oven		
Oven/Range		
Portable Electric Heater		
Radio		
Refrigerator/Freezer		
Toaster		

The wattage may not appear on some appliances. In that case, amperes are given. To change amperes to watts, the student may use this formula.

*Energy Quotient

Amperes x Voltage of circuit = Watts

On the following day, a list will be compiled and comparison of brand name appliances will begin with the selection of the brand using the least energy

SKILLS. Multiplication of whole numbers and decimals Comparison of results

**Note With Larger appliances, the student may use the brochure to obtain the wattage or amperes

Activity 3 Changing Watts to Kilowatts

GRADE LEVEL: 9 - 12

OBJECTIVE: The student should be able to. 1) convert watts to kilowatts, 2) relate the energy demand to consumption of kwh in a specified time.

VOCABULARY: Kilowatt and Kilowatt-hour

ACTIVITY Using Chart A (revised from accumulation of students' results), the teacher introduces the kilowatt (a unit of electric power equal to 1000 watts) and begins the activity of changing the wattage of individual appliances to kilowatts.

Example Light bulb 100 watts = ______________ kilowatts

100 ÷ 1000 = 1 kw

APPLIANCES	WATTS	KILOWATTS
Black and White TV		
Blowdryer		
Color Television		
Dryer		
Electric Alarm Clock		
Hot Water Heater		
Microwave Oven		
Oven/Range		
Portable Electric Heater		
Radio		
Refrigerator/Freezer		
Toaster		

After converting all the wattage to its kilowatt equivalent, the teacher introduces the term kilowatt-hour (the use of one kilowatt in one hour or 1000 watt-hours).

A good activity to do with the students at this time is a demonstration involving the Watt-Counter Information about this device may be obtained from your County Coordinator The Watt_Counter is an electronic device which measures the kwh an appliance uses It is programmed to indicate the kwh for the larger appliances (e.g. refrigerator, over/range, dryer, central air and heat, water heater, and lights) at the average use for a family of four. It also gives a reading in the cost per day in dollars and cents. (Some students relate to this figure better.)

SKILLS. Division of whole numbers and decimals

MATERIALS NEEDED Watt-Counter or the "Blue Box"

Activity 4: Reading Your Electric Meter

GRADE LEVEL: 9 - 12

OBJECTIVE: Student can read his/her electric meter.

VOCABULARY: Clockwise, counter clockwise

ACTIVITY: Complete the handout "Read Your Electric Meter Right." Using their meter readings, have each student figure the amount of KWH his/her household consumed over a specified time.

SKILLS: Subtraction and/or addition of whole numbers.

Activity 5: Word Problems Involving Electrical Energy

GRADE LEVEL: 9 - 12

OBJECTIVES: The student is able to apply basic math skills to calculate correct answers to energy word problems.

VOCABULARY: Peaked

ACTIVITY: Find the answers to the following 20 problems.

1. Fill in the table with the wattage of each appliance (Use Chart A). How long would you have to run each appliance to burn 1 kwh of electricity? Round answers to the nearest tenth.
   Hint: Divide 1000 watts (to 1 kwh) by the watts of the appliance.

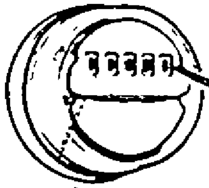
APPLIANCE	WATTS	HOURS
1000 watt light	1000	10 hrs. = 1 kwh
1. toaster		
2. portable electric heater		
3. blow dryer		
4. electric alarm clock		
5. color t.v.		
6. black and white t.v.		
7. microwave oven		
8. oven/range		
9. hot water heater		
10. electric dryer		
11. refrigerator/freezer		
12. radio		

13. In Florida you are charged approximately $.06 for each kwh used. In a month's time your family used 900 Kwh of electricity. What was the basic charge you paid on your electrical bill?

14. In August your use of electricity peaked to 1500 kwh. How much was your basic charge for this summer month?

Read your ELECTRIC METER RIGHT

If you have a meter like this (digital), just write down the numbers



4	6	3	7	2

If your meter looks like this (dials), read the right one first. Write down the last number the hand has passed

READ FROM RIGHT TO LEFT

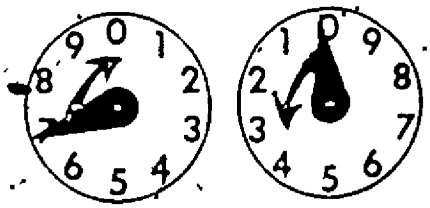
Look, some of the hands turn right and some turn left

4 6 3 7 2

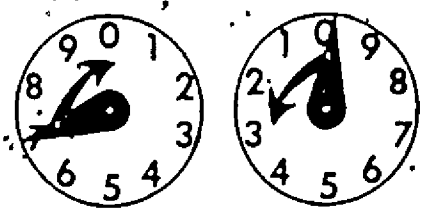
Take the last reading from the new reading

46372	new reading	
45109	last reading	
1263	amount of kilowatthours you have used	

This is the way to read a meter. But there is one more thing. If a hand is right on a number and you don't know if it has passed or not, then do this. Look at the dial to the right. Has the hand passed 0?



If this dial on the right *has passed* 0, write down the number the hand on the left is pointing to. In this case "7."



If the dial on the right has *not* passed 0, write down the number the dial on the left has just passed. In this case "6"

WEEK OF	METER READING

TVA Tennessee Valley Authority

Office of Power
Division of Energy Conservation & Rates
Conservation and Energy Management Branch

15. On one weekday you had your refrigerator on for 24 hrs., your color t.v. on for 4 hrs., and your dryer on for 1 hr. What would be the total number of kwh consumed? Hint: Use Chart C.

16. Using the number of kwh from problem how much did it cost to run those 3 appliances for that particular day?

17. Seventy-gallons of oil must be burned to generate 1000 kw of electricity. Your school uses 30,000 kw per month. How much oil was burned to provide electricity for your school?

18. Each barrel of oil hold 42 gallons. Your dad's company used the equivalent of 4 barrels of oil for heat last January. How many gallons of oil were consumed?

19. Approximately how many kw did your father's company consume in January.

20. If you could conserve 20 kwh a day, how much oil in barrels would you conserve in a period of 300 days?

SKILLS: Completing a chart interpreting information and selecting appropriate math operations (division and multiplication of whole numbers, use of decimals and rounding off to the nearest tenth) to answer each problem correctly.

Activity 6: Evaluating Air Conditioners

GRADE LEVEL: 9 - 12

OBJECTIVE: The student is able to compute the Energy Efficiency Ratio (EER) and apply this knowledge to his own air conditioners.

VOCABULARY: BTU, Cooling Capacity, and Energy Efficiency Ratio

ACTIVITY: Air conditioners can be evaluated in two ways: (1) by its cooling capacity (the amount of heat that an air conditioner can remove from the air in one hour). This amount of heat is measured in British Thermal Units (BTU) (the amount of heat needed to raise the temperature of one pound of water one degree F). A 10,000 BTU unit will extract 10,000 BTU's of heat from a room every hour. (2) its "Energy Efficiency Ratio" (EER) which is the number of BTU's of heat that one watt of electrical energy will remove from the air in one hour. The student can determine the EER of his/her air conditioner by dividing the capacity in BTU's per hour by its power required in watts. This information can be found on a metal plate on the unit.

$$EER = \frac{BTU/HR}{WATTS}$$

For example: a 10,000 BTU unit consumes 2000 watts, its EER = $\frac{10,000}{2,000}$ = 5. The higher the EER rating the better. It is an important factor to consider when purchasing an air conditioner.

SAMPLE QUESTIONS

Find the EER rating for each air conditioner and rank each according to the scale

1 - 5 poor
6 - 7 fair
8 - 9 good
10 - over great

1.	BTU/hr 12,000	Watts: 3,000
2.	BTU/hr 25,000	Watts: 3,000
3.	BTU/hr. 17,700	Watts: 2,500
4.	BTU/hr. 20,000	Watts: 2,000

SKILLS: Division of Whole Numbers

Information obtained for this activity was found in. Energy for Today and Tommorow, Energy Conservation Research, Malvern, Pa. 19355, 1979; pp. 19-20.

EVALUATION Give each student a fictitious amount of money and ask each to go out and buy major appliances needed in his/her future home. The student may not spend more than the specified amount of money and must justify why he/she bought certain appliances in terms of energy conservation and consumption.

WILL THERE BE ENERGY FOR ME IN 1993?

Jeanne Earnest

Grades: 9 - 10

LENGTH OF TIME: 1 - 3 weeks

GENERAL OBJECTIVE. To learn to organized material to make a 3 - 5 minute informative speech.

KEY VOCABULARY: Solar, geothermal, exponential, fusion, fission, photovoltaic, biomass, conservation, OPEC, DOE, ethics

ACTIVITIES:

1. Teach 2-level outlining (3 days). Use your grammar book with handout exercises.
2. Teach note card technique from grammar book.
3. Brainstorm on the use of energy and the waste of energy.
4. Show film. See suggestions in resources.
5. Handout: "Energy Vocabulary." Students look up definitions and learn for quiz.
6. Handout: "Suggested Speech Topics on Energy." Let students look them over and choose three. Sign up on a master sheet for the first choices. No more than 2 students to a topic. Many topics will be narrowed to some other aspect or angle.
7. Go to library for 2 class days to gather material. Students encouraged to use public, community college, university libraries, or pamphlets from local agencies.
   The student is required to use 3 different sources:
   a. newspaper
   b. book
   c. magazine
   d. pamphlet
   e. personal interview of local expert
8. A week later the 2-level outline is due. This sould have between 12-16 items. Teacher evaluates for ample ideas for 3 - 5 minutes speech.
9. Students have a week to write and prepare speech to be given orally. It takes between 5 - 8 pages of written material for a 3 - 5 minute speech.
10. Rough readable draft in ink outline, note cards are turned in when speech is given.

HANDOUT:

ENERGY VOCABULARY

Look up definitions and learn. Write a good sentence using each word.

1. biomass
2. DOE
3. fission
4. exponential
5. geothermal energy
6. conservation
7. fusion
8. OPEC
9. solar energy
10. photovoltaic

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Handout:

ENERGY QUIZ

In the space at the left, write the letter of the correct matching answer.

____1. solar energy	A. saving natural resources
____2. OPEC	B. Dept. of Energy
____3. fission	C. plant materials in any form
____4. photovoltaic	D. doubling time
____5. geothermal	E. splitting of atoms
____6. conservation	F. formation of heavier nucleus by combining 2 lighter ones
____7. exponential	G. mixture of hydrocarbons
____8. fusion	H. heat energy in the earth's crust
____9. biomass	I. electromagnetic radiation emitted by the sun
____10. DOE	J. changing energy from one form to another
	K. BTU
	L. organization of Petroleum Exporting Countries
	M. providing a source of electric current under the influence of light.

ANSWERS 1. I 2. L 3. E 4. M 5. H 6. A 7. D 8. F 9. C 10. B

Handout.

SUGGESTED SPEECH TOPICS ON ENERGY (3-5 minutes)

1. What is Energy?
2. How Long Will Our Coal Last?
3. Is There an Oil Shortage?
4. What is Nuclear Energy?
5. What are the Nuclear Arguments?
6. What are the Anti-nuclear Arguments?
7. How Long will Our Natural Resources Last?
8. Is Solar Energy Practical?
9. Is there a Place for Synthetics?
10. How do We Get Energy for Our Homes?
11. What is the Future for Electric Automobiles?
12. How Does Energy Effect Our Environment?
13. What are Some Careers in Energy?
14. Should you Use Wood to Heat Your Home?
15. How Practical is Gasohol?
16. Who Should Have Energy Education?
17. How Much Does Energy Costs?
18. Is Energy Important to Agriculture?
19. Can the U.S. Get Along Without OPEC?
20. Discuss Ethics in the Use Of Energy.
21. Is there Any Alternative to Our Energy Problems?
22. Do We Need Rationing?
23. What are the Energy Solutions for the Developing Countries?
24. What Shall we do With Nuclear Wastes?
25. Is Oil Shale A Solution?

26. Petroleum as Energy.
27. Wind Power for Energy.
28. Transportation Energy Use.
29. Water Power as Energy.
30. Why is Uranium Important?
31. Are Reactors the Answer?
32. Could Breeders Help the Energy Problem?
33. Should the U.S. Take the Soft Path?
34. Should the U.S. Take the Hard Path?
35. Why is Saudia Arabia Important to Energy?
36. How Does Japan Get Its Energy?
37. Why is Exponential Growth Scary?
38. Is Cogeneration the Answer to Energy?
39. Biomass - How Can We Use It?
40. Ethics in Energy Production.
41. Do We Have Enough Gas?
42. Lew Howard Latimer.
43. Natural Gas May be The Solution.
44. Oil Solution Needs Our Immediate Attention.
45. How Can We Conserve Our Energy?
46. Are Synfuels the Solution to our Energy Needs?
47. Who Can Use Geothermal?
48. Will the South Survive?
49. What are the Moral Issue of Energy?
50. Will We Have Enough Electricity for Your Hair Dryer?
51. If you have another topic you would like to consider, see your teacher.

11. Write your governor, legislators, environment agency power company, or appropriate group for information as resource material or asking their positions on an energy issue.
12. Speech time 3 - 5 days. Speeches are timed. Pre-volunteering works well the day before.
13. Visit the power company in your area.
14. Read Silent Spring, by Rachel Carson and write a summary.

SKILLS. Note taking for note cards, outlining, vocabulary speaking, using Reader's Guide and vertical file in library, letter writing, listening and evaluation.

RESOURCES: Film. "Energy - A Family Album," 8½ minutes, clr, DOE
"Energy - The American Experience," 28½ minutes, clr, DOE
Check county catalogue or media center

Posters. Display energy poster on bulletin boards

EVALUATION:
1. Vocabulary Quiz
2. Student will grade each others speeches.
3. Teacher gives 2 grades - one for the speech, one on readable rough draft, outline and notecards.

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"World Energy Survey," Ruth Leger Sward, The Rockerfeller Foundation, 1133 Avenue of the Americas, New York, N.Y. 10036

THE YOU IN ENERGY USE

Sharon L. Wilk Guy S. Warner Nelda S. Segers Mary Ann Davis

GRADE LEVELS: 10, 11, 12 (Average--advanced abilities)

LENGTH OF MODULE: 6 days

GENERAL OBJECTIVES:

The YOU In Energy Use is an energy module designed as an interdisciplinary study for secondary science, social studies, and/or English courses. The following criteria were used in developing the module:

1. Is the subject appropriate for these students and is it important for society?

We are living in a world that is doubling its population every 37 years. By 2018, we will add as many people to the earth as have been added in the history of mankind.

The industry of the world id doubling every 10 years. At this rate we will need as much energy between now and 1991 as was produced throughout the earth's history.

Our nation doubles its oil consumption every 9 years. At this rate, we will increase our use and dependence on oil between now and 1990 as much as we did from the beginning of history of man until today.

Often our hopes for new and abundant sources of energy are clouded by problems nuclear power has unsolved problems of thermal pollution and disposal of hazardous wastes; sources of transportation problems. In order to solve these porblems, we desperately need a generation of scientists who are committed to the wise use of their discoveries. Moreover, we need a generation of non-scientists who know enough about chemistry and physics to anticipate the outcome of technical decisions and to compute long-range costs and benefits as well as short-term gains. There has never been a time when political and economic judgements were likely to get us into scientific trouble.

2. Is the subject related to course goals and objectives?

This energy module addresses and reinforces the following basic skills.

a. English
   (1) determining main ideas
   (2) sequencing of facts
   (3) identifying cause and effect
   (4) drawing conclusions and predicting outcomes
   (5) making inferences
   (6) discriminating between fact and opinion
   (7) constructing sentences, paragraphs, essays
   (8) increasing vocabulary
   (9) increasing reading skills

b. Social Studies
   (1) comparing and contrasting ideas
   (2) interpreting graphs
   (3) discriminating between fact and opinion
   (4) specific objectives related to economics:
      (a) determining future through examination of past and present
      (b) encountering choice
      (c) relating supply and demand

c. Science
   (1) preparing an hypothesis
   (2) making observations
   (3) preparing data tables and graphs
   (4) organizing facts and manipulating variables
   (5) drawing conclusions
   (6) interpreting data and making predictions

3. Are adequate materials available for all views?

The module includes a brief reading assignment on many possible energy sources, as well as a bibliography of classroom materials. Most media centers will provide bibliographies of available energy materials to teachers upon request.

4. Can students be evaluated?

Evaluation of the reading assignment and construction of positive immediate and long-range personal goals for energy use will be given to the students on the final day. Students will add the above evaluation to the collection of written materials formulated during the energy study. This compilation will be turned in for teacher evaluation.

5. Can the subject be dealt with in the time provided?

The energy module as stated will easily fit into the prescribed six-day schedule. Teachers also have flexibility within the schedule to enlarge various sections, relevant to their particular subject matter.

SPECIFIC OBJECTIVES:

Upon completion of this module, the student should be able to:

1. Assume responsibility of managing a personal energy budget for a given period of time.

2. Predict the consequences of exponential growth as it applies to the production and consumption of energy.

3. Compare the long-term and short-term alternative energy technologies with hard-path and soft-path technologies.

4. Identify benefits and potential risks associated with the application of alternative technologies in meeting our energy needs.

5. Evaluate the impact of life styles upon the consumption of energy.

6. Evaluate personal opinion concerning ethical responsibilities toward energy/economic trade-offs.

KEY VOCABULARY ITEMS:

Refer to: (1) Factsheet No. 18--Alternative Energy Sources Glossary of Terms, National Science Teachers Association, Washington, D.C. 20009.

(2) Energy Quickies (see attached sheet)

SEQUENCE OF ACTIVITIES:

DAY 1

TIME	ACTIVITY
5-10 minutes	A. Discuss: 1. What is energy? (The ability to do work) 2. How are we able to do work (e.g. daily tasks) without running out of energy? 3. What effect does a food shortage (hunger) have on you in your "Energy consumption?
5 minutes	B. Use Overhead Transparency and Discuss: Forms of Energy (See attached sheet.)
	C. Show Film: Energy in Perspective. This film maybe obtained on loan from the following address: Dr. Stan Kmet Florida Council on Econmic Education P.O. Box 17785 Tampa, FL 33682
10-15 minutes	D. Summarize the film: 1. List and discuss different energy sources. 2. Emphasize loss of energy when converting from "type" of energy to another.
5 minutes	E. Assign Keeping of Notebook: All information distributed and activities completed during this module will be compiled in a separate notebook which will be evaluated by the teacher upon completion of module. Encourage students to include in this notebook the following: cartoons, newspaper articles, pictures, etc.--all pertinent to the topic under discussion. Explain Grading Procedure: The following criteria will be used in assessing a grade:

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a. Completing activities and writing assignments
b. Sequential recording of discussion topics and main points
c. Using notebook specified by the teacher and arranging neatly all information therein
d. Providing accurate answers to the objectives questions
e. Answering subjective questions

DAY 2

TIME	ACTIVITY
15 minutes	A. Show Film: Toast. Order from Bullfrog Films, Inc. Oley, PA 19547 Rental fee: $18
10 minutes	B. Assign In-Class writing. Before discussion of film. Have students write a paragraph describing their immediate responses to this film. Note: Depending upon the ability level of the students, "I think the main idea of this film was ..,"
20 minutes	C. Discuss Energy Wastes. The emphasis of the film is on the loss of energy in producing a commodity which is also wasted--the concept of net energy profit and loss. Point out the energy changes when dealing with foodstuffs. 1. Processing Wastes--home cooked meals versus TV dinners, fast food restaurant meals; and natural/organic foods versus those foods with additives and perservatives. 2. Packaging Wastes--fast food's wrappers, non-returnable bottles and cans, also plastics which are not biodegradable. 3. Production Costs and Energy Loss--Discuss transportation costs in imported foods, foods shipped cross country (lettuce), and value changes if everyone lived on local supplies only. 4. End Result: In all the changes involved in dealing with the foods we eat, energy loss must be considered. Although we can "afford" to purchase another piece of bread to replace the burned toast, can we afford the energy loss?

5. Optional: Write a paragraph which describes personal opinion based on new information.

10 minutes

D. Review Energy Use Survey Form. Students are to monitor 6 waking hours by recording approximate time usage for each item listed. (Automobiles must record miles/gallon and distance traveled). See attached sheet.

DAY 3

TIME	ACTIVITY
10-15 minutes	A. Discuss the Six-Hour Energy Use Survey. 1. What Item(s) was/were used most of the time? 2. What Item(s) may have used the most energy?
15-20 minutes	B. Manipulate the Energy Market: Divide the class into three equal sections. Give the students in each section an energy credit card (see attached sheet).* With a designated budget limit. An abundant availability by 250 units, and conservative availability by 150 units. Note that time is no longer a consideration. The energy units prescribed on the survey form are to be recorded for long-term or short-term use of the item during the 24 hr. recording period.
20-25 minutes	C. Discuss the Parallelism of the Terms Financial Crisis in a Financial Budget and Energy Crisis in an Energy Budget. 1. What are the signals of a crisis? a. Inability to make income (resources) meet demands b. Decreased or stabilized income (e.g. inflation causing students to bargain for higher allowances) c. Spending spontaneously d. Borrowing from the future (credit use and layaway e. Making purchases beyond financial means 2. What are appropriate responses to the signals? a. Evaluating available resources. b. Eliminating credit use, spontaneous spending, and purchasing beyond means c. Identifying areas of overuse d. Budgeting resources to cover basic needs

* Energy Credit Card

Budget Limit
400 Units ______________ Owner's Signature

Energy Credit Card

Budget Limit
250 Units ______________ Owner's Signature

Energy Credit Card

Budget Limit
150 Units ______________ Owner's Signature

DAY 4

TIME	ACTIVITY
30 minutes	A. Assign In-Class Writing. Ask student to write a 1-2 page essay answering the following questions: 1. How was your lifestyle changed due to the amount of energy available for consumption? 2. What were your personal feelings about your lifestyle change?
	B. Discuss Ethical Implications. (Paralleling Financing and Energy Fluctuations) 1. How would the public react to a sudden decrease in the supply of energy? a. Inherent goodness of man - humanitarianism (e.g. natural disasters) b. Panic behavior--Conflict between self-interest and social interest 1. Focusing on placing the blame rather than on finding solutions 2. Zero-Sum: Ones person's gain is another person's loss. Competition for energy 1979 Gas Shortage--Gas lines 3. How would the public react to a sudden increase in the supply of energy? a. Savings Plan--Investing in the future, increasing future reserves b. Spending Plan--Increasing consumption rate 4. What are alternative behaviors for each scenario?

DAY 5

TIME	ACTIVITY
25 minutes	A. Discuss: 1. Supply and Demand Relationships with Future Energy Resources a. Infinite Resources: (Time is the only infinite resource that we have; and if it is not consumed wisely, it too, is wasted. b. Supply dependent upon consumption (Facts do not cease to exist because they are ignored. Aldous Huxley)

2. Exponential Growth

a. $T_2 = \frac{70}{R}$

b. Growth Rate and Energy Consumption

1. World at 2%--double in 35 years
2. U.S. at 1%--double in 70 years
3. Florida at 3.5%--double in 20 years
4. Electrical use per person at 5.6% in U.S. --double in 12.5 years

[illegible] minutes B. Use Overhead Transparency and Discuss

1. World Use of Oil (see attached sheet). Note that consumption will double in on decade if consumption rate remains at 7%.
2. Oil Consumption and Exponential Growth--with an exponential increase in any reserve, it does not matter exactly how much the reserve is; what matters is the percent consumption.

20 minutes C. Assign In-Class List. (Personal Energy Management)

Have students list the specific conservation/efficiency measures that they could use to decrease their energy demand. Some examples to use are the following: restricting the use of electricity during peak hours (be specific) taking shorter or cooler showers, and using lower watt light bulbs.

D. Assign "Putting the YOU in Energy Use" to read and answer questions over the weekend.

DAY 6

EVALUATION DAY The reading assignment, the questions, and the answers should be placed in the notebook. On Day 6, the teacher will go over the answers and have students check their answers. Teacher will then collect the notebooks for evaluation. Discussion of the entire module will follow.

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Energy Quickies.....

By David E. LaHart
Florida Solar Energy Center

Energy

First Law Energy cannot be created or destroyed

Second Law Energy can be changed from one form to another, but at each change there is a significant loss of energy All energy becomes heat radiated into the environment

Consumption

Americans use about 1/3 of the world's energy but represent 6 percent of the world's population In 1980, we used 82 quads (quadrillion Btu is 10^{15}) One quad is equal to the amount of gasoline used by 12 million cars in one year, enough energy to heat 1 million homes for 10 years Florida will consume over two quads in 1981

Petroleum

In 1978, the U S consumed an average of 18 7 million barrels of oil per day (785 4 million gallons) Of this, 8 2 million barrels (44 percent) was imported oil Floridians used an average of 574 gallons of gasoline in 1978, the national average was 532 gallons Florida's rate of gas consumption is 12 million gallons per day

Electricity

Electricity-generating plants take three units of fuel and produce two units of heat and one unit of electricity

Electricity is usually measured in watts and time (Kilowatt = 1,000 watts)

Kilowatt/hour = 100-watt light bulb burning for 10 hours The average Florida household uses 1,000 kwh each month Since it takes about one pound of coal to produce one kwh of electricity, it requires about 1,000 pounds of coal to produce the electricity for each Florida household each month (six tons per year).

Electrical Power

10 mw (million watts) produces enough electricity for 3,000 people

A 1,000-mw plant produces enough electricity for a city of 350 000 people This is a common size for a nuclear plant

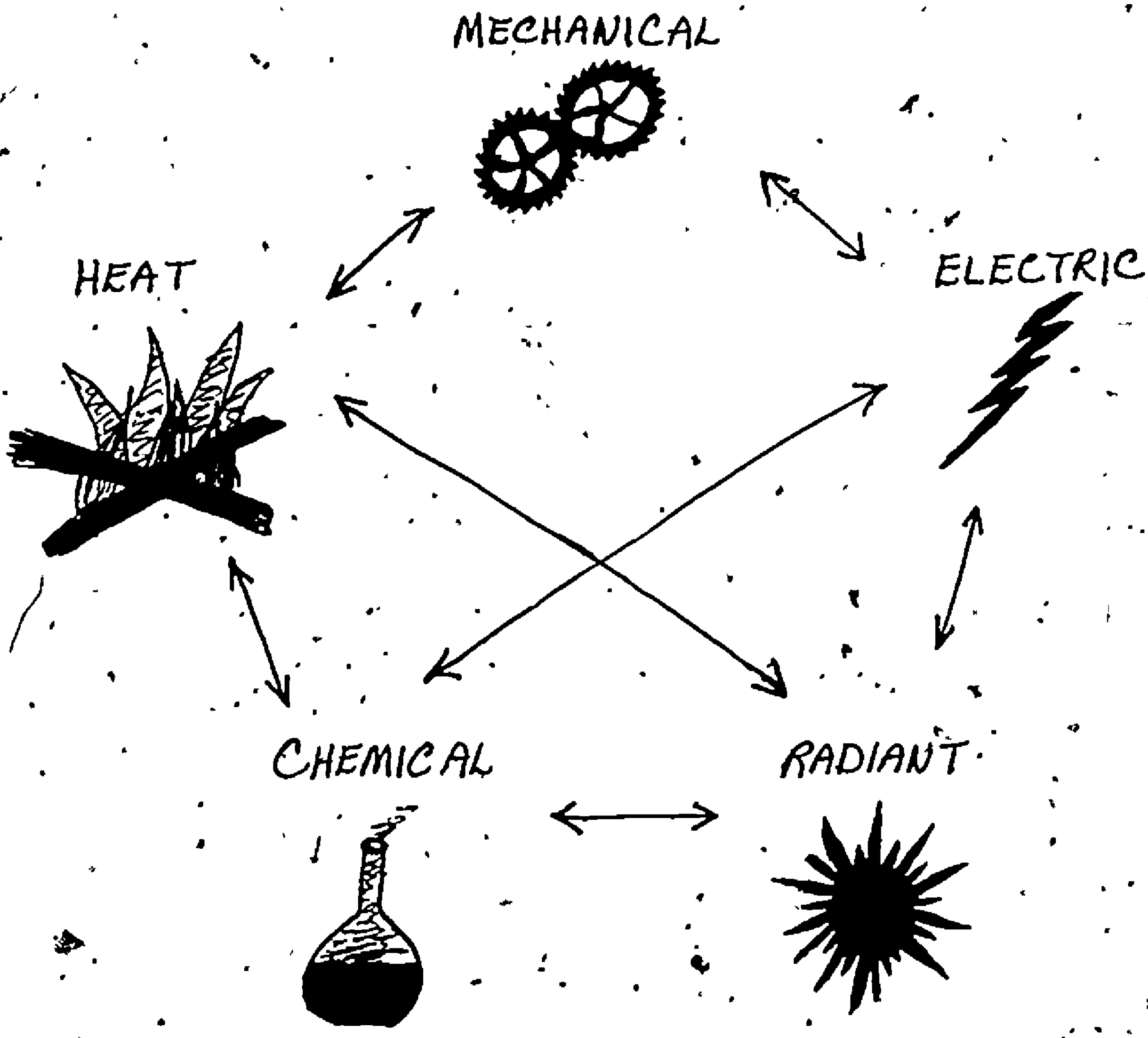
It would take the primary productivity of 912 square miles of southern pine forest to provide the fuel for a 1,000-mw electrical plant operating at 80 percent load and 33 percent efficiency each year

Solar Facts

The solar radiation that falls on ½ of 1 percent of the land area in the United States is equal to our total projected energy demand in year 2000 Unfortunately land plants collect this energy at less than 1 percent efficiency Total U S biomass fixation is about 5 million tons per year and (at 7,500 Btu per pound) is equal to 75 quads

Florida receives a maximum of about 300 Btu per square foot at solar noon on a cloudless day 1 600 Btu per square foot (5,045 watt hour/m²) is a good average for the entire day

INTERCHANGEABLE GUISES OF ENERGY



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ENERGY USE SURVEY

ELECTRIC ENERGY USE

APPLIANCES	AMOUNT OF TIME IN USE
Large	
Air Conditioner	______
Water Heater	______
Clothes Dryer	______
Refrigerator	______
Deep Freezer	______
Dishwasher	______
Range	______
Clothes Washer	______
Incandescent Lights	______
Color TV	______
Fan	______
Microwave Oven	______
Fluorescent Lights	______
Black/White TV	______
Stereo	______
Radio	______
Vacuum Cleaner	______
Trash Compactor	______
Garbage Disposal	______
Small (Heat Producing)	
Electric Skillet	______
Hair Dryer	______
Iron	______
Coffee Maker	______
Toaster	______
Other: ______	______
______	______
Small (Non-Heat Producing)	
Clock	______
Blender	______
Mixer	______
Can Opener	______
Toothbrush	______
Electric Shaver	______
Other: ______	______
______	______

TRANSPORTATION ENERGY USE	MPG	DISTANCE TRAVELED
Automobile	______	______
School Bus	______	______

HANDOUT

ENERGY CREDIT CARD

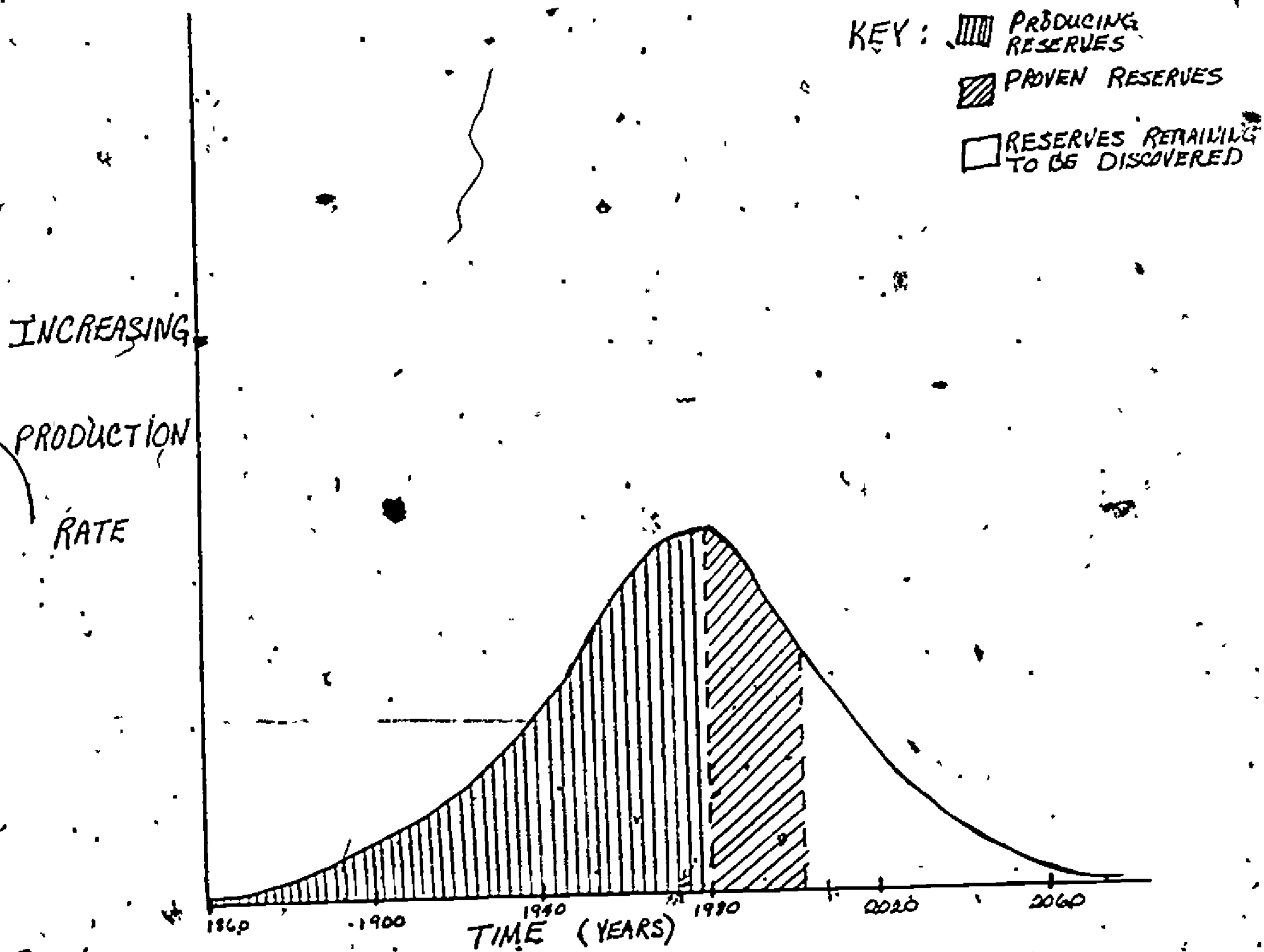
BUDGET LIMIT
____ Units

Owner's Signature ____________

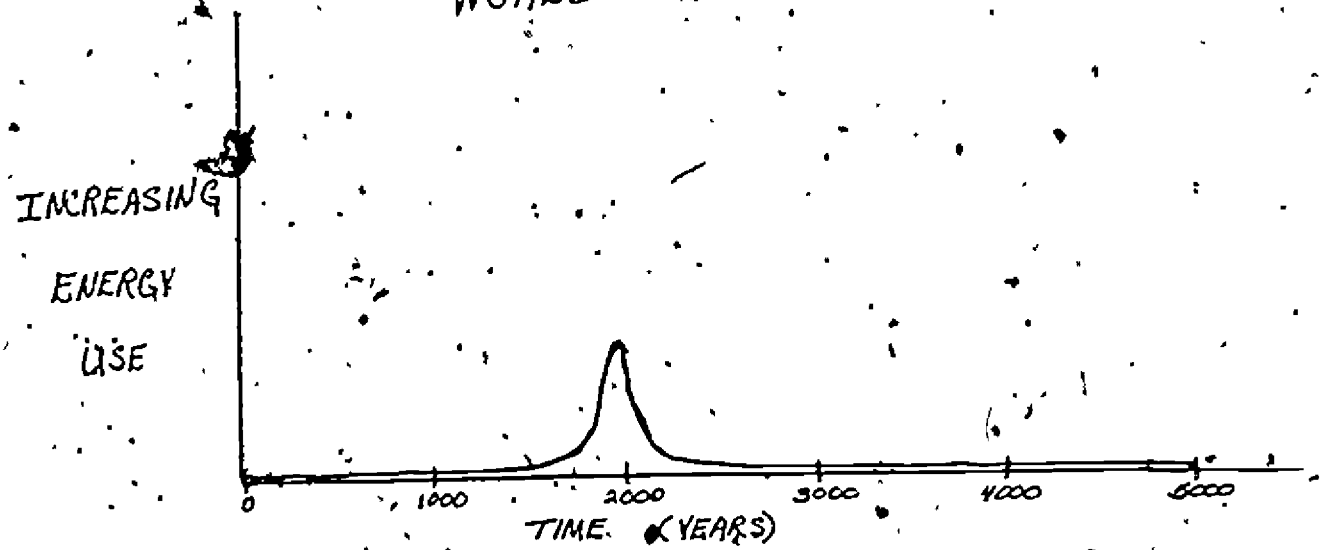
ELECTRICAL ENERGY USE APPLIANCES	COST IN ENERGY UNITS	COST UNITS USED IN 24 HOURS
Large		
Air Conditioner	132.00	____
Water Heater	42.00	____
Clothes Dryer	20.00	____
Refrigerator	18.00	____
Deep Freezer	18.00	____
Dishwasher	15.50	____
Range	12.00	____
Clothes Washer	10.00	____
Incandescent Lights	8.00	____
Color TV	4.50	____
Fan	3.00	____
Microwave Oven	3.00	____
Fluorescent Lights	2.65	____
Black/White TV	1.00	____
Stereo	1.00	____
Radio	1.00	____
Vacuum Cleaner	0.50	____
Trash Compactor	0.50	____
Garbage Disposal	0.30	____
Other: ____		____
____		____
Small (Heat Producing)		
Electric Skillet	2.00	____
Hair Dryer	1.50	____
Iron	1.50	____
Coffee Maker	1.00	____
Toaster	0.50	____
Other: ____		____
____		____
Small (Non-Heat Producing)		
Clock	0.20	____
Blender	0.10	____
Mixer	0.10	____
Can Opener	0.05	____
Electric Toothbrush	0.05	____
Electric Shaver	0.05	____
TRANSPORTATION ENERGY USE		
Automobile		
1 passenger	150.00	____
2 passengers	75.00	____
3 passengers	50.00	____
School Bus	1.50	____
		____ TOTAL

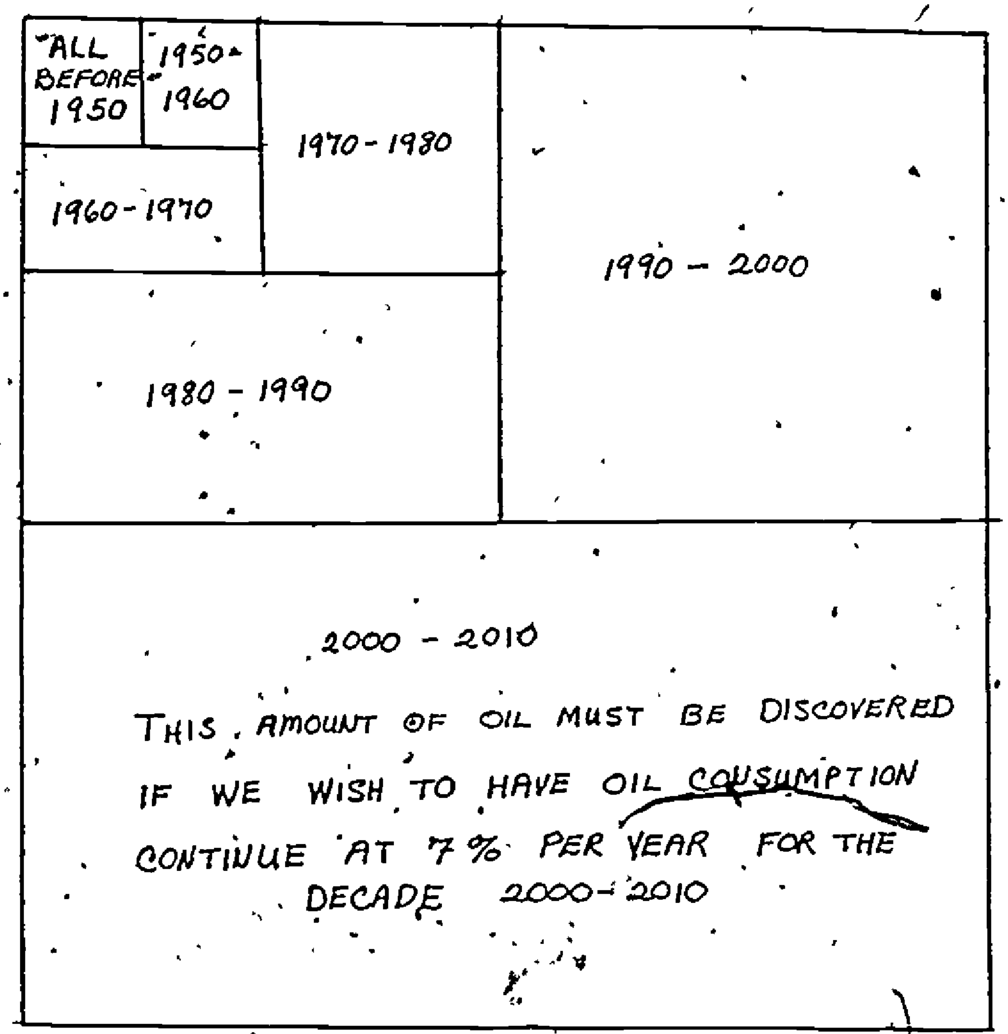
HANDOUT

PROSPECTS FOR OIL



WORLD ENERGY USE FOR OIL





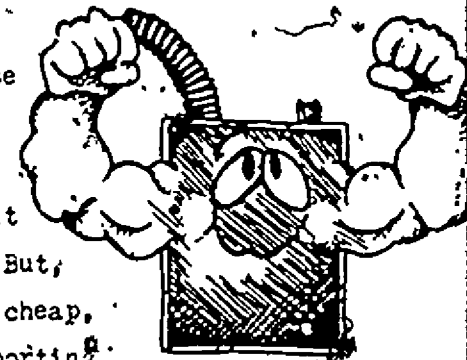
OIL CONSUMPTION
(AT A RATE OF 7% PER YEAR)

$$T_2 = \frac{70}{R}$$

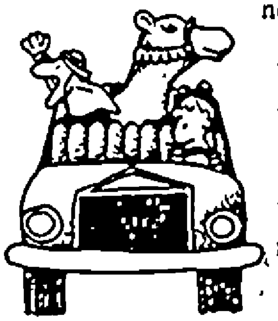
T_2 = Doubling Time
R = Rate of Increase

Putting the YOU in Energy Use

For the past five days, you have been studying about the energy situation in our country. Personal choices in energy use, as reflected by our lifestyles can and do play a vital role in determining how much energy must be produced to meet our energy needs. In the past when there were fewer people (energy consumers) and petroleum was both plentiful and cheap, we did not have to be concerned with how we used energy nor even how much we needed. Now, however, we must be concerned. You have learned that our demand for energy has been growing exponentially and that this kind of a growth pattern inevitably leads to serious problems in supplying energy no matter how large our energy resources might be.



Petroleum became our chief energy resource because it is a highly concentrated form of energy. It has been relatively easy to extract petroleum from the ground, transport it from place to place, and refine it into a variety of products to meet our energy needs. But, the picture is fast changing. Petroleum is no longer cheap, nor is it plentiful. We are now importing nearly as much petroleum as we are producing from our own oil wells. This, of course, results in a transfer of significant amounts of our capital to other countries (especially OPEC countries) and makes the United States vulnerable to interruptions in our energy supply.



What about the future? Will we be able to shift away from our dependence on petroleum as our chief energy resource to another fuel source? Is it wise to deplete the world's supply of petroleum by burning it in our cars and trucks? Remember that the petrochemical industry produces thousands of important products that we use in our everyday lives. If the petroleum resources become exhausted, or prohibitively expensive, how will our lifestyles be affected by a scarcity of petrochemical products? What about our existing alternate technologies, or possible scientific discoveries and "breakthroughs" in the future? Will they help? Think about these questions while you consider the following information on our energy future.

Fossil Fuels--Coal

The United States has the largest coal reserves in the world. How long our coal supplies will last depends upon the rate of use, and especially upon the growth in the rate of use. But there are problems as well as benefits in increasing our use of coal to fuel our electrical generating plants. Part of the environmental price we pay for coal concerns land use. A deep mine requires around 9,000 acres to produce enough coal to operate a 1,000 megawatt coal-fired electric powerplant. If a surface mine is used such as a strip mine, then 14,000 acres of land are required.

Some water pollution also occurs as a result of producing electricity from coal, both from the mining process and in the form of thermal pollution from the conversion process. Air pollution, however, is the most serious environmental problem of a coal-fired plant. Much care must be taken to clean the smokestack's emission of particulate matter such as fly ash. This is accomplished by passing the hot exhaust gases over electrostatic precipitators which remove a significant amount of the particulate matter that is present in the gases. It is, however, difficult and very expensive to remove all of the potentially harmful agents that may have an adverse effect on the environment.

Sulfur dioxide, carbon monoxide, and nitrogen oxides are present in the exhaust gases produced from the burning of coal. Sometimes, they may cause problems in our atmosphere and help produce undesirable products such as smog and acid rain. The smog can lead to serious respiratory problems, especially among those who are elderly and those who are affected by emphysema, asthma, and other respiratory conditions. Rain that is slightly acidic can greatly speed up the erosion of building materials as well as the corrosion of metals. Acid rain can also make lakes become sterile, thereby reducing opportunities for commercial and recreational fishing.

Increasing our use of coal will also increase the amount of carbon dioxide that is released into the atmosphere. Scientists are not certain what overall effect this might have on our climate. Some have argued that the increase of carbon dioxide in our atmosphere will bring about a "greenhouse effect" which will result in a slight warming of the earth and its atmosphere. Even a slight warming of just a few degrees could (through a partial melting of the polar ice caps) bring about an increase in the size of our oceans. If this occurred, the coastal cities of the world would be in jeopardy of becoming inundated or flooded.

As you can see, there is the potential for many serious social and environmental problems associated with increasing our use of coal to the point where its use will help us reduce our dependence on petroleum. Yet, it is true that we have an abundance of coal at the present time and that it is a very concentrated form of energy. Undoubtedly, we will have to depend on an increase in our use of coal to help meet our energy needs for the near future. But, we must use it wisely and continue our search for ways to use the coal that will lessen its impact on the environment. Here are some ways that are being considered:

Fluidized-bed Combustion of Coal

Coal is by far the nation's most extensive fossil fuel resource, a resource on which we shall surely have to rely heavily. Research is underway on new ways to burn coal cleanly. One of the possibilities is fluidized-bed combustion of coal, in which pulverized coal is burned in the presence of tiny particles of limestone. Sulfur from the coal is captured in the limestone, and the temperatures of combustion are low enough that formation of nitrogen oxides is minimized. The solid residue from such a process, instead of being a disposal problem as in the case of flue gas scrubbers, may have value as an agricultural nutrient.

Coal Gasification and Liquifaction

In order to fill the oil and natural gas gaps of the future satisfactorily, it is possible that coal will need to be converted to liquid and gas fuels. In this way, most existing fuel-burning devices would be able to use the gas or liquid made from coal without major modifications. Also, the processing that the coal would receive would remove most of the pollutants, such as sulfur, oxides of nitrogen, and ash, leaving a clean-burning fuel.

Coal gasification involves subjecting coal to intense heat and capturing the resulting gases. Depending on the process used, the final gas product may have a relatively low energy content, or may be a "synthetic natural gas" that is very pure and has the same high energy content as natural gas.

The National Petroleum Council expects some coal gasification plants to be in operation by 19[illegible] but it does not appear possible that there will be enough to fill the projected gap between the demand for natural gas and the domestic availability.

While synthetic natural gas would not present the pollution problems of coal when it is burned, the gasification process presents its own pollution problems. It is, however, easier to remove the pollutants from coal during its gasification than try to remove them from the smoke as the coal is burned.

A major environmental concern with coal gasification is that involved in getting the coal out of the ground. Tremendous amounts of coal would be required—about 605 tons an hour for each plant. Much of the coal would probably be strip mined from large western coal deposits. Without reclamation, which would ultimately add to the cost of the gas produced, large areas of western wilderness lands could be devastated.

Another major problem for coal gasification is water availability. Plants will require a great deal of water, and some of this water will be lost by evaporation. Unfortunately, the western areas where the most promising coal deposits occur have limited water supplies. A recent National Academy of Sciences report concluded that enough water is available for mining and land reclamation at most potential coal mining sites, but not for large-scale conversion to other energy forms at the western locations.

Thermal pollution is also a problem in coal gasification.

Coal could also be liquified and used as a substitute for oil. Techniques to accomplish this are now being studied, but are not as far along as gasification techniques. The environmental considerations for liquified coal are generally the same as for coal gasification, except that water requirements will probably be even greater.

Oil Shale

Oil shale is a finely textured rock that contains a tarlike material called kerogen. When melted, kerogen gives off vapors that can be converted to shale oil. This shale oil can then be refined into oil, gasoline, and other petroleum products. Oil shale deposits are located primarily in Colorado, Utah, and Wyoming. These deposits are estimated to contain the equivalent of several times the recoverable oil in the United States.

There are two general ways of recovering shale oil. The one that has already been demonstrated is above-ground retorting, where the shale is collected and heated, distilling the vapors to produce the shale oil. The other process, which is being studied, is in-situ retorting. This involves breaking up the shale underground by hydraulic pressure or some type of explosion. Then air or gas would be introduced underground to support combustion. Some of the shale oil would be burned in place to provide the heat to liquify more of the shale oil so it can be pumped from the ground. This in-situ retorting has many unresolved problems, control of the explosion and underground fire are among the largest. But it is being studied because above-ground retorting has two tremendous drawbacks. One is the strip mining that an above-ground operation would entail. But an even greater problem is the disposal of wastes. Even high-grade shale is about 87 percent rock or inert material, and these wastes swell up to almost twice the volume of the original shale. Nothing will grow on these wastes without large amounts of fertilizer and watering.

Shale development would require enormous quantities of water in areas where the water is simply not available.

These problems make anything more than token shale oil production unlikely through 1985.

THINK ABOUT IT

1. What are some reasons why petroleum became our chief energy resource?
2. What are some problems that might result from our dependence on foreign oil?
3. Describe some of the problems associated with mining and burning coal to produce electricity.
4. What benefits does coal have as a fuel to power our electrical generating plants?
5. Fluidized-bed combustion of coal, coal gasification and liquifaction, and oil shale are three technologies being considered to help supply our energy needs. Which of these technologies do you feel may be the most promising? Why?

Nuclear Processes--Fission Reactors

For many years we have used nuclear reactors as a heat source for producing steam to drive electrical generators. Nuclear energy presently makes only a small contribution--less than 10%--to our total electrical energy. Our nuclear electrical power plants are all based on the light water fission reactor. This type of reactor used uranium 235 (U^{235}) as its fuel source. But, the world's reserves of U^{235} are limited, and this fuel source may also become scarce in the near future.

The nuclear plants that are presently operating in the United States have, for the most part, been relatively safe in operation, and produce minimal problems of air and water (thermal) pollution. One of the most serious problems with nuclear plants is in the safe disposal and/or storage of the highly radioactive waste materials that are produced. These waste materials must be kept strictly isolated from the environment for long periods of time--some up to thousands of years. As of yet, a satisfactory (safe) solution for radioactive waste disposal has not been found. Most people do not want radioactive waste dumps located within their states. Would you?

If the utility industry relies only on light water reactors, the exhaustion of uranium reserves is not too many years in the future. The advanced nuclear reactor which would solve this supply problem is called the breeder reactor. Of many types of breeders proposed, the most promising has been thought to be the liquid metal fast breeder reactor (LMFBR). Such a reactor is significantly different from today's light water reactors. It is cooled with liquid sodium instead of with water. It is called a fact reactor because it does not use a moderator to slow down neutrons. And finally, it actually produces (breeds) additional fuel as it makes heat for electricity.

The breeder reactor would use a mixture of uranium and plutonium for fuel. The plutonium can be fissioned, and in the process, neutrons strike the nuclei of the uranium and produce more fissionable material, including plutonium.

The LMFBR has the potential of being more efficient than light water reactors because of the properties of the sodium coolant. Thus less waste heat would be produced.

Breeder reactors would also reduce the escape of radiation into air and water. The reactor core would essentially be a sealed system, and even the small amounts of radioactive fission products now released by light water reactors would be trapped in the core.

There are problems with breeder reactors, however. Some are due to the nature of the sodium coolant. Sodium is a highly chemically reactive metal that will burn if it is exposed to either water or air. Further, it is a solid at room temperature and requires an elaborate heating system to assure that it will remain liquid throughout the coolant system. Sodium is not transparent, which would complicate refueling and maintenance. The sodium coolant would also become intensely radioactive.

Some people believe that an accidental power surge in an LMFBR could lead to an uncontrolled chain reaction, which could explode the reactor and release dangerous amounts of radiation. Others knowledgeable in this area say such an explosion is strictly impossible.

The major controversy exists over the plutonium produced by the breeder reactor. Plutonium can be fashioned into nuclear weapons. Plutonium is also extremely poisonous, and it is a radioactive substance with a very long half life. Thus it must be handled and stored under very carefully controlled conditions, and will remain radioactive for thousands of years. It should be noted that plutonium has been transported and stored for years as part of the nation's nuclear weapons program, so the problem is not unique to the breeder reactor. Proponents also contend that light water reactors and breeder reactors can work in complementary fashion by recycling waste plutonium from light water reactors into fuel for breeder reactors. The quantity of available plutonium can then always be adapted to demand so that there would never be a stockpile of plutonium. It has been estimated that the stored uranium-238 left over from producing fuel enriched in uranium-235 for light water reactors and weapons manufacture, if converted to plutonium in a breeder reactor, would make available to us energy equivalent to all our known coal reserves.

Demonstration breeder reactors are operating in the Soviet Union and France and are under construction or planned in West Germany and Japan. The U.S. demonstration plant, the Clinch River Breeder Reactor Project, was planned to be operating by 1983. The future of this plant is now unknown. The U.S. was a pioneer in breeder technology, but we have now fallen far behind other countries. It is probable that by 1985, about 10 breeder plants will be operating in European countries. Germany, Italy, and France are mounting a cooperative effort in the Superphenix project, with a large breeder plant to be completed in 1982.

Nuclear Processes--Fusion Reactors

In the process of nuclear fusion, two light nuclei are forced together under extremely high temperatures and pressures to form a heavier nucleus, and a small amount of their mass is converted into a tremendous amount of energy. The fusion reaction for electrical power production will probably use forms of hydrogen called deuterium and tritium to make a single helium nucleus and a neutron.

Scientists have been working for 30 years to control fusion as a power source. The major part of their effort has been spent in trying to create a magnetic "bottle" to hold the thin, hot, ionized gas of hydrogen atoms, called a plasma, needed for fusion. A solid container cannot be used because the slightest contact would destroy the plasma, in addition, no material could remain intact at the temperature needed to achieve fusion. But because the plasma consists of particles with electrical charges, it can be contained within a magnetic field of the proper shape.

No one has yet been able to make such a confinement field that will hold together even for the fraction of a second needed to achieve fusion. In the 1960's, some physicists said that fusion power appeared impossible because of the basic laws of science. But today, it appears that success is possible, although many engineering problems remain to be solved.

The most promising magnetic confinement approach seems to be the tokomak, a doughnut-shaped device originally developed by the Soviets (who have freely shared peaceful fusion information) and later refined by the the United States. Other approaches are the theta pinch concept, which uses brief, powerful pulses of energy to squeeze a tube of plasma into the fusion range; and the magnetic mirror concept, which contains the plasma between "walls" of magnetic fields.

A race is now on to see which of these three concepts (each of which has its variations and refinements) will be the most effective--with the possibility that elements of any of the tree may be combined in a working fusion poser reactor. A progression of experiments in the U. S. and other countries could lead to operation of commercial scale fusion power plants in the 1990's, with fusion making a significant contribution to the overall energy supply in the first decades of the 21 century.

One hope for bettering this timetable is the concept of inertial confinment of plasma. In this process, the powerful, concentrated energy of lasers would be used. Thus this process is often called laser fusion.

These timetables for development of fusion power assume a relative moderate level of government spending. A large increase in spending might speed commercial use of fusion power. But it must be remembered that physicists working on fusion power are roughly in the situation of scientists working on fission in early 1942: they believe that their concept will work, but have not yet proved it by experiment. Considering the engineering problems of building a fusion reactor once the concept is proved, it seems safe to say that fusion power under the best of circumstances will not make an appreciable contribution to the nation's energy supply until the 21st century, unless the most optimistic predictions turn out to be true.

THINK ABOUT IT!

1. The type of nuclear reactor that we are presently using in our nuclear power plants is the ______________________.

2. Light water fission reactors use ______________ as a fuel source.

3. One of the biggest problems associated with our nuclear reactors is in finding a safe method to store and/or dispose of ______________.

4. Some of the radioactive waste materials must be kept strictly isolated from the environment for ______________________.

5. Another type of nuclear reactor that is under study and being developed in other countries is the ______________________.

6. The liquid metal fast breeder reactor uses ____________ as a coolant instead of water.

7. Sodium is a highly chemically reactive metal that will burn if it is exposed to ______________________.

8. The breeder reactor produces ______________ which can be fashioned into nuclear weapons.

9. Scientists have been working for 30 years to control ____________ as a power source.

10. No one has yet been able to make a ______________ that will hold together even for a fraction of a second needed to achieve fusion.

breeder reactor
plutonium
light water fusion reactor
confinement fluid
Uranium 235
fusion
water or air
liquid sodium
radioactive nuclear waste
thousands of years

GEOTHERMAL ENERGY

Geothermal energy is the natural heat of the earth. This heat can be tapped by drilling into the earth, and can be turned into usable energy by running turbines to generate electricity.

At present, the only large-scale geothermal power generation complex in the country is the Geysers field in California, whose electrical output is 502 megawatts. The only geothermal facility of comparable size is in Italy, and there are smaller such plants in other parts of Italy and in Japan.

These facilities use a rare natural phenomenon called "dry steam." This is produced when hot water boils in an underground reservoir. Some of the resulting steam condenses on the surrounding rock, and the rest reaches the surface. Dry steam can be used in a turbine without the need for a boiler. There are problems with dry steam--among them the pollution created when minerals such as sulfur are released with the steam. But this form of geothermal energy is the most easily usable, and unfortunately the least available.

"Wet steam" is created when underground water is heated by surrounding rock to the boiling point, but remains liquid because of high underground pressure. This water flows to the surface when wells are drilled in the right places, in a mixture that is 10 to 20 percent steam and the rest hot water. A well-known example is the geysers at Yellowstone National Park. Power production is complicated with wet steam because the steam must first be separated from the hot water before it can be used to run a turbine.

Wet steam now is being used to generate electricity in New Zealand, where the steam is used directly to turn a generator, and in Mexico, where the hot water is used to heat isobutane (a liquid with a lower boiling point than water) which turns the generator. A number of wet steam reservoirs have been identified in the United States, chiefly in the western part of the country. The effort to tap these resources is in its earliest stage.

A third form of geothermal energy is "geopressurized systems," reservoirs of water trapped far underground at high pressures, usually mixed with natural gas. Petroleum exploration has discovered a number of such reservoirs in a belt running 750 miles along the Gulf Coast. There is hope for quick commercial use of these reservoirs, but there is a lack of knowledge about them, especially insofar as how long the high pressures will last. Thus there could be reluctance to invest large amounts of money in the deep drilling needed to reach the geopressurized systems.

The fourth and most common form of geothermal energy is hot, dry rock, which is found near the surface in large areas of the world, including a substantial portion of the western part of the U. S. The potential energy of the western states' hot rock areas is very large, but use of this energy depends on both an increase in knowledge about this resource and major advances in technology. To tap these resources, it is proposed to drill a hole deep into the rock formations, fracture the rock either by explosives or hydraulically, pump water down and withdraw the heated water through another hole, extracting the heat to generate electricity. The essentials of this technique are commonly used in oil drilling technology, but their application to hot rock systems is still in the experimental stages. Energy production from the normal heat gradient of the earth would require a major advance over the technology needed to tap hot rock resources.

The speed with which geothermal resources are brought into use obviously depends on a number of economic and technical factors. The best estimate is that the nation's geothermal resources will be supplying only a small part of the country's energy needs by the year 2000.

SOLAR ENERGY

Most of the earth's energy comes from the sun. What is needed now is a way of harnessing solar energy other than the method of first allowing solar energy to produce organic material and then having the organic material turn into fossil fuels by geological activity.

The potential of solar energy seems almost unlimited. A solar energy panel of the National Science Foundation and the National Aeronautics and Space Administration estimated that all the electric needs of the U. S. in 1969 could have been met by converting 10 percent of the energy received by just 0.14 percent of the U. S. land area into electricity. But solar energy is a diffuse, low-temperature heat source, and it must be transformed into a more concentrated, hotter form for practical use.

SOLAR HEATING AND COOLING

There are a number of buildings in the U. S. using solar energy for heat. ERDA's forecasts are for as many as 2,000 residential units and 400 commercial units using solar energy either through private research funds or by purchase of some of the commercial solar energy heating units now on the market.

It is possible for a solar heating unit to serve as a supplement to a conventional heating system, although large areas of the United States have enough sunlight for the solar unit to serve as the main source of heat, with a conventional system as backup. Such a solar unit would have a collector, facing south for maximum solar exposure, with an area of 400 to 600 square feet. The collector, surfaced with glass or plastic traps energy through the "greenhouse effect"--allowing short wave length solar energy to enter, and retaining longer wave length infrared energy. The trapped energy heats an absorbing surface and is transferred to a fluid, usually water, to be stored and used to heat the house. While energy can be stored for as long as three days, a conventional heating system is usually required as a supplement, since the least sunshine seems to be in areas needing the most heat.

Solar cooling is a more complex technical problem, since it requires higher temperatures to use solar energy to run heat-actuated air conditioners. But it is regarded as a highly promising area for research and development, since there is a coincidence between the peak times of energy use (mostly for air conditioning) in a given area and the amount of solar energy arriving in that area.

Use of solar energy for heating and cooling depends not so much on technical advances--working solar energy heaters have been used for decades in sunny parts of the world--but on a resolution of the problems involved in introducing an unconventional technology into a market as fragmented as the U. S. housing industry. Studies by NSF show that two-thirds of all building are solar candidates--about 40 million buildings by the year 2000. One expert, Charles Alexander of Youngstown State University, estimates that half of the new homes in the U. S. will have solar heating and cooling by 1985. A more conservative estimate, made by a joint NSF-NASA panel, is that 10 percent of new homes will have solar heating by 1985. Since heating and air conditioning of buildings and homes takes a tremendous amount of energy, this promising use of solar energy could take some of the burden off other scarce energy supplies.

Solar Electricity Generation

Solar cells capable of converting 19 percent or more of incident sunlight directly to electricity are now available, but their cost is 100 times the price per kilowatt of conventional generating plants. An important need in making such generating systems practical is the development of a way of storing electricity for use during times when the sun is not shining. A number of systems have been proposed, including the sort of pumped-water facilities already in use with conventional generating sources. Other proposals include giant flywheels, whose effectiveness has not been proved in practice.

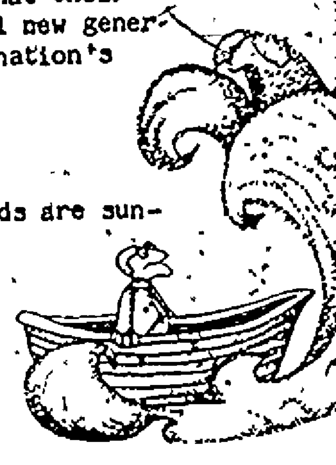
The NSF has said that solar cell systems for schools and shopping centers could be in use by the early 1980's. Central generating plants are not expected to be operational before 1990.

A proposal to orbit a giant array of solar cells at an altitude where its orbit would keep it above a fixed spot on earth has been made. The electricity from this array would be beamed back to earth by microwaves. Such a station would be orbited with the use of the space shuttle. It is not expected to become a reality until some time in the 21st century.

The concept of building a solar thermal generating station which would use lenses or reflectors to concentrate the sun's heat for operation of a turbogenerator is also being explored. Such systems have been run experimentally in many areas, but a number of practical engineering questions remain to be answered. It is estimated that such a plant in the southwestern part of the U. S. would require 10 square miles of collectors, covering an area about half the size of the island of Manhattan, to generate 1,000 megawatts. The NSF-NASA panel said that their estimate is that solar thermal plants will represent 10 percent of all new generating capacity after the year 2000 and will provide 5 percent of the nation's capacity by 2020

Wind Power

Wind power come under the heading of solar energy, since the winds are sun-driven atmospheric systems.



Windmills which were previously used in this country were made obsolete by electrification, but the concept has lived on. Scientists have identified a number of areas in the U. S. where the winds seem suitable for large-scale power production. Although wind power requires large initial capital costs, there are no fuel costs and no pollution. However, objections on esthetic grounds to putting huge windmills on large tracts of unspoiled land may be a problem.

NSF is studying the suitability of wind power at a number of sites. NSF and NASA are cooperating in production of a 100 kilowatt wind turbine with a 125-foot-diameter rotary blade on a 125 foot tower that will be tested at a NASA facility in Sandusky, Ohio. Experience with this unit will determine when and if the next step to larger units will be taken. The problem of energy storage comes up again with wind power, since provision needs to be made for times when the wind is not blowing.

Thermal Gradient

A more speculative proposal would use the difference in the temperature of surface water and deep-sea water to run huge generating stations. In the tropics, solar heat keeps surface water at 80 degrees Fareheit or above, while water at a depth of 2,000 feet is between 35 and 38 degrees. Experimental plants that generated electricity by utilizing this temperature gradient have been operated before, but ceased operation because of damage by waves and currents.

ERDA has commissioned a number of studies on various aspects of solar sea-power, but there are no estimates of when such systems might be able to make a meaningful contribution to national energy needs.

Tidal Power

Tidal power is another use of solar energy. A small plant in France has been in operation since 1965, but progress elsewhere has been almost nonexistent. A proposal to build such a plant in Maine has been debated for years, but has not proven to be economically feasible. With a limited number of sites suitable for tidal power generation, and the huge investments necessary to build such facilities, the concept does not seem to be competitive with other energy sources.

Bioconversion

Bioconversion implies converting organic materials to fuels or directly to energy.

A familiar form of bioconversion involves the use of wood as a fuel. In this era of high fuel costs, more and more people are choosing to supplement (or even replace) their home heaters with wood-burning fireplaces and stoves. From an industrial standpoint, however, trees currently have a higher value as a raw material for products than as a fuel. New techniques are making possible the use of more and more of the forest products as a raw material for items such as chipboard and particle board. Thus wastes which would previously have been used as fuel by the forestry industry are now being turned into products. Reseachers are continuing to study methods of using wood as a fuel on a wide scale.. Methods being studied include direct burning of wood, and using wood as a source of gaseous or liquid fuels or as a raw material for organic chemicals. Proposals exist for "energy plantations" to grow short rotation tree crops or other plants to be used as fuel.

PYROLYSIS OF SOLID WASTE

This process involves burning of solid waste in an oxygen-free atmosphere to produce oil and gaseous products. Such wastes could include manure, garbage, paper, logging residue, some industrial waste, and sewage.

A major difficulty with this method is that the waste material tends to be scattered in small amounts at various sites, and it would be enormously expensive to gather it at a location where it could be burned.

THINK ABOUT IT!

(True-False)

Geothermal

_____ 1. Geysers field in California is the only large-scale geothermal complex in this country.

_____ 2. Dry steam can be used in a turbine without the need for solar.

_____ 3. Wet steam is created when underground water is heated by surrounding rock to the boiling point but remains liquid because of high underground pressure.

_____ 4. The best estimate is that the nation's geothermal resources will be supplying a major part of the country's energy needs by the year 2000.

Solar

_____ 5. Solar energy is a concentrated high-temperature heat source.

_____ 6. A solar collector surfaced with glass or plastic traps energy through the "greenhouse effect".

_____ 7. Solar cells capable of converting 19% or more of incident sunlight directly to electricity are now available, but their cost is 100 times the price per kilowatt of con-conventional generating plants.

Wind Power

_____ 8. With wind power, energy storage is never a problem.

Thermal Gradient

_____ 9. It is estimated that by 1990, huge ocean thermal generating plants will be able to supply us with nearly 25% of our electrical energy needs.

Pyrolisis of Solid Waste

_____ 10. This process involves burning solid waste in an oxygen-rich atmosphere.

The use of any one of the following energy resources may help to supply our energy requirements but may at the same time present us with new problems to consider. In the lefthand column of this page are some of these issues. Some are problems; some are solutions. Mark each statement either "S" for solution or "P" for problem as it relates to energy issues. Check appropriate energy technology to which each statement applies. The first one is done for you.

	IF THIS ENERGY SOURCE IS USED, IT....	SOLAR	NUCLEAR	WIND	GEO-THERMAL	COAL GASIFICATION	COAL LIQUIFACTION	OIL SHALE	PYROLYSIS
S	WOULD HELP SOLVE THE PROBLEM OF SOLID WASTE DISPOSAL.	✓		✓	✓	✓	✓		✓
	COULD POLLUTE WATER								
	WOULD CONSERVE THE DWINDLING RESERVES OF FOSSIL FUELS.								
	COULD DAMAGE WILDLIFE OR THEIR HABITAT								
	WOULD BE DIFFICULT TO STORE AND TRANSPORT								
	WOULD NOT POLLUTE THE ATMOSPHERE.								
	WOULD DISRUPT THE NATURAL USE OF LAND SURFACES								
	WOULD NOT BE ABLE TO SUPPLY ENERGY ALL THE TIME.								
	WOULD HAVE TO WAIT UNTIL THE TECHNOLOGY IS DEVELOPED								
	WOULD USE LOTS OF WATER TO PROCESS.								
	WILL DECREASE THE NEED FOR OIL IMPORTS								
	WILL MAKE LARGE AMOUNTS OF WASTE MATERIAL								
	WILL MAKE USE OF THIS COUNTRY'S MOST ABUNDANT FOSSIL FUEL								

WHERE DO WE GO FROM HERE?

Today's energy sources came into wide use because they were relatively cheap, abundant, and efficient. The attractiveness of any of these alternate energy sources will increase if the sources we are now using continue to become expensive and scarce. It seems that no promising source of energy, however unconventional it may be, should be neglected by a nation and a world that is so dependent on a supply of energy and so unsure of the length of time that supply will last.

Basically, there are two paths that we may follow as we strive to find ways in which we can meet our energy needs for the future. One path is often described as the "hard path" and the other is the "soft path". Consider some of the important characteristics of these alternatives.

Hard Path

1. High degree of advanced technology
2. Large technical staff for planning and development.
3. Long planning and developmental period
4. Large amount of capital investment required
5. Cost and time involved in developing the technology are almost impossible to predict

Soft Path

1. Rely on energy income to meet energy budget
2. Diverse--energy supply made up of contributions from many sources
3. Flexible and relatively low developmental costs
4. Easy to understand
5. Matched in scale and in geography
6. Matched in energy quality to end-use needs

Whether we follow the hard path, the soft path, or some combination of the two, there are some very important tasks ahead of us. Some of these may be defined as follows:

1. Shift to new sources of energy
2. Reduce per capita consumption of energy
3. Emphasize renewable energy sources
4. Change our lifestyles
5. Effectively manage and conserve the energy that we have
6. Improve agriculture methods to be less energy intensive
7. Rebuild our railroad system
8. Decentralize energy use

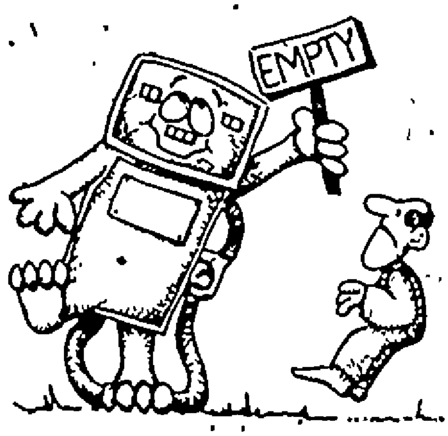
The ways in which we use energy undoubtedly will have to change in the near future. On a daily basis the United States, with a population that is only around 6% of the world's population, consumes nearly 33% of the world's energy resources. As fossil fuels become more scarce it is apparent that we will no longer be able to do this. What part will you choose to put the YOU in energy use?

THINK ABOUT IT!

1. Make two columns on your paper. Label one Hard Path and the other Soft Path. Now take the following list and put each item in the column where you feel it belongs.

Fluidized combustion of coal
Coal gassification and liquifaction
Oil shale
Nuclear light water reactors
Nuclear breeder reactors
Nuclear fusion reactors
Geothermal energy
Solar Heating
Solar Cooling
Solar electricity generation
Wind power
Ocean Thermal energy
Tidal power
Bioconversion
Caulking windows
Insulating buildings properly
Adjusting thermostats to 68°F. in the winter and 75°F. in the summer
Turning off the water while you brush your teeth
Using a small fuel efficient car
Wood stove or fireplace
Observing the 55 mph speed limit
Car pooling
Insulation blanket on water heater
Setting the water heater at 120°F.
Managing your own use of energy wisely

2. Discuss what you think is the best way for the United States to meet its energy needs in the future.



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- --excellant for alternative energy sources

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Material Cycling Rules of the Game 53
Some Important Biogeochemical Cycles 57
--Section V. Fouls and Penalties 94
Some People Fouls 105
Manipulation of Ecosystems 109
Depletion of Finite Resources 117
Pollution 124
Some Cycles Run Amuck 127
Messing Up the Flow of Energy 141
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Abiding by the Rules 147
Energy 147
Material Cycling 151
Careful Manipulation of Ecosystems 152

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--Activity 7: To discover the relationship between the movement of air and the energy it produces
--Activity 13: To discover the relationship between the sun's energy and its use for power.
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--Chapter 13, An Ecological Viewpoint, p. 219.
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--P. 19, interesting quote from Kenneth Cantor which could be used by students opposing the use of the automobile

Teachers Environmental Resource Unit: Energy and Power. Brevard County Schools.

--p. 5, Energy and the American Family

--discusses average family consumption relative to Florida

Tips for Energy Savers. Washington, D.C.: Department of Energy, 1978.

FILMS:

Individual County Public Schools have many good films on energy and the environment. The Secondary Science Teacher's Handbook has a complete listing of these films.

Free loan films are also available at the regional Energy Information Centers. Three good films that may be obtained from these centers are listed below:

Toast, Earth Chronicles. 15 min.

Energy: Less is More, Churchill Films. 18 min.

Energy Sources of the Future, McGraw Hill Films. 15 min.

Energy in Perspective, Address given in sequence of activities. 28 min.

EFFICIENT USE OF THE AUTOMOBILE

Don Hostetler

GRADE LEVELS: 10, 11, 12

OBJECTIVES:

1. Demonstrate the effects of the following factors in the efficient operation of the automobile. The factors are:
   - A. Starting and Breaking habits.
   - B. Use of Air Conditioning.
   - C. Cruising speed.
   - D. Tire Inflation.
2. Determine the miles per gallon for variations in each of these factors.
3. Develop more efficient driving techniques.

*"Running On Empty" is an excellent 35 mm film that is available on these topics: Order from U.S. Department of Energy Film Library, P.O. Box 62, Oak Ridge, TN 37830.

SEQUENCE OF ACTIVITIES:

<u>Activity 1</u>: The Effect of Accelerating and Braking on Fuel Economy.

The students are to divide into groups and each group is to drive over a prescribed course using one of the following acceleration and braking combinations.

1. "Jack Rabbit" start and "Panic" stop.
2. Moderately fast start and "Panic" stop.
3. Slow start and "Panic" stop.
4. "Jack Rabbit" start and Moderate stop.
5. Moderately fast start and Moderate stop.
6. Slow start and Moderate stop.
7. "Jack Rabbit" start and slow stop.
8. Moderately fast start and slow stop.
9. Slow start and slow steady stop.

The students are to determine the miles per gallon for each of these combinations by filling the gasoline tank before and after each journey around the course. The miles per gallon can then be determined by dividing the length of the course in miles by the amount of gasoline needed to refill the tank in gallons. This procedure is to be repeated by the students during the following activities.

<u>Activity 2</u>: The Effect of an Air Conditioner on Fuel Economy at Various Highway Speeds.

The students are to divide into two groups, one using the cars air conditioner and one using only open windows to cool the interior. Each group is to travel over the prescribed course at each of the following speeds:

- A. 20 miles per hour
- B. 30 miles per hour
- C. 40 miles per hour
- D. 50 miles per hour

At completion of each circuit of the course the miles per gallon is to be determined for each vehicle. Following the completion of the four circuits of the course, the two groups will then switch methods of cooling the interior and repeat the above. The students then are to compare the fuel economy of air conditioning and open windows at each speed for each seperate vehicle.

They then can establish the speed: if any, that air conditioning becomes more economical than just opening the windows.

Activity 3: The Effect Cruising Speed on Fuel Economy.

This activity is unnecessary because it was included in activity 2. If it is desired activity 2 can be expanded upon by having the students travel around the course in speeds ranging from 20 miles/hr to 55 miles/hr varying the speed each time around the course by 5 miles per hour. Then they could plot the miles per gallon versus miles per hour on a chart and determine the optimum speed for fuel efficiency for each car.

Activity 4: The Effect of Tire Inflation on Fuel Economy.

The students are to determine the miles per gallon while completing the course under the following conditions:

A. Inflating the vehicles tires at the pressure recommended by the manufacturer.
B. Underinflating the tires by two pounds of pressure.
C. Underinflating the tires by five pounds of pressure.
D. Overinflating the tires by two pounds of pressure.
E. Overinflating the tires by five pounds of pressure.

After the miles per gallon has been determined for each inflation pressure, the optimum pressure for the best fuel mileage can be determined.

SKILLS TO BE DEVELOPED:

1. Intelligent judgement in using the automobile as efficiently as possible.
2. Braking and starting techniques to improve fuel efficiency.
3. Determining miles per gallon.
4. Determining optimum efficiency or optimum mileage.
5. Making and reading graphs to use in determining optimum efficiency.

EVALUATION PROCEDURES:

1. Construction of graphs using given data.
2. Computation of miles per gallon using given data and student reports on the above activities.
3. A Drivers - Ed Contest similar to the "Mobil Economy Run."

"The Efficient Use of the Automobile Unit" can be used in Physical Science in the unit on machines and engines and in Earth Science in the section on petroleum. This unit can be accomplished in cooperation with the Drivers' Education Department. The results of these activities are apt to expose several myths. For example the car is usually more efficient with the air conditioner on at speeds over 40 miles per gallon and moderately fast starts are more efficient than slow starts.

BIOMASS: RENEWABLE ENERGY SOURCE

Irma Jarvis

GRADE LEVEL. High School (10 - 12) ecology, environmental science, marine biology.

GENERAL OBJECTIVES:
1. To understand jargon connected with biomass as an alternative energy source.
2. To trace and identify energy flow through a biological system.
3. To identify four major biomass sources and describe the type of energy produced and how this is done.

KEY VOCABULARY:

primary productivity	bioconversion
food chain	biomass
producer	biomass energy
herbivore	omnivore
carnivore	scavenger
trophic level	decomposer
aerobic	anaerobic

SEQUENCE OF ACTIVITIES:

1. Biomass - is made up of all the plants on our planet.

   Biomass Jargon

   Biomass Energy - is all the energy released when plants are eaten, burned or converted into fuel.
   Primary productivity - is the rate at which biomass is "fixed" by photosynthesis per unit area per unit time.
   Food chain - is the passing of energy and nutrients from plants to animals.
   Trophic level - is the point at which energy (chemical) has been transferred from one organism to another (each step of the way) sometimes referred to as a niche.
   Producers - usually plants, that convert solar energy into chemical energy.
   Herbivore - is a plant eater.
   Carnivore - is a meat eater.
   Omnivore - is both a plant and meat eater.
   Decomposer - usually fungi or bacteria, that break down both plant & animal tissue to basic elements to be recycled in living systems.
   Scavenger - eats leftovers or newly - dead organisms.
   Bioconversion - changing energy trapped in plants and animals into fuels or food readily available for human use.

2. Energy flow through a biological system (see figure #1)

ACTIVITY. Field trip - mangroves, salt marsh or wetlands.

Solar energy, is changed by plants into useable chemical energy.

This process is called photosynthesis.

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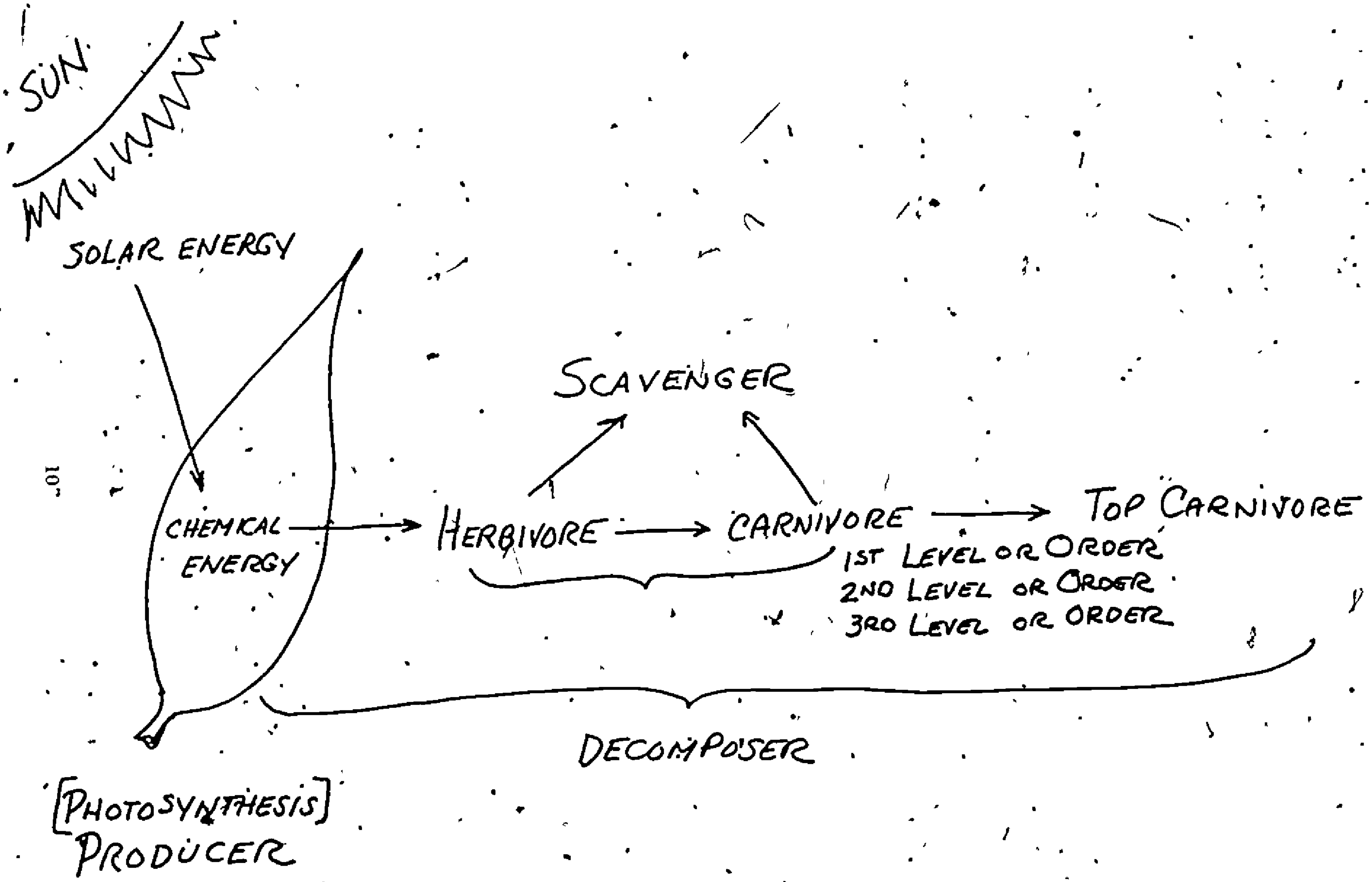

FIG. 7 - FOOD CHAIN - WITH TROPHIC LEVELS OR NICHES.

When an organism eats a plant for food, that energy is changed into heat, usable nutrients and energy by the process we call respiration. This organism is referred to as an herbivore since he is a plant eater or vegetarian.

When the herbivore is eaten by another animal for food, this energy transfer occurs again.

A flesh eater is known as a carnivore, and as a first level or first order carnivore indicting its closeness in feeding to the herbivore.

When this carnivore is eaten by another animal, the second carnivore is referred to as a second level or second order carnivore, etc.

This predator - prey relationship continues until an animal with few, if any, predators, and it is known as a top carnivore.

Scavengers are our garbage collectors. They feed on both herbivores and carnivores - newly dead.

Decomposers, made up of bacteria and fungi, recycle all nutrients trapped in all organisms. Without them dead organisms would not decay.

3. Four major sources of biomass usable for alternative energy sources. (Figure #2).

ACTIVITY: Newspaper articles on renewable biomass resources.
Solid wastes - sewage, garbage, agricultural wastes.
Silviculture - tree farming.
Aquaculture - algae, fish farming.
Sea Farming - algae harvesting.

ACTIVITY. Grow chodrella cultures.

ACTIVITY: Students may build an aerobic digestor and an anaerobic digestor, each producing a usable alternative energy. (Figure #3).

ACTIVITY: Decorated tree boxes in each classroom and offices.

SKILLS.
1. Trace energy from solar to chemical through food chains in living systems.
2. Identify biomass sources.
3. Identify bioconversion methods and alternative energies produced.

ACTIVITIES - Additional
1. Build a model digestor
   a. Anaerobic model
   b. Aerobic model
2. Collect magazine and newspaper articles on renewable biomass resources.
3. Collages on biomass energy sources.
4. Decorated tree boxes in each classroom and office - collect paper.
5. Grow culture of chlorella to produce food or energy.
6. Chart weight of paper collected in Four vs. Energy Saved in Recycling.
7. Composting of vegetable wastes from cafeteria or home.
8. Experiments to compare different grasses including native ones, as to rate of growth vs. total dry weight.

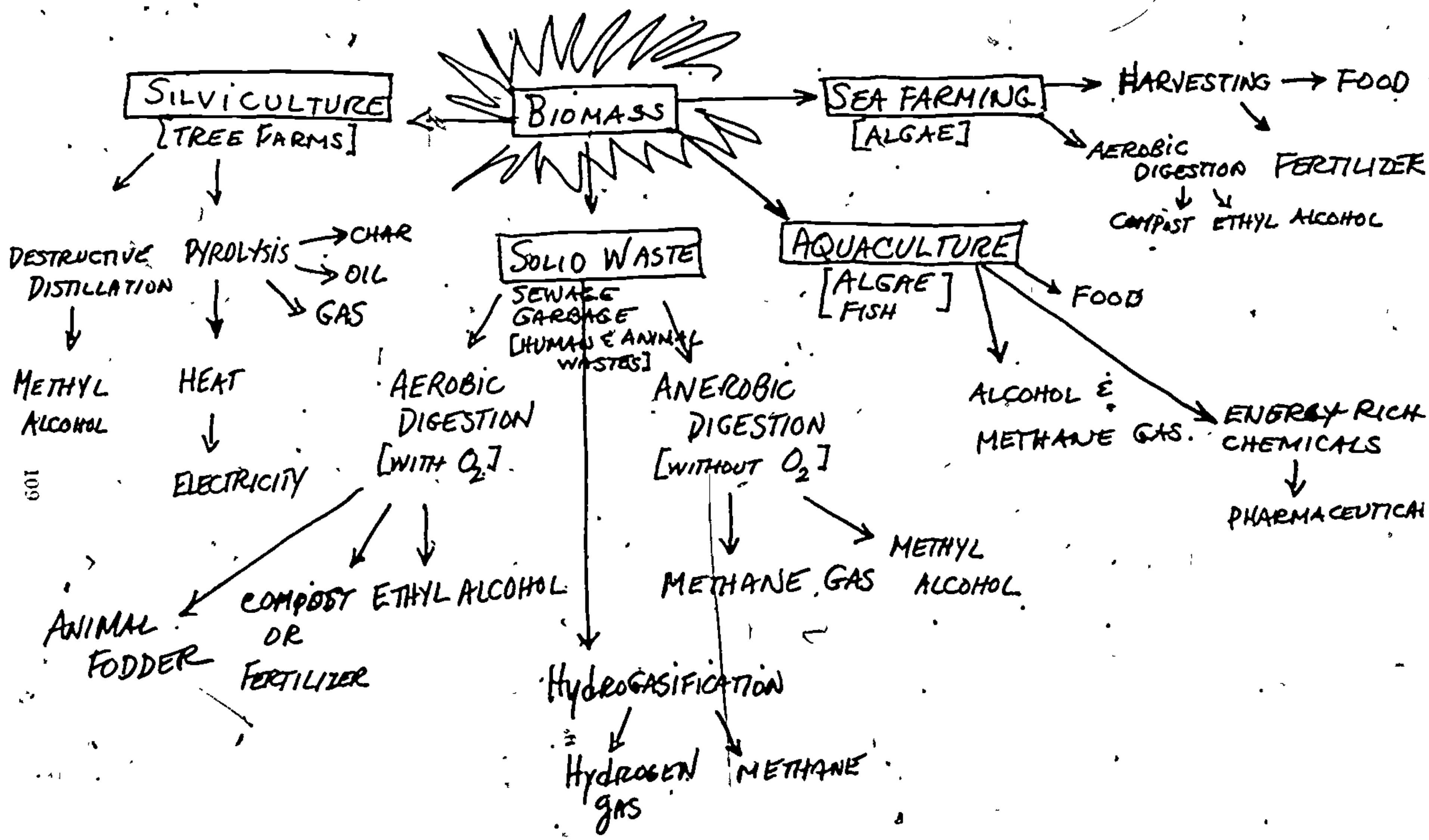

FIG. 2. MAJOR BIOMASS SOURCES...

9. Student's research and design projects using experimental results from previous hands - on activities. (Experimental or literature search).
10. Establish a cross-reference file on subject.
11. Oral report on an article on biomass energy source.

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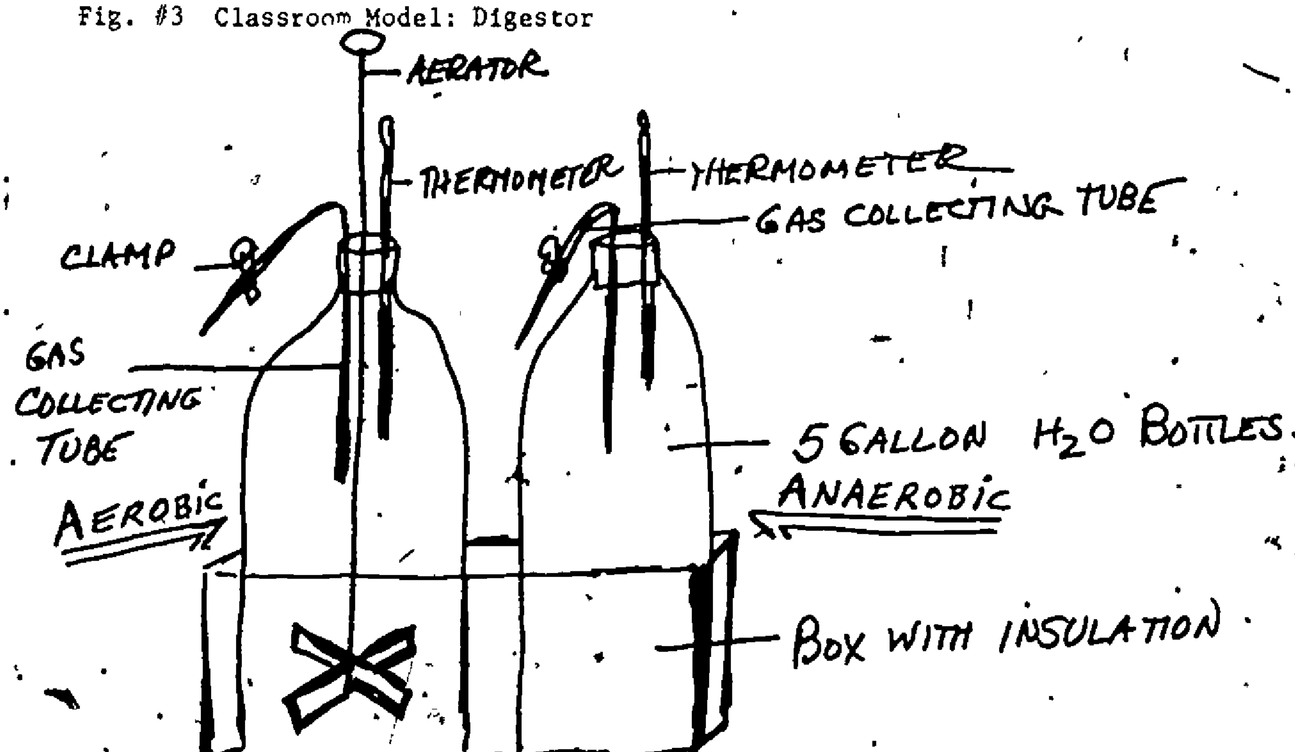
Fig. #3 Classroom Model: Digestor



Directions: Using vegetable wastes (plants) from the cafeteria or home, set up an aerobic digestor which uses yeast and air to produce alcohol by fermentation and an anaerobic digestor using no air to produce methane gas. The aerobic digestor should be turned several times a day to circulate air. Fill only 1/8th full with wastes and vent off gases daily. Let run for about a week. It may be tested after the first day.

ENERGY LESSONS - SECONDARY SPECIAL EDUCATION

Christopher R. Crozier

The following lesson plans will provide the secondary EMH or TMH students with a basic understanding of todays energy problems. It will also incorporate reading, writing, and math activities related to energy. Each lesson will use 2 to 3 hours of class time and 30 minutes of homework time.

Lessons to be taught:

1. What is Energy?
2. Energy Conservation.
3. Using the Suns Energy - Solar hot water
4. Using the Suns Energy - Passive design
5. Using the Suns Energy - Passive design
6. Using the Suns Energy - Photo-electric

LESSON ONE: What is energy?

GRADE LEVEL: Secondary Special Education

GENERAL OBJECTIVES.
1. The student will be able to define energy as the ability to do work.
2. The student will be able to name the major energy sources. (mechanical, chemical, electrical, nuclear, heat, and light).

KEY VOCABULARY: Energy, mechanical energy, chemical energy, electrical energy, nuclear energy, heat energy, and light energy.

SEQUENCE OF ACTIVITIES:

1. Classroom demonstration of toy electric cars.
2. Trace the path of the electric energy used by the toy car back to its original source. (sun)
3. Ask the class for examples of other things that use energy and trace their power back to their source. (examples - family car, light bulbs, range, etc.)
4. Identify big energy spenders and small energy spenders.
5. Have each student keep a list of Enerwords' used during the lesson.
6. Identify instances of energy waste.
7. Compare energy use by the class with a class of fifty years ago.
8. Take an electric meter reading on the school electric meter, read it again an hour later and determine the amount of energy used by the school each hour.
9. Determine the cost of energy to the school for each hour.
10. Homework - Ask each student to make a list of all the ways his or her family uses energy and ask them to identify the types used.
11. Film - Energy - A Family Album #518. (free loan) DOE TIC Film Library, P.O. Box 62, Oak Ridge, TN 37830.

SKILLS TO BE DEVELOPED:
1. Enerwords' vocabulary, writing
2. Reading an electric meter
3. Subtraction and multiplication in figuring kw's used by school and cost.

EVALUATION PROCEDURE. Oral or written evaluation depending on particular student.
1. What is energy?
2. Name several different forms of energy.

LESSON TWO: Energy Conservation

GRADE LEVEL: Secondary Special Education

GENERAL OBJECTIVES. 1. The student will be able to name several different ways by which energy is being wasted in the community.

KEY VOCABULARY: heat lost, insulation, conservation, wasted energy.

SEQUENCE OF ACTIVITIES:
1. Take the class on a survey tour of the school to find examples of energy being lost or saved.
2. Ask each student to make a list of the example found.
3. Discuss with the class their finding.
4. Have each student add to his Enerword list.
5. Discuss ways in which energy in the school could be saved. (Insulation, thermostat settings, hot water heater settings, etc.)
6. Take the class outside the school and look for more examples of energy being lost or wasted. (examples, large cars in the parking lot, shade trees for the building, passive solar design of building etc.)
7. Have each student keep a list of these.
8. Homework - have each student survey his or her home and make a list of ways energy is being wasted or saved.
9. Film - Energy Proofing Your Home #547, DOE TIC Library, P.O. Box 62, Oak Ridge, TN 37830. (free loan - 10 minutes)

SKILLS TO BE DEVELOPED: 1. Enerword vocabulary, writing

EVALUATION PROCEDURE. 1. Oral or written evaluation depending on level of particular student.
   a. Name several different ways in which energy is being wasted or saved in the community.

LESSON THREE: Using the Suns' Energy.

GRADE LEVEL: Secondary Special Education.

GENERAL OBJECTIVES. 1. The student will be able to identify a way in which solar energy can be used to replace a conventional energy form.

KEY VOCABULARY. Solar energy, solar collector, thermometer, temperature, magnifying glass, efficiency.

SEQUENCE OF ACTIVITIES:
1. Have the student construct simple hot water solar heaters.

MATERIALS. Various color opaque and solid plastic glasses of the same size, clear plastic wrap, rubber bands, styrofoam cups, aluminum foil, thermometers, canned drink coolers, magnifying glasses, and cardboard boxes.

PROCEDURE FOR CONSTRUCTION. Give each student one glass of water and challange him to construct a solar water heater that will produce hot water faster then anyone else's. Tell him he may use any or all of the materials listed above.

2. Have each student record the water temperature of his water before it is placed in the sun, 5 minutes after being placed in the sun, and again every 5 minutes it is in the sun for one hour.
3. Have one student record the air temperature in the same manner.
4. Have one student run a control clear water glass without any other factors involved and have him also record the temperature of the water in the same manner.
5. After one hour in sun see who has the hottest water.

FOLLOW UP ACTIVITY:

1. Have each student plot a graph of the temperatures recored during the hours in the sun and shade.
2. Compare graphs by posting all graphs on a bulletin board and discuss with students the reasons for differences.
3. Place each students' solar water heater in the shade and record water temperatures again every 5 minutes for another hour.
4. Have each student write a short paragraph telling how he could have made his solar water heater more efficient.

SKILLS TO BE DEVELOPED.

1. Reading a thermometer - Vocabulary Enerwords"
2. Plotting a graph.
3. Writing a paragraph.

EVALUATION PROCUDURES.

1. Oral or written depending on individual student level, define key vocabulary words.
2. Homework - Each student will conduct a home hot water heater survey. They will record:
   a. type of water heater (gas, electric, solar)
   b. the temperature at which the hot water is set.
   c. the use of insulation on pipes and water heater.
   d. The amount of hot water used each day and the use.

LESSON FOUR: Using the Suns' Energy.

GRADE LEVEL: Secondary Special Education

GENERAL OBJECTIVES. The student will be able to identify ways inwhich a home maybe passively heated or cooled.

KEY VOCABULARY: passive solar design, roof overhang, ventilation

SEQUENCE OF ACTIVITES.

1. Divide the class into two groups.
2. In one group, each individual is to build a cardboard box house that will get as hot as possible when placed in the sun.
3. In the other group, each individual will build a cardboard box house that will stay as cool as possible when placed in the sun.

MATERIALS. Enough cardboard boxes of equal size so that each student has one, different color paint, clear plastic wrap, tape, aluminum foil, a large supply of different size pieces of cardboard.
After the cardboard houses have been constructed have each student write a short paragraph telling why he thinks his house will get hot or stay cool.

SKILLS TO BE DEVELOPED:
1. Writing a paragraph.
2. Fine motor skills.

HOMEWORK. - Have each student draw a ~~simple~~ floor plan of the house he lives in. Note the direction the house faces, the placement of windows, the amount of roof overhang, the color of the house and the roof and the position of shade trees.

LESSON FOUR CONTINUED: Using the Suns' Energy, and passive design.

GRADE LEVEL: Secondary Special Education.

KEY VOCABULARY: passive solar design, roof overhang, ventilation

SEQUENCE OF ACTIVITIES:
1. Have each student record the interior temperature of his cardboard house before it is placed in direct sunlight.
2. Have each student place his house outside in direct sunlight.
3. Have each student record the interior temperature of his house every 5 minutes for one hour.
4. After on hour see which house has the hottest interior and which house has the coolest interior.
5. Have each student plot a graph of the interior house temperatures for the hour they were in the sun.
6. Discuss with the students the possible reasons for differences.
7. Have each student write a short paragraph telling why his house got hot or stayed cool while it was in the sun.

SKILLS TO BE DEVELOPED:
1. Reading a thermometer.
2. Writing a paragraph.
3. Vocabulary skills.
4. Plotting a graph.

EVALUATION PROCEDURES: Oral or written depending on the individual. Define passive design.
Homework - Each student will write a paragraph telling why his house is or is not a good passive design.

LESSON FIVE: Electricity from the sun.

GRADE LEVEL: Secondary Special Education

GENERAL OBJECTIVES. The student will be able to tell what a photo-electrical cell does.

KEY VOCABULARY. photoelectric cell, photon, direct sunlight, cost factor, D.C., volt ohm meter.

SEQUENCE OF ACTIVITIES:

Materials needed - photoelectrical cell large enough to power a small D.C. motor with a propellor attached, D.C. motor with propellor attached, volt ohm meter.

1. Take the class somewhere where there is direct sunlight.
2. Hook up the D.C. motor to the photoelectric cell and aim it at and then away from the sun.
3. Next explain what a volt ohm meter does.
4. Connect the photoelectric cell to the volt ohm meter and record the output of the cell when it is facing the sun directly and at various angles to the sun. Also try using direct and indirect sunlight.
5. Back in class, have the students individually plot a graph showing the output of the cell under the different conditions.
6. Next using a 100 watt light bulb as an energy source record the output of the photelectric cell at various distances from the light bulb.
7. Have the class plot a graph of the photoelectric cells output with the light bulbs as a source.
8. Compare the graphs of output for the sun condition and the bulb condition.
9. Discuss with the class the differences.

HOMEWORK - Have the students count the number of light bulbs used in their homes and have them determine how many photoelectric cells, similar to one used in class, they would need to run all of those light bulbs.

EVALUATION PROCEDURES. Each student will be evaluated orally or in writing depending on the individual. Ask students to define key vocabulary words.