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ABSTRACT

These self-contained energy units were developed by Florida teachers to help high school students better understand energy, energy conservation, and life-styles. The major objectives are to help students understand the science and technology of energy, make informed and fair judgments on energy options, make personal life-style commitments which are morally responsible, and prepare for participation opportunities in setting energy policy. The units contain easy to implement student activities which deal with conservation, fossil sources of energy, generating electric power, and life-styles. Teachers can integrate the activities into many subject areas including social studies, science, earth science, geography, reading, mathematics, and spelling. The activities are varied and involve students in classroom discussions, making collages, writing pamphlets on ways to conserve energy, drawing cartoons, doing mathematics exercises, constructing a model nuclear power station, and doing scientific experiments. For Volume 1, see ED 129 677. (Author/RM)



# Energy and the Environment

Volume 2

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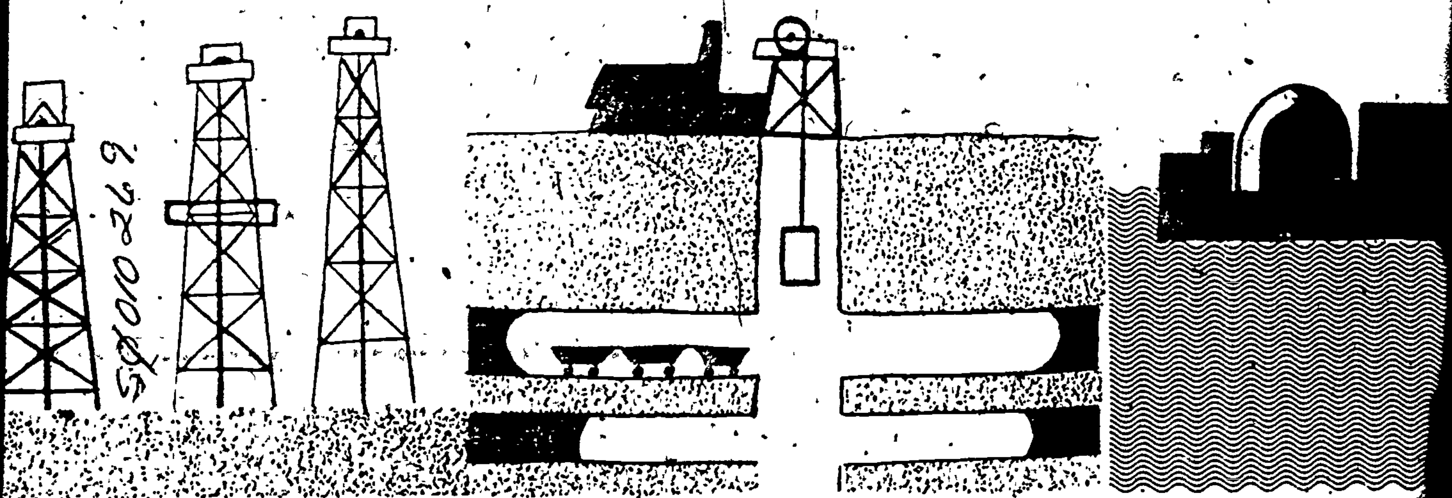

THE FLORIDA STATE UNIVERSITY TALLAHASSEE 32306

# FINAL REPORT

Volume II

United States Energy Research and Development Administration
400 First Street, N.W.
Washington, D.C. 20545

## IMPLEMENTING ENERGY EDUCATION IN FLORIDA'S HIGH SCHOOLS:

A Two-Week Credit Institute for Teachers in South Florida

Project Director: Rodney F. Allen, Associate Professor
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May 12-14, 1977

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College of Education
Area of Instructional Design
and Personnel Development
Program of Science and
Human Affairs
Science Education
Social Studies Education

The Florida State University
Tallahassee, Florida 32306

September, 1977

Dear Educator:

Education in Florida's public schools is developing a national reputation for highly innovative and enlightened programs that uniquely respond to public interest. Schools in Florida reflect the values, norms, and concerns of current society. The responsiveness of the Florida system is largely due to the highly skilled classroom teachers employed by the system and the flexibility of the curriculum.

Recent public awareness of environmental and other energy-related problems led to the establishment of the Florida Office of Environmental Education within the Department of Education. This office is strategically located directly on the Commissioner of Education's staff and enjoys a unique prominence in state educational structures. The field staff of this office are in regular contact with teachers and principals throughout the 67 school districts in Florida. Each district and each school within that district has a person responsible for implementing environmental education. This structure of field coordinator, district contact, and school resource person provides the mechanism for implementing energy education programs in Florida.

The Environmental Education Project at Florida State University has worked closely with the Florida Office of Environmental Education to provide a series of in-service teacher training workshops throughout Florida. These workshops deal primarily with specific content areas such as beach ecology or specific implementation strategies such as developing valuing skills. Last year, over 100 such workshops were conducted in Florida.

A frequent need expressed by teachers was for specific content instruction in the realm of energy education and ways to teach energy education in its broadest scope. Teachers expressed the desire for workshops that would open a new content area for them but within the subject matter they currently teach. Science teachers wanted to learn more about the technology of biological and physical energy systems; home economics teachers expressed interest in exploring the many dimensions of energy use and conservation in areas that relate to family life and personal values.

These energy units were developed by Florida teachers in Palm Beach County to help better understand energy, energy conservation, and lifestyles. Volume I is available from the Educational Resources Information Center (ERIC) as ED 129 677.

David

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# FOREWORD

Energy education is increasingly a national and a personal need in America. School-based educators can have a direct and immediate impact on energy conservation through students. Four general goals for school-based energy education are:

1. The student-citizen will understand the science and technology of energy and its pervasive role in the universe, in living systems, and in human systems (e.g., national, global, political, economic, and social systems).

2. The student-citizen will be able to make informed and fair judgments on energy options as they arise, being able and willing to participate in the political decision-making process.

3. The student-citizen will be able to make personal life-style commitments which are consistent with energy realities and are morally responsible.

4. The student-citizen will be aware of and prepared for participation opportunities in setting energy policy and in encouraging energy conservation at the personal, local, state, and national levels.

With adequate materials and training, educators in our schools can meet energy education objectives, responding both to student and national needs. Technological advances may be spectacular. Direct legislation may force immediate conservation gains. In the long run, however, it is the knowledge, abilities, and personal commitments of the people which permit successful responses to crises. Education offers Americans a way to achieve energy conservation as part of the personal growth of citizens.

## A FRAMEWORK FOR CURRICULA

A conceptual scheme for the development of an energy education curriculum was developed as part of the Florida State University's energy education project. The tentative listing of MAIN IDEAS provides a method through which inquiry and reflective lessons can be developed. The flexibility of the listing enables units to be produced that are appropriate for any grade level.

The MAIN IDEAS are grouped into three functional categories:

1. The Universe of Energy

2. Living Systems and Energy

3. Social Systems and Energy

"The Universe of Energy" and "Living Systems and Energy" outline scientific ideas fundamental to basic energy concepts and energy flow models of which people are a part. "Social Systems and Energy" sets forth fundamental concepts in social systems, including governmental, economic, and moral systems, the understanding of which is vital in making decisions affecting the production, distribution, and consumption of energy resources.

This list of MAIN IDEAS is focused upon "energy conservation"--decisions by individuals, decisions by groups, and systemic decisions on matters affecting energy resources. These decisions range from when and where to turn on a light bulb, to personal lifestyle commitments, to vast matters of societal/global planning like design and industrial location. This is extensively rewritten form a schema produced by the John Muir Institute for Environmental Studies.

## STRAND A - THE UNIVERSE OF ENERGY

1. Energy is the ability to work.

2. Energy exists in many different forms, including light energy, electrical energy, mechanical energy, and heat energy.

3. Changes in the motion or position of matter only occur when energy is exerted.

4. Almost all of the energy available on earth comes from the sun.

5. The earth is an open system which constantly receives solar energy and which constantly gives off heat energy.

6. Life can exist on earth only because of the constant and steady arrival of solar energy and the equally steady loss of heat energy into outer space.

7. Machines and living organisms change energy from one form to another.

8. Energy can be changed, but it can never be created or destroyed.

9. Different forms of energy are able to do different amounts of work.

10. Kinetic energy refers to any form of energy that is actively doing work.

11. Potential energy refers to any form of energy that is inactive or stored. All matter contains potential energy.

12. Sources of energy for future use include organic matter, nuclear materials, and solar energy.

## STRAND B - LIVING SYSTEMS AND ENERGY

1. All living organisms require energy to maintain such characteristic functions as movement, responsiveness, growth, reproduction, and metabolism.

2. Green plans (producers) are the only form of life that can capture the energy available in solar radiation. They do it by means of a chemical reaction: photosynthesis.

3. Organisms, like humans, which cannot capture solar energy obtain energy from green plants either directly or indirectly. These non-green organisms are consumers.

4. Organisms that break down dead animals and plants into molecules and atoms are decomposers. Decomposers are usually bacteria and fungi.

5. Feeding relationships between producers, consumers, and decomposers form patterns called "food chains" or "foodwebs" that describe the paths by which energy is transferred from one organism to another.

6. The overall pattern formed by the movement of energy from producers to consumers is a complex foodweb called an energy pyramid.

7. As energy flows through a living system, it imposes order and organization on that system.

8. Under certain conditions, energy stored in the tissue of dead organisms may become a fossil fuel.

## STRAND C - SOCIAL SYSTEMS AND ENERGY

1. All people must consume energy to stay alive.

2. People transform and manipulate energy sources to satisfy their needs and wants.

3. People use energy to improve their environmental conditions, to power machines, and to maintain culture.

4. People are among the very few organisms that use large quantities of energy resources.

5. People have increased their consumption of energy resources throughout history.

6. People living in technological cultures have greatly increased their consumption of energy resources in the last few hundred years.

7. Sources of energy have changed as new types have been found and as old sources have been depleted or found to be less desirable.

8. The major sources of energy have changed, from renewable ones such as plants and animals, to depletable ones such as coal, oil, and natural gas.

9. People use energy to create and sustain special ecosystems

such as cities, recreation areas, and agricultural areas.

10. People have used energy resources to increase agricultural yields and thus increase the amount of food energy available to them.

11. People are beginning to look toward energy resources that are nondepletable.

12. All societies have wants greater than their resources are able to fulfill, creating the condition of scarity. Economic systems, governmental systems, and moral systems are used to give direction in allocating scarce resources, including energy resources.

13. Energy consumers have interests, obligations, rights, and ideals which govern their personal and collective consumption of energy resources.

14. Energy producers have interests, oblications, rights, and ideals which govern their production and distribution of energy resources.

15. Social systems, including government, the economy, and societal networks, have interests, obligations, ideals, and rules affecting the production, distribution, and consumption of energy resources.

16. Individuals, groups, and the society-at-large face conflicts of self-interests, obligations, rights, and ideals as they make choices or rules affecting the production, distribution, and consumption of energy resources.

17. Energy conservation deals with increasing the efficiency of energy use and decreasing the amount of energy used.

18. Social systems that regulate energy supplies and use are important components in energy conservation.

19. People as energy consumers and decision-makers are individually and collectively responsible for energy conservation.

The strands and MAIN IDEAS are tools for environmental educators involved in the development of energy-related materials and teaching units. Because of their multidisciplinary nature, they can be used in both formal and non-formal educational settings. Taken collectively, the strands and MAIN IDEAS can provide a core for the development and implementation of a viable energy conservation program.

Today, more Americans realize that the energy crisis is real. It is not another series of doomsday forecasts, nor is it another crises hyped by the media and then forgotten as the new crises arrive like waves striking the beach. It has arrived and we must deal with it. This packet of activities is a step forward.

# SECTION I: THE ENERGY CRISIS AND REFLECTIONS UPON CONSERVATION

LESSON I

Purpose: To define energy.

SUBJECT: Any subject area.

CONCEPT: Energy exists in many forms.

REFERENCE: General reference sources and periodicals.

ACTIVITY: Students will spend a class period in the school library researching the various forms of energy in preparation for individual or group presentations before the class. Each student or small group will choose or be assigned a subject for his class presentation. The following is a list of possible subjects:

- Energy
- Work
- Potential energy
- Kinetic energy
- Heat energy
- Sound Energy
- Radiant energy (light)
- Mechanical energy
- Electrical energy
- Chemical energy
- Magnetic energy
- Nuclear energy

Following the students' classroom presentations, the teacher will present to the class examples of energy being used and have the students identify the types of energy involved.

For example:

Walking = Chemical energy converted to mechanical energy and heat energy and doing work.

An explosion = Chemical energy converted to heat, light, sound and mechanical energy.

Flashlight = Chemical energy converted to electrical energy which is converted to light, heat, and magnetic energy.

Food = Chemical energy, potential energy.

EVALUATION: Ask the students for other examples and discuss the types of energy involved.

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LESSON II

PURPOSE: To measure energy.

SUBJECT: Any subject area.

CONCEPT: Each of the forms of energy can be measured.

REFERENCE: General reference sources and periodicals.

ACTIVITY: Students will spend a class period in the school library research-int the terms and methods of measurement of the different types of energy. They will form small groups and research one of the types of energy in preparation for a class presentation.

EVALUATION: Following the class presentations and discussion, students may take part in measuring energy with thermometers, volt and ampere meters, light meters, torque gauges, scales, etc. as availability of equipment permits. They may also check the information plates on various appliances and pieces of equipment to see how much energy is used to operate the item.

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LESSON III

PURPOSE: To determine whether the present oil shortage is fact or fiction.

SUBJECT: Science - Social Studies

CONCEPT: President Carter, in his energy address to the nation, stressed the energy crisis as the major problem confronting the nation. Yet, many reports are being written stating that there is really no critical shortage of oil <u>now</u> but that it is being fabricated by the oil companies in order to reap huge profits. This fact or fiction of an oil shortage must be resolved so that severe conservation measures will be accepted by the people.

ACTIVITY: Familiarize students with the types of reference material that could be used to research this problem. Current newspaper articles, Time or Newsweek magazines, economic reports and other sources particularly those dealing with quarterly profits of oil companies should be used to analyze the question. It might be particularly beneficial to divide the class into a "pro and con" group. Oral reports using charts and visual aids, prepared by the students, should be required and the students informed that they will be evaluated on the basis of their reports.

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LESSON IV

PURPOSE: To understand the increasing need for energy conservation due to our changing life styles from 1800 to 1970.

SUBJECT: Social Studies

CONCEPT: Within the last 200 years society has become more and more dependent on energy resources, primarily fossil fuels.

REFERENCE: Encyclopedias and history books available in a library

MATERIALS: Poster board, felt markers, yard stick.

ACTIVITY: Divide students into groups to trace the changes in the following areas since approximately 1800: population, transportation, communication, lighting, foods, fuels. Students will do their research in the library. Each group will fill in the part they are responsible for on posters set up as a timetable.

When the timetable is completed the class should discuss the significance of the changes in life style and why these changes have caused the great increase in the use of electricity and fossil fuels.

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LESSON V

PURPOSE: To reflect upon the nature of "Energy Crises" especially the one during 1973.

SUBJECT: Ecology, Social Studies, Environmental Science, Economics

CONCEPT: Shortages, such as the fuel crisis of 1973--what caused it? Will it happen again? What must we do to prevent other crises?

REFERENCE: The Fuel Crisis, The Associated Press Special Report, 1974. (Filmstrips & cassettes - approximately 27 minutes)
"People are Still Wondering--Is Energy Shortage for Real" U.S. News and World Report, 28-30, May 9, 1977.

ACTIVITY:
1. Discuss ways our economy and lifestyle came to revolve around fossil fuels.
2. Make a collage of ways Americans waste energy.
3. Describe some inconveniences resulting from the energy crisis and list some long-range effects of the crisis on our American way of life.
4. Discuss how environmental concerns come into conflict with the development of energy resources.
5. Name at least four potential sources of energy in the future.
6. React to the following statement:
   Dr. Paul Ehrlich is quoted as saying:
   "The mini-crisis of the moment is largely a joke...The real crisis is just around the corner."
7. Profits, laws of supply and demand, favorable or unfavorable tax laws, ease of production and production costs, are all considered when companies decide where to refine oil and where to sell it. Should moral judgements, concerns for fair play or patriotism play a part in these decisions? Explain your answer.

OPTIONAL CONTINUING ACTIVITY:
Have each student submit brief written reports (and oral reports before the class) on energy related items that they discover in the news media. The written report should have the news clipping attached (if from the print media). The student reports should a) summarize the news item and b) offer reasons why the news item is connected to the students' lives. These news items can be filed as a reference source for later student reading and research efforts.

LESSON VI Part A

PURPOSE: To examine uses of energy in our present lifestyle and to develop alternatives to those uses.

SUBJECT: Science or Social Studies

CONCEPT: Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

REFERENCE: Energy Watch Calendar (published by IRDA). Teacher's Handbook on Energy, Colorado Department of Education, Denver, Colorado 80203.

ACTIVITIES: Develop with the class a list of 15-20 pairs of alternative ways of doing things commonly found in our way of life such as the dishwasher vs. doing dishes in sink, fan vs. air-conditioner, power mower vs. hand mower, bath vs. shower, etc. Ask the students, working in pairs, to select one of the alternatives and to compare/contrast the amount of energy used and the benefits received from the alternative they have selected. Encourage the students to think seriously about the advantages of both alternatives. Ask the class to select one of alternatives and list their reasons for the preference. Then have the class debate on the various alternatives.

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LESSON VI, Part B

PURPOSE: To demonstrate the finiteness of our major energy resources and how quickly they could be depleted without conservation.

CONCEPT: The students will realize the seriousness of the fossil fuel shortage and how rapidly present energy supplies are being depleted.

REFERENCE: Energy and the Environment, published for the Citizens' Workshops by the Energy Research and Development Administration.

MATERIALS: A fact sheet entitled, "Fossil Fuels-How Much for How Long?", and a game called "Doomsday." While each group picks a "doomsperson," each student will receive an equal number of white, black, and red beads, two green beads and one yellow bead, and a small box to keep the beads in. The "doomsperson" in each group will receive a doomsday calendar.

When the "doomsday recorder" gives the signal to begin, one person in each group will decide how he wants the world's energy for that day to be spent. He will give up 1 white bead if the world runs on natural gas that day, 1 black bead if it runs on coal, or 1 red bead if it runs on petroleum. The "doomsperson" will accept the bead and record on the calendar which fossil fuel is being used that day. Occasionally a student may wish to use hydroelectric or nuclear power in order to conserve on fossil fuels, in which case he gives up a green or yellow bead.

The next student in each group will decide how he wants to spend his fuel the following day, and so on.

Every 5 minutes the "doomsday recorder" will visit each group and keep a running account on the blackboard of how the class is using the world's energy supply.

The game continues with students maneuvering to avoid being the one to spend the last remaining drops of oil, tons of coal, or cubic feet of natural gas.

The game ends when the world's fossil fuels are totally gone.

EVALUATION: As a class, the students will exchange ideas concerning how they felt when the game began, how they felt as it progressed, and how they felt as the world's energy supply was nearly gone. Be sure to get the responses of the person who used the last bit of energy.

*"The energy problem is complex. To understand and deal with it, we must learn new things and think and act in new ways."*

FOSSIL FUELS--HOW MUCH FOR HOW LONG?

At present, in the United States:

1. People use 30 times the energy of 100 years ago.
2. Our population has increased seven-fold in 100 years.
3. Our population uses 4 times the energy used by their great-grandparents.
4. Each person uses 400 million BTUs of energy each year.
5. We have 6% of the world's population, but consume over 1/3 of the world's energy.
6. Fossil fuels (coal, natural gas, oil) supply 95% of our present energy needs.

Fossil fuels:

1. Coal:
   a. Supplies approximately 18% of present energy needs.
   b. Only 390 billion tons are economically able to be taken from the ground and used.
   c. An estimated 3.2 trillion tons are in the ground.
   d. Estimated reserves will last 500-600 years at present rate of use.
   e. U.S. uses approximately 1 billion tons per year.

2. Natural gas:

   a. Supplies approximately 32% of present energy needs.
   b. Known reserves in 1970 were 291 trillion cubic feet.
   c. 18 trillion cubic feet are used each year at present and use is rising.
   d. 4.5 billion cubic feet are used per day.
   e. Present supplies will be exhausted by 2000 A.D.

3. Petroleum (oil):

   a. Supplies approximately 45% of present energy needs.
   b. U.S. has reserves of 35-40 billion barrels.
   c. U.S. uses 5.1 billion barrels a year.
   d. Estimated undiscovered oil of from 60-400 billion barrels.
   e. Use 14,000,000 barrels of oil per day at present.

Other fuels:

1. Hydroelectric power:

   a. Supplies approximately 4% of present energy needs.
   b. Very few new sites for dams are suitable.

2. Nuclear:

   a. Supplies approximately 1% of present energy needs.
   b. Approximately 40 years are needed for the necessary research and development to make this a more important energy source.

LESSON VII

PURPOSE: To make students aware of ways in which they can conserve energy

CONCEPT: Students not only conserve energy but can also make rational choices concerning the areas in which they are best able to conserve.

REFERENCE: *Alternate Energy Sources--A Guide to Alternate Energy Devices*, by Dr. Anthony J. Llewellyn, 1975.

MATERIALS: A ditto called "Average Monthly KWH Consumption," from *Alternate Energy Sources--A Guide to Alternate Energy Devices*, a large poster on which to record progress of individual classes, and a ditto called "My Personal Energy Savings Account."

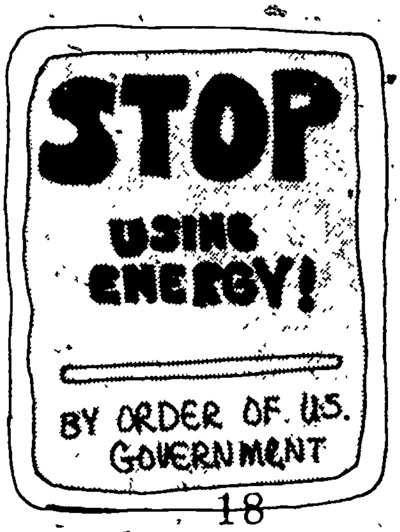
ACTIVITY: Students will make a list of 15 ways they use electric energy every day. They then place an X in the left margin beside three things they just can't do without. They then rank the other twelve items in order from those easiest to give up to those hardest to do without.

Students divide into groups of 4 or 5 to discuss their choices with each other. Criteria for discussion are:

1. Why did you choose numbers 1-3 as being easiest to give up?
2. How much energy would you save in a month by giving up those three things (refer to ditto entitled Average Monthly KWH Consumption)?
3. Which of the others (numbers 4-12) could you give up without too much pain?
4. How much energy would you save in a month by giving these up?

Students are given a ditto called My Personal Energy Savings Account to keep in their notebooks. They are challenged to see how much energy they can save in one month by turning off unused lights, playing fewer records, etc.

EVALUATION: Each student's record of money accrued from his conservation measures during the month will allow him as well as the teacher to see just how well he has performed in conserving energy.



## AVERAGE MONTHLY KWH CONSUMPTION

### Appliances (Cooking)

| | |
|---|---|
| Range | 100 |
| Roaster (3 hrs/wk) | 18 |
| Deep Fat Fryer (1 hr/wk) | 6 |
| Broiler or Rotisserie (2 hrs/wk) | 12 |
| Fry Pan (3 hrs/wk) | 15 |
| Toaster or Sandwich Grill | 4 |
| Coffee Maker (4 hrs/wk) | 15 |

### Refrigeration

| | |
|---|---|
| Refrigerator (12 cu. ft.) | 64 |
| Refrigerator-Freezer (12 cu. ft.) | 119 |
| Refrigerator-Freezer (12 cu. ft. frost free) | 173 |
| Refrigerator-Freezer (15 cu.ft. frost free) | 195 |
| Refrigerator-Freezer (18 cu.ft. frost free) | 248 |
| Refrigerator-Freezer (21 cu. ft. frost free) | 254 |
| Refrigerator-Freezer (24 cu. ft. frost free) | 297 |
| Refrigerator-Freezer (24 cu. ft. frost free, 3 doors) | 346 |
| Freezer (12 cu. ft.) | 167 |
| Freezer (16 cu. ft.) | 178 |
| Freezer (13 cu.ft. frost free) | 190 |
| Freezer (16 cu. ft. frost free) | 243 |

### Laundry Service

| | |
|---|---|
| Washer - Automatic (3 hrs/wk) | 7 |
| Washer - Conventional (3 hrs/wk) | 6 |
| Dryer (3 hrs/wk) | 65 |
| Iron (3 hrs/wk) | 14 |

### Water Heating

| | |
|---|---|
| Stand-By Usage | 30 |
| Family of Four | 300 |
| Add for each additional person | 75 |
| Add for each load of clothes washed | 5 |

Continued on next page.......

Other Services

| | |
|---|---|
| TV - Color (28 hrs/wk) | 40 |
| TV - Black & White (28 hrs/wk) | 30 |
| Radio (20 hrs/wk) | 7 |
| Record Player- Radio (23 hrs/wk) | 11 |
| Dishwasher-With Heater Unit (5 hrs/wk) | 26 |
| Bed Covering - In Peak Season | 20 |
| Dehumidifier - In Peak Season | 30 |
| Incinerator | 53 |
| Water Pump (1/3 HP 10 hrs/wk) | 15 |
| Vacuum Cleaner (2 hrs/wk) | 5 |
| Clock, Heating Pad, Warmer Tray, Waste Disposer Toothbrush, Sewing Machine, Waffle Iron, Floor Polisher, Hair Dryer, Bottle Warmer, Food Mixer, Ice Cream Freezer, Heat Lamp, Workshop, Blender, Equipment | 2 |

Lighting

| | |
|---|---|
| 4 to 5 rooms | 50 |
| 6 to 8 rooms | 60 |
| 9 to 12 rooms | 75 |

Ventilation - Fans

| | |
|---|---|
| Attic (15 hrs/wk) | 32 |
| Circulation (9 hrs/wk) | 4 |
| Ventilating (12 hrs/wk) | 13 |

## MY PERSONAL ENERGY SAVINGS ACCOUNT

How much will power do you have? You are being challenged to stop using energy you do not absolutely need.

Here is your energy savings account record to keep for one month. Every time you want to use an appliance, etc., but don't, record the information and <u>deposit</u> $5 to your account. If you do use an appliance or energy source you decided to give up, <u>withdraw</u> $5 from your account.

Each week your class' savings will be recorded on a large poster in the room and a prize awarded to the class that saves the most energy at the end of the month.

| DATE | APPLIANCE OR ENERGY USER | DEPOSITS | WITHDRAWALS | BALANCE |
|---|---|---|---|---|
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LESSON VIII Part A

PURPOSE: To study families' use of energy and how they can conserve.

CONCEPT: Most families are energy "hogs," but can save themselves money and "headaches" by becoming aware of how they use energy at home.

REFERENCE: "How to Read Your Electric Meter," published by the Florida Energy Office.

MATERIALS: "How to Read Your Electric Meter" and "Energy Conservation Scoreboard", and a class set of Conservation Comparison Fact Sheet.

ACTIVITY: Today students are bringing back their "Energy Conservation Scoreboard" completed after two months of recording their daily KWH consumption at home.

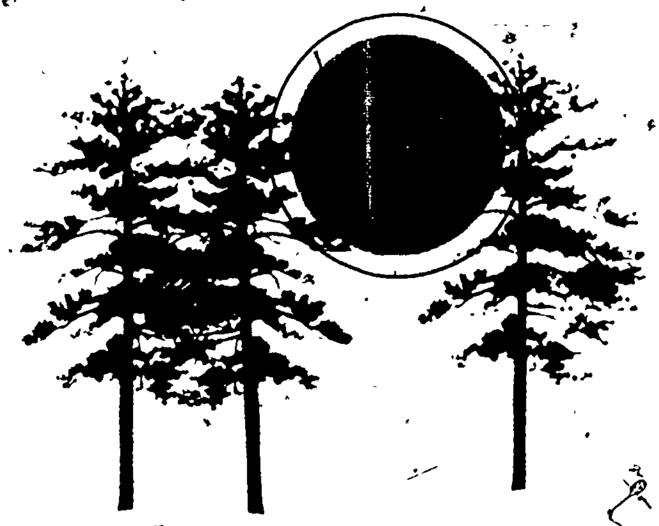
Each student will receive a Conservation Comparison Fact Sheet to fill out using the information gathered from his Energy Conservation Scoreboard. He will answer questions 1-6.

The students will then divide up into groups of 4 or 5. Each student will discuss his Energy Conservation Scoreboard findings with the others and ask for their ideas. These ideas can be recorded in question 7 on the Conservation Comparison Fact Sheet.

The students will then meet as a class again to discuss their ideas and suggestions for each other. The teacher can list the best suggestions on the blackboard.

The class period ends by having each student decide on the practicality of the conservation measures the others gave him. He records his responses in questions 8 and 9.

EVALUATION: The evaluation has already been accomplished during the completion of the Conservation Comparison Fact Sheet.



# ELECTRICITY CONSERVATION SCOREBOARD

See Back of Page for Instructions

(1) (2) (3) (4) (5)

1 2

| DAY OF MONTH 1 | DAY OF THE WEEK | DAILY METER READING | KILOWATT HOURS USED EACH DAY | REASON FOR INCREASE OR DECREASE | DAY OF MONTH 2 | DAY OF THE WEEK | DAILY METER READING | KILOWATT HOURS USED EACH DAY | REASON FOR INCREASE OR DECREASE |
|---|---|---|---|---|---|---|---|---|---|
| | S | | | | | S | | | |
| | M | | | | | M | | | |
| | T | | | | | T | | | |
| | W | | | | | W | | | |
| | T | | | | | T | | | |
| | F | | | | | F | | | |
| | S | | | | | S | | | |
| | WEEKLY TOTAL | | KWH | | | WEEKLY TOTAL | | KWH | |
| | S | | | | | S | | | |
| | M | | | | | M | | | |
| | T | | | | | T | | | |
| | W | | | | | W | | | |
| | T | | | | | T | | | |
| | F | | | | | F | | | |
| | S | | | | | S | | | |
| | WEEKLY TOTAL | | KWH | | | | | KWH | |
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| | T | | | | | T | | | |
| | W | | | | | W | | | |
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| | S | | | | | S | | | |
| | WEEKLY TOTAL | | KWH | | | WEEKLY TOTAL | | KWH | |
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| | WEEKLY TOTAL | | KWH | | | | | KWH | |
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| | F | | | | | F | | | |
| | S | | | | | S | | | |
| | WEEKLY TOTAL | | KWH | | | WEEKLY TOTAL | | KWH | |
| | S | | | | | S | | | |
| | M | | | | | M | | | |

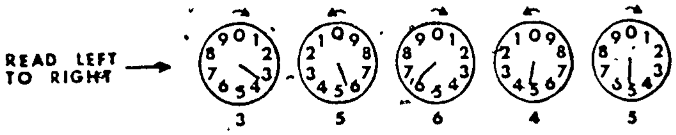
MONTHLY TOTAL ______ KWH

MONTHLY TOTAL ______ KWH

Florida Energy Conservation

DIFFERENCE BETWEEN MONTH 1 and 2 ______ KWH

## HOW TO READ YOUR ELECTRIC METER




There's nothing mysterious about reading a meter -- in fact, it's easy. Take a look at your meter -- it has five (or possibly four) dials. Note that some dial hands turn clockwise → and some, counterclockwise ←.

To read it, read each dial from left to right and record the number that each hand HAS JUST PASSED. On the dials above you'll see the reading is 35645. If you then read the meter a month later and the new reading is 36378 (for example), the difference would be 733 - the number of kilowatt-hours you had consumed between the two readings.

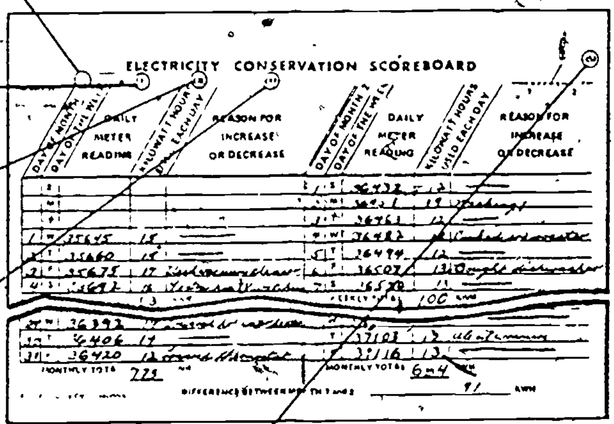
1. Fill in the date opposite the corresponding date of the week, i.e., Jan. 1 was a Wednesday so place the day 1 in front of the letter W.

2. Read your meter according to preceding instructions and at the same time each day. Write the daily reading in column 2.

3. Subtract the previous day's reading and place the difference in column 3 to give you daily kwh usage.

4. Jot down what you did differently than on a normal day; i.e., "washing/ironing" or "lowered thermostat"

5. Enter the months you are comparing, i.e., Jan/Feb or Feb/Mar.




### AVERAGE MONTHLY KWH CONSUMPTION

| | |
|---|---|
| ***WATER HEATING*** | |
| Family of four ............... | 300 |
| Add for each additional person.... | 75 |
| Add for each load of clothes washed | 6 |
| ***HEATING AND COOLING*** | |
| Electric Heat Pump - 1000 sq. ft. home. ............ | 692 |
| Air Conditioning - Whole House - 1000 sq ft. home.......... | 809 |
| Air Conditioning - Room Unit - 1 Ton - 12,000 BTU........... | 425 |
| ***REFRIGERATION*** | |
| Refrigerator-freezer - 15 cu. ft. frost free. . . .. | 195 |
| Freezer - 16 cu ft. ............. | 178 |
| Freezer - 16 cu. ft. frost free... | 190 |
| Freezer - 12 cu. ft. ...... ..... | 167 |

WISE INDIVIDUALS SAVE ENERGY

**FLORIDA ENERGY OFFICE**
**DEPARTMENT OF ADMINISTRATION**

This public document was promulgated by the Florida Energy Office at a cost of $0.01 each to create electrical consumption awareness within Florida residents

CONSERVATION COMPARISON FACT SHEET

1. How many KWH did your family use during the first record keeping month? ________KWH

2. The second month? ________KWH

3. How much increase or decrease did you notice the second month? ________KWH

4. Is there a simple reason for this increase or decrease? If so, what?

________________________________________

________________________________________

5. Are there several other reasons for the increase or decrease? What are they? (refer to column called Reason for Increase or Decrease)

________________________________________

________________________________________

________________________________________

6. In what ways do you think your family could do a better job of conserving?

________________________________________

________________________________________

________________________________________

After group meetings, answer the following:

7. What other ways do your classmates think your family could conserve?

________________________________________

________________________________________

8. Do you agree or disagree with their ideas? Why or why not?

________________________________________

________________________________________

9. Which conservation suggestions, if any, will you try to implement next month?

________________________________________

LESSON VIII Part B

PURPOSE: To develop student awareness of energy waste in the community and how students can spark conservation measures.

CONCEPT: Recognizing invividual abilities and limitations, students will recognize the need for conservation in the community and be motivated to do their share to eliminate waste.

ACTIVITY: Each student will list as many ways as he can think of in which energy is wasted in the community.

With teacher and student direction, a student will compile a list on the blackboard of most frequently mentioned wastes.

The students will then discuss the items to determine if "waste" really exists in all items listed. They will also decide and list on the board what actions, if any, they can take to promote conservation in those areas.

Finally, as an assignment, each student will choose the course of action he wishes to pursue in an effort to cut down on a wasted energy resource in the community.

EVALUATION: After several days each student will present his "finished product" (poster, broadsheets, results of telephone call, report on an interview, etc.) to the group for their consideration and advice. In some instances, effort is more important than the result.

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LESSON VIII (Optional)

PURPOSE: To stimulate an awareness in the costs of electric power as part of an institution-wide conservation program.

SUBJECT: All subjects.

CONCEPT: Energy can be conserved. Conservation of energy will help reduce the drain on our limited fuel supplies. Conservation of energy will result in reduced costs to the consumers.

REFERENCE: Check with your local power company.

ACTIVITY A: 1) Calculate (based on current charge per KW) the cost per hour (4 hour period and 24 hr. period) to use various items which operate on electric power: lights, stoves, air conditioners, electric heaters, etc.
2) Take name tags (the self-adhesive type) and mark in the cost information.

HELLO
MY NAME IS:
Watt Burner
I cost 17¢ per hour
64¢ per 4 hours
4.08 per 24 hrs.
122.40 per month
Do I really need to burn this $

3) Put the tags on the points where one can turn on and off the electric consumers.

ACTIVITY B 1) A very careful analysis of projected electric use for the next 12 months should be made [illegible] the institutions. Base the analysis on the last 12 months and be sure to take into account the addition or deletion of any electric consuming item.

2) A notice of weekly energy savings and costs should be made public.

3) The institution should set a goal (10%) and when monies are saved, part of it should be used as an incentive. Part of the money should be used to purchase (goods or services) which are desired by the people who are saving the energy.

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LESSON VIII (optional)

PURPOSE: To determine what effect increasing the efficiency of heat engines in the transportation industry will have on consumption rates.

SUBJECT: Science-Social Studies-Math

CONCEPT: Energy, a limited resource, must be utilized in a manner which minimizes waste and maximizes useful output.

ACTIVITY: Review the concept of efficiency of heat engines (gas engines, diesels, jet engines, and etc.) to students correlating percent efficiency to miles per gallon of fuel.

Divide the class into four groups and assign each group one of the following categories:

Group 1 - Gas automobiles
Group 2 - Diesel automobiles
Group 3 - Gas trucks
Group 4 - Diesel trucks

Have each group divide into subgroups which will work on one of the following efficiency increasing possibilities:

Subgroup A - Less friction
Subgroup B - Research and development of new types of engines
Subgroup C - Anti-gravity devices
Subgroup D - Lower speed limits
Subgroup E - Less weight per vehicle
Subgroup F - Other factors

Refer each group to the library where a special section of applicable research material should pertain to this activity and should have been prepared in advance. Each group should be prepared to present a written report, orally summarized, to the class. The summary should include their charts, data, and conclusions. Students should be evaluated on the basis of their written and oral reports.

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LESSON VIII (Optional)

PURPOSE: To assess miles per gallon of the family car before and after a tune-up of the engine.

SUBJECT: Industrial Arts (Power Mechanics)

CONCEPT: A poorly tuned automobile engine wastes fuel and money.
Wasted fuel leaves the engine as an atmosphere pollutant.

ACTIVITY: Have the students record the mileage of the odometer when fueling their cars. (Fuel tank must be filled.)
After driving 50 miles or so, again fill the fuel tank and record the mileage and the gallons of fuel purchased.
Subtract the first mileage reading from the second mileage reading and divide this figure by the gallons of fuel of the last purchase. This figure will give the miles per gallon the car is getting.
Have a complete tune-up of the engine performed and again compute the miles per gallon of the vehicle.
Have the students calculate the savings this represents over 10,000 miles of driving (usual life of an engine tune-up).
Have the students calculate how many gallons of unburned fuel would be put into the atmosphere by a poorly tuned engine over the same 10,000 miles of driving.

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Lesson IX, Part A

SUBJECT: Ecology, Social Studies, Environmental Science, Economics

CONCEPT: How will our lifestyles change in the future?
Will our energy shortage change our lives and how?
Is conservation the answer to buying time for the development of other energy sources?

REFERENCE: Young, Suzanne E., "Digging up the Future", Science Digest, 77:85-87, June, 1975.
"How Energy Shortage Will Change Life in America", U.S. News and World Report, 2425, February 14, 1977.

ACTIVITY:
1. Discuss the changes that will be necessary in all our activities and uses of energy.
2. Draw a cartoon using some item that uses energy today and project that item into the 21st century.
3. Project what might happen if instead of running out of energy, we discovered an infinite energy source where all of us could have as much energy as we want.

4. Do a research paper exploring the points that "Digging up the Future" made.

5. React to the statement by Ms. Young:
"Waste is the result of human actions not intentions; therefore waste materials are a telling and honest index of a society's way of life.

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LESSON IX, Part B

PURPOSE: To help students understand the role of government in conservation and encourage the government to take the lead in energy conservation.

SUBJECT: Social Studies

CONCEPT: Our various levels of government use a great deal of energy. Citizens should expect the government to set an example others could follow in conserving energy.

RESOURCES: Various pamphlets published by such agencies as the Federal Energy Administration, Department of Housing and Urban Development, Florida Energy Office, and utility companies.

ACTIVITY: Make available various pamphlets on ways to conserve energy. Students will pick out suggestions that could be applied to governmental agencies. The suggestions would include such items as:

1. Thermostats in buildings should be turned up in summer and down in winter.
2. Cars purchased should be small, gasoline-efficient models.
3. Solar energy should be used when practical.
4. Unnecessary street and building lighting should be eliminated.
5. Garbage and trash pick-up routes should be planned to make efficient use of equipment and fuel.
6. Recyclable materials should be collected.
7. Bicycle paths should be built.
8. New subdivisions should be planned to conserve energy.

Once the list is completed a city official should be invited to visit the class and discuss the list with them. An alternative would be to write letters to members of the city commission, zoning board, city manager, etc., and send them copies of the suggested list.

SECTION II FOSSIL SOURCES OF ENERGY

LESSON I

PURPOSE: Make students aware of the concepts behind potential and kinetic energy. Discuss power, work, horsepower, law of machines, and classes of lever.

SUBJECT: Earth Science

REFERENCE: Physical Science, Cambridge Work-a-Text, by Otho E. Perkins.

CONCEPTS: Potential energy is the energy that is stored and kinetic energy is the energy in motion. What is work? The result of the exertion of a force through a certain distance to overcome a resistance. The four resistances to work are gravity, friction, molecular attraction and inertia.
Horsepower is that power measured by machines. Law of Machines states that, under ideal conditions, the work output of any machines must theoretically equal the work input.
Levers are grouped into three classes according to the relative positions of the effort, fulcrum, and the resistance. Lever classes are known as first class lever, second class lever, third class lever.

ACTIVITY:
1. Have the teams of students to collect and demonstrate various kinds of levers.
2. Using scissors, pliers, nutcrackers, and hammers, have a discussion of the types of fulcrum, effort, and resistance--use them to do work.
3. Discuss the first simple machines invented by man.
4. Do exercises which show work being done. (lifting a box)
5. Do mathematics exercises on the work formula:
   (W = F x D)
   (Work = Force x Distance)
6. Have students to give examples of kinetic and potential energy. (at least ten examples of each)
7. Define the vocabulary words.
8. Answer questions of the concepts.

MATERIALS:
1. textbooks
2. scissors
3. hammer
4. pliers
5. box
6. nutcrackers
7. paper
8. pencil

KEY WORDS:
1. energy
2. potential energy
3. kinetic energy
4. horsepower
5. fulcrum
6. resistance
7. inertia
8. gravity
9. molecular attraction
10. effort
11. lever
12. classes of levers
13. machines
14. Law of Machines
15. pulley
16. wheel and axel
17. inclined plane
18. wedge
19. screw
20. work

EVALUATION: 1. Evaluate each activity by awarding points for each individual activity.
2. Give a final examination on the concepts and the exercises.

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LESSON II, Part A

PURPOSE: To acquaint students with coal's abundance, its basic properties and production.

SUBJECT: Science, Geography

CONCEPTS: Students should become familiar with:
1. The manner in which coal was formed and its basic chemical properties.
2. Location of major coal deposits throughout the world and within the United States.
3. Reserves of U.S. coal in comparison with other domestic fuel sources.
4. The methods of mining coal, both underground and surface.
5. The various means of transporting coal from the mines to the consumers.

REFERENCES:

1. The World Book Encyclopedia, Coal and Research Washington DC 20023
2. Coal in Today's World, National Coal Association, 1130 Seventeenth St.N
3. Energy-Activity Guide, Park Project on Energy Interpretation, National Recreation and Park Assn., 1601 North Kent Street, Arlington, Virginia 22209

ACTIVITIES:

Have a student or a group of students conduct the following activities:
1. Describe how coal was formed and how it is mined.
2. Discuss the chief kinds of coal (anthracite and bituminous).
3. Make maps showing the major deposits of coal in the world and the United States.
4. Draw charts showing the transformation of coal into pipeline quality gas.
5. Do reports and models of shaft mining.
6. Invite an underground or surface coal miner to describe his work to the class.

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LESSON II, Part B.

PURPOSE: To acquaint students with the present uses of coal, its potential for the future and its effects on the environment.

SUBJECT: Science, Geography

CONCEPTS: Students should become familiar with:
1. The major uses of coal.
2. The future uses of coal.
3. The environmental effects of mining and burning coal and the equipment and technology used to ameliorate these effects.

REFERENCES:

1. Coal and Research, National Coal Association, 1130 Seventeenth Street N.W., Washington, D.C. 20023
2. Coal and the Environment, National Coal Association, 1130 Seventeenth Street N.W., Washington, D.C. 20023
3. Coal and the Environment, The World Book Encyclopedia 1975

ACTIVITIES:

Have the student or a group of students conduct the following activities:

1. Prepare a classroom display showing at least ten coal-derived products.
2. Discuss how coal is used as fuel.
3. Research methods for reducing sulfur dioxide emissions from coal-fired plants.
4. Reports on new technology in the production and uses of coal.

EVALUATION:

Students should be able to answer the following questions:

1. What is a preparation plant?
2. Why was coal not widely used until long after its discovery?
3. How and when is coal believed to have been formed in the earth?
4. How is coal used in the productuion of nuclear energy?
5. What are the four largest coal mining countries of the world?
6. What are the four leading coal producing states of the Union?
7. How much coal is mined each year in the United States?
8. Give the definitions of hard and soft coals.
9. What are coking coals?
10. What are the chief types of coal mines and how do they differ?
11. What are some of the chief products of coal?
12. What is the principal means of transporting coal in the U.S.?
13. What is the gasification process?
14. Develop a reclamation plan for an area that has been strip mined for coal.

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LESSON II, Part C

PURPOSE: To help students become aware of the possibilities of coal as an alternative energy supply.

SUBJECT: Social Studies

CONCEPT: The domestic reserves of coal are much greater than those of petroleum and gas. It may be one of the answers to our energy needs, but there are serious problems relating to its mining and use.

RESOURCES: Coal Facts (set of pamphlets published by the National Coal Association; Proceedings: Conference on Magnitude and Deployment Schedule of Energy Resources, Oregon State University; Energy and Ecology, Reading Laboratory, Inc..Film, "An American Asset," Modern Talking Picture Service, New York.

ACTIVITY: Show film "An American Asset" to introduce the class to the present methods of producing and using coal. Members of the class should choose slides and prepare to debate the question of whether or not the increased use of coal to meet the energy needs of our country can be permitted in view of the environmental and technological problems its use presents.

The materials listed under resources should be available plus other pertinent publications and current materials in news magazines.

The class would consider the subject in the form of a formal debate.

TEACHER NOTES:

1. Problems with Coal
   A. Underground mines:
      (1) Cave ins 2) Fires 3) Breathing methane gas 4) Breathing coal dust - "Black lung."

   B. "Strip Mining"
      1) Billions of tons of coal just below the surface.
      2) Method - Strip soil back with giant shovels--then dig coal with them and haul to market.
      3) Strip mining can ruin the environment. How?
         a. Destroy top soil b. Kill vegetation.
         c. Stop use of surface d) Endanger and make useless surrounding areas by drain off.
         e. Rock piles cause water back up and flooding
         f. Great open scars ruin the country
         g. Drownings in the rock pits
   C. Use of Coal
      1) Smoke from it 2) Sulfur dioxide gas

SAMPLE ACTIVITIES:
How can we deal with each problem?
Divide class into 5 or 6 groups and give each group a problem: (Do this in Library possibly)
1. What can be done to make underground mines safer?
   a) better inspection b) Breathers c) Medical exams - Investigate in library.
2. What can we do to save our country from the after effects of "strip mining" (1) Landscape (2) Replant (3) Restore
3. How does water drainage hurt surrounding areas in strip mining?
4. What are the effects of breathing coal dust on the worker?
5. How does coal smoke hurt us and how can we eliminate it?
   1) "Scrubbers" 2) Stacks
6. How can we deal with sulfur dioxide from coal?
   1) Dissolve the coal 2) Gasify the coal.

Words to know: 1) Appalachia 2) fossil fuel 3) Reclaim 4) sulfur 5) industry 6) dissolve 7) solvent

LESSON III

PURPOSE: To acquaint students with the formation, uses, production and supply of petroleum (crude oil).

SUBJECTS: Science, Geography

CONCEPTS:

Students should become familiar with:

1. The manner in which petroleum was formed and its basic chemical properties.
2. The methods of drilling and refining petroleum.
3. Major uses of petroleum.
4. Major locations of petroleum in the world and United States.
5. Reserves of Petroleum

REFERENCES:

1. PETROLEUM, World Book Encyclopedia, 1975
2. The Energy Challenge, Federal Energy Administration, Washington, D.C. 20461
3. The Energy Crisis: What You Can Do About It, Standard Oil Company, Code 3705, 200 East Randolph Drive, Chicago, Illinois 60601

ACTIVITIES:

Have the student or a group of students conduct the following activities:

1. Describe the formation of petroleum.
2. Do reports and models on the drilling and refining processes of petroleum.
3. Locate the major petroleum producing countries and states.
4. Discuss the pro and con of offshore drilling.
5. Make charts of transporting petroleum from oil wells to consumers.
6. Make a bulletin board display on petroleum products.
7. Discuss the remaining reserves of petroleum in the world and the United States.

EVALUATION:

Students should be capable of answering the following questions:

1. What common elements make up petroleum?
2. What part did the automobile play in the development of the petroleum industry?
3. How do oilmen make sure that an area contains oil?
4. What part did a former railroad conductor play in the history of the petroleum industry?
5. What is the most important method of drilling for oil?
6. What is offshore oil?
7. Why do refineries paint the roofs of their storage tanks a light color?
8. What is a wild oil well?
9. Why did refineries at one time dump gasoline into creeks and rivers?
10. Make a list of petroleum products.

OPTIONAL EXTENDING ACTIVITIES FOR LESSON III:

For each of the following options, teachers should obtain a small bottle of Florida crude oil from Ted Duncan, Jr., Florida Petroleum Council, Gadsden Street, Tallahassee, FL 32301

Option One:

Goals:
1. Students will learn some of the uses of petroleum such as gasoline for automobiles, fuel for heating homes and making electricity, and in the manufacture of plastics and medicine.
2. They will learn that petroleum is a fossil fuel and, therefore, is a limited resource.
3. They will discover that we are using petroleum so rapidly that it may be used up in their life-time if some changes in their life style are not made soon.
4. Some ways of conserving petroleum products such as driving cars less, driving cars which get better mileage, and using less electricity will be discussed.

Method: To stimulate interest the bottle of petroleum will be placed on the demonstration table. Students will look at it and ask questions about it.

The class will be divided into groups of three students and given 20 minutes to find out what they know about petroleum. The following questions will be written on the board. They are to answer them in their group.

1. Where is petroleum found and what does it come from?
2. List as many uses of petroleum products as you can.
3. Do you think we will ever run out of petroleum? Why?
4. List ways to conserve petroleum.

One student from each group should write the answer to one question at a time on the board. For each question, those with the correct answer or the most items listed correctly get a point for their group.

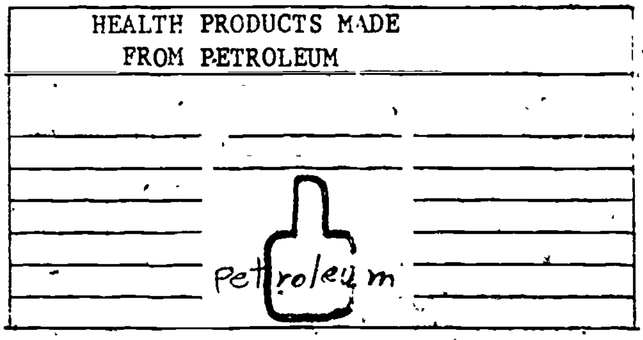
Discuss each question using student answers as a starting point.

Option Two:

Goals:
1. Students will be aware that many health products are made from petroleum.
2. Petroleum is used for other purposes than the production of energy and in some cases there may be no alternative product.

Method:
1. Show bottle of oil. Discuss products they know are made from the oil. Point out that some health products are made from petroleum, as they will soon discover.

2. Through research (in the library) each student will list as many health products made from petroleum as he can find.
3. Using the bottle of petroleum as the center of a display the students (with the aid of teacher) will consolidate all of the findings on a chart to be used as an informative display or learning center.
   Example:




4. Each student will then select one product to report. The report will be an argument on the importance of "saving" this product through energy conservation.

Option Three:

Introduction: Pollution? What is it? A dictionary definition defines it as: To make foul or unclean; to render impure; to defile; to impair. What happens to oil when it is released into the oceanic environment? Oil does not float unchanged until it is washed ashore. All oils contain some volatiles that evaporate. Thus, up to 25% of the spilled oil is lost through evaporation. Bacterial decomposition accounts for up to another 60% of the original mass in approximately 3 months. It is these black, tarry lumps that most frequently wash up on the beach and stick to one's feet. With massive oil spills close to shore, there isn't enough time for a significant decrease in volume to take place and a thick mass of sticky oil is deposited on anything solid in its path.

Goal: To provide a hands-on experience for students in trying to clean up the environment after an oil spill.

Method:
1. Each student or student group will be supplied with the following:
   a. 25cc of crude oil
   b. Sand
   c. Sea water
   d. Feathers
   e. Detergent
   f. Chalk dust
   g. Paper towels
   h. Alcohol

2. The student or student group will then proceed as follows with each type of environment:
   a. Sand Spill the oil onto the sand. Try to remove it by using detergent, try chalk dust.
   b. Sea water Divide the sea water into two samples, spill half of the oil on each sample. Agitate the water vigorously in one sample, let the oil float in the other sample. Try to remove the oil by using detergent or chalk dust. Try to burn it off, add some alcohol and try to burn it off.
   c. Feathers Spill some oil onto the feathers. Try to wash it off by using detergent. Try to absorb it with chalk dust and wipe it off.

QUESTIONS FOR THOUGHT AND RESEARCH

1. What effect did the detergent have upon the oil in the calm sea water? In the agitated sea water? Did it absorb it? Did it disperse it? Did it decompose it? Did it remove it?

2. What effect did the detergent have upon the oil on the sand? On the feather?

3. What effect did the chalk dust have on the oil in each of the environments? Was the effect different for each environment?

4. What effect do you think the detergent (by itself) has upon the flora and fauna of the ocean? Could this be better or worse than the effect of the oil?

5. Could oil pollution of the ocean have an effect upon the atmosphere? Think about white caps and the release of bubbles into the air.

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LESSON IV

PURPOSE: To acquaint students with the formation, uses, production and supply of natural gas.

SUBJECT: Science, Geography

CONCEPTS: Students should become familiar with:

1. The manner in which natural gas was formed and its basic chemical properties.
2. The methods of drilling for natural gas.
3. Major uses of natural gas.
4. Reserves of natural gas.

REFERENCES:

1. Natural Gas, The World Book Encyclopedia, 1975
2. The Energy Challenge, Federal Energy Administration, Washington, D.C. 20461

ACTIVITIES:

Have a student or a group of students conduct the following activities:

1. Describe the formation of natural gas.
2. Discuss the process of drilling for natural gas.
3. Describe the locations of natural gas.
4. Make charts of natural gas traveling from oil wells to consumers through pipelines.
5. Locate leading natural gas producing countries.
6. Make scrapbooks on natural gas products.
7. Discuss the remaining reserves of natural gas.

EVALUATION:

Students should be capable of answering the following questions:

1. How was natural gas formed?
2. Name five chemical products of natural gas.

3. How much fuel energy in the United States is supplied by natural gas?
4. What are the two leading gas producing states?
5. How many miles of natural gas line are used?
6. What is mixed gas?
7. What is LP gas?
8. Where are major reserves of natural gas located?

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LESSON V

PURPOSE: To determine if full employment is possible in an economy that must use less fossil fuel.

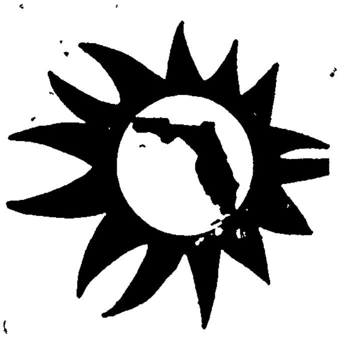
SUBJECT: Social Studies

CONCEPT: The production and consumption of energy have a direct effect on the economy of the country.

ACTIVITIES: The Teacher should use the following questions to lead the discussion:

1. What is the "economy"?
2. Where do jobs come from?
3. Discuss full employment
4. Discuss unemployment.
5. Do jobs consume or use energy or fuel?
6. If you have a diminishing supply of fuel, can you have an increase in the number of jobs?
7. What are some possible solutions?

EVALUATION: The students will divide into groups to discuss "their" questions and then write a summary statement or "position paper" covering their answers.



# SECTION III: NUCLEAR ENERGY

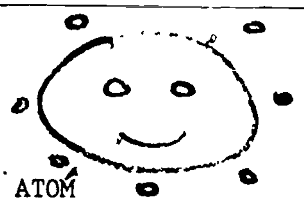
LESSON I

PURPOSE: To stimulate an awareness in the basics of nuclear energy.

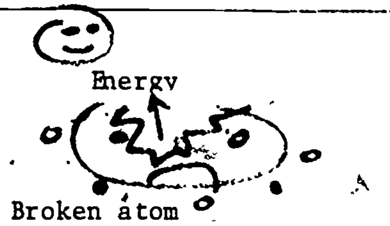
SUBJECT: Science, spelling, reading, math

CONCEPT: Energy can be released by nuclear fission and/or fusion.

ACTIVITY: Children read the lesson card; study the spelling words, locate the spelling words in the puzzle, study the meanings of the spelling words, take part in a teacher led discussion of the concept, spelling words and meanings and draw a picture to represent fission and fusion..




Atoms are very small.
Atoms are so small that you cannot see them.
All things are made up of atoms

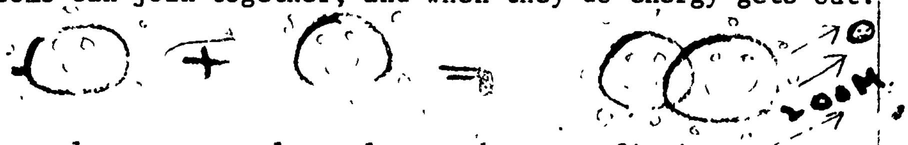



If we break an atom apart, energy gets out.

To break an atom apart is called nuclear fission.

The broken atom is now called nuclear waste, because we have no use for it. Nuclear waste is very dangerous.

Atoms can join together, and when they do energy gets out.



Atom plus atom equals nuclear and energy fission.

Joining of atoms is called nuclear fusion.

NEW WORDS:

1. Energy: Ability to do work.
2. Nuclear: When we talk about atoms.
3. Fission: To break apart.
4. Fusion: To join together.
5. Waste: Something we have left over and have no use for.

FIND THE NEW WORDS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| B | O | R | B | A | W | O | P | J | P |
| E | P | J | C | F | D | W | R | F | R |
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| R | S | B | R | G | R | E | T | O | U |
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| R | I | R | I | S | F | C | F | O | J |
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LESSON II

PURPOSE: To examine fission reactors and breeders to help determine if they hold the key to our energy economy in the future.

SUBJECT: Science

CONCEPT: Nuclear energy from nuclear power plants is a unique combination of old and new technology. The energy emanates from a nuclear reactor where a process known as nuclear fission takes place.

RESOURCES: The Environmental Impact of Electrical Power Generation: Nuclear and Fossil. U.S. Energy Research and Development Administration, 1975.

Energy and Ecology, A Newsbook. The Reading Laboratory, Inc., 1976.

Student Handouts No. 39, 40, 41 (pages 112-115), The Energy Crisis, A Simulation, the School Board of Brevard County, c. 1973.

Breeder Reactors, questions and answers, p. 106 and 107. Nuclear Power and the Environment, American Nuclear Society, c. 1976.

LESSON III

PURPOSE: To realize the potential of nuclear fusion and to understand the present status of its development.

SUBJECT: Science - Social studies

CONCEPT: The need for alternate energy sources, compatible with environmental and economic factors, coupled with large fuel reserves is readily apparent.

Nuclear fusion represents the ultimate source of power. It could provide for all electric power requirements for all time with acceptable environmental effects.

Briefly, nuclear fusion occurs when hydrogen atoms are heated to extremely high temperatures (about 100 million degrees fahrenheit) to "fuse" together and form helium atoms releasing an enormous amount of energy in the process.

For example, the entire 1975 United States electrical power demand of 350 million kilowatts could be supplied by fusion which utilized an input of 10 kilograms of deuterium per hour. The deuterium (a stable isotope of hydrogen) could be produced from one deuterium separation plant processing 15 gallons of ordinary tap water per second. Primary fusion fuels are so abundant (the oceans) as to be considered inexhaustible, even on a time scale of millions of years.

REFERENCE: Questions and Answers, Nuclear Power and the Environment, American Nudlear Society.
Proceedings: Conference on Magnitude and Developmental Schedule of Energy Resources, July 21-23, 1975, Oregon State University

ACTIVITY: Present the concepts and potentials of nuclear fusion to the class. Review sources of material for them, explaining where the material is available.

Divide the class into several groups of 4 to 6 students. Ask each group to prepare a report on "fusion" to be presented to the class.

Groups should consider including the following topics in their presentations:

1. What is fusion?
2. Has the fusion reaction been achieved and controlled?
3. What is the state of present day fusion technology?
4. When can we expect commercial fusion power?
5. Will it be the answer to all of our energy problems?

Stress innovation and originality in the presentation of reports. Each member of the group could present a report in a different area.

LESSON IV

PURPOSE: The student will examine various job descriptions in the field of nuclear energy so as to become aware of career possibilities.

Problem: Since the use of nuclear energy is a growing industry, what types of career opportunities might I find?

SUBJECT: Social Studies (7-8)

MATERIALS: (1) Career Opportunities Handbook
(2) ERDA Materials
(3) Materials from Florida Power & Light Company.

ACTIVITIES:

(1) Class studies these materials.
(2) Have each class develop a collage on a different section of the wall of the classroom.
(3) Have each child select and prepare a sharing activity on a different career.
(4) Guest speaker from Nuclear energy.

EVALUATION:

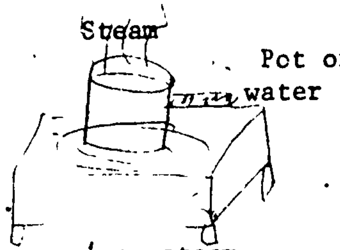
Judge progress by participation and preparation of a sharing activity; also the ability to talk about various career opportunities.

## Section IV: GENERATING ELECTRIC POWER

PURPOSE: To stimulate an awareness in the basics of electric production.

SUBJECTS: Science, spelling, reading, math

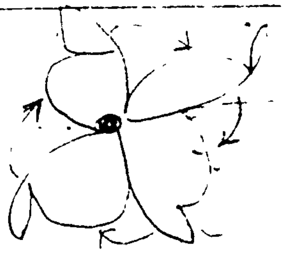
ACTIVITY: Students read the lesson card, study the spelling words, locate the spelling words in the puzzle, (take part in a teacher led discussion of the concept, spelling words and meanings) and draw a picture to represent electric production..




Energy gives steam.

Energy, in the form of heat, can make water hot.

Steam will come off of hot water.

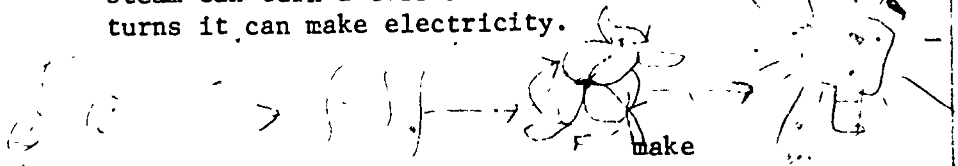


pinwheel

STEAM CAN MAKE A PINWHEEL TURN

Steam turns pinwheel

A great big pinwheel is called a turbine. Steam can turn a turbine. When a turbine turns it can make electricity.




Energy gives steam Turns pinwheel electricity

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| U | H | E | N | E | R | G | Y | S | A | B | S | I |
| Z | H | A | L | M | V | U | T | I | G | S | O | N |
| A | P | M | L | E | W | X | T | H | J | W | J | W |
| U | Q | O | O | B | C | Z | A | K | L | O | B | W |
| B | R | G | C | F | J | T | U | R | B | I | N | E |
| W | U | D | E | H | H | U | R | M | N | N | C | E |
| C | W | S | F | I | N | M | Q | I | O | S | P | L |
| V | Z | T | V | A | X | H | P | R | C | P | O | A |
| D | Y | B | J | F | G | I | S | T | U | I | N | R |
| X | C | C | H | E | Q | U | C | U | X | R | T | S |
| E | M | P | D | O | W | R | V | Z | Y | Z | C | Y |

Words: ENERGY
STEAM
PINWHEEL
TURBINE
ELECTRICITY

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PURPOSE: To acquaint students of the operations of a fossil fueled electrical generating station.

SUBJECT: Science

CONCEPTS:

Students should become familiar with:

1. The methods of using fossil fuels to produce electricity by steam generation.
2. Determine existing reserves of fossil fuels and their predicted availability.
3. Discuss the particular problems related to the use of coal in the production of electricity.

REFERENCES:

1. The Environmental Impact of Electrical Power Generation: Nuclear and Fossil, ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.
2. The Economics of America's Energy Future, Henry Simmons; ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.
3. The Energy Challenge, Federal Energy Administration, Washington, D.C. 20461.

ACTIVITIES:

Have a student or a group of students conduct the following activities:

1. Construct, demonstrate and discuss the Hero's Engine, made from a toilet tank float and copper tubing.
2. Perform destructive distillation of a sample of soft coal and describe the products.
3. Visit a fossil fueled electrical generating plant.
4. Compare the methods of transporting coal, petroleum and gas.
5. Using a polaroid camera, photograph the stack emissions from a power plant over a one-week period.

EVALUATION:

Students should be capable of doing the following exercises:

1. Summarize the process of producing electricity from fossil fuels.
2. Discuss the environmental impact of fossil fueled generating station in the community.

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PURPOSE: To acquaint students of the operations of a nuclear fuel generating station.

SUBJECT: Science

Concepts:

Students should become familiar with:

1. The process of fission and chain reaction.
2. Major components of a nuclear reactor.
3. The concept of the breeder reactor and the types of breeder reactors.
4. The safety features of reactors, including natural safeguards and engineered safeguards.

REFERENCES:

1. The Environmental Impact of Electrical Power Generation: Nuclear and Fossil, ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.
2. Nuclear Energy, ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, TN. 37830.
3. Nuclear Reactors, John F. Hogerton, USAEC, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.
4. The Breeder Reactor, ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830
5. Nuclear Power Plants and Safety, Dr. Richard W. Roberts, ERDA, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.

ACTIVITIES:

Have a student or a group of students conduct the following activities:
1. Construct a model nuclear power station.
2. Tour a nuclear power station.
3. Conduct mock hearings relative to licensing of an imaginary power reactor in the school district.
4. Prepare a list of similarities and differences between a nuclear reactor and an atomic bomb.
5. Discuss the safety aspects of a nuclear power plant.

EVALUATION:

Students should be capable of doing the following exercise:
1. Summarize the operations of a nuclear power generating station in producing electricity.
2. Discuss the safety factors of the nuclear power generating station.

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PURPOSE: To produce static electricity

SUBJECT: Science

CONCEPT: Electricity is a form of energy. Nature produces electricity in only a few ways. One is lightning and another is in the electric eel.

Man has learned other ways of producing electricity and one such way is by friction. The kind of electricity produced by friction is called Static electricity because it doesn't flow along a wire.

ACTIVITY:

The student will need a plastic ruler or ball-point pen, comb. flannel or wool cloth, cork silk, cloth and a glass rod.
1. Rub the ruler or part of the ball-point pen briskly on a dry flannel. Try picking up pieces of paper with it. What happens? Why?
2. Rub your comb with a piece of flannel. Will it attract small pieces of paper? Why?
3. Rub your comb through the hair or with a flannel and put it near a metal conductor, such as a water pipe. What are the tiny sparks? (Darken the area around the pipe.)
4. Rub the piece of sealing wax with the piece of dry flannel. What do you observe?
What causes the crackling noise when you remove clothing from a hot clothes dryer? (Note: Clothing must not contain

fabric softener such as Bounce or Sta-puff.)
What causes the crackling noise when you comb through your (cool) hair with a warm dry comb? All of these things when rubbed, become negatively charged.

5. Now rub the dry, glass rod with the piece of silk cloth, try picking up the pieces of paper. The glass rod is positively charged.

INFORMATION:

Electricity or electric current is a flow of electrons.

All matter is composed of small particles called atoms. All the protons in the nucleus of the atom carry a positive (+) electrical charge, and neutrons carry no charge, while all the electrons which revolve around the nucleus carry a negative (-) electrical charge.

In the demonstration just performed, some of the negatively charged electrons of the glass rod were rubbed off the rod and became attached to the silk cloth. The rod was then positively charged because it contained more protons than electrons. The silk cloth was negatively charged because it contained more electrons that protons.

These articles attracted the paper because unlike charges attract each other and like charges repell each other.

Vocabulary:

Atoms
protons
electrons
nucleus
negatively charged
positively charged
friction
attract
repell

Resource:
The Milliken Duplicator Transparency-Duplicating Book- "Magnetism and Electricity, transparencies and sheets may be used.

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PURPOSE: To show how stored chemical energy can be released to produce electricity.

SUBJECT: Science

CONCEPT: To help students understand wet and dry cells.
To build a simple wet cell.

ACTIVITY: Student will need a copper strip, a magnesium strip, cardboard, small beaker, small light bulb and socket, small motor, and copper sulfate solution.

a) Fill the beaker 1/2 full with copper sulfate solution.
b) Cut a piece of cardboard that will stand in the middle of the beaker.
c) Connect the copper strip to one end of the test lead and the other end to the light bulb. Do the same with the magnesium strip.

wire (test lead

copper

Magnesium

cardboard

beaker

copper sulfate

Does the bulb light? What forms of energy are observed?

d) Replace the bulb with a small motor.
Does the motor run? What forms of energy are being observed?

II Do a report on electrical cells. (Batteries).

III Examine a small dry cell and if possible a lead-acid storage battery (car).

IV Do worksheets, "Wet and Dry Cells" and "Batteries" from Milliken's Magnetism and Electricity Duplicating Series.

V Challenge students to try and find out if stored chemical energy can be used as a practical way of producing large amounts of electricity. List the advantages and disadvantages.

Information:

When metals are placed in a salt, acid, or basic solution a current will flow along the wires. This is producing electricity chemically. The device used is called an electrical cell.

There are two kinds of electrical cells:
1. Dry cell - The materials in the dry cell are in the form of a paste. Example: "D" cells as used in the flashlights.
2. Wet cell - a cell that contains liquid. Example: cells made in class.

The parts of an electrical cell are:
1. Negative electrode -
2. Positive electrode (+)
3. Electrolyte - liquid solution.

In an electrical cell the electrons flow from negative to positive electrodes.

PURPOSE: To understand the differences between series and parallel connections.

SUBJECT: Science and Mathematics

CONCEPT: 1. To understand the volt, ampere, resistance and watt and how each is affected by series and parallel connection.
2. To be able to connect a circuit in parallel and series.

ACTIVITY:

1. Using reference books from the media center or classroom, define the following and discuss them with your teacher.
   a) ampere  c) ohm
   b) resistance  d) watt
2. Using the following mathematical formulas calculate the sample problems:

$$\text{Amperes} = \frac{\text{volt}}{\text{ohm}} \qquad (\text{Amperes} = \text{volt} \div \text{ohm})$$

Volts = ohms x amperes

Ohms + volts + amperes

Watts = volts x amperes

SAMPLE PROBLEMS

a. What pressure is needed to cause a current of 3 amperes to flow through a resistance of 2 ohms?
b. What current will flow through a wire with a resistance of 1.5 ohms if 2 dry cells, each with a pressure of 1.5 volts, are used?
c. A 6-volt battery supplies a current of 2.5 amperes to a light bulb. What electric power does the lightbulb consume?

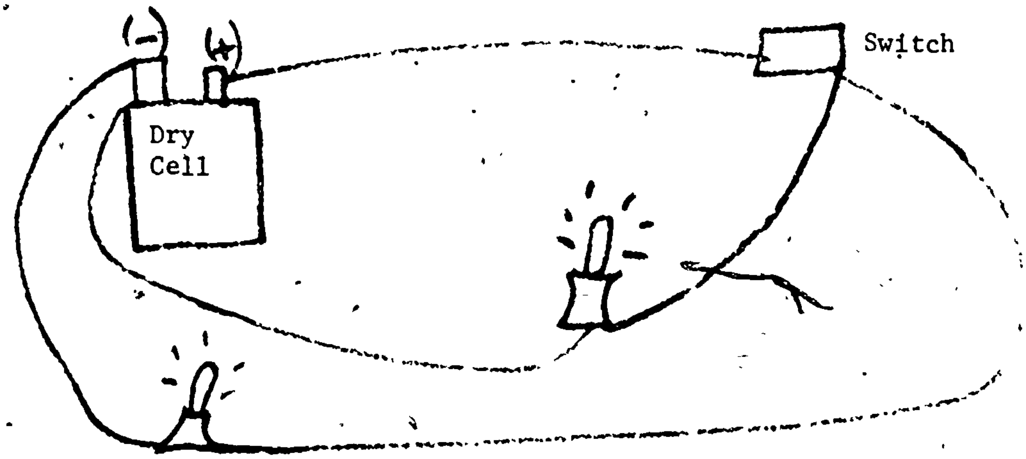
3. Student will need two dry cells, and ammeter, a voltmeter, copper wire, a switch, and 3 light bulbs.

Connect the circuit in series as shown.


a. Close the switch. Do the bulbs light?
b. Unscrew one of the bulbs; what happens to the other bulbs?
c. Now connect a voltmeter and an ammeter to the circuit. (Remember (–) to (–) and (+) to (+).

How are the voltage and current affected by a series connection

4. Connect the equipment as shown. (Parallel)

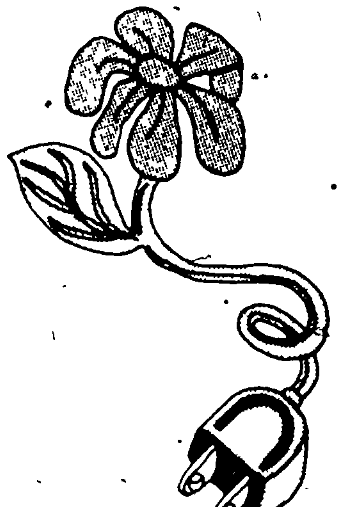



a. Close the switch. Are all bulbs burning?
b. Unscrew one of the bulbs. Does the other bulb go out?
c. Now connect the voltmeter and ammeter to the circuit.

How are the voltage and current affected by a parallel circuit?

What kind of circuits do you have in your home?

How would the electrical bill of a home wired all in series compare with an electrical bill of a home wired parallel and series?



## SECTION V: THE ENERGY CRISIS AND LIFE STYLES

LIFESTYLE -- WHAT IS IT?

Objectives:

1. Students shall be able to write an operational definition of lifestyle.
2. Students shall be able to list general aspects of lifestyle.

Materials:

Magazines could be scoured for pictures and slides made of people involved in home, dress, dining, play, travel, communicating, working, etc.

Presentation: Leading questions should be used to stimulate imagination and participation.

You occasionally hear the word "lifestyle" as...

"I like his/her lifestyle." "The lifestyle I'd like to have..." "The American lifestyle." "We have a wasteful lifestyle." "Our present lifestyle is the product of cheap energy." "We must change our lifestyle."

What is lifestyle? Whad does the word mean? What do we think of when we hear or say the word? What makes up lifestyle? Does lifestyle have distinctive sides to it--general aspects?

Would you say that there is a home/family-living aspect? How so? Can we distinguish necessities and options or luxuries?

We include foods and various food appliances and preparation devices. Do their range and choice constitute an aspect of lifestyle?

Isn't there a vast field of various manufactured products which is an aspect of lifestyle. Name some that come to mind.

Is clothing an aspect of lifestyle? How so?

Is there a recreational aspect of lifestyle? What are the major recreational activities? What are some uncommon ones? How do we entertain ourselves individually?

Isn't our work and how we go about it a part of lifestyle? Can you name some machines that have a great deal to do with our work?

Transportation?

Communication?

Is there a lifestyle of a community - at a city, county or state? Can a whole nation be characterized as having a lifestyle?

Would you say that there is a distinctive aspect of lifestyle made up of knowing about other people and their thoughts and activities? Is this sophistication on our part? Is this a cultural-intellectual aspect of lifestyle? What part does basic education play in this? Higher education? Does it tend to enlarge our own personal lives?

Evaluation:

Write a description of your lifestyle looking at your activities in respect to the thoughts expressed in our discussion--or if you prefer, do so of some other person's lifestyle that you are familiar with.

*"The success of any program to reduce energy consumption is dependent upon citizen action. Government and industry must play major roles, but it is the people, finally, who must accept--and ultimately demand--energy conservation and make it a way of life.*

Henry L. Diamond in the Introduction to Citizen Action Guide to Energy Conservation, 1973.

LIFESTYLES IN HISTORY

Objective:

1. Students will be able to give an estimate of the possible phase of history during which notable changes in lifestyle occurred.

2. Students will be able to state elements of later lifestyles which were missing in earlier times.

Materials: Ditto and provide the following listing of historical stages for each student to use during class discussion for making notes.

Early primitive man
Late primitive man
Early agriculture
Ancient civilizations
Time of Roman sway
Barbarian conquests - The dark age
Medieval time
Renaissance - Reformation
Age of Reason
Early industrial
Middle industrial - Rise of modern science
Second World War
Post War
Recent
Present

Presentation: Following the lesson "Lifestyle - what makes it up" Phrase leading questions stimulating discussion respecting each of the above proposed historical stages concerning - home/family living, foods and food preparation, making utility items, clothing, recreational-diversionary activities, work, war transportation, communication, and education.

It is desirable for students to contribute to constructing images (vignettes) of people functioning in those historical times. The following events may have had some considerable implication for lifestyle modification:

(Start with man, the scavenger-food gatherer-hunter, who lived outside and who found shelter in holes and lean-to's)

Increasing effectiveness in fashioning stone weapons and tools- late primitive.

Control of fire, wood fuel - late primitive.

Domestication of animals - animal power - late primitive/ early agriculture.

Advent of agricultural methods and the growth of larger communities.

Introduction of slavery for use in agriculture and other purposes.

Advancement in the manufacture of useful materials and articles.

Refinement of government--Ancient civilizations.

Improvement of transportation and distant communication

Accumulation of extra-survival knowledge--Ancient Civilizations

Depletion of forests - Erosion of Soil - Ancient

Barbarian invasions and devastations

Rise of feudalism - Dark age

Spread of self governing communities - Medieval

Invention of the printing press - Renaissance-Reformation

Industrial Revolution - Large scale use of coal - Early Industrial

Invention of steam engine - Early industrial

Rapid increase in population - Middle industrial

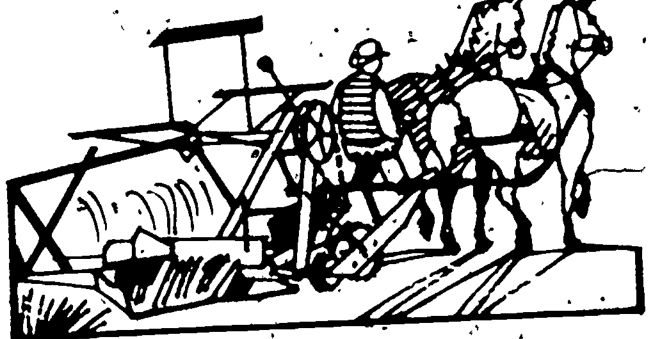
Germ theory of disease

Modern scientific discoveries

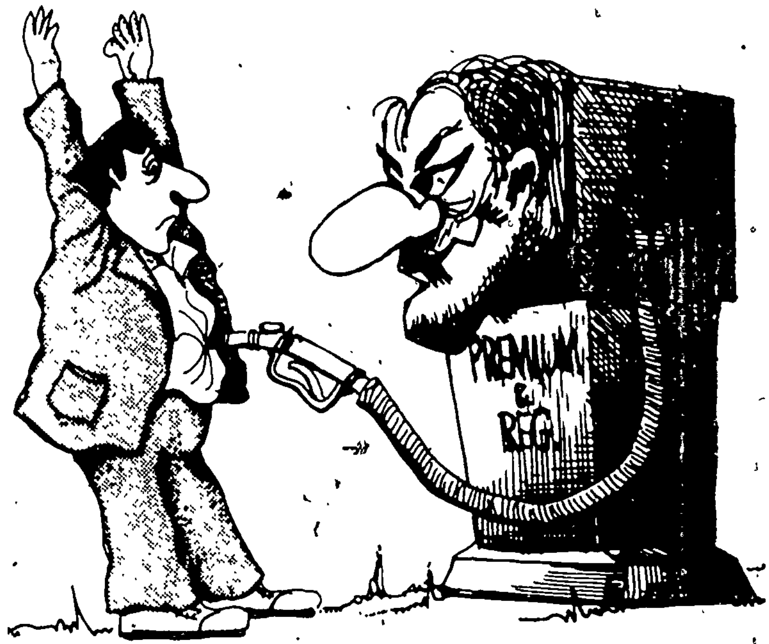
Increases in the use of petroleum for power and for chemicals

Evaluation: Every student should be involved in the discussion and contribute some bit to a vignette of the individual period under consideration.

Application: Students will be asked to contrast their present lifestyle with some previous one.



*"How can we respond to higher gasoline prices? We can use a lot less, not by denying ourselves the pleasure of travel, but better by practicing more careful driving habits and buying more efficient cars."*




## DECISIONS, DECISIONS, DECISIONS

LESSON: On Making Choices

<u>Pretest:</u>

Marian turned on the TV. She wanted to catch the Secretary's interview during breakfast. Being very efficient she had the electric frying pan, toaster and coffee maker busy in five minutes. She had to interrupt herself for a few minutes to send one of her children to the other bathroom. They were having the usual fight - who gets the outlets. Jeannie had the contact lens sterilizer and the electric toothbrush both going and Kenny wanted to blow dry his hair and use the electric shoe polisher.

Going past the TV she noted the Secretary getting out of the limousine. "Gee, it must be nice having a chauffeur drive you to work," she thought, remembering her own old station wagon. George went further to work - 30 miles - so he usually took the Corvette. Kenny and Jeannie used a Honda 360 - school was only a half-mile away.

George flicked off the clock radio and came in for breakfast in time to catch the Secretary's first words. The Secretary of the newly created Energy Cabinet post began, "This country is facing a crisis! I propose we begin by using people power instead of machine power..."

"Gee, that's a great idea," thought Marian, "I wonder what I can do: OOPS." (She cut her finger using the electric knife to cut some ham.)

Activity

Rewrite the story using less watt-power and less gas power.

Write the story of your morning. Remember all the kinds of energy you used.

Post Test

Now evaluate your learning. Base your answers to the questions below only on the two stories.

My two stories of my morning activities show:

1. I use electrical appliances -
   ( ) more than before ( ) the same ( ) less than before

2. I use terms dealing with energy -
   ( ) more ( ) the same ( ) less

3. I use gas energy
   ( ) more ( ) the same ( ) less

4. I am aware of the source of the energy I use.
   ( ) more ( ) the same ( ) less

5. I am an energy-saver.
   ( ) more ( ) the same ( ) less

6. I can determine the approximate cost and amount of energy used in my activities.
   ( ) more ( ) the same ( ) less

7. My family used electrical and gas energy in the morning.
   ( ) more ( ) the same ( ) less

8. The friends I met on the way to school used electric/gas energy.
   ( ) more ( ) the same ( ) less

9. The school used electric/gas energy.
   ( ) more ( ) the same ( ) less

10. I can do more to conserve electric/gas energy.
    ( ) more ( ) the same ( ) less

LESSON: Making Choices - How

Problem: Problems can be attacked and alternatives chosen based on a logical procedure.

Materials: A Floridian's Guide to Solar Energy

Vocabulary:

solar water heater
zoning restrictions
collector plates
roof elevation
Kwh - kilowatt hour

Introduction: To ourselves we've often said, "Why did I do a dumb thing like that?" or "Gee, that's simple, how come I didn't think of that?"

The energy situation is at a crisis point. We need to make decisions. The consequences of a wrong choice may be drastic. So we could follow a step-by-step procedure such as the following:

1. "Get the facts." Gather as much information from as many sources as possible.
2. Get "cold" about the facts. Separate opinion and emotion from the cold hard facts.
3. Say "why". Be able to sort out why you would make a certain decision. (Which is most important to you: to wash the dishes by hand and save energy or wash the dishes in the dishwasher and save time?)
4. "Preview" the alternatives. Look ahead the try to figure out what the consequences of each alternative choice might be.
5. Know the "why" and the "worth" of the choice you make. Be able to tell others (yourself) in unemotional terms why your choice is the best.
6. "Leave it open." In the light of new information, choices may have to change - be firm yet flexible. Is that possible?

ME (You-right now)

1. Evaluate the house you live in. Would you be able to install a solar water heater? Would it be practical? Gather the facts. What is the elevation of the roof? Could you install a set of collector plates high enough so the water could run down into your house water system? Do you have an exposure with enough sun? Do you have enough space on the roof to put a solar heater?
   1. What are the facts?
   2. Why would you want to have a solar heater on your house?
   3. What are your alternatives?
   4. Tell your parents why they should or should not have a solar water heater installed.
   5. Why is your decision the best that can be made?
   6. What additional information might change your mind in the future?

US (The society in general)

1. Your neighbor plants a large tree on the southwest side of his house to shade his patio. It shades your family's solar heater.

Describe the steps you would take to settle the conflict with the neighbor.

**THEM** (Future citizens)

1. Your town decides to put in solar water heaters. Project yourself into the future about 80 years. What are the consequences of your choice on the people living in the year 2060?

2. Your town decides not to put in any solar water heaters? What are the consequences of your choice on future generations?

**NOW WHAT CAN I DO?**

1. Investigate solar water heaters.

2. Read advertisements about solar water heaters and evaluate the product and the honesty of the advertiser.

3. Estimate the saving if a solar water heater heated 80% of the hot water your family used. An electric water heater uses about 4,219 kwh a year. Look at your electric bill at home. How much does a kwh cost? You might save_____.

4. Your electric clothes dryer uses a lot of energy. Build a solar clothes dryer. Materials: 2-6" bolts with nuts, 4 - 1/2" eyelet screws, 2-2" boards 2" x 4", 2 - 8' posts 4" x 4", 1 - 50' cotton clothes line, clothes pins,

Procedure: Dig two holes 24 feet apart, 18 inches deep with a southern exposure to the sun (east/west) direction. Place posts and stabilize. 3. Drill a hole 6 inches from the top of each post to size of bolt. Drill the same size hole in center of each 2" x 4" board. Bolt together in "T" shape. Place eyelet screws three inches from each end of cross bar. Tie on pieces of rope. Place clothes on line and pin (does not work in rain - temperature has minor effect.) FROM: "Family Energy Watch Calendar"

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LESSON: Making Choices - Who - You?

Problem: Decisions are being made with or without your consent. This lesson introduces some alternatives you can make decisions about.

Vocabulary: Fossil fuels
Nuclear energy

Introduction: Most of the energy we use comes from our own muscles, the sun, the wind, water, fossil fuels, and nuclear sources. Other possible sources of energy are ocean currents, tides, geothermal sources, waste products and many more.

Each source has its advantages and disadvantages. Choices are being made as to which source is used.

Choices are also being made as to how we use the energy. Do we use an incandescent light bulb, a flourescent light or no light?

A flourescent lamp is 3 times as efficient in energy use as an incandescent bulb.

**ME**

1. " I can choose how much energy I need or want to use." At a certain time this evening go through your house and write down all the electric users that are turned on. Talk to your family about saving electrical energy and try the same experiment on another night.

2. A refrigerator door opened frequently causes a waste of energy. Put a thermometer inside the door of the refrigerator. Wait 15 minutes. The temperature is _____. Unplug the refrigerator (get permission first) and leave the door closed 15 minutes. Open the door and read the thermometer. _____ Now do the experiment over. This time open the door of the refrigerator every five minutes just as if you were looking for something. Read the thermometer after 15 minutes.-----Do you have a choice about how much electricity is used in your house?

3. Do you take a shower or a bath? Which is a better "saver" of how water? Next time you take a bath fill the tub as usual. Measure the depth of the water with a yard stick. Another day take a shower - the usual shower - but put the stopper over the drain. After the shower measure the water in the tub as before. Your conclusion about which uses less water?

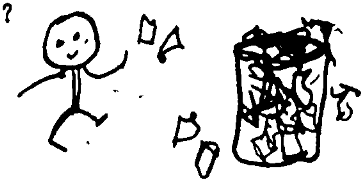
One 100-watt bulb burning for 10 hours causes the power company to burn 1/2 pint of oil-11,600 BTUs

**US**

1. Look at the chart enclosed. As you see we have many choices about which source of energy we use. Which sources of energy do you think your city should use? What other factors might influence the choice of the energy sources used in your community?

**THEM**

1. Our country seems to have a throw-away ethic. We toss away billions of beer cans, pop cans, paper plates, etc. We have made a choice - convenience instead of saving resources. If we used people power and returned pop bottles instead of energy from machines to make more how would that affect future generations?




Energy used for the manufacture of 20 cans using recycled aluminum. = Energy used in the manufacture of 1 aluminum can using only virgin aluminum.

NOW WHAT CAN I DO?

1. Plan a course of action to save energy. Write your plan down and follow it. Explain why you have chosen to save energy.
2. Change your life style to avoid wasting energy.
3. Plan ways for your community to save energy
4. Plan ways for your school to save energy and explain to your friends why that alternative is a good course of action.
5. Write a commercial that encourages people to save energy.
6. Criticize a commercial that discourages energy conservation and write the company about your objections.
7. Determine which are uses of energy in your house that are absolutely necessary to help you live. These are the "life support" energy utilization devices. Which uses in your house are not necessarily vital to maintaining life but make life pleasant? These are the "life style" utilizations. List five that are absolutely necessary. List five that you could do without, if necessary. Would you? Why don't you?

| Energy equivalent of 1 barrel of oil | = | Energy equivalent of a man at hard labor for 2 years |
|---|---|---|

PROBLEMS/SOLUTIONS

In this unit, you have learned about eight new energy resources. The use of any one of these 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 S (for solution) or P(for problem). Place a checkmark in every energy-resource column on the right to which a statement applies. The first one is done for you.

| IF THIS ENERGY SOURCE IS USED, IT . . . | SOLAR | NUCLEAR | WIND | GEO-THERMAL | COAL GASI-FICATION | COAL LIQUI-FACTION | OIL SHALE | PYROL-YSIS |
|---|---|---|---|---|---|---|---|---|
| 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. | | | | | | | | |

LESSON: Choices Made Here - for me - by whom - why?

Problem: We need to find out what sources of energy are used in this community. Why is that source used? What do we pay for his choice in terms of safety, environmental quality and economic cost? Who made the decisions?

Vocabulary:

strip-mining
deep-shaft mining
coal

Introduction: The local power companies have a choice. If they use natural gas to produce electricity they have chosen a clean, efficient, expensive fuel that will eventually run out. Oil is less clean and needs to be imported - usually from foreign countries. Coal is more abundant in this country but is less clean. The cost of shipping it to the plant is a factor especially if you live in South Florida. Nuclear energy presently is less expensive to use. Building plants using nuclear energy is expensive. The wastes from a nuclear plant cause a problem.

ME

1. Call your power company and find out what source of energy is used by that company. What source of energy do you think the power company should use? Why?

US

1. Miami has a nuclear power plant. Electricity produced in that plant sells at a lower rate. Nuclear energy use is less polluting in terms of air pollution, Disposing of wastes is difficult because the wastes are still radioactive and dangerous. A nuclear plant has a by-product--a great deal of hot water. Fish and plants can't live in water if it is too hot. An accident might occur at the plant killing many people. The Miami plant reactors have been shut down for long periods of time because of repeated leaks of radioactive cooling water.

   a. Write an argument for continuing operations at the plant.
   b. Write an argument for closing the plant - but be sure to list your alternative choice and explain why your choice is better.

2. Commercial users of huge amounts of electricity have a cheaper unit rate for electricity than single family homes do. How would this effect the amount of electricity used? What advantages for your town can you see in that policy?

| Energy required to produce: | |
|---|---|
| 1 coke bottle | 9726BTUs |
| Al. TV dinner tray | 5938BTUs |
| Aluminum can | 6518BTUs |
| Glass picle jar | 4061BTUs |

You require 341 BTUs of energy for one hour of normal activity.

3. Architects plan buildings to suit current tastes. When air-conditioning was the "in thing" buildings had few windows or none which could be opened. Now what effect does this have on our current need to open windows and use breezes to cool rooms, thereby requiring less electricity?

   a. Analyze your own school building. Can you open windows and let a breeze cool the rooms? What changes could be made in your own building so it would be more energy-efficient?

4. The things we buy in stores come in plastic covered containers. We take them home in paper bags. It takes energy to produce the packages and resources are used up in making the packages. Design some attractive ways to sell merchandise that requires less packaging.

| Paper needed to package food in 1 fast-food chain 1 year | = | 174 million pounds of paper | = | 315 square miles of forest |
|---|---|---|---|---|

THEM

Strip mining is an efficient way of getting coal out of the ground. More coal is removed by strip-mining than by deep shaft mining because some cannot be reached in a shaft mine. Deep-shaft mining is dangerous for miners involved. Either way will change the environment for future generations.

a. Put yourself in the place of a person born in 1990. Write an argument for strip mining.
b. Write an argument opposing strip mining.

NOW WHAT CAN I DO

1. Find out what agencies are concerned with conserving energy and/or protecting the environment. Write them a letter giving your opinions on energy conservation.

2. Find out what decisions are made in your town about energy use, lights, and mass transportation.

3. Stop buying packaged goods and tell your grocer or the product manufacturer why you don't like all that extra plastic.

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LESSON: Consequences of Choices Made Here - Alternative Choices which Could Have Been Made

Problem: Every decision has a consequence. Looking back we can analyze the alternative choices that could have been made and speculate on their consequences.

Vocabulary: bbls - Barrels
MMB/D - million barrels per day.

Information:

Fossil fuels are finite. Our present policy can be termed "gobbling up." Between 1918 and 1974, 290 billion bbls. of oil were produced. Sixty per cent of this oil was produced between 1960 and 1974. That's only 14 years. The increase in consumption is 8% a year. Figures vary but the conclusion is obvious--if we use more and more oil we will run out. Period. The present choice is to produce more and buy more. The Alaskan oil pipe line is supposed to bring more oil into the country.

Alternative choices have been made. A nuclear power plant was built in Miami. Problems include: Heated water released by the plant into a cooling field, danger from nuclear leaks, growing expense of fuel, waste storage problems, accident, even possible sabotage.

Could we have chosen solar energy, ocean current energy, and other? Hydro-electric power is practical in hilly areas. Geothermal can't be used here. We need to gather more facts and look without emotion at the alternatives.

In another area we seem bent on hurrying to use up all the gas we can. Mass transportation isn't popular in Florida. Yet 58% of the energy consumed in Florida is spent on moving people and things around.

ME

Gather some facts. Read the daily newspaper and find out what energy decisions have been made.

US

1. Sometime when you are riding along on the highway count the cars with one driver. Could they be riding the bus? Find the bus schedule for your area (if there is such a thing as bus service!)

2. Role playing - Have a town council meeting. Students can take the role of community people and discuss a current issue.

THEM

Nuclear power plants dispose of radioactive wastes in ceramic cases, and dump them in the ocean. These cases aren't supposed to leak for a century or so. They are clearly marked with a sign we all know meaning "Danger."

Project yourself way into the future - say year 3077 A.D. Those carefully wrapped packages are leaking and destroying a major source of food for you and the rest of the people.

(English - the United States - all that stuff is such ancient history that your people no longer know anything about the citizens who dumped those ceramic containers.)

You isolate the area of the fish kill and you suspect the kill might have something to do with those heavily encrusted bulky objects.

a. What are you going to do about those objects? What might be the consequences of your action?

**NOW WHAT CAN I DO?**

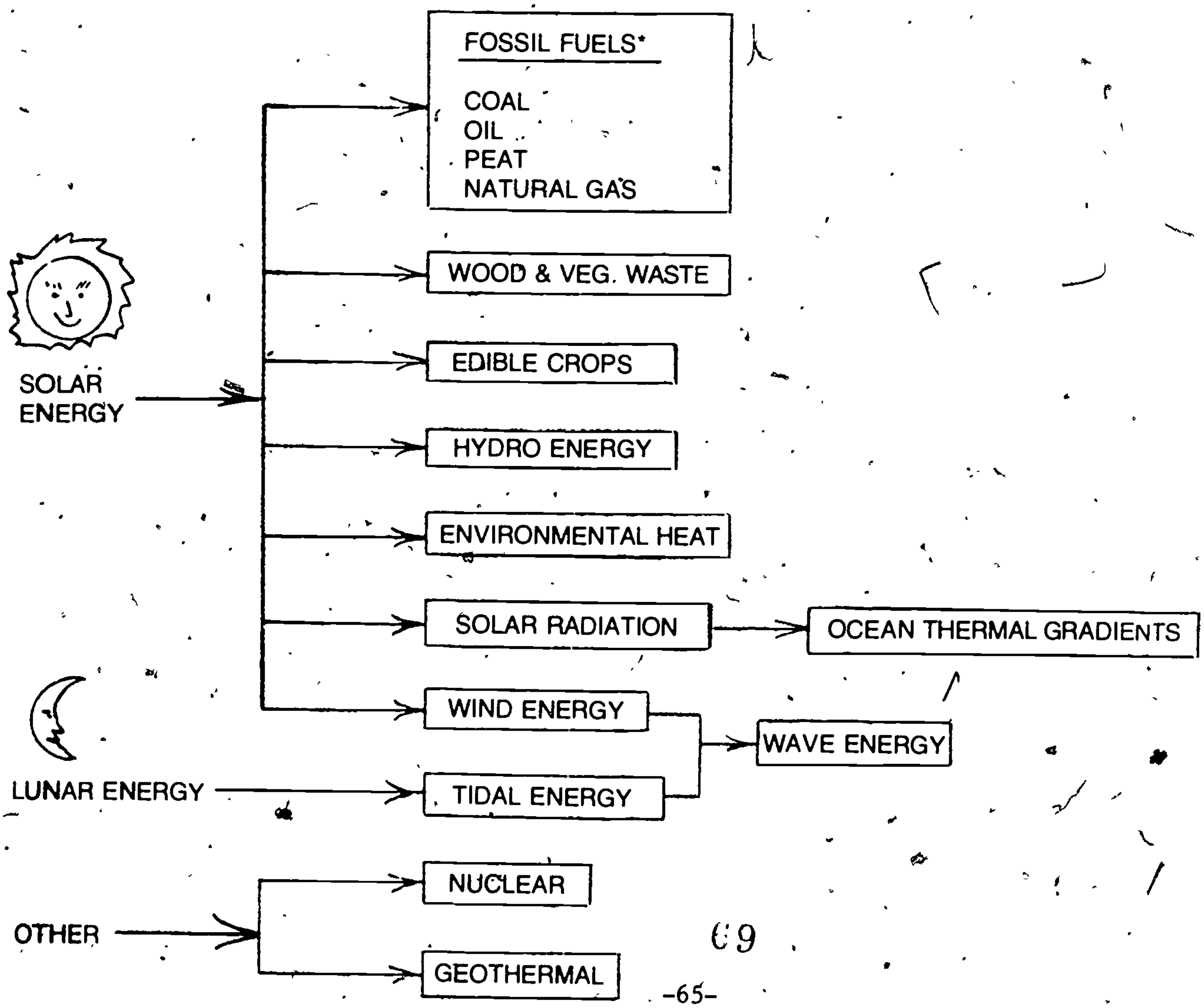
1. Find out. Do something!

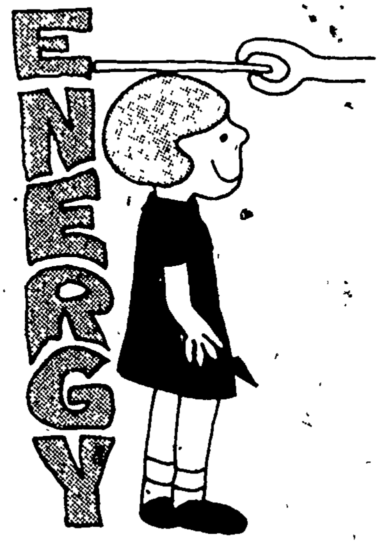
Find out what other schools have done.

Write: Energy Conservation Corps
c/o Bolton Institute
1835 K Street N.W.
Washington, D.C. 20006

"Energy Crisis - What Can we do?"
Alliance for Energy Education
1785 Massachusetts Ave. N.W.
Washington, D.C. 20036

## THE WORLD'S SOURCES OF ENERGY






AGRICULTURE AND ENERGY

I. What is needed to produce food?

Clues

Read statement I and study figures 1 and 2 on Student Information Sheet.

1. What are the sources of water and carbon dioxide for green plants?
2. What are the three major nutrients needed by green plants?
3. In figure 2 what types of work are required to change acre A into acre B?

Other Activities:

1. What are the major agricultural crops in the U.S., and in what regions are they located?
2. What are the major agricultural crops in Florida, and where are they located? What are the limiting factors for food production in each crop? What methods are being used to remove these limiting factors?
3. Make a map of your country showing major crop areas and water storage areas. Compare your map with a map 25 years old.

Materials:

Reference books, encyclopedias, atlas (old and new), agricultural publications from local country extension agent, old county map, pencil, paper, poster board.

What did you discover?

You have just moved into an area and intend to make your living growing oranges. Assuming you have sufficient money to invest wisely (but not enough to allow for mistakes) what factors must you consider and what actions must you take to become a successful grove owner? (You cannot buy an already successful grove!)

II. How has man produced food in the past?

Clues

Read statement II and study figure 3 on Student Information Sheet.

1. What were the major sources of food for primitive man?
2. Describe a typical farm in the U.S. around 1875 to 1900. You may select any region of the U.S.
3. Using the information on crop production in Fig. 3 how could you increase production?
4. From your answer to #3, describe the work needed for each change. Where would you get the energy to do the work?

Other Activities:

1. Pick one of the following cultures and describe its major food sources: Roman Empire (Italian states only), Ancient Greece, Hebrew (B.C.), India (today), China (today), and South American country (today)
2. Describe what limiting factors determine the food sources for the culture you chose.

Materials:

Reference books, encyclopedias, atlas, Bible, religious history or Hebrew history, history books (old or new).

What did you Discover?

Compare one day in the life of a person on a farm in the past with a day in your life today. As you make each comparison describe the source of energy for each activity.

III. In what ways has energy use increased?

Clues:

Read statement III and study Table I and Figures 4 & 5 in Student Information Sheet.

1. Using the concept of limiting factors, list ways in which fossil fuels may be used to increase energy in agriculture.
2. How can you account for the number of hours of labor decreasing on farms and the amount of production increasing?
3. Using Figure 4, what was the percentage increase in bushels per acre of corn between 1940 and 1970? (#bu 1970 - #bu1940) ÷ #bu 1970 x 100 = % increase)
4. Using Table I, what was the percentage increase in energy use in the food system between 1940 and 1970?
5. Make a statement comparing your answers to 3 and 4.

Other Activities:

1. From Table I: What were the 4 largest energy components on the farm in 1940? What were the 4 largest energy components on the farm in 1970? Which single component has shown the greatest % increase between 1940 and 1970? Which has shown the least?

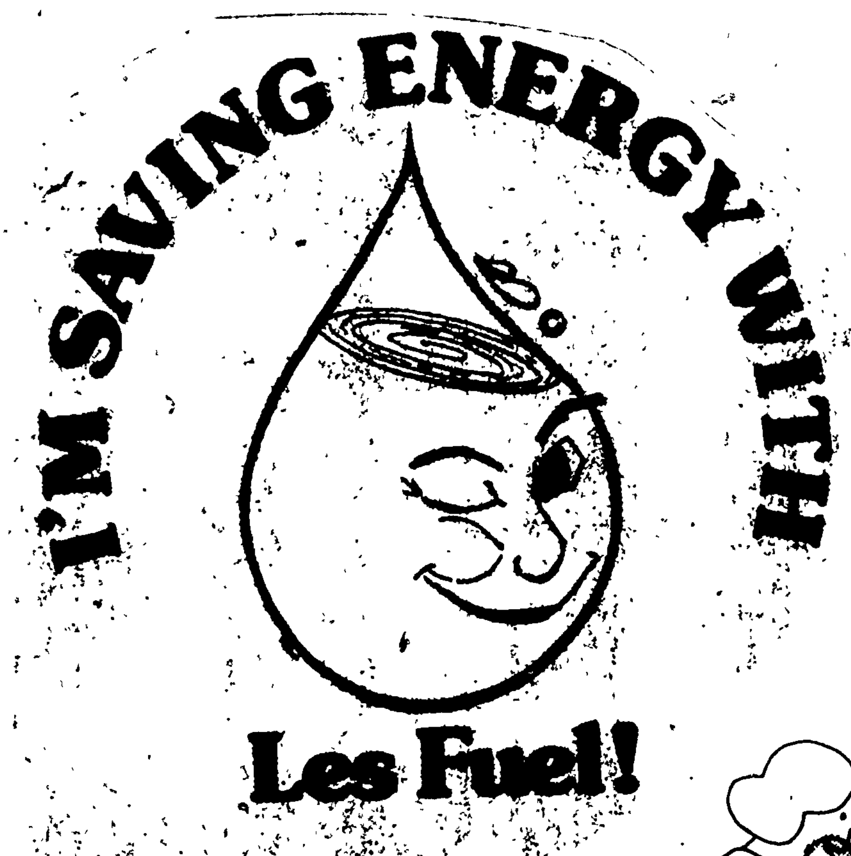
   From your own figures, briefly state your opinion as to the trend in energy use in the U.S. between 1940 and 1970.

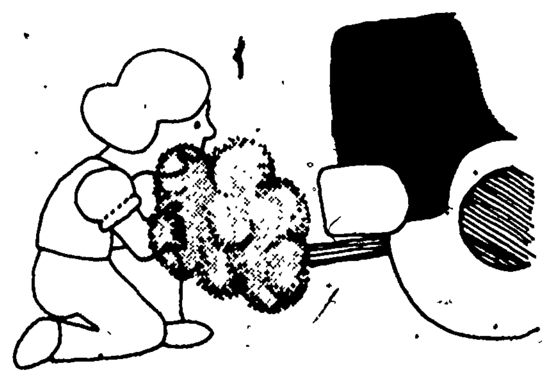
2. Using Table I and Figure 5 - as labor has decreased from 1940 to 1970 what energy sources have been used to take its place?

Materials: Pencil and paper

What did you discover?

Construct a graph comparing energy input into the agricultural system and food production.



STUDENT INFORMATION SHEET

STATEMENT I

The process of basic food production uses the sun's energy, water, carbon dioxide and other basic mineral nutrients to manufacture a product which supplies energy to a consumer. In our agricultural system the amount of food products produced per acre of land is limited by the availability of each of these items as well as the amount of space available in which the producer (food crop) may grow.

Arrows (⟶) indicate energy flow

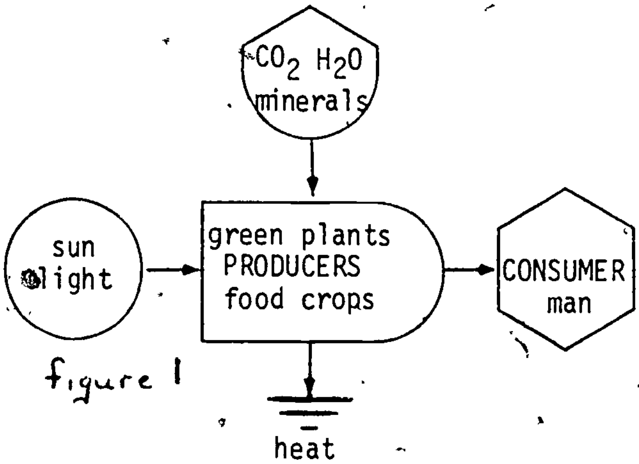



figure 1

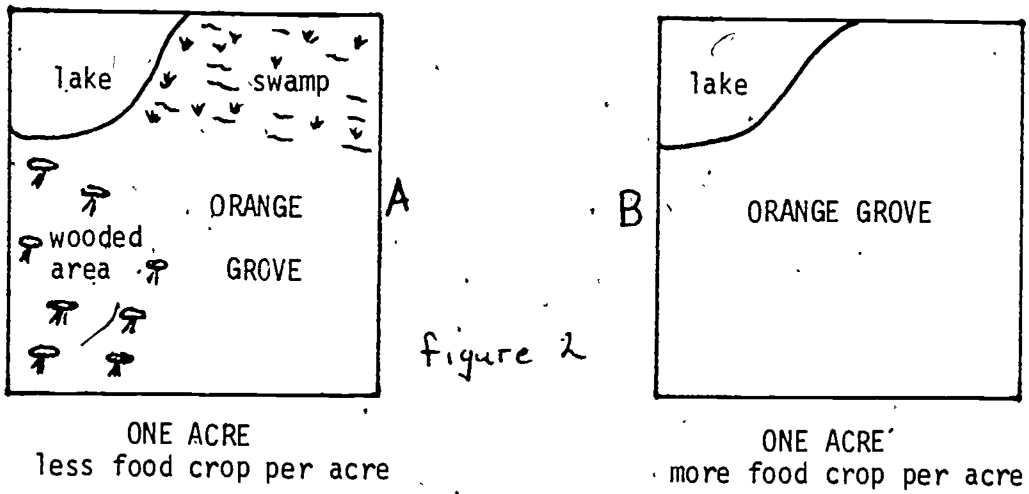



figure 2

STATEMENT II

Before 1900 much of the agricultural production in the United States relied on manpower (the farmer) to clear and till the land, (provide space) and nature to supply all the other resources. The amount of external energy put into the crop, other than that from the sun, was very small - the farmer and domestic animals (horses, cows, etc.) receiving most of their energy from the crops themselves.

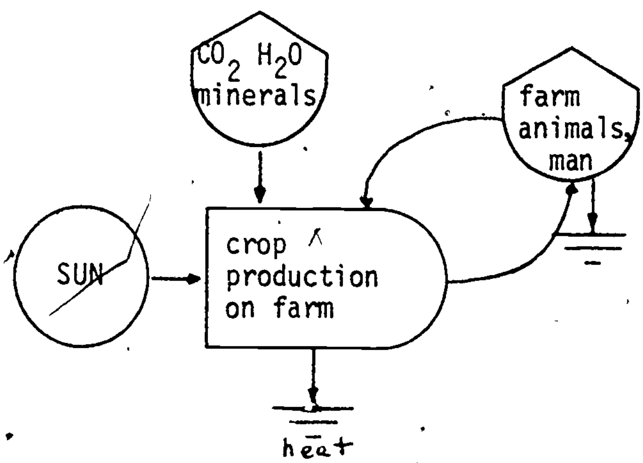



Figure 3.

STUDENT INFORMATION SHEET

STATEMENT III

In the past 50 years the amount of energy from the sun has not changed; however, the amount of energy from fossil fuels used in agriculture has increased almost 10 fold. The amount of production of agriculture products per acre has also increased over the past 50 years, but the number of hours of labor, both man and domesticated animal, per acre has decreased. We now have fewer farmers producing more food than at any time in our history.

Table 1. Energy use in the United States food system. All values are multiplied by $10^{12}$ kcal.

| Component | 1940 | 1947 | 1950 | 1954 | 1958 | 1960 | 1964 | 1968 | 1970 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | On farm | | | | | |
| Fuel (direct use) | 70.0 | 136.0 | 158.0 | 172.8 | 179.0 | 188.0 | 213.9 | 226.0 | 232.0 |
| Electricity | 0.7 | 32.0 | 32.9 | 40.0 | 44.0 | 46.1 | 50.0 | 57.3 | 63.8 |
| Fertilizer | 12.4 | 19.5 | 24.0 | 30.6 | 32.2 | 41.0 | 60.0 | 87.0 | 94.0 |
| Agricultural steel | 1.6 | 2.0 | 2.7 | 2.5 | 2.0 | 1.7 | 2.5 | 2.4 | 2.0 |
| Farm machinery | 9.0 | 34.7 | 30.0 | 29.5 | 50.2 | 52.0 | 60.0 | 75.0 | 80.0 |
| Tractors | 12.8 | 25.0 | 30.8 | 23.6 | 16.4 | 11.8 | 20.0 | 20.5 | 19.3 |
| Irrigation | 18.0 | 22.8 | 25.0 | 29.6 | 32.5 | 33.3 | 34.1 | 34.8 | 35.0 |
| Total | 124.5 | 272.0 | 303.4 | 328.6 | 356.3 | 373.9 | 440.5 | 503.0 | 526.1 |

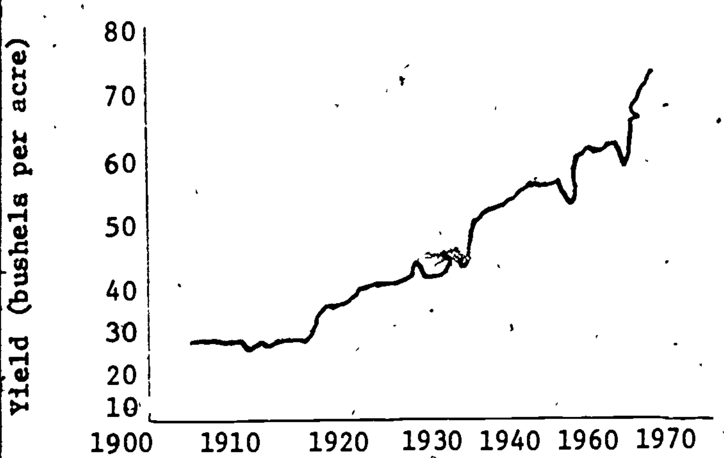



Fig. 4 Corn production (bushels per acre) in the United States from 1909 to 1971

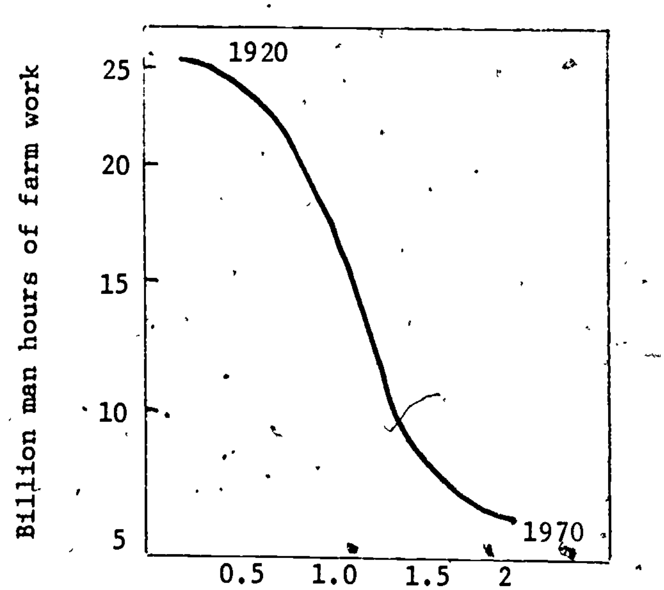



Fig. 5 Labor use on farms as a funct of energy use in the food system.

## SOCIAL IMPLICATIONS FOR AN ENERGY EFFICIENT SOCIETY

Objective: To design a planned energy-efficient community of the future.

Man has traveled a great road; he has evolved from primitive, tribal man to the sophisticated expansive man of NOW. Because he has been wasteful and has consumed a large portion of the world's natural resources, he shall again in the future, as in the past, be compelled to live in closer contact with his fellow man and community.

He has made a complete cycle. Your assignment is: To design the tribal community of the future.

Directions: Complete the community structure questions prior to designing your community. Emphasize the social areas highlighted in the worksheets. Remember to be Energy-wise.

Materials: Paper, pencil, graph paper, clay.

### THE FAMILY

The family in the tribal society is very close. It includes grand-parents, mothers, fathers, children. Your particular tribe (you have given it a name; haven't you?) is limited to a twenty square mile area of land. You live on the coast at these coordinates 79° longitude, 27° lattitude.

1. The average family will consist of ________ members. How many children will each woman bear? __________

2. Will marriage be the same institution as it is today? How could it be improved?

3. In what situations would it be helpful to you as a teenager to have such a close community?

4. What problems may you encounter as a result of living so close together?

5. Draw a diagram representing the family structure from the standpoint of authority or control.

### THE SCHOOL

The schools of the future are very concerned with ________________________. In the schools, children are divided into __________ groups. These groups are selected on the basis of ________________ and ______________. Some of the subjects you would be taught in school are: ______________, ______________, ________________, and ________________. Most of the students like the ________________ class best.

The tribal school has learned much from their ancestors; the classroom is not designed as the schools of the 70's were. Some of the most obvious changes are in energy efficiency. What would you see as the five most obvious changes?

1.
2.
3.
4.
5.

## TRANSPORTATION

Because of the closeness to shopping, friends, schools and churches it is not necessary for the modern tribal man to have personal transportation. A mass transit within the village provides the very necessary energy efficient mobility. Drawing from what you have learned or by using reference books describe what form of fuel you might find in this system. To what extent would the system be necessary?

## COMMERCE

How would commerce be carried on? What would the five major goods and services be? Would the role of industry be different in the future? In what way would it be different and why?

## CAREERS

The future must provide a sophisticated technician, well-trained in energy conservation. What, in your opinion, would be the 5 most important jobs? Why?

| Jobs | Why |
| --- | --- |
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |

RECREATION

The tribal community is divided into five recreational areas. These areas must serve the entire community.. What would you find at each of these areas? Who would it serve? The National Wildlife Federation had made certain years before that our wildlife, forests and waters would be protected. Each year the teenagers are taken on back-packing trips through the forests that surround the village. Design a summer program for your family.

CULTURE

What books, movies, plays, poetry of the present will the tribal man be reading? what will the music be like?

We have considered 7 social aspects of the future tribal man. Now physically design this community adding other components you feel necessary. Use graph paper and/or clay. Choose, but specify the scale you are using. Be certain to identify all the structures.

Objective: To teach students how to interpret data found on charts and graphs. Is the quality of life a function of the per capita consumption of energy?

Materials: Paper, pencil, knowledge of percents and how to calculate percents.

A. Rank the following countries according to how you feel about their style of life. Number one would be the highest.

Nigeria
Chile
India
Nepal
America
Germany
Russia
Puerto Rico

Now, get together with some friends and try to reach a consensus. Rank them again, as a group.

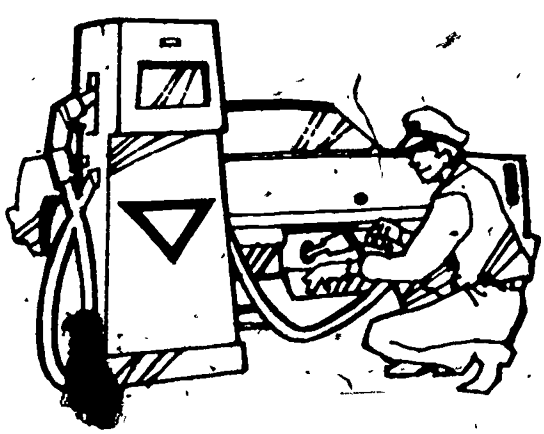
HOW MUCH ENERGY DOES EACH PERSON USE IN A YEAR?

| | |
|---|---|
| An American | 300 million BTU/year |
| A German | 150 million BTU/year |
| A Russian | 130 million BTU/year |
| A Puerto Rican | 100 million BTU/year |
| A Chilean | 40 million BTU/year |
| The World Average | 35 million BTU/year |
| A Chinese | 13 million BTU/year |
| An Indian | 5 million BTU/year |
| A Nigerian | 1.5 million BTU/year |
| A Nepalese | 0.3 million BTU/year |

B. Using the data provided, answer these questions.

1. What country has the highest energy usage?
2. What country has the lowest?
3. Which country comes closest to the world's average?
4. What is the range?
5. How would you account for the differences between the highest and the lowest?
6. What is the difference between the U.S. rate of use and the world average?
7. In terms of consumption, is the quality of life a function of BTU's? Justify your position.
8. Look at lesson A. Is there any conflict between the way you ranked the countries and their energy use?

C. How much energy do you use?

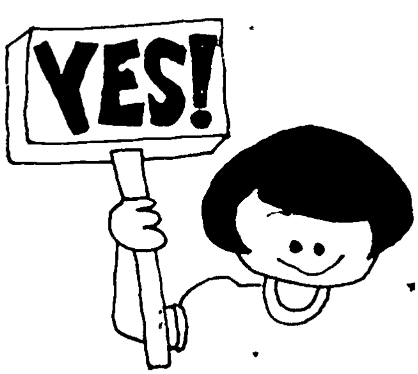


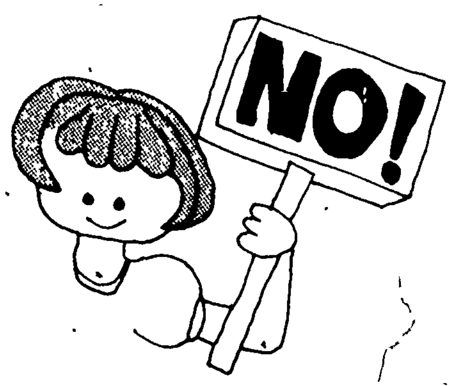
PER CAPITA CONSUMPTION OF ENERGY
(In Millions of BTU's)

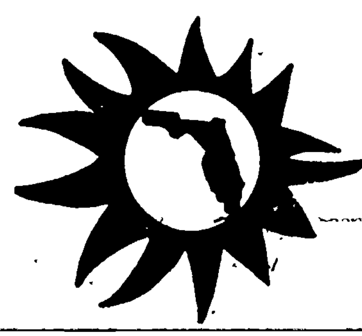
| COUNTRY | 1960 | 1970 | 1971 | 1972 |
|---|---|---|---|---|
| Florida | 150.34 | 219.263 | 224.494 | 233.849 |
| United States | 246.674 | 328.693 | 331.690 | 345.332 |
| World | 43.472 | 56.087 | 56.978 | 58.977 |
| Canada | 173.953 | 265.957 | 275.213 | 319.768 |
| Brazil | 10.621 | 14.125 | 15.196 | 15.814 |
| Italy | 34.698 | 79.343 | 78.489 | 83.115 |
| India | 44279 | 5,378 | 5.488 | 5.529 |
| Japan | 35.837 | 95.005 | 96.400 | 96.640 |
| U.S.S.R. | 88.084 | 128.368 | 133.874 | 141.706 |
| England | 151.169 | 158.451 | 162.496 | 160.463 |
| France | 74.661 | 112.263 | 115.904 | 123.454 |
| Germany | 112,961 | 152.570 | 154.204 | 160.404 |
| Mexico | 28.048 | 36.524 | 37.474 | 39.179 |
| Israel | 38.177 | 74.586 | 78.489 | 80.618 |

Source: U.N. Statistical Office - Dept. of Economics & Social Affairs.

1. Rank the countries according to 1960 and 1972 per capita consumption.
2. Which country experienced the greatest increase in per capita consumption? Which had the least?
3. What energy are you using now that you were not using in 1970?
4. Using percentages, how does Florida compare with the world, with the U.S.?
5. Explain the relationship between the quality of life and energy consumption.



## SECTION VI: MIGHTY MINI UNITS FOR YOU

WHAT ENERGY CRISIS

Objective: To show that there is an "Energy Crisis."

Materials: Access to data material on energy resources.

Presentation:

Using resource materials find and identify our energy resources. Now find the approximate amounts of these resources. Begin, present and future amounts. Using a consensus of student data construct a similar chart on the board.

| Energy Resources: | Present | Remaining |
|---|---|---|
| 1. Coal | 80% Remaining | |
| 2. Oil | | |
| Domestic | 55% Remaining | |
| Import | 80% Remaining | |
| 3. Natural Gas | 50% Remaining | |
| 4. Nuclear | | |
| Fission | 95% Remaining | |
| Fusion | 100% Remaining | |
| 5. Hydroelectric | 20% remaining | |
| 6. Unknown | 100% Remaining | |

Using the data developed by students, set up an Energy Resources game.
Give each group of 4 students 10 tokens which represent 100% of that energy resource.
Start game at beginning stating that at one time there was 100% of each resource.
Remove tokens from each resource until you have the present percentages.
Now remove tokens from each category to show future resources in year 2000.
Continue game until tokens start running out in most resources.

Evaluation:

Students will realize that our Energy Resources are finite. Also game could be played a second time starting at present resources and allowing students to demonstrate ways resources can be stretched far into future.

Application:

Students realize the argument is not that there is an "Energy Crisis" or not; but that all energy resources are finite and future alternatives must be produced from all areas of society (government, private industry, etc.)

TRANSPORTATION AND ENERGY

Objective: To identify energy consumption in various methods of transportation.

Teaching Activities:

1. Examine data concerning energy consumption of various kinds of transportation.

2. Prepare a graph comparing the efficiency of the various modes of transportation.

3. Prepare a report on one mode of transportation and tell whether this mode should be continued or discontinued.

4. Make a list of current auto model and the EPA rating on each and show difference in gas consumption on a graph.

Materials:

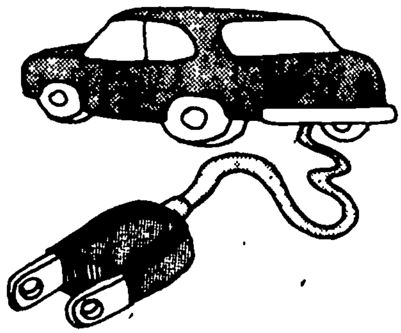
Overhead projector
Transparencies
Brochures from auto dealers
Graph paper, colored pencils, etc.

References:

Brochures collected from Ford, G.M.C., Chrysler, etc. or the Environmental Protection Agency.

Evaluation:

Students will develop a prioritized list of energy saving transportation methods.



# FOSSIL FUELS

<u>Objective</u>: To identify uses of fossil fuels.

<u>Teaching Activities</u>:

1. Define fossil fuels/develop vocabulary.
2. Prepare charts showing uses of fossil fuels.
3. Make graphs illustrating uses of fossil fuels in making energy.
4. Collect pictures and make collage of uses of fossil fuels.
5. Prepare a list of energy uses that we could eliminate, and those we cannot eliminate.

<u>Materials</u>:

Overhead projector
slide film projector/cassette player
16 mm movie projector
Transparencies
Packets of materials - coal, natural gas, oil
Graph paper, drawing paper, glue, scissors, magazines, newspapers, etc.
Dittos of word games
16 mm movies: Energy - choices-options-decisions 17 mc
Energy Crisis 13 mc
The Energy Challenge 25 mc

<u>References</u>:

World Book Encyclopedia

<u>Evaluation</u>:

Students will develop and compare prioritized list for the future uses of fossil fuels.

# FOSSIL FUELS

Objective: To identify the location of the world's supply of fossil fuels (crude oil, natural gas, coal).

Teaching Activities:

1. Locate crude oil, natural gas, coal reserve areas and indicate identification by color on a world map.

2. Make a list of countries having the most of each kind of fossil fuel and the predicted time of use.

3. Make a list of the countries using the most fossil fuels energy.

4. List problems that could happen as a result of this imbalance between supply and demand.

5. Discuss problems (listed in No. 4) and derive possible solutions.

Materials:

Overhead projector
Slide film projector/cassette player
movie projector 16 mm sound
Map of world
World map dittos - each student
Overhead projector Trans. World map
Packets of materials - coal, natural gas, oil
Colored pencils/crayons/pins

| | | |
|---|---|---|
| Film 16 mm sound: | Oil in Mideast | 20 mc |
| | Oil in U.S. | 37 mc |
| | Coal | 27 mc |
| | Natural Gas | 17mc |
| | Energy in Living Things 11 mc | |

References:

World Book Encyclopedia

Evaluation:

Students will identify areas of fossil fuels reserves and major areas (countries) of use.

## COMMUNITY ENERGY CONSERVATION

Objective: To examine ways the community is conserving energy.

Teaching Activities:

1. Develop a list of places in community that use substantial amounts of electricity, natural gas, coal.

2. Students will examine their homes to see if conservation practices are being used and will list those practices in use.

3. Student will observe users of energy (identified in step one) to see what steps are being taken to reduce consumption of energy.

4. Student will visit users and list less obvious energy conservation practices.

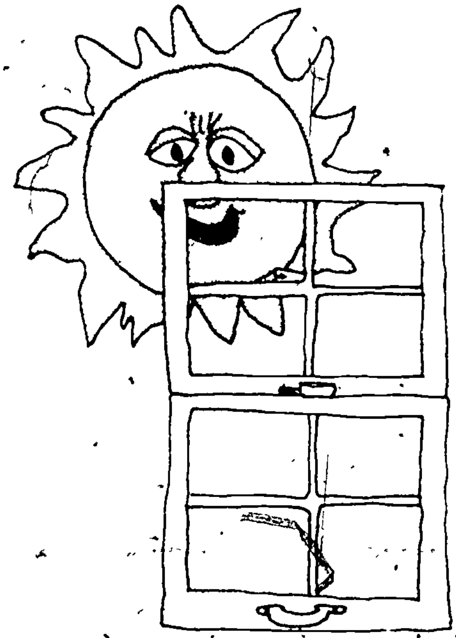
5. Students will prepare a report on their findings.

References:

Local newspapers (articles on energy conservation).

Evaluation:

Students will compile a list of the energy conservation practices being used by large energy consumers and compare those practices with the ones used in student's home.



## POWERLESS

**Objective:** To decide who should turn down the power You ⟶ or ⟶ Me.

**Materials:** Classroom groups of 8.

**Presentation:** Sandy Beach utilities have demanded a 10% reduction in residential use. Failure to do results in large fines. Gasoline prices have risen 100%. This results from the energy demand of this country.

The basic question remains: Is an individual's freedom greater than the community's good?

See if your group can come up with any kind of agreement concerning the following:

1. Who should control your energy use, or should it be controlled at all?
2. If energy is controlled, who do you want to control it? You or some agency?
3. Does cost alone control energy use? Give examples.
4. What do we do with members of society who cannot afford the price of energy? Example: Cut off electric in the middle of winter or do utilities lose money on these people?
5. Some states have started "lifeline rates." This is cheaper electric for minimal use. Who should be allowed these rates? Just the lower economic groups?
6. I live in an apartment building. I watch my energy use. I am a minimal user and in the so-called "middle class." I want a "lifeline rate."
7. I am a member of the "upper class" of America. I want a big car. I want the things the "American Dream" is supposed to give me. Why can't I have all I want?
8. Can an energy system be devised to make everyone happy? Can we keep our individual freedom?

**Evaluation:** Have the students judge the merit of the following utilities rate system.

1. Minimal user: under 500 kilowatt-hours paying the lowest amount per K/hr.
2. Median user: using between 500/K/hr. and 1500 K/hr. paying the average cost per K/hr.

3. High user: Above 1500 K/hrs. paying the average cost + difference for minimal user

4. Individual chooses the rate level they want to attain or is assigned by his use.

Application: That student will see that without self-control the community good will control the individual's freedoms.

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## USING SOLAR ENERGY

Problem: Use solar energy to produce electricity.

Materials: The solar cube which has four silicon cells, a small DC motor and a tri-blade propeller.

Vocabulary: Solar energy
Photovoltaic conversion

Introduction:

On a global scale, the solar energy that arrives in 1-2 weeks is equivalent to the fossil energy stored in all the earth's known reserves of coal, oil and natural gas. In the U.S. the solar energy that reaches 1/500 of the country - an area smaller than that of Florida - could, if converted at 20% efficiency, satisfy all our present needs for electrical power.

In a silicon cell, the absorption of sunlight creates an electrical voltage that can be used to generate electric current in a circuit. This is photovoltaic conversion. Solar radiation falls upon the junction surface of two dissimilar materials in a silicon cell and creates an electron flow. The electron flow moves along an imprinted metalic conductor to create an electric current.

Space vehicles effectively use solar cells to produce electricity. Other uses include remote sensing devices, harbor and buoy lights, and fire telephones.

Activity 1: The class can experiment with the solar cell. Where does it work best? Does it work under incandescent lights? Does it work under fluorescent light? Does it work in shadows?

Activity 2: Determine the cost factor. The solar cell array on the Skylab space station cost about $2 million per kwh to build - about 4000 times the cost of a power plant (oil) on Earth.

| Cost of the solar cube | |
|---|---|
| One silicon cell is | $3.50 |
| four cells | x 4 |
| solar cells | |
| DC motor | + 4.95 |
| Approximate total (case extra) | |

Solar cell cost
Cost per watt-about $15.00
Cost per 60-watt bulb

When would it be economically reasonable to produce electricity for use by a town using solar cells?

Activity 3: Observe the solar cube at work. Do you see any forms of pollution? Was the solar energy itself expensive? Will we run out of solar energy? Is it hard to find? Is the source of energy continuous? Is much space required to produce electric energy using a solar cell?

What are the advantages of using solar energy instead of nuclear energy?

Oil resources?

Wind energy?

What are the disadvantages of using solar energy compared with nuclear energy?

Oil resources?

Wind energy?

Evaluation: Design a car using an array of solar cells to power the car.

## THE AUTOMOBILE

Problem: How has the automobile affected the energy crisis?

Materials: Coal samples, petroleum samples, gasoline - unleaded, regular, high test.

Vocabulary: Crisis, import, shortage, population, pollution, economy, fuel, methane, oil.

Introduction: Man first started using machines to increase his prosperity in the 18th century. Ever since he has to worry about feeding these millions of machines. The world's population of hungry machines has been growing faster than the human population. In addition, today's machines use more energy than those of the past. *Do you own one? You must know that the big tin monster sitting in your front yard is one of our major energy consumers... A GAS GUZZLER.*

Activities:

1. Was the automobile a good invention or was it the worst thing to happen to planet earth?
2. List ways in which the automobile has improved our lives.
3. List ways in which the automobile has been bad for us.
4. Take a survey of the number of teachers at your school who car pool.
5. Go to the library and find information on "How can a car run off of garbage."
6. Make a survey of all teachers who drove over 14 miles/day during the gasoline shortage.
7. Find as much information as you can on the gasoline shortage of 1974.

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## ENERGY AT SCHOOL

Problem: How is energy used at school?

Materials: Paper, pencils.

Vocabulary: Temperature, thermostat, furnace, air-condition, filter, air-circulating system, meter, ventilation, natural light, light meter, footcandles, caulking, heat loss, plastic-sheeting.

Introduction: The sharp rise in fuel cost has put a special burden on school systems and other institutions. But when cost of necessary supplies such as a school, which is on a fixed budget, it has to close down, lay off teachers, or otherwise find the additional money. Some school administrators are busy improving the operation and maintenance of school facilities while others are modernizing existing schools. What ways do you think you can help cut energy cost at your school?

Activities:

1. Form a discussion group and make a list of energy conserving methods that could be used by your school custodian.
2. Have the custodian present to the class and be questioned on: Furnace peak efficiency, individual room thermostat setting, most efficient air condition thermostat setting, air circulating system, natural lighting versus artificial, insulation of the existing school plant.
3. Students will gather information on the above topics so intelligent meaningful questions can be asked. The principal will be asked to sit in on the session.
4. Students will compile a plant improvement sheet and post in front office, teacher's lounge, gym areas, and individual classrooms.

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## FORMING FOSSIL FUELS

Problem: To constuct a facsimile of a fossil as a model for student study of the formation of fossil fuels.

Materials:

1. Plaster of paris
2. 6x9 inch pan
3. Large leaf
4. Black, water-based paint

Vocabulary:

1. Coal
2. Fossil
3. Carboniferous period
4. Ferns
5. Geologist
6. Peat
7. Lignite
8. Bituminous
9. Anthracite
10. Decomposition.

Introduction:

Fossil fuels began to form from decaying plants and animals long before dinosaurs roamed the earth. In fact, geologists have found that fossils help trace back the origin of coal some 300 million years. This period of time is known as the Carboniferous period. Pressure, heat and chemical changes through this long period of time converted tropical plants such as ferns into peat. Continued decomposition of peat resulted in lignite. More heat and pressure on lignite resulted in the formation of bituminous and anthracite coal.

Activities:

1. Grease a 6x9 inch pan.
2. Mix plaster of paris in a separate container until it is the consistency of putty.
3. Pour this plaster of paris into the greased pan.
4. Press a good-sized leaf into the surface of the plaster.
5. Paint the dried plaster with black, water-based paint.
6. Display as coal fossils from the Carboniferous period.

Evaluation:

1. Students will develop a vocabulary of words relating to the formation of coal.
2. Students will be able to identify the four basic kinds of coal.
3. Students will be able to construct or locate fossils of their own.

---

## WHERE'S THE COAL

Problem: To construct locator maps for coal

Materials:

1. Paper and pencil
2. Carbon paper
3. World and U.S. maps

Vocabulary:

1. Reserves
2. Deposits
3. Bituminous coal
4. Lignite
5. Anthracite

Introduction:

Part of the President's energy strategy is to tax industries that have not converted from coal and natural gas to coal. Utilities have until 1983 to convert to coal. This means that the U.S. and Canada will contain 1/2 of the world's reserves of coal and will not have to rely so heavily on Arab oil.

Activities:

1. Have students trace a map of the U.S. using carbon paper and an original U.S. map.
2. Have students shade in with a red colored pencil which represents bituminous coal the following states: Montana, Wyoming, Utah, Colorado, Arizona, New Mexico, Kansas, Iowa, Missouri, Oklahoma, Texas, Illinois, Michigan, Indiana, Kentucky, Tennessee, Ohio, Pennsylvania, West Virginia, Alabama.
3. Have students shade in with a dark colored pencil which represents lignite the following states: North Dakota, South Dakota.
4. Have students trace a map of the world using carbon paper and an original world map.
5. Have students shade in with a red colored pencil which represents half of all the coal in the world the following countries: United States and Canada.
6. Have students shade in with a blue pencil which represents forty per cent of the world's coal reserves the following countries: Russia and China.
7. Have students shade in with a black pencil which represents 10 per cent of the world's coal reserves the following countries: European countries.

## ENERGY CONSERVATION PAYS

Problem: How to save our energy and buy an extra porterhouse a month.

Materials: Booklet on: Tips for Energy Savers, dictionary and textbooks.

Vocabulary: Fuel, energy, conservation, natural resource, gasoline, Electricity, shortages, vent, develop, production, insulation, weatherstrip, insulate, utilities, appliances, generating units, consumption and exhaust.

Introduction: Have students look up vocabulary words using their booklet, dictionary or textbook. Go over the vocabulary words, low groups can put the vocabulary words in alphabetical order. All classes will have test on vocabulary words, after having studied them. Next we as a class would go over the booklet step by step. Each student can read a paragraph, stop, discuss and go on until the book has ended. Give test on booklet every day to see if student understands what's being discussed. Here again read the book. Get to low groups. Have students at end of booklet make a small booklet as to how they would save to buy "the extra porterhouse."

Activities:

A. Role playing by pretending to be different people, Example: taking charge of 1) Insulation, 2) Electricity, 3) Lighting, 4) Hot weather energy savers, 5) Cold weather energy savers, 6) In the kitchen, 7) In the laundry, 8) In the bath, 9) In the workshop, 10) The yard, and 11) The garden.

B. Have contest on spelling the vocabulary words.

C. Have contest on knowing the vocabulary definitions.

D. Make your own booklet, vocabulary words and games. Example: crossword puzzles, word finder.

Evaluation: Make a crossword puzzle using the definitions and vocabulary words.

---

## RADIATION

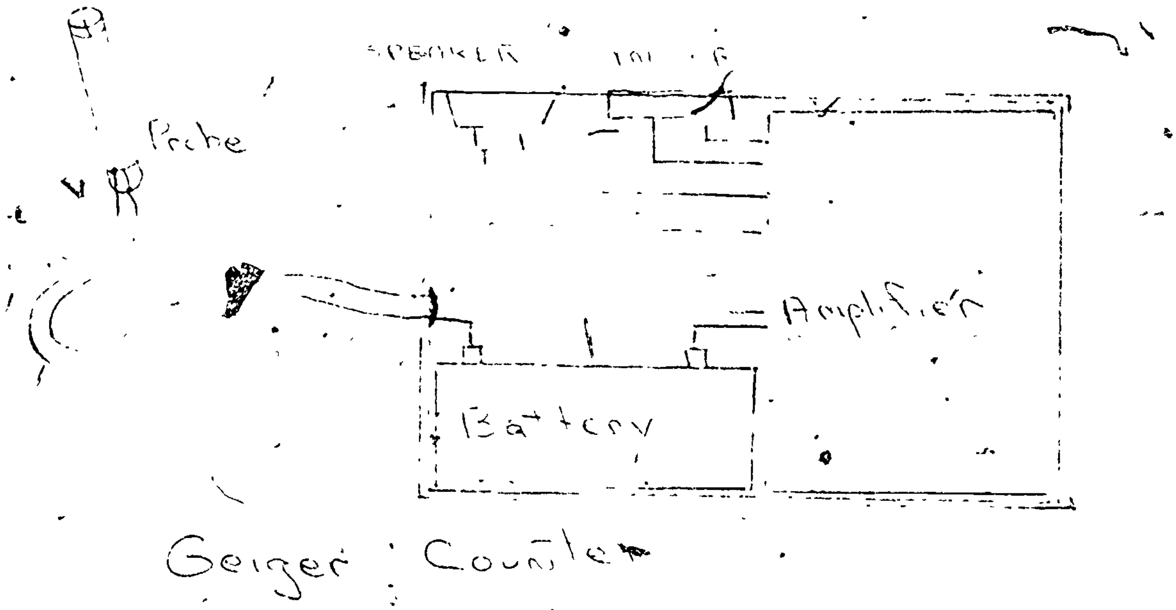
Problem: How can radiation be detected?

Materials: Geiger counter, radioactive sample

Vocabulary: Radioactive, Flourescent, geiger counter, background radiation.

Introduction:

Radioactive substances give off particles or energy. The particles or energy can be detected in several ways. It affects light sensitive photographic film, it will discharge an electroscope, it will cause certain compounds to become flourescent (to glow), and it can cause radiation burns in living things. One of the best ways to detect radiation is to use an instrument called a Geiger counter. Particles or energy from radioactive substances pass through the probe of the Geiger counter. This causes an electric current to flow in the probe. The electric current passes to an amplifier which makes a speaker click, or a light flash, or a needle in an electric meter move. See diagram below.




Activities:

Read the introductory material to the class, or distribute copies of this information to the students. Show the class the Geiger counter and explain how it works. Ask the class why the machine clicks when you turn it on, even though it is not near anything radioactive? To find out why it clicks, show one of the following films:

1) Strange Case of the Cosmic Rays, available from Southern Bell
2) A Sea We Cannot Sense, available from ERDA

If films cannot be obtained, explain the clicking is caused by background radiation which comes from natural sources.

Ask how students could tell if an object was radioactive without using a Geiger counter. Reinforce introductory concepts. Then place the radioactive sample near the Geiger counter and turn on the machine. Vary the distance of the sample to the probe. How does distance affect radiation intensity? Have a student hide the radioactive sample somewhere in the room. Locate the hidden sample by using the Geiger counter.

Evaluation: Select the best answer to complete each of the following statements.

1. Radioactive substances can be detected because they
   a) glow in the dark
   b) are hot
   c) interfere with radio reception
   d) Kill plants
   e) give off particles and energy

2. Light sensitive film left near a radioactive rock will:
   a) become exposed   b) catch on fire   c) melt
   d) become wrinkled   e) glow at night

3. Radiation causes an electroscope to:
   a) explode   b) implode   c) discharge   d) enlarge
   e) recharge

4. Compounds which glow when they are near radioactive substances are:
   a) cancerous   b) incandescent   c) organic
   d) flourescent   e) dangerous

5. One of the best ways to detect radiation is to use an instrument called a (an):
   a) radiometer   b) barometer   c) Geiger counter
   d) electroscope   e) amplifier

6. In a geiger counter, radiation first causes an electric current to flow in a (an):
   a) amplifier   b) battery   c) speaker   d) meter   e) probe

7. A Geiger counter clicks even when it is not near a radioactive rock because of:
   a) poor construction   b) poor operation
   c) improper amplification   d) background radiation
   e) speaker short circuiting

8. Geiger counters can be used to find radioactive substances because:
   a) radiation is stronger near a radioactive substance
   b) the probe is omnidirectional
   c) They have a very sensitive current meter
   d) new models have a detecting pointer
   e) they use a radiosensitive compass

---

## MORE RADIATION

Problem: How long would we need to be protected from radiation from nuclear power plant wastes?

Materials: Geiger counter, radioactive Iodine 131, sheets of shielding materials (glass, wood, lead, copper, paper, etc.)

Vocabulary: Radium, half-life, alpha particles, beta particles, gamma particles

Introduction:

The first radioactive substance discovered was radium. Radium atoms break down into simpler atoms and give off particles and energy (radiation). In about 1600 years one-half of the radium atoms in a sample of radium will break down. In another 1600 years one-half of the remaining atoms that are radioactive will break down, leaving one-fourth of the sample still radioactive. In another 1600 years one-half of the remaining radioactive atoms will break down, leaving one-eighth of the sample still radioactive. This continues until all the radioactive atoms have broken down. The length of time it takes for one-half of the atoms in a radioactive substance to break down is its half life.

The radiation given off by radioactive elements is of three kinds:

1) Alpha particles are helium nuclei. They do not have much penetrating power and can be stopped by a sheet of paper.
2) Beta particles are electrons. Their penetrating power is much greater than alpha particles.
3) Gamma rays are high energy X-rays. They are the most penetrating of the radiations given off by radioactive elements.

Activities:

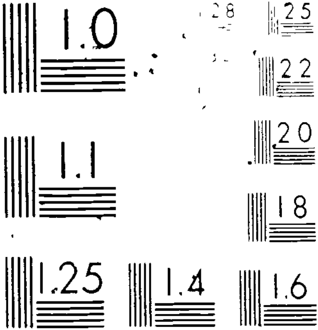
Place a radioactive sample near the probe of a Geiger counter. Turn on the Geiger counter and count the number of clicks in five minutes. Place a sheet of shielding material between the sample and the probe. How does this affect the radiation? Are the clicks decreased? Try different materials and compare their shielding abilities. Is it difficult to shield radiation?

How long will a radioactive sample give off radiation? Place a sample of iodine 131 in a stoppered flask. Use the Geiger counter to measure the radiation (background) in the room. Count the number of clicks in five minutes. Now place the I-131 sample on the base of a ringstand. Suspend the probe approximately 2 centimeters above the sample. Count the number of clicks in five minutes. Subtract the background radiation count from the sample count to determine its radioactivity. Repeat this process every day for about 10 days. Now make a graph of the radioactivity of the sample versus the number of days tested. From the graph determine the half life of Iodine 131. Now discuss the implications of the following chart:*

| Important radioactive products | | |
|---|---|---|
| Product | Type of Radiation | Half-life |
| Krypton-85 | Beta Gamma | 10 years |
| Strontium-90 | Beta | 28 years |
| Iodine-131 | Beta Gamma | 8 days |
| Cobalt-60 | Beta Gamma | 5 years |
| Plutonium-239 | Beta Gamma Alpha | 24,400 years |

Which of these is most dangerous to the future of mankind? What problems do these products impose on our environment? How could these problems be handled?

* Modified from Nuclear Power and the Environment - Questions and Answers, published by the American Nuclear Society.


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8

Evaluation: Select the best answer to complete each of the following statemements.

1. The most penetrating type of radiation is:
   a) alpha b) beta c) gamma d) light e) heat

2. The amount of time it takes for one-half of a sample of a radioactive substance to break down is its:
   a) breakage rate b) deterioration frequency
   c) half life d) radioactive duration
   e) danger allowance

3. The first radioactive substance discovered was:
   a) iodine b) cobalt c) uranium d) plutonium 3) radium

4. The biggest problem with plutonium wastes from nuclear reactors is their:
   a) intense radiation b) large size c) long half life
   d) great heat e) difficulty in handling

5. Types of radiation made up of particles include:
   a) alpha and beta b) gamma and beta
   c) alpha and gamma d) alpha only
   e) gamma only.

---

LESSON: THE ENERGY CRUNCH

Problem: What is the energy crisis and how does it affect you?

Materials: Dictionary, newspaper, textbooks, pamphlets, coal samples, petroleum samples, oil, gasoline, light bulbs, slides of homes with solar plates, design pictures of solar heaters.

Vocabulary: Crisis, develop, geothermal, import, petroleum, produce, rationing, shortage, source, population, pollution, advocate, environment, prosperity, nuclear, industry, resource, economy, fuel, energy, BTU, coal, oil.

Introduction: We have dug coal out of the ground for the past 700 years and have burned 1/2 of that in the last 32 years. Likewise, we have burned 1/2 of all oil that has ever been pumped in the last 14 years. We need energy to live. The big problem is: "Just how much energy do we really need" and "How can we make better use of the energy we already have?" The answer can be found but... it takes time and a lot of work. ARE YOU WILLING TO DO YOUR SHARE?

Activities:
1. List five ways electricity has improved your standard of living.
2. Chart the electricity you would use if you only had four hours of limited use per day.
3. Cut newspaper articles or magazine articles out..read and write your opinion. Agree or disagree.
4. Draw a cartoon of the energy shortage for your school newspaper on energy conservation.
5. Write an imaginary interview with George Washington titled: Energy uses compared...yesterday vs. today.
6. List 10 things that can be done by McDonald's to conserve energy.
7. List all energy consuming appliances in your home and the number of minutes or hours they are used per day; ex. clothes dryer; blender.

LESSON I

PURPOSE: Investigate the amount of radiant energy received by the earth from the sun.

SUBJECT: Earth Science

REFERENCE: Earth Science, by Brown, Kemper, and Lewis; Silver Burdett Company.

ACTIVITY:

1. Define vocabulary list of words
2. Discussion of the following:
   a. Types of energy radiated by the sun
   b. Molecular structures of the layers which make up the atmosphere and how they are affected by radiant energy.
   c. The affects that the energy has on on matter and how matter affects energy.
   d. Make the solar oven
   e. Observation of the Solar cube

CONCEPTS: The atmosphere is made up of layers which are named according to their individual characteristics. Energy comes from the sun in the form of heat energy and light energy. This has a great affect of the matter of the earth--some energy is absorbed, reflected back into the atmosphere, and some is refracted. In order for energy to reach the earth, it must pass through the gases of the atmosphere, being converted in long wavelength from short wave length.

Key Words:

1. energy
2. atmosphere
3. matter
4. molecule
5. radiant energy
6. light energy
7. heat energy
8. absorption
9. refraction
10. reflection
11. photons
12. wavelength
13. solar energy
14. Troposphere
15. ozone layer
16. stratosphere
17. thermosphere
18. mesosphere
19. ionosphere
20. tropopause
21. radiation
22. beta rays
23. gamma rays
24. alpha rays

Key Problems:

1. What is the difference between matter of the lithosphere and the atmosphere?
2. What are the two forms of energy received by the earth from the sun?
3. Why are there matter to reflect, refract, and absorb energy on earth?
4. What would happen if the sun burned out?
5. Give examples of radiation as short wavelength and long wavelength.
6. Give the characteristic differences of each layer in the atmosphere.
7. How can astronauts and spaceships survive in outer space?

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EVALUATION: 1. Students will be able to successfully answer the key problems.
2. Evaluate the students oral response.
3. Students will be tested on the concepts.

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LESSON II, Part A

PURPOSE: To demonstrate the heat generated by the sun and the effect of color in absorbing solar energy.

SUBJECT: Science

CONCEPT: Sun sends solar energy of the eco-sphere, part of which is absorbed by the earth and objects in sun light.

Different colors of materials affect the absorption of heat from the sun.

ACTIVITY: Place various colored sheets of construction paper on the ground in a sunny area. Be certain that each sheet is flat and on the same type of surface--e.g., concrete, grass, dirt, etc.

Place thermometers under each sheet of paper. Record the temperatures each 15 minutes for one hour. Chart your results.

EVALUATION: What effect does color have on the different temperatures for each sheet of construction paper? Which color absorbed most heat? Least heat?

How would these conclusions affect your choice of:
--car color? --tent color?
--roof color on a home?

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LESSON II, Part B

PURPOSE: To demonstrate effectiveness of flat plate collector.

CONCEPT: Presently most of our energy requirements are met through using fossil fuels. However, there are other alternative sources of energy such as solar, which must be considered and developed.

REFERENCE: Robert J. Pozzo, A Floridian's Guide to Solar Energy, State Energy office, Data Collection and Analysis Section, 108 Collins Building, Tallahassee, FL 32304.

ACTIVITY: Students can build a makeshift flat plate collector by using a cardboard box, aluminum foil, flat black paint, glass or sheet of clear plastic, and tape. Line the shallow box with tin foil, then spray with flat black paint. Cover the top with glass or clear plastic. Poke hole through side and slide thermometer into position for reading temperature inside the collector. Make temperature readings.

1. How hot does collector get?
2. What time of day is the collector most effective?

3. How do clouds covering the sun affect the collector?
4. How might this type of collector be used in your everyday life?

Here the teacher can guide the students into a discussion of the potential use of solar energy for space heating, water heating and production of steam to run turbines. A study of weather conditions and geographic conditions and geographic locations suitable to the use of solar energy could be researched.

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LESSON III, Part A.

PURPOSE: To demonstrate the construction and use of a solar furnace - paraboloid type.

SUBJECT: Mathematics and Science

CONCEPT: To demonstrate one of the more sophisticated applications of solar energy. Care must be taken since very high temperatures occur at the focus.

REFERENCE: Mathematical basis can be found in Analytic Geometry, Gordon Fuller, Addison Wesley.

ACTIVITY: The paraboloid reflector is capable of producing very high temperatures not available by other means.

Materials: (a) One of the best ways to build such a device is to get a surplus reflector from television, telephone or radar installations. With a good reflective coating work can begin as soon as the focal point can be found. (b) Another possible source of a ready made reflector is the automobile headlight. A standard headlight or a spotlight bulb of the sealed beam type can be used. In either case the covering fresnel lens must be removed. - broken carefully away. The filament of the bulb was at the focal point. (c) To build a reflector from scratch is much more difficult but an excellent challenge for students interested in working with fiber glass. Remember that a paraboloid can be thought of as formed by rotating a parabola about its axis.

Procedure: Draw and cut out a parabolic bending form from masonite or plywood using the equation $x^2 = 20\ y$.
This gives a focal length of 5 cm. The formula $x^2 = 4$ ay length. With this form bend a number of lengths of bare #12 copper wire to match the edge of the form. These wires may be joined together at the vertex to produce a grid over which the fiberglass cloth is stretched. (If desired the parabolic grid can be strengthened by circular rings of wire soldered in planes perpendicular to the axis of the parabaloid.) After the resin has hardened a reflective surface must be applied. Then materials of very high melting point can be observed (carefully) to melt in a refractive crucible placed at the focal point. If tracking is desired the parabolic dish may be secured to a telescope tracking mount available from such sources as Edmond Scientific Supply.

LESSON IV

PURPOSE: To demonstrate the construction and use of a solar cooker - parabolic boat type (parabolic cylinder)

SUBJECT: Mathematics and Science

CONCEPT: Demonstrate one of the alternatives to fossil fuels as a source of energy.

REFERENCE: Mathematical basis can be found in Analytic Geometry, Gordon Fuller, published by Addison Wesley.

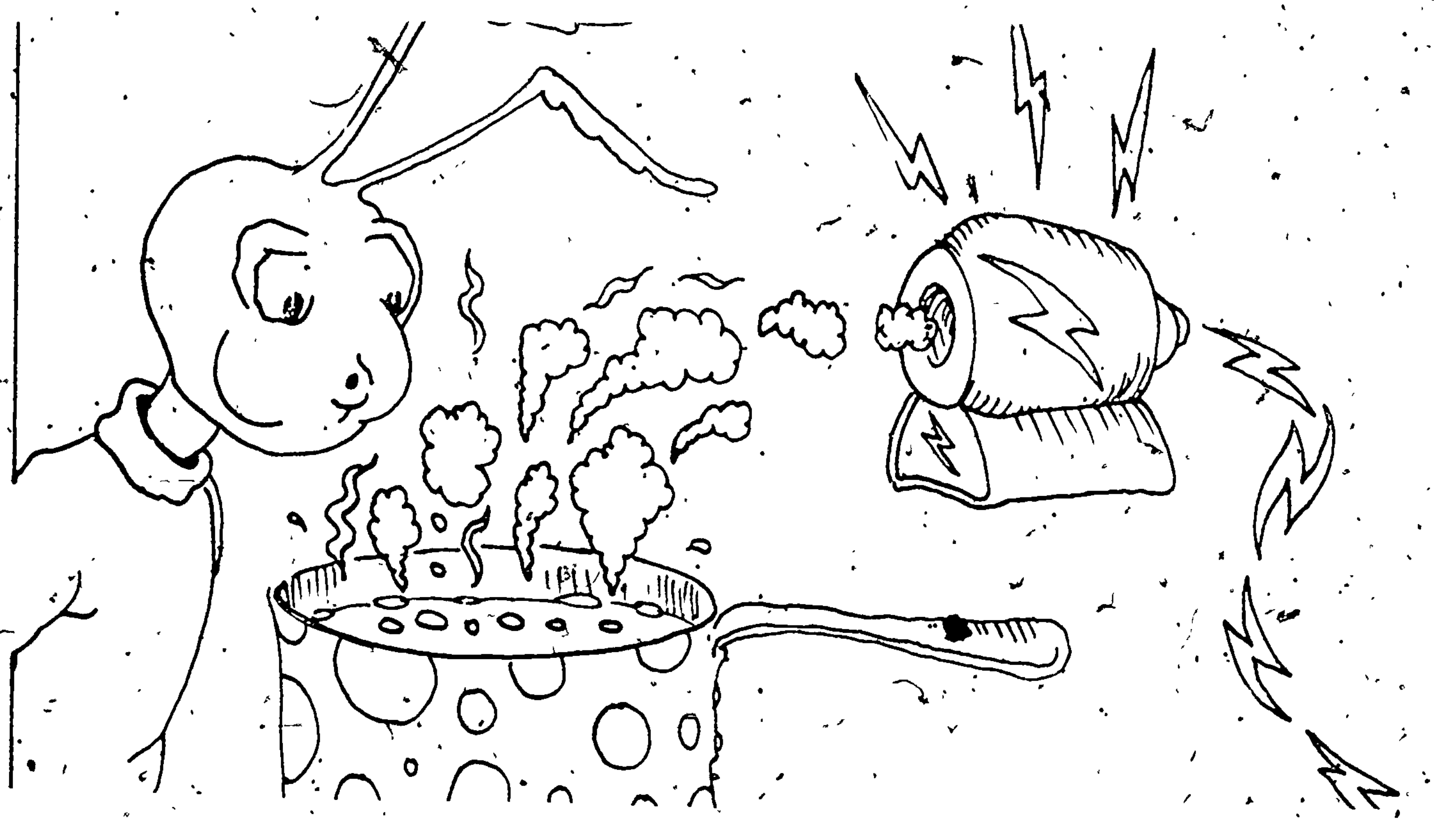
ACTIVITY: We are told that even wood as a fuel is in short supply in many parts of the world. Direct applications of solar energy are evident throughout the recorded history. We take one slightly more sophisticated device to demonstrate the use of this resource.

Materials: 2 - 30 x 30 cm pieces of cardboard - plywood, particle board, masonite if cutting facilities are available.
Sharp knife.
Fastening materials - tape, staples, thumb tacks.
Reflecting material which can be formed easily.
Device (spit) for holding food in proper position.

Procedure: Draw or mount some form of rectangular grid on one of the pieces of cardboard. Refer to reference materials to identify the position of the parabola.
Let the opening of the boat be 20 cm. Then the parameter "a" is equal to 5 cm and the equation for the parabola $x^2 = 4ay$ becomes $x^2 = 20y$. Using the equation in the form $y = \frac{1}{20}x^2$ or $y = .05x^2$ compute a set of ordered pairs (x,y) for x = -10 cm through x = +10 cm. This can be done by selecting x = 0 cm through $\pm$ 10. A desired degree of accuracy in drawing the parabola can be obtained by choosing an appropriate number of points. A sample set is shown.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| x | 0 | $\pm$ .5 | $\pm$ 1 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
| y | 0 | .01 | .05 | .11 | .20 | .31 | .45 | .61 | .80 |
| x | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 |
| y | 1.01 | 1.25 | 1.51 | 1.80 | 2.11 | 2.45 | 2.81 | 3.20 | 3.61 |
| x | 9.0 | 9.5 | 10 | | | | | | |
| y | 4.05 | 4.51 | 5.00 | | | | | | |

Plot these points on the grids and cut to shape. Attach the reflective material to the two curves. The spit should be inserted through holes on the y-axis about 4 cm about the origin. Since the focus is at the top of the boat care should be exercised.



LESSON V

PURPOSE: To understand the potential of and stimulate interest in the future of wind power.

SUBJECT: Science, Social Studies

CONCEPT: Today most of our energy needs are met through the use of fossil fuels; however; other sources available include solar, fission, fusion, hydro-electric, geothermal and wind, the second most abundant source of energy available to mankind.

REFERENCE: Oregon State University Study on Magnitude and Deployment Schedule of Energy Resources.
Energy Technology, Wm. Eaton, ERDA, Oak Ridge, Tennessee.

ACTIVITY: Discuss the history/backbround of wind power from the ancient Persians through the 19th Century to the present day.

Investigate the economic potential of large scale wind energy systems with the rapid growth of fossil fuel costs.

Discuss the problem of wind availability and its unreliability. Include assessments in progress, location of sites or areas, and back up systems.

Discuss potential application through highgrade energy in the form of electricity as well as direct mechanical coupling. Include non-utility application.

Discuss expected utilization--Now--Year 2000--2010 and beyond.

EXTENDING ACTIVITY:

An Investigation into: WIND POWER

Goal: To investigate the potential power of the wind as a source of energy.

MATERIALS: Windmill model, small fan or hair dryer or blower, pieces of cardboard to block off wind (size depends on type of windsource used).

ACTIVITY: This investigation can be performed by the teacher as a demonstration or by a group of students as a laboratory investigation. If done by students have them answer the following questions; if done as a demonstration use these for guiding class discussion.

1. Examine the model windmill. Which way will the blades on the windmill turn if wind hits them? Turn on the fan or hair dryer to find out.

2. Use a piece of cardboard to choke off the wind going to the windmill. When the wind slows down, what happens to the windmill?

3. Continue choking off the wind until the windmill stops turning. Is a minimum windspeed necessary to turn the blades?

4. Move the fan quickly to one side of the windmill so the wind changes direction. Does the windmill change direction? Why?

5. Turn the fan to its highest speed so the windmill is turning very fast. Now quickly move the fan around the windmill so the wind rapidly changes direction. Does the windmill resist changes in direction? If so, why? Would this reduce the efficiency of the windmill?

6. How do you think this turning windmill would be useful to man?

7. Do you think wind energy would be useful in Florida? Explain your answer.

For further investigation:

1. Write a report on how electric companies make electricity and how windmills could be used to make electricity.

2. Write a report on the latest developments in windmill technology. Describe the different designs being tested and the advantages and disadvantages of the designs.

3. Build a model of a Savonius Rotor type windmill and report on its advantages over a conventional windmill design.

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LESSON VI

PURPOSE: To examine the origin, nature, use and technological advantages and developments of geothermal energy.

SUBJECT: Science, Social Studies

CONCEPT: Geothermal energy, the heat deep inside the earth, is a vast potential source of useful power which should become available for a wide variety of important applications as economic exploitation technologies are developed.

RESOURCES: Geothermal Energy, Energy Research and Development Administration, Office of Public Affairs, Geothermal Energy, by William W. Eaton, Energy Research and Development Administration, Geothermal Energy, No. EDM-526. Proceedings of Conference on Magnitude and Deployment Schedule of Energy Resources, Oregon State University, 1975.

ACTIVITIES: By 1980 it is expected that the electrical power produced by the geothermal energy at the Geysers will more than meet the requirements of the city of San Francisco "Energy News Notes", March 25, 1974. Have the students research the energy requirements of the city of San Francisco. Have them prepare a paper on the production of geothermal energy at the Geysers.

Place on overhead projector the system for extracting energy from a dry geothermal reservoir on p. 9 of Geothermal Energy (ERDA). Discuss Normal Thermal Gradient, Magma, Location of Geothermal Resources Environmental Effects, Future Prospects.

Have the students make a list of the active geothermal areas in the United States.

Have students write reports on various topics such as history, generating electricity, geothermal technology, prospecting for heat, drilling technology, dry steam wells, wet steam wells, etc.

Have the students prepare a table showing the approximate relation between investment, energy cost and financial return for geothermal and petroleum-based electricity. (from data given in handouts).

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LESSON VII

PURPOSE: To stimulate interest in hydroelectric power as the only source available needing no significant additional technological development to gain an economical level.

SUBJECT: Science

CONCEPT: In the broad field of energy sources available hydroelectricity is unique in that at the present scale of application no additional development time or money is needed to meet an economic level.

REFERENCE: Oregon State University Study on Magnitude and Development Schedule of Energy Resources. Energy Technology, by Wm. Eaton.

ACTIVITY: Discuss the recent trends in Hydroelectric Power developments in the 50 states.

Investigate the adverse and beneficial effects of stream flow regulations by reservoirs. Include the adverse and beneficial effects of large land masses required. Discuss the distractive and significant advantages.

Discuss the "no emission" problem to adversly affecting air quality, and the "no heat" discharge.

Discuss the availability of sites remaining and the feasibility of using the sites available in regard to the distance from consumer.

Discuss the political aspect, the sentiment in Congress and President versus the need for energy.

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LESSON VIII, Part A

PROBLEM: Alternative Energy Source--Garbage!!

SUBJECT: Ecology, Social Studies, Environmentsl Science, Economics

CONCEPT: If fossil fuels become scarce or too expensive, alternative fuels will be produced from garbage which are cleaner and cause less pollution.

REFERENCE: Rocks, Lawrence and Richard P. Runyon: The Energy Crisis, Crown Publishers, Inc., 1972.
"Better Ways to Use Your Trash." Changing Times, 30:45-47. April, 1976.
"Turning Trash into Energy: More Cities are Trying It," U.S. News & World Report, 67-68, October 20, 1975.

ACTIVITY:
1. Have students find out from their city or county government what resource recovery programs are in existence in their area.
2. Invite the Solid Waste Manager of your county to present a program on his field.

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LESSON VIII, Part B

PURPOSE: To show students how methane gas can be produced from waste products.

SUBJECT: Science

MATERIALS: Empty CLOROX bottles, rubber tubing, a bell jar, hose clamps, aquarium heater, thermometer, straw, chicken manure.

ACTIVITY:
1. Mix the manure and straw together.
2. Place 4 cups of manure in each Clorox bottle.
3. Secure the tops, with hose attached, on the bottle.
4. Attach tubing from the bottle to the bell jar.
5. Put 2 Clorox bottles in a small foam cooler.
6. Fill the cooler 1/2 full of water.
7. Use the aquarium heater to heat the water around the bottles to 98 degrees F.
8. Set the methane generator aside for 48 hours, checking the temperature twice a day to maintain the 98 degree temperature.
9. At the end of the second day attach another tube from the valve on top of the bell jar to a bunson burner.
10. Release the hose clamp, permitting gas to flow into the bell jar.
11. At the end of 10 minutes open the valve on the bell jar and let the gas flow to the burner.
12. While opening the valve on the burner strike a match above the burner.

EVALUATION:
1. Does the gas on the bell jar have a color? Does it have an odor?
2. How long did the flame last before it went out?
3. Compare the flame coming from the burner to the flame of a candle. Which is hotter? Why do you think so?
4. How do you think the gas was produced?
5. How could we use this gas to help our energy crisis?
6. How might this gas affect our environment?