DOCUMENT RESUME

ED 293 748 SO 018 669

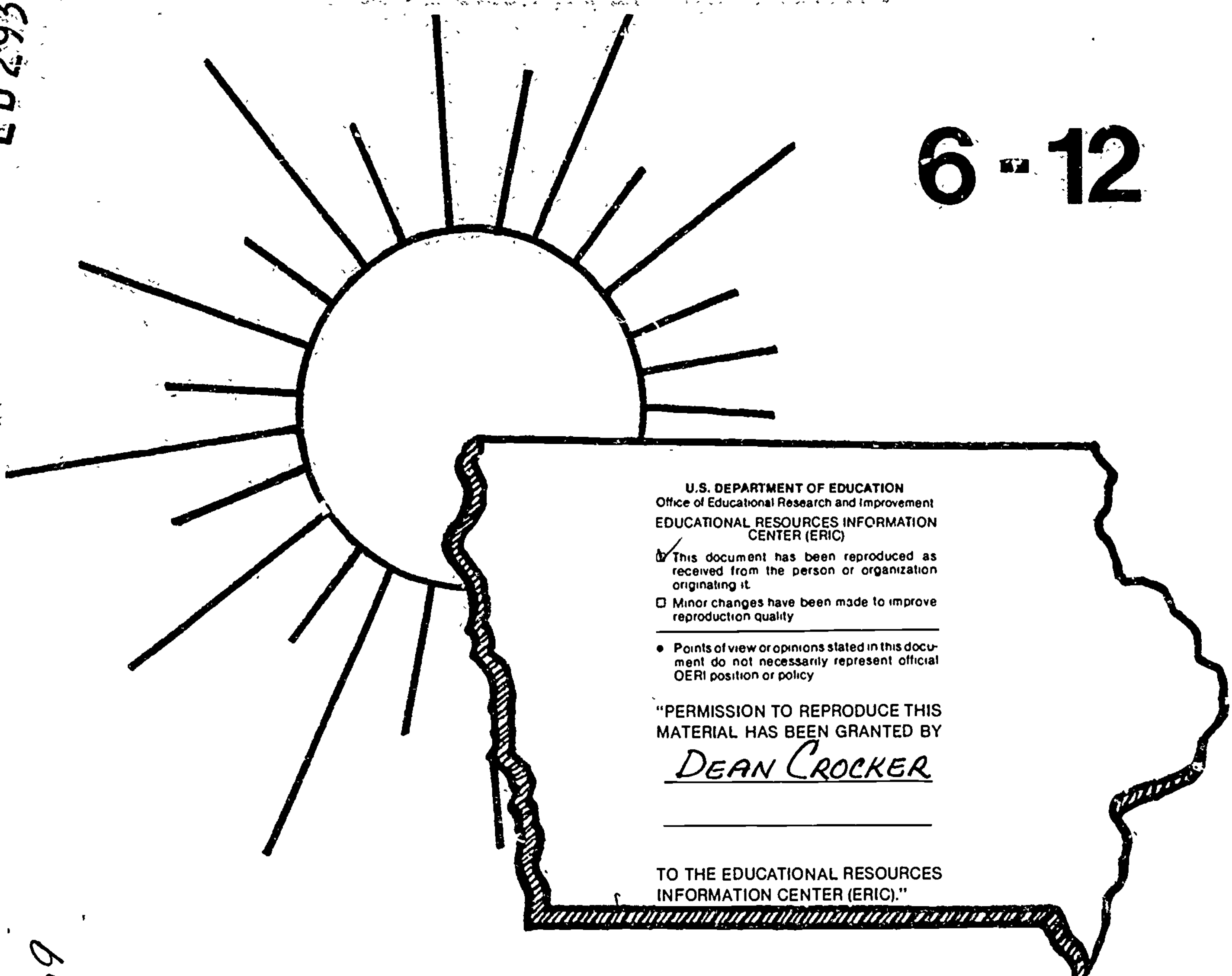
TITLE	Iowa Developed Energy Activity Sampler: 6-12. Social Studies. Revised 1987.
INSTITUTION	Iowa State Dept. of Education, Des Moines.
SPONS AGENCY	Iowa State Dept. of Natural Resources, Des Moines. Energy Div.
PUB DATE	87
NOTE	119p.; For related documents, see ED 119 115 and ED 275 525.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Activity Units; *Class Activities; Concept Formation; *Conservation Education; Decision Making; Elementary Secondary Education; *Energy; *Energy Education; Learning Activities; Natural Resources; Resource Units; *Social Studies
IDENTIFIERS	*Iowa

ABSTRACT

Thirty-eight energy related classroom activities for sixth to twelfth grade are included in this document. The activities are based on the following conceptual themes: (1) energy is basic; (2) energy's usefulness is limited; (3) energy exchanges affect the environment; (4) energy conservation is essential; and (5) people can develop and share energy in the future. Major goals of these activities include developing decision-making skills and emphasizing energy conservation. The activities stress awareness, concept development, and application and are flexible to encourage student exploring, hypothesizing, and decision-making. The interdisciplinary importance of energy education, especially between social studies and science, is emphasized. Each activity sheet includes: (1) a title; (2) subject and grade level designations; (3) a description of the activity; (4) learning objectives; (5) required materials; (6) approximate time required; (7) a suggested learning cycle; (8) evaluation procedures; and (9) follow-up or background information. Pictures, maps, games, puzzles, and charts are included. (JHP)

IOWA DEVELOPED ENERGY ACTIVITY SAMPLER

6 - 12



SOCIAL STUDIES

Revised 1987

State of Iowa
DEPARTMENT OF EDUCATION
Grimes State Office Building
Des Moines, Iowa 50319-0146

Funds for development and printing provided
under contract to the Department from the

Energy Division
Iowa Department
of
Natural Resources

Table of Contents

SOCIAL STUDIES

Acknowledgments iii

Educating Energy Waste (6-12) . . . . SS- 1
Don't "Waste" Time (6-12) . . . . SS- 3
The Energy Ledger (6-12) . . . . SS- 5
How Do You Keep That Energy Down on the Farm? . . . . SS- 7
Marketing Energy (6-12) . . . . SS- 9
But What's the Alternative? (6-12) SS-11
Energy - Using Our Share (6-12) SS-13
Remember When (6-8) SS-15
Energy Web (6-8) SS-17
Just in Case - Study Nuclear Energy (6-8) SS-19
Iowa Coala (6-8) SS-21
Energy - More for Less (6-8) SS-23
Take It Personally, or Be Less Electric (6-8) SS-25
Clearing Up the "Con-Fusion" (6-8) SS-27
Energy - Just "Blowin' in the Wind" (6-8) SS-33
Transportoons (6-8) SS-37
Energy and Agriculture - An Historical View for the Future SS-41
Have a Ball and Not Waste Energy (6-8) SS-45
Puzzling Over Energy (6-8) SS-51
What's The Difference? (6-8) SS-57
Energy Questionnaire (6-8) SS-63
Collaging Energy (6-8) SS-67
Casing Up Nuclear Energy (9-12) SS-69
"Agrenergy" (9-12) SS-71
Hyping Iowa - Iowa promotion (9-12) SS-73
Energy Issues Strategy (9-12) SS-75
Energy Opinions Needed to Make Things Run Better (9-12) SS-77
Lighting Up Three Mile Island to Fuel Roles of Concern (9-12) . . . SS-79
Transpenergy - Revisited (9-12) SS-83
Designer Energy (9-12) SS-85
Energy "Produstribution" Impacts (9-12) SS-87
Energy for Food Distribution (9-12) SS-89
Iowa's Energy Potential (9-12) SS-91
Impact of Nuclear Fusion (9-12) SS-93
What the World Needs Now (9-12) SS-95
Educated Energy Guess (9-12) SS-101
Real Energy Costs (9-12) SS-107
Making Energy Issues Radioactive (9-12) SS-111
Energizing Teachers (9-12) SS-113

REVISED IOWA DEVELOPED ENERGY ACTIVITY SAMPLER - IDEAS

INTRODUCTION TO IDEAS

The revised IDEAS were developed from the Energy Conservation Activity Packets, (ECAPS), by Ruth Bakke, and Iowa Developed Energy Activity Sampler (IDEAS), developed by Dr. Doris G. Simonis under the auspices of the Iowa Energy Policy Council and the Iowa Department of Public Instruction, now the Iowa Department of Education. An "infusion model" was used as a basic framework which recognized the interdisciplinary nature of energy education concepts. These included:

1. Energy is basic.
2. Energy usefulness is limited.
3. Environment is impacted by energy exchanges.
4. Energy conservation is needed.
5. The future of energy is ours to shape and share.

The revised IDEAS adheres to these concepts and provides activities that utilize a learning cycle to develop a knowledgeable student population concerning energy matters. Decision-making skills are emphasized and developing an energy conservation ethic is a major goal.

Under the joint sponsorship of the Iowa Department of Education, Duane Toomsen, Environmental and Energy Education Consultant, and the Energy Division of the Iowa Department of Natural Resources, Dr. W. Tony Heiting, Coordinator; the revised Iowa Developed Energy Activity Sampler (IDEAS) was created to meet the continuing need for energy education from the 1980's into the twenty-first century.

Conservation of natural resources and environmental awareness has been mandated by the State of Iowa to become a part of the quality education experienced by Iowa's future citizens in grades K-12. Energy is an integral part of our nation's natural resource base. The major emphasis of IDEAS is to provide uniquely designed K-12 classroom activities that are adaptable into various classroom situations, i.e., highly populated, urban schools to less populated rural facilities. The focal points of IDEAS are: energy concerns, impacts, choices, challenges, and conservation.

Revised IDEAS adopts a learning cycle strategy based upon the learning theory of Jean Piaget. The cycle has three phases: awareness, concept development and application. Activities are loosely structured to allow for student exploring, hypothesizing, and decision-making.

Awareness activities encourage students to experience a new idea, phenomenon or perception. A variety of experiences should stimulate the students' interest, appreciation, and initiate a positive attitude toward the concept to be formulated. Concept development involves the building of a concept of energy based upon the awareness phase. Concept development may include such activities as reading, performing experiments, solving problems, group interactions, games and role-playing in order to reinforce the developing concept. The application phase is designed to enable the student to apply the new concept to various situations or problems. Application activities may include the same types of activities plus a gamut of others, including debates, panels, simulations, surveys, designing, constructing and community or school projects.

This learning cycle approach integrates content with processes and encourages the development of higher level reasoning and thinking skills. The interdisciplinary importance of energy education is emphasized.

The activity format used in the revised edition of IDEAS includes a title, subject and grade level designation, a short description of the activity, learning objectives, materials needed, approximate time required, and descriptions of the three phases of the activity. A suggested evaluation section has been included, in most packets, to assist the instructor and/or learner in determining the extent to which each learner achieved each objective. Follow-up or background information and a detailed activity description complete the format.

Iowa is an excellent example of how energy is an interrelated and interdependent resource. Iowa imports 98% of the energy it uses and has a high potential for reducing its dependence on outside energy sources through conservation and alternative energy forms. Iowa's current energy dependence has a major impact on Iowa's economy and the ability of the state to compete in the industrial and agricultural community. All segments of Iowa's society involving service-related employment, agriculture, and industry, are impacted by energy costs and availability.

The most obvious means of energy reduction is energy conservation. More efficient use of energy resources available in Iowa (i.e. coal, wind, hydro, solar, gasohol, biomass) can have a significant impact on the cost of production/distribution factors as fossil fuels begin to diminish in the twenty-first century.

The revised IDEAS were developed by classroom teachers who realize the need to provide students with an enriched curriculum. Iowa's tradition of excellence in education has always pointed toward an improved future for our youth. IDEAS will provide the creative educator with a multitude of activities from which they can choose, adapt, and improve.

The professional educator who uses IDEAS may adapt the activities for any classroom setting. Students will be given the basis to form an energy attitude, ethic, and philosophy which will serve them and the citizens of Iowa throughout life.

Members of the IDEAS Revision Committee

Duane Toomsen, Environmental and Energy Consultant, Department of Education

Dr. Tony Heiting, Research/Education Director, Energy Division, Iowa Department of Natural Resources.

Dr. Bob Vanden Branden, University of Northern Iowa, editor.

The following were responsible for the grade and/or subject level indicated:

Primary	Linda Scheuermann	Roland-Story Elementary School Story City, Iowa
Intermediate	Janey Swartz	Sac and Fox Settlement School Tama, Iowa
Home Economics	Viki Van Ryswyk	Lewis Central High School Council Bluffs, Iowa
Industrial Arts and Technology Education	Alan Glass	Ballard High School Huxley, Iowa
Language and Creative Arts	Dr. Doug Larche	Grandview College Des Moines, Iowa
Mathematics	Dorothea Trost	Sutherland Community High School, Sutherland, Iowa
Science	Peggy Steffen	Ottumwa High School Ottumwa, Iowa
Social Studies	Steve Heiting	Oskaloosa High School Oskaloosa, Iowa

Advisory members included:

Dr. Lynn Glass, Iowa State University
Brian Johnson, Iowa Power and Light

Special Tribute to Jody Cosson, Des Moines Graphic Artist

Notebook Cover by Carol Doerr

RESOURCE ORGANIZATIONS

Iowa Department of Natural Resources. Energy Division,
Wallace Building, Des Moines, Iowa 50319

CAREIRS (Conservation and Renewable Energy Inquiry and Referral Service)
800-523-2929.

Iowa Energy Extension Service, Iowa State University,
110 Marston Hall, Ames, Iowa 50011. 515/294-6978

National Energy Foundation, 4980 West Amelia Earhart Drive
Salt Lake City, Utah, 84116. 801/539-1406

Energy and Self-Reliance Center, 3500 Kingman Boulevard
Des Moines, Iowa 50311. 515/277-0253

National Energy Information Center, El-20, Energy Information
Administration, Forrestal Building, Room 1F-048
Washington, D.C. 20585. 202/252-8800

New York Energy Education Project and the
Solar Energy Project, SUNY at Albany, 1400 Washington Avenue
P.O. Box 22100, Albany, New York 12222

Ministry of Energy, 56 Wellesley Street West,
Toronto, Ontario, M7A2B7, Canada

NATAS (National Appropriate Technology Assistance Service) 800-428-2525.

The NEED Project, P.O. Box 2518, Reston, Virginia 22090
703/860-5029

U.S. Government Printing Office, Washington, D.C. 20402

Your local public utility

SOCIAL STUDIES

INTRODUCTION

A major focus of the Revised Iowa Developed Energy Activities Sampler (IDEAS) is to deal with student perspective concerning the connection between science and social studies. The impact that energy technology has on today's society reveals the importance of interdisciplinary learning. The activities included in this section were developed in the hope that creative educators would select, modify, and apply them to their particular classroom situation. The learning cycle methodology gives students a complete learning experience. This design will assist them in developing skills to acquire knowledge, make decisions and form educated opinions (values).

Educators who assisted in the formation of this section include:

Velma Burris	Newton Community School District
Vicki Dillon	Burlington Community School District
Barbara Freese	Davenport Community School District
Susan Hopp	Chariton Community School District
Lorraine Houck	Decorah Community School District
Morgan Masters	Chariton Community School District
Joe Moore	Keystone Area Education Agency
Dean Rudloff	CAL Community School District
Dave Schlicker	Wapsi Valley Community School District
Ann Tharnish	Urbandale Community School District
Fred Worrell	Denison Community School District

A very special thanks to Robert P. Rye, Jr. and his staff for the enjoyment and use of the Conservation Education Center, Springbrook State Park.

GRADE LEVEL : SIX - TWELVE

SS-1

EDUCATING ENERGY WASTES

SUBJECT Social Studies | LEVEL 6 - 12

ACTIVITY IN BRIEF

Students will conduct an energy audit of their school building(s) and present a report to the principal with recommendations for improving the school's energy efficiency.

OBJECTIVE

Each student 1) collects data about energy efficiency, 2) constructs a part of an energy audit form, and 3) analyzes and evaluates energy audit information.

MATERIALS

paper, pencils containers

TIME

3 class periods

LEARNING CYCLE

AWARENESS - Students become informed about various ways in which energy is wasted and how their school can improve its energy use and save tax dollars.

CONCEPT DEVELOPMENT - Students create an energy audit form which measures the school's efficiency in energy use.

APPLICATION - Students conduct an energy audit and analyze the data in order to make recommendations to school officials.

SUGGESTED EVALUATION - Each student uses the energy report information to write an essay which details how the local school district would benefit from having an "energy efficiency plan of action." This essay is evaluated by the instructor according to how many energy audit references are made, the length (250-500 words), and appropriateness of points made to local conditions.

FOLLOW-UP/BACKGROUND INFORMATION

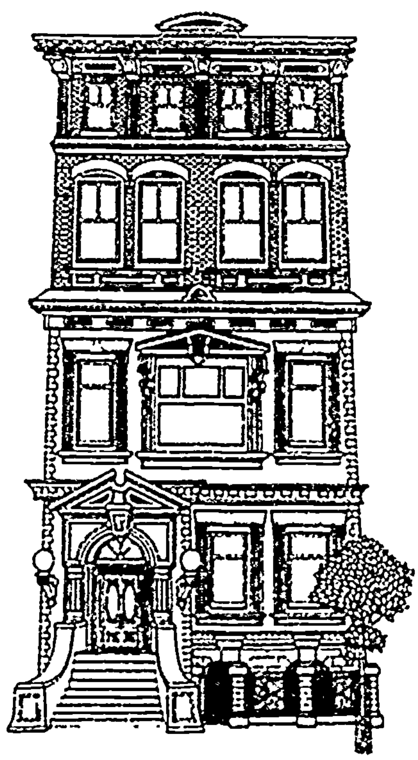
With the support of teachers, the students are encouraged to develop an energy conservation plan which can be measured in terms of energy savings to the school (and therefore, the taxpayer).

ACTIVITY

After exploring information about energy conservation, available from the Iowa Dept. of Natural Resources-Energy Division or local utility companies, the students are challenged to develop an energy audit form which would accurately measure the schools energy use. Students can work in groups, individually or as a class. Examples are available from sources mentioned. The students will use the form to investigate the school's energy use situation and should seek assistance from teachers and administration. Groups of "energy investigators" are assigned to evaluate energy used in different sections of the school building(s). Data should be analyzed to determine how efficiently the school is using energy. The information is organized into a report that can be presented to school officials - hopefully in a "good news, bad news" format. School administrators can be invited to class to respond to the report. Recommendations from students should be used to develop an energy use policy for the school that would involve school personnel and students. If successful, this procedure and policy can be shared with other schools in the district and brought to the attention of the school board, emphasizing the students accomplishments. Local press could be used to increase community awareness about the importance of energy and education.

SOURCE OF ACTIVITY

Originated by S.E. Heiting for I.D.E.A.S., JUNE, 1986.



DON'T WASTE TIME

SUBJECT Social Studies LEVEL 6-12

ACTIVITY IN BRIEF

Students become involved in a possible transport incident where radioactive waste and burning oil could threaten the safety of an area in south central Iowa.

OBJECTIVE

Each student 1) describes what would result from an "energy accident, 2) determines the cause/effect relationship between the accident and the peopled environment surrounding it, and 3) hypothesizes how this problem would best be handled.

MATERIALS	TIME
description cards, markers, paper, blackboard	1 - 2 class periods

LEARNING CYCLE

AWARENESS - Students discover potential problems in the transport of energy resources and their potential impacts on a community by reacting to a scenario read by the teacher.

CONCEPT DEVELOPMENT - Students create a group/class news bulletin and develop a chart showing the cause/effect impact on people.

APPLICATION - Students determine how their products relate to real situations occurring in Iowa.

SUGGESTED EVALUATION - The instructor presents three groups for each student to hypothesize about. The hypothesis response should predict how the 1) producers and distributors; 2) people in the surrounding area; and 3) the government should react to the situation studied. The teacher evaluates each student according to their participation in previous activities and if they are able to write a reasonable hypotheses for two of the three questions given.

FOLLOW-UP/BACKGROUND INFORMATION

The teacher may want to get copies of the Des Moines Register concerning the derailments occurring in southern Iowa in 1983-84 and the controversy about these trains carrying high level nuclear wastes. The rail route could easily be plotted on a map of Iowa.

ACTIVITY

The teacher sets the scene by telling students of a train derailment. The situation occurs near a town in south central Iowa. It involves a burning oil tanker and some rail flatcars holding containers of high level radioactive waste, which are being transported from Nebraska to the federal depository in Illinois. The students are given cards which separate them into groups with varying interests in the accident. Each group should view the situation from their respective roles and consider the weather, energy-economic factors, government responsibilities, and community response. The groups develop a news bulletin to inform the public about the incident. Each bulletin is displayed and the class reacts to the merits of each. The best parts are combined into a final news bulletin. Students develop a cause and effect chart to show the accident's impact on residents of a nearby community. An Iowa map is used to identify the probable locations of the accident and which town(s) would be involved. The cause/effect chart is developed with each student contributing an impact or opinion. Students research the probability of this situation (senior high) or are given articles from the newspaper which demonstrates the reality of this event (junior high).

SOURCE OF ACTIVITY

Adapted from an OUTLOOK activity entitled "We Interrupt the Program" created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides, 1983, By S. E. Heiting.

THE ENERGY LEDGER

SUBJECT Social Studies LEVEL 6-12

ACTIVITY IN BRIEF

Students assume the role of newspaper reporters to publish a newspaper which informs the reader about various aspects of energy use.

OBJECTIVE

Each student 1) defines her/his role in constructing an NRG Newspaper, 2) designs a newspaper item for publication, and 3) evaluates the final product.

MATERIALS	TIME
newspaper print (paper)	2 - 3 class periods

LEARNING CYCLE

AWARENESS - Students become familiar with basic energy concepts and how they apply to various aspects of daily life. Students gain awareness of how newspapers are set up and published.

CONCEPT DEVELOPMENT - Students write a newspaper article which would point out a connection between a specific news section and energy.

APPLICATION - Students use their articles to "publish" a newspaper which follows the general format used by papers available in their locale.

SUGGESTED EVALUATION - The instructor explains the criteria for evaluating the newspaper; possible inclusions might be for each student to list energy themes or concepts identified in the publication, rate a set number of articles, graphics or other content on a 1-5 scale explaining each of their ratings. Another possibility would have each participant respond to a question relating to how the newspaper is a good (or bad) way to learn about the use of energy resources.

FOLLOW-UP/BACKGROUND INFORMATION

Students share their product with interested groups or individuals. If there is no school newspaper, this publication could satisfy that need, future editions being sold at a nominal charge so that students could purchase materials to improve their efforts.

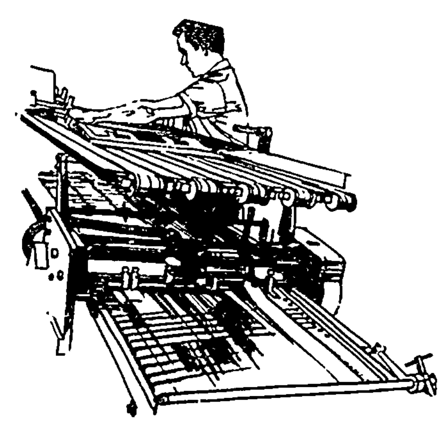
ACTIVITY

The teacher separates the class into groups which will report on energy aspects related to different sections of a newspaper, i.e., sports, weather, international, national, local news, classified section, cartoons, editorials, human interest, Dear Abby, etc. Part of a class session is devoted to setting up the groups and brainstorming possible energy themes or ideas connected to each newspaper section. The teacher sets up a "deadline" for the articles and shows the class a format to be used. Space, length, and other "real" newspaper considerations should be pointed out. Each group should decide what individual assignments are appropriate for their section of the newspaper. Students are given brief energy background ideas, data and concepts to assist them in developing their stories. After the articles are submitted and proofread the class works in their assigned sections to develop the entire publication. This activity will include planning, layout, past up and arranging edited sections into a plausible newspaper production. Copies of this product should be made, displayed and shared with parents, administrators and other classes. Some of the best articles may be approved for an existing school newspaper or a second edition done on a different theme.

SOURCE OF ACTIVITY

Originated by S. E. Heiting

The Des Moines Register has information kits available for schools which would give useful newspaper background.



HOW DO YOU KEEP THAT ENERGY DOWN ON THE FARM?

SUBJECT Social Studies LEVEL 6-12

ACTIVITY IN BRIEF

Students develop a questionnaire, survey farmers, tabulate and analyze data to see how energy impacts agriculture.

OBJECTIVE

Each student 1) constructs part of an agri-energy survey, 2) synthesizes the results of the questionnaire into a written report, and 3) predicts an energy future for agri-business.

MATERIALS	TIME
special paper, markers, etc. to enhance the appearance of the booklet	2 - 3 class periods

LEARNING CYCLE

AWARENESS - Students become aware of agri-industry dependence on energy resources. Students discover the usefulness of surveys to obtain information.

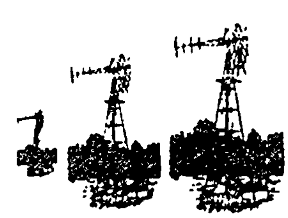
CONCEPT DEVELOPMENT - The students create a questionnaire to serve their energy information needs which is tabulated and analyzed.

APPLICATION - Students develop an Agri-Energy Report which reveals the conclusions they drew from the data obtained.

SUGGESTED EVALUATION - The teacher has each student write an essay predicting a future for agri-business. Evaluation can be done according to how many times the student is able to incorporate survey - report information into the essay.

FOLLOW-UP/BACKGROUND INFORMATION

Copies of the report are shared with participating farmers and a request for their reactions (feedback) is obtained if time and conditions allow.



ACTIVITY

Students are given instruction on how to conduct a survey, i.e., types of statements or questions, answer (form) format, reliability-validity factors, margin of error, etc. Students discuss how energy use connects to agriculture and the farming business. Each student submits potential survey questions and the questionnaire is developed. Students develop strategies for administering the survey which are appropriate for their locale. Some time may lapse before the data is returned, at that point the students develop a tabulation system to analyze the information. Students should be instructed to draw conclusions about the importance of energy in agriculture. An oral class report is given based on the conclusions written by individual students. This report should be recorded and formalized into a booklet. Some students should bring a drawing, graph, chart, cartoon or picture which is incorporated into the report booklet showing various aspects of agri-energy. If possible, copies of the "AgriEnergy Report" should be shared with the farmers who participated in the survey.

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from part of an OUTLOOK activity entitled "Hometown USA", created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides, copyright 1983.

MARKETING ENERGY

SUBJECT Social Studies **LEVEL** 6-12

ACTIVITY IN BRIEF

Students develop advertising campaigns for energy products that they create.

OBJECTIVE

Each student 1) designs part of a marketing campaign for an energy products, 2) explains his/her role in the energy activity , and 3) identifies positive implications for selling the energy product.

MATERIALS

various materials to construct products (see Follow-up/Background Information)

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Small groups of students will create a simple product from materials provided, with special attention given to the energy aspects of mass producing/distributing the product.

CONCEPT DEVELOPMENT - Students will develop an advertising campaign to market one of the products, taking into consideration the energy implications of distributing the product.

APPLICATION - Each group presents their ad strategy and students determine which would be most successful, judged on the basis of most energy efficient to make and market.

SUGGESTED EVALUATION - The teacher requires that each student describe exactly a) what they contributed to the group activity; b) what they learned about energy; and c) which product they think would be most successful and why. This assessment could be done orally or in writing.

FOLLOW-UP/BACKGROUND INFORMATION

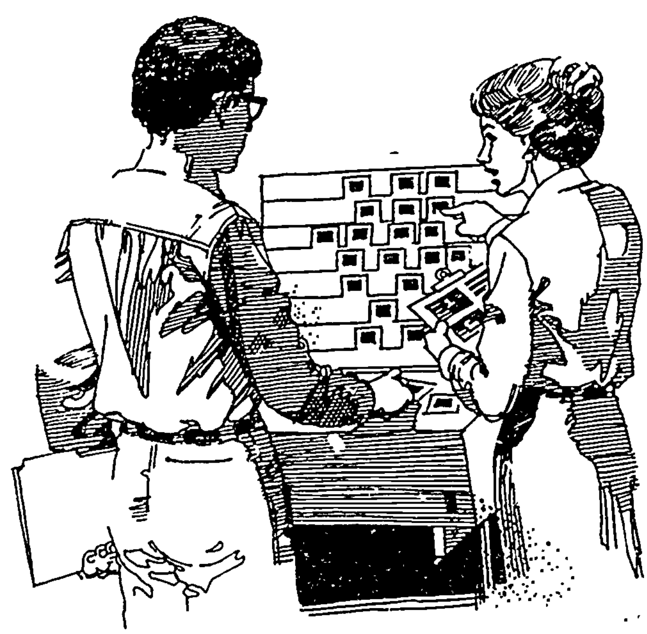
An award could be given to the group whose product is chosen as most successful. Materials need not be expensive. (Scrap art materials, toothpicks, tongue depressors, string, tape, styrofoam, meat or egg trays, cartons, etc.)

ACTIVITY

Small groups of students create a simple product that requires energy in order to operate. Students should try to consider the efficient use of energy as a selling point for their product. When time and materials have been used to develop the products, the students present their products and explain their use. Each group chooses one of the presentations and develops an advertising campaign to market the product. Each group will present their campaign to the class and discuss strategies used to develop the campaign (to what age group it appeals, cost, energy us and efficiency, image, etc.). After all ad campaigns have been given, discuss the energy impacts connected to the production and distribution of the products. From an NRG perspective, which product would stand the best chance of being successfully produced, distributed and marketed?

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Make a Market" created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides.



BUT WHAT'S THE ALTERNATIVE ?

SUBJECT Social Studies **LEVEL** 6 - 12

ACTIVITY IN BRIEF

Students investigate a hypothesis about using solar energy and form groups on each side of the issue. A third, judgment group, is formed to judge a debate on the hypothesis issue, each student writes a response to the judgment panels decision.

OBJECTIVE

Each student 1) cites evidence connected to the use of solar power, 2) critically discusses a position on a solar energy hypothesis, and 3) states if they agree or disagree with a judgment panel and completes a written position statement about solar power.

MATERIALS	TIME
blackboard space, solar hypothesis, notebooks	2 class periods

LEARNING CYCLE

AWARENESS - Students are presented with a hypothesis about solar energy and directed to investigate the statement in order to support a position which accepts, rejects, or modifies the hypothesis.

CONCEPT DEVELOPMENT - Students positions are expressed and used to determine groups pro/con on the issue, the modifying group is used as a judgment panel. The groups develop their position to be debated by representatives, of each group.

APPLICATION - After an informal debate, the judgment panel presents its decision as to which group presented the strongest position. Students respond to the decision in their notebooks.

SUGGESTED EVALUATION - The instructor has each student submit a true/false solar energy statement. These statements are made into a true/false test which the student must pass by getting 85% or more correct. Each student writes a 100 word essay about solar energy using the information on the test to help them clearly state their position.

FOLLOW-UP/BACKGROUND INFORMATION

Much information on solar power is available from the Iowa Dept. of Natural Resources Energy Division. School buildings themselves are often solar energy labs which can be used by students to experience the passive impact of this energy resource. A statement about the amount of money spent on producing Nuclear vs. Solar Energy could be made into a good hypothesis. Students could formulate such an hypothesis and present it to the class.

ACTIVITY

The following hypothesis is written on the blackboard: Increased U.S. investment in solar power would result in enough new energy being used by the year 2,000 to eliminate the need to import oil! Students are directed to research the hypothesis in order to support a position rejecting, accepting or modifying it. Their positions on the hypothesis issue will determine which group they are in to debate the issue. The modification group acts as a judgment panel listening to representatives from each side and making a decision which side has presented the strongest case pro or con on the issue. The decision of the judgment panel is responded to by each student in their notebook. They should explain why they agree with the decision or write a rebuttal to the panel's view. Depending on the school's facilities, students could experience the impact of passive solar energy by reporting on (perhaps drawing a chart) where in the school's southern exposure doors/windows allow solar heating to occur and what could be done to make better use of this energy resource.

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from an OUTLOOK activity called "Agricultural Distribution" created by Marilyn Sand, Bob Lancaster and Steve Heiting.

ENERGY - USING OUR SHARE

SUBJECT Social Studies LEVEL 6-12

ACTIVITY IN BRIEF

Students develop implication categories for a given energy statement about U.S. energy consumption in order to come to a conclusion about global energy impacts and interdependence.

OBJECTIVE

Each student 1) lists implications about U.S. energy use under specific categories, 2) proposes and justifies reasons for a future vs. interdependent energy use policy.

MATERIALS

notebook, blackboard

TIME

1 class period

LEARNING CYCLE

AWARENESS - Students are to read the prepared statement about U.S. energy consumption and asked to discuss the implications of it in a specified taxonomy. Implications are noted in categories on the blackboard.

CONCEPT DEVELOPMENT - Students are directed to determine what they personally feel about the situation and write suggestions for changes needed in current U.S. energy consumption.

APPLICATION - Students add to their response an answer to a question about U.S. reduction in the world energy resources. A list of positive and negative impacts is put on the board.

SUGGESTED EVALUATION - The teacher prepares a test which distinguishes between categories used and has each student predict the consequences of the U. S. continuing its present energy policy. Grade performance is based on the instructors normal grade scale for the objective section, and the students' ability to make a rational generalized statement in the written section.

FOLLOW-UP/BACKGROUND INFORMATION

Students are told what interdependence means and asked to react to a final question about U.S. energy policy and the concept of global interdependence. Details of these responses are shared by class members.

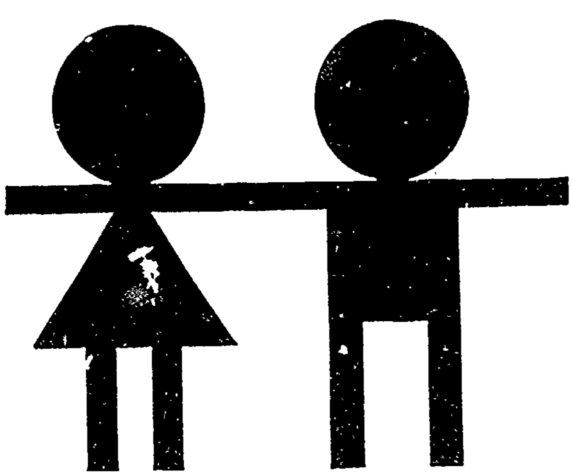
ACTIVITY

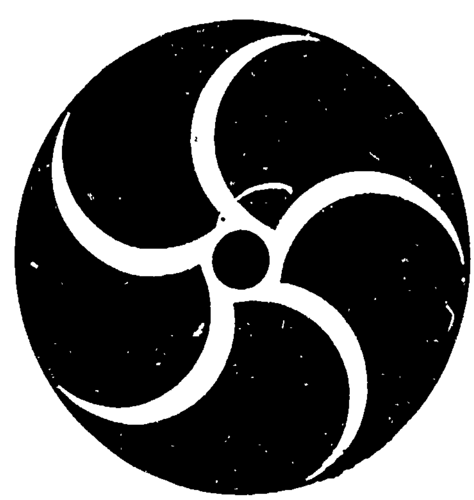
The teacher reads the following statement to the class, "The U.S. consumption of the world's energy is six times as high per capita as the world average". Students, individually, in groups or as a class, discuss the implications of this statement and determine what it means in the following categories:

1. Environmental, 2. Economic, 3. Political, 4. Social. After listing implications on the board under each category the students are directed to determine what they personally feel about the situation and write suggestions for changes (if any) needed in the current U.S. consumption of world energy supplies. The students add to their feedback an answer to the question, "What would be the social, economic, political and environmental affect of the U.S. reducing the amount of its energy consumption?" A list of positive and negative impacts is put on the board and the students are introduced to the term interdependence. Finally, each student reacts to the following question, "If the U.S. is interdependent with other nations, what would be a proper energy policy for the U.S. to follow in the future?" Students should answer in as much detail as possible.

SOURCE OF ACTIVITY

Originated by S.E. Heiting for I.D.E.A.S., June, 1986.





GRADE LEVEL : SIX-EIGHT

SS-15

REMEMBER WHEN...

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students write an obituary for a favorite natural place, death due to strip mining. After a discussion of energy-environmental tradeoffs, a news publication is made with various energy themes.

OBJECTIVE

Each student 1) describes a natural setting they have experienced, 2) lists reasons for and against strip mining, 3) designs or illustrates an obituary for a natural location due to strip mining.

MATERIALS	TIME
paper, pencil, AV material, newspaper ("obits" section)	1-2 class periods (40-80 Min.)

LEARNING CYCLE

AWARENESS - Students discover what occurs when this energy form (coal mining) is used and determine the impact of energy use vs natural area use.

CONCEPT DEVELOPMENT - Students make an "obit" which could become part of a "conservation newspaper" created by the whole class.

APPLICATION - Discussions and lists of reasons for/against strip mining, impacts on local areas and tradeoffs that occur everyday could all become part of news publication to be named by the students.

SUGGESTED EVALUATION - The instructor grades the designs and illustrations according to the following criteria:

a. how well it makes clear the students position about this energy use.
b. how well it conforms to the normal grammar/art expectations.
c. how creative the work is in making a point about energy use.

FOLLOW-UP/BACKGROUND INFORMATION

Take a field trip to a strip mine or other related area if available.
Investigate standards that have to be met by mining companies.
Investigate the land reclamation project(s) done in Iowa (ISU research).
Students may make a tombstone with their "obits" and a fitting statement on it.
What other negative environmental activity has caused the loss of natural areas?
What impact did the Soviet Union's Chernobyl meltdown have on surrounding areas?

ACTIVITY

Students are instructed to write about a favorite natural setting which they have experienced. They should include their feelings about it as well as a description of the physical setting. Some students may want to sketch the place. Descriptions and sketches can be shared. The teacher introduces the idea that strip mining has an impact on natural areas and discuss how this process has been done; showing pictures, slides, etc. Explain why it is done. Students then prepare an obituary for their favorite natural place. The teacher may need to read and show students what an obituary is. Following those activities the "obits" can be posted around the room, shared, and discussed in terms of the reasons why strip mining will develop and the tradeoffs involved. This energy issue and others could be combined into an energy newspaper developed by the entire class.

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from an Outlook activity c. 1983 entitled "In Memory Of..." created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides.

ENERGY WEB

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

The relationship between energy and society is explored by constructing a web of interdependence.

OBJECTIVE

Each student 1) illustrates part of an energy use mural, and 2) explains how energy is an interdependent resource.

MATERIALS	**TIME**
plain large sheets of paper, colored markers	1 - 2 class periods

LEARNING CYCLE

AWARENESS - Student attention is focused on different types of energy resources available and how various lifestyle factors are at work making energy use an interdependent process involving geography, economics, government and society.

CONCEPT DEVELOPMENT - Students create a visual display showing the interconnections between energy resources and energy use.

APPLICATION - Students discuss what implications their murals have for local (home) energy consumption

SUGGESTED EVALUATION - The instructor has each student write a statement about energy use as it connects to a social, economic, political, geographic and environmental factor of our life. Each student is directed to hypothesize how the use of energy in the U. S. has an impact on other nations of the world. Grading for the "NRG Quiz" should follow the criteria normally used by the classroom teacher.

FOLLOW-UP/BACKGROUND INFORMATION

Discuss how alternative forms of energy may increase the efficiency of energy consumption, how energy conservation can impact consumption and what economic factors limit reasonable energy use, i.e. utility costs, budgets, product cost, transportation, etc.

ACTIVITY

Students are asked to brainstorm how many different kinds of energy resources are used in the U. S., a list is made on the blackboard. A second list is developed, in the same manner, concerning how these energy resources are used or consumed by people in the U.S. Students should make connections between types of energy and uses (who uses what and why). Large sheets of paper are used to create a mural showing connections and implications of energy resources and use. For example, people in the Northwestern states could be shown using hydroelectric power (in the Southwest, solar, etc.) to generate electricity for heating homes, powering industry, etc. Different groups can show and share their murals with a spokesperson from each group describing the energy resource-use connections. After viewing all of the murals displayed, the students are asked to indicate how the murals show the energy use resource connections involved in their community. Questions should be raised concerning the kind of energy resource(s) used. Are there alternatives which would increase the efficiency of local energy consumption? If different sources of energy are used, students might inquire as to what sources are being consumed in their homes. A chart or graph may be constructed on the chalk board; list students' home, kind of energy resource used, and origin of the energy source.

SOURCE OF ACTIVITY

This activity adopted by S. E. Heiting from "Aggies Web", an OUTLOOK resource written by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides, c. 1983.

JUST IN CASE - STUDY NUCLEAR ENERGY

SUBJECT Social Studies **LEVEL** 6-8

ACTIVITY

Students develop a case study about the Chernobyl Meltdown in the U.S.S.R. (Spring, 1986) to discover the complexities involved with using nuclear power as an energy source.

OBJECTIVE

Each student 1) designs part of a case study, 2) submits questions to be used on a quiz, and 3) clearly relates a position about the use of nuclear energy.

MATERIALS	TIME
news articles, illustration materials	1 - 2 class periods

LEARNING CYCLE

AWARENESS - Students are given time to collect data about the nuclear incident at the Chernobyl reactor near Kiev, U.S.S.R. Newspaper, magazine, and library resources should be used to develop a pool of information.

CONCEPT DEVELOPMENT - Students list main points on the board and divide up into three writing teams to produce case study sections which include background, impact and illustration of the event.

APPLICATION - Students put the parts of the case study together, evaluate and revise it into a finished product.

SUGGESTED EVALUATION - The instructor has each student turn in two or more multiple choice quiz questions about the Chernobyl case study. The teacher constructs a quiz using the students' questions and administers the quiz with an expectation of 80% correct for passing. The instructor has each student clearly describe their position about the use of nuclear energy on one page (back side of the quiz).

FOLLOW-UP/BACKGROUND INFORMATION

The teacher has each student record a list of lessons to be learned from the Chernobyl situation and make a statement which reflects their attitude about nuclear power.

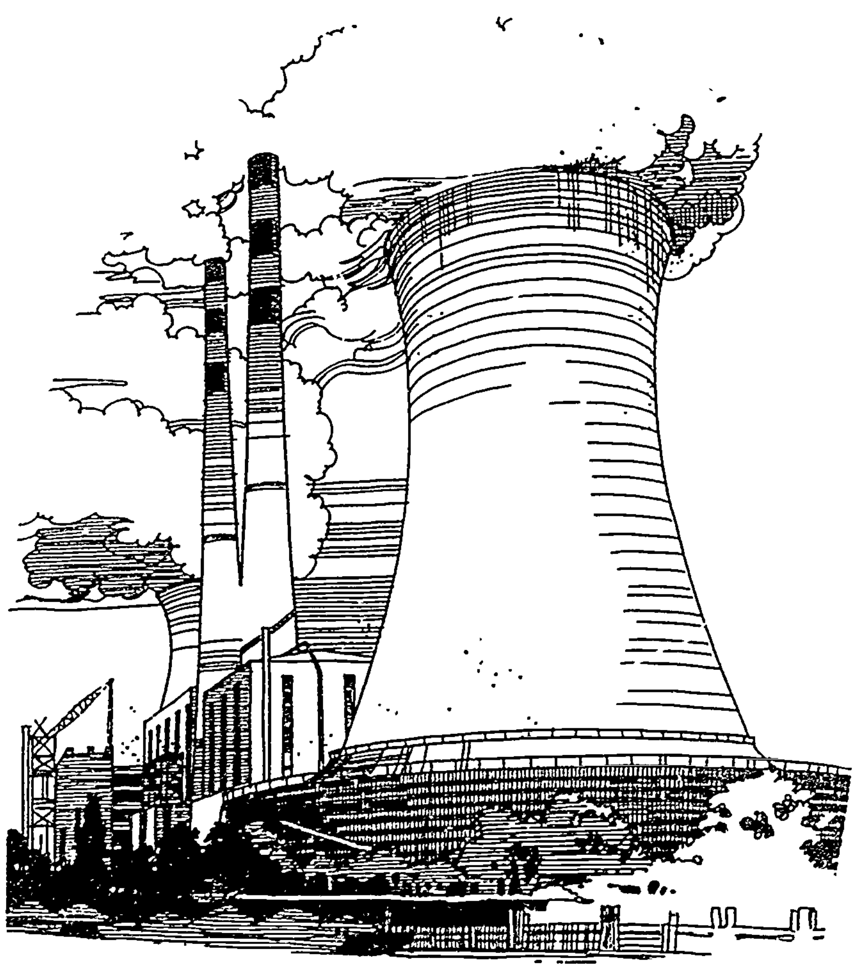
ACTIVITY

For the Student

Students are provided with information, or library time, in order to gather data bout the nuclear disaster at the Chernobyl reactor near Kiev, U.S.S.R. Students put key points of information on the blackboard and use them to determine a case study. Writing teams are made to develop the case study - one team writes the background of the event, another team determines the impacts the incident has had and a third team makes pictures, charts, maps, or graphs to help illustrate the situation. The teams pool their resources and writing efforts to determine a finished product. The case study should be evaluated by the class and changes made as needed. The teacher has each student record a list of lessons to be learned from the event and make a statement which reflects their attitude about the use of nuclear energy.

SOURCE OF ACTIVITY

This activity was created by S. E. Heiting, June, 1986.



IOWA COALA

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students investigate the ingredients of the Iowa coal industry (or Iowa Coala) as an energy resource, and develop a "mapographic" which shows state and national coal use.

OBJECTIVE

Each student 1) identifies and draws information about the coal industry, 2) compares Iowa's and the national use of coal, and 3) evaluates coal as an energy resource.

MATERIALS

drawing paper, markers, notebooks

TIME

2 - 3 days

LEARNING CYCLE

AWARENESS - Students are divided into two groups, one to cover Iowa's coal resource, the other the nations's. Information recorded in notebooks about amounts of production, distribution, and consumption of coal is presented by each group, main points put on the blackboard.

CONCEPT DEVELOPMENT - Each group draws a map showing their topics and the main points found out about state vs. national coal use.

APPLICATION - Using the mapographics, the students compare Iowa's coal with the nation's.

SUGGESTED EVALUATION - The teacher can assess what the class got out of this activity by directing each student to turn in a two part assignment. Part one has the student explain why Iowa's and the national coal industry should be limited or expanded. Part two has the student design a graph or illustration comparing or contrasting the Iowa/U.S. coal industry.

FOLLOW-UP/BACKGROUND INFORMATION

Students discuss the associated topics such as land reclamation, coal gasification and the significance of fossil fuels as a source of energy. Information and studies about these topics are available from the Iowa Department of Natural Resources - Energy Division.

ACTIVITY

The class is divided into two groups. One will gather background information on the Iowa coal industry, the other will find out about national use of coal as an energy resource. Students in each group are assigned to research various background topics such as history, production factors, types of mining, environmental impacts, amount of energy provided by coal, etc. Sources and information are presented by each group. Students are given a large piece of paper on which to draw a map of their assigned area. On each map indicators are drawn and labeled showing the main points they found concerning the use of coal as an energy resource. (Such a graphically designed map is called a mapographic) Students are asked to compare the two maps and compare the use of Iowa coal in relation to the U.S. total. Students should describe why Iowa coal has limited use, and what can be done to increase its use. Follow up discussion could be held concerning coal reserves, land reclamation, and coal gasification. Other fossil fuels can be brought into the discussion.

SOURCE OF ACTIVITY

Originated by S. E. Heiting, 1986.

ENERGY - MORE FOR LESS

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students in proportional population areas represent world energy consumption, so that highly industrial or affluent regions receive an amount disproportionate to their population.

OBJECTIVE

Each student 1) measures the effects of unequal energy distribution, 2) critically discusses the world energy distribution problem, and 3) devises methods to solve this problem.

MATERIALS

tokens, such as cookies or strips of colored construction paper

TIME

1 class period

LEARNING CYCLE

AWARENESS - Students are divided into groups representing different geographic regions. Tokens are given proportional to each area's energy consumption. Students notice the disparity in tokens vs. population areas and questions are raised.

CONCEPT DEVELOPMENT - Students questions are answered and they suggest ways for more equal distribution of energy resources. Recommendations are recorded on a poster labeled "Fair is Fair?".

APPLICATION - Using one or more of the recommendations, a resolution for fair global energy consumption is drawn up.

SUGGESTED EVALUATION - The teacher gives grade points to each student for every reasonable method resolution devised for the "NRG Distribution Problem." A chart showing how many ways to resolve the problem could be posted in the room. If students have difficulty earning points individually, they could be paired up.

FOLLOW-UP/BACKGROUND INFORMATION

Chart to be used to make proportional geographic regions and determine how many tokens given.

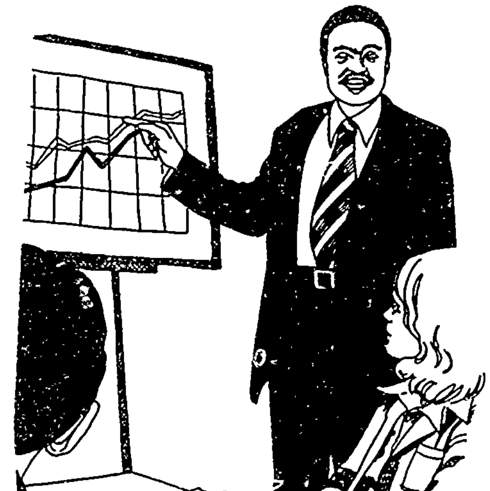
REGION	POPULATION %	NRG CONSUMPTION %
North America	8	35
U.S.S.R.	10	19
Oceania	1	16
Europe	4	13
South America	6	7
Asia	50	4
Middle East	1	1
Africa	10	1

ACTIVITY

Students are divided into groups representing different geographic regions. The number of members in each group is proportional to the population of each region. Tokens are passed out proportionally representing each region's energy consumption. Students will become aware that many regions receive more tokens than others, even though their population is smaller. Students might become upset. Ask what their feelings are concerning the distribution of the energy (tokens). Students will make suggestions for distributing the tokens fairly. Using one of the suggested solutions, an attempt is made to resolve the uneven energy consumption problem. To find the number of students needed to represent each region, multiply the decimal equivalent of the population percentage on the chart provided under FOLLOW-UP/BACKGROUND INFORMATION times the number of students in the class. To find the number of tokens each region gets, multiply the decimal equivalent of the energy consumption percentage in the chart, times the number of tokens used. Using one hundred tokens makes figuring easy. Students could make a display/bulletin board showing world energy consumption and lifestyles of each region represented.

SOURCE OF ACTIVITY

Adapted by S.E. Heiting from on OUTLOOK activity called "The Rich Get Richer" created by Barbara Bonnett, Sharon Goff, Jean Ketchum and Bob Winkleblack.



TAKE IT PERSONALLY, OR BE LESS ELECTRIC

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

Students will be directed to list and classify a personal inventory of their electrical use. Emphasis will be on limiting the use of three major sources of electricity, their cost and availability.

OBJECTIVE

Each student 1) computes her/his personal use of electrical energy, 2) determines ways to cut their "NRG use" in half, and 3) predicts the societial impact of cutting energy use.

MATERIALS

information from the Iowa Department of Natural Resources - Energy Division and local utility companies on resources/cost of electrical energy.

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students inventory their personal electrical use and are read a hypothetical statement saying that energy use will be rationed because of fossil fuel depletion. It is suggested that personal energy consumption be cut in half.

CONCEPT DEVELOPMENT - Students invent ways to cut their electrical usage at home, in school, and in other places they frequent.

APPLICATION - Discuss the 3 major sources of electrical power, the cost of each and alternative resources that could be used in place of fossil fuels. Investigate and discuss the impact of various energy resources — Political, Economic, Social, Environmental.

SUGGESTED EVALUATION - The instructor developes a quiz for this activity that includes questions about the various sources of energy investigated and the various impact categories of social, economic, political, geographic and environmental. The quiz could end with each student proposing and justifying reasons for cutting or not cutting electrical energy use.

FOLLOW-UP/BACKGROUND INFORMATION

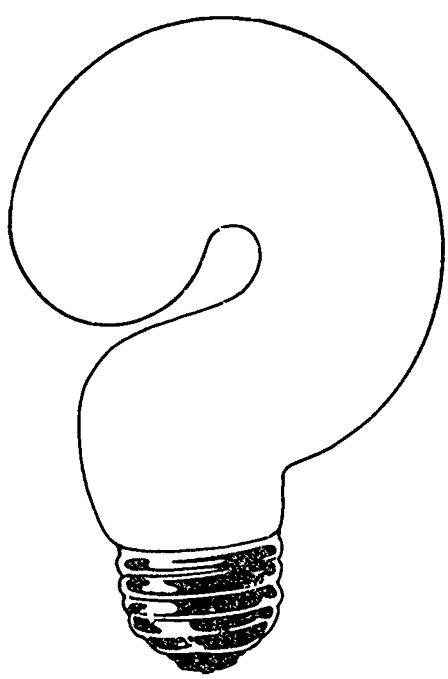
Invite a utility representative or visit a generating plant to gain current energy perspective. Construct an energy conservation collage (bulletin board) which suggest the problem - solution of electrical (fossil fuel) energy usage.

ACTIVITY

Students make individual lists of all their electrical uses. The teacher reads a hypothetical statement describing how each family's electrical use will be rationed due to the depletion of fossil fuels that run many generating plants in our nation. In order to help us all survive, we will have to reduce our personal use. Students must then invent ways to cut their electricity use. Discussion of the three major sources of electrical power (hydroelectric, nuclear and fossil fuels) and other energy alternatives is held. The class determines how much each kind of energy costs and how much each person would save by eliminating unnecessary uses. Students should determine what it would take to reduce their energy consumption in half. Investigation of alternative energy resources should be made. The impacts of increased use of nonfossil fuels should be discussed including social, political, economic and environmental factors. Speakers from the local utility might be employed to gain perspective about the current energy use and reserves of fossil fuels. A visit to a local generating plant might be arranged. An energy conservation collage would be an appropriate supplemental activity.

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "A Shocking Development", created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides.



CLEARING UP THE "CON-FUSION"

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students learn about Nuclear Fusion as an energy resource and determine a prioritized list showing the benefits of using nuclear fusion in generating electrical energy.

OBJECTIVE

Each student 1) distinguishes between nuclear fusion and nuclear fission, 2) determines priorities connected to issues involving nuclear energy, and 3) explains their position on the use of nuclear energy.

MATERIALS	TIME
chalkboard, notebook, letters	1 - 2 class periods

LEARNING CYCLE

AWARENESS - Students obtain information about the nuclear fusion issue from an Asimov article and determine a list on the board of the benefits of using nuclear fusion over nuclear fission to get electricity.

CONCEPT DEVELOPMENT - Students prioritize the list of benefits putting the most important considerations at the top. A final prioritized list is determined (by vote) and posted.

APPLICATION - Students react to the final list and do research on the current problems associated with the continued use of nuclear fission energy. Students write a letter to the U.S. Department of Energy encouraging the development of nuclear fusion.

SUGGESTED EVALUATION - The teacher evaluates the students' work on this activity by having each student write a letter to the Department of Energy in which they identify: a) the difference between fission and fusion, b) the top two priority issues to be resolved connected to the use of nuclear energy, and c) their position on the use of nuclear energy.

FOLLOW-UP/BACKGROUND INFORMATION

Iowa Developed Energy Activity Sampler provides the article by Isaac Asimov and other useful information that students can use to develop their position on this issue.

ACTIVITY

Students read the article "Nuclear Fusion" by Isaac Asimov and ask questions about terms and concepts that are confusing. They make a list of the advantages, mentioned in the article, of using nuclear fusion instead of nuclear fission to produce electrical energy. The list is put on the board and students work in groups to prioritize the list, ordering the list so that the most important reason for developing fusion energy is at the top and the least important reason at the bottom. Students may add ideas to the prioritized list. Each group puts its ranking on the board and students compare the listing. A class discussion follows and a final class "agreed (by vote if necessary) upon" prioritized list is made, put on a poster and used to research the current problems the nuclear industry has today using nuclear fission reactors. The students can conclude this study by writing letters to the U.S. Department of Energy encouraging the government to put more money into the research of nuclear fusion for the benefit of their generation.

SOURCE OF ACTIVITY

This activity was created by S. E. Heiting

Nuclear Fusion:

Where to Get Energy When the Oil Wells Run Dry

*by Isaac Asimov**

The world faces a crisis that may destroy civilization in our own lifetime. It is usually referred to as an energy crisis, but it isn't.

It is an oil crisis. The earth's oil wells may begin to run dry in 30 years, and without oil it would seem that the industrial world will clank to a grinding halt and that there will be no way in which the teeming population of the world could be supported.

Yet who says oil is the only source of energy? It is, at present, the most convenient source; at present, the most versatile. Matters do not, however, have to stay in the present.

The early decades of the 21st century may see oil supplies at a useless trickle and yet find energy plentiful and electricity coursing through the nerves and veins of industry. With plentiful, unending electricity, we could even manufacture our own oil to fill indispensable needs: Electricity can break down water to hydrogen and oxygen; the oxygen can be discarded, and the hydrogen can be combined with carbon dioxide from the air to form gasoline. The gasoline can then be burned and will combine with the discarded oxygen to form water and carbon dioxide again.

Nothing will be used up but electricity, and the electricity can come from the greatest and most copious source of energy on our planet--the hydrogen in seawater.

That hydrogen represents the great ark in which humanity can ride out the oil shortage that now threatens to overwhelm us and come to rest finally on the quiet uplands of energy-plenty.

There is a catch. The ark is not yet quite within reach. Our hands still grope for it, but we cannot yet squeeze the energy out of hydrogen.

The simplest way of getting energy out of hydrogen is to combine it with oxygen—to let it burn and deliver heat. Such a process, however, involves merely the outermost fringe of the hydrogen atom and delivers only a tiny fraction of the energy store available at its compact "nucleus."

Something other than hydrogen-burning--something much more dramatic--takes place at the center of the sun. Under enormous gravitational pressures, the substance at ıe sun's core is squeezed together, raising the temperature there to a colossal 15 million degrees Centigrade (24 million degrees Fahrenheit).

At such pressures and temperatures, the very atoms of matter smasn to pieces. There outer shells break away and expose the tiny nuclei at the center, which then drive into each other at thousands of miles per second and sometimes stick. When hydrogen nuclei stick together to form the slightly larger nuclei of helium atoms, the process is called "hydrogen fusion."

Every second, 650 million tons of hydrogen are fusing into 645.4 million tons of helium at the sun's center. This process produces energy. Each missing 4.6 million tons per second represents the energy that pours out of the sun in all directions. A very small fraction is intercepted by the earth, and on that energy all life is supported.

Though it takes an incredible amount of hydrogen fusion each second to support the sun, there is so much hydrogen in that giant object that, even after some 5 billion years, it is still mostly hydrogen. The sun can continue to produce energy for perhaps 7 billion more years before its fusion mechanism begins to falter.

Can we somehow take advantage of this process on earth?

The trouble is we can't duplicate the conditions at the center of the sun in the proper way. To begin with, we need enormous temperatures.

One way of achieving such temperatures is to explode an "atomic bomb" that is powered by uranium fission. For just a brief period of time, temperatures in the millions of degrees are produced at the center of that explosion. If hydrogen in some appropriate form is present there, it will fuse. The result is that the atomic bomb becomes the trigger for the greater blast of a "hydrogen bomb."

Naturally, we can't run the world by exploding hydrogen bombs. We want controlled fusion--the kind that produces energy a little bit at a time in usable, nondestructive quantities.

One way would be to start with a small quantity of hydrogen and heat it until it fuses. There would only be a small amount of energy produced. This could be bled away while new hydrogen is added to the mix to undergo fusion in its turn.

Heating hydrogen to the required temperature isn't easy, but it can be done by electric currents or by pumping in energetic subatomic particles. The trouble is that hydrogen expands as it's heated, and its atoms drift irretrievably away in all directions. We must hold the hydrogen in place while it is being heated. But how? The sun holds its hydrogen in place with its enormous gravitational field, but we can't imitate the sun's gravity on earth.

We can't use a fission bomb for controlled fusion, however. Some other way must be found to raise the temperature very rapidly.

One way is to make use of a laser. Lasers, first developed in 1960, produce light in a very tight beam. The total energy may not be unusually great, but the beam can be focused on such a microscopic point that the concentrated energy raises the temperature at the point to millions of degrees in a fraction of a second.

Imagine a mixture of deuterium and tritium inside a tiny, thin-walled glass bubble. If the bubble is struck simultaneously by a number of laser beams from different directions, the heating takes place all around the outer skin of the bubble. What expansion there is forces the gas upward. The inner portion of the bubble goes way up in density, further up in temperature, and begins to fuse.

We can imagine bubble after bubble dropping into position and being fused by accurately timed bursts of laser light. Work is underway at the University of California's Lawrence Livermore Laboratory to determine the feasibility of laser fusion.

Of course, it takes considerable energy to keep the lasers going, and they are expensive devices. Simpler and more efficient might be beams of high-energy subatomic particles such as electrons.

We still haven't reached controlled fusion in this fashion either. Larger, more reliable lasers are needed--or more powerful electron beams.

Still, at the rate we are going now, it seems that sometime before the mid-1980's, one or the other of the methods--magnetic fields, lasers or electron beams--will work. Perhaps all three will work.

And how exciting that would be! We have atomic power now in the form of uranium fission, but hydrogen fusion would be much better:

- Fission uses uranium and plutonium as fuel--rare metals that are hard to get and handle. Fusion uses hydrogen, easy to obtain and handle.

- Fission must work with large quantities of uranium or plutonium, so runaway reactions can take place by accident and cause damage Fusion works with tiny quantities of hydrogen at any one time, so even runaway fusions would produce only a small pop.

- Fission produces radioactive ash, which can be extremely dangerous and may not be disposed of safely. Fusion produces helium, which is completely safe; plus neutrons and tritium, which can be used up as fast as they are produced.

- Finally, fission only produces a 10th as much energy as fusion, weight for weight.

Nor can we force the hydrogen to remain in place by keeping it in a container. The heat might cause the container to vaporize. On the other hand, if we kept the container cool while the hydrogen heated up, the hydrogen would lose heat again upon contact with the cool container.

One possibility is to use a magnetic field. A magnetic field is not matter and is neither hot nor cold. As the hydrogen is heated, its atoms break down to electrically charged fragments, and these are repelled by the magnetic field. The fragments can't break through the magnetic field and must stay in place.

The problem is designing a magnetic field of the proper shape and intensity that will remain stable and not spring a leak. It's not an easy job. Scientists in the U.S., Great Britain and the Soviet Union have been working at it for nearly 30 years. The best device proposed thus far is the "tokamak," first developed in the Soviet Union.

But even a tokamak won't do the job for ordinary hydrogen. In the center of the sun, a temperature of 15 million degrees Centigrade is sufficient because the hydrogen is squeezed together very densely. On earth we must work with much thinner gas, and that requires still higher temperatures.

Fortunately, there is a kind of hydrogen easier to fuse called deuterium. Only one out of every 6500 hydrogen atoms is deuterium, but even so there is enough in each gallon of seawater to equal the energy supplied by burning 300 gallons of gasoline. Since there are 3.6 quintillion gallons of seawater on earth, there is enough deuterium to last billions of years at the present rate of energy use.

The temperature required can be lowered further if a still-rarer kind of hydrogen called tritium is added to the deuterium. Tritium is radioactive and hardly occurs in nature, but it can be manufactured in the laboratory.

If a quantity of deuterium-tritium mixture is made dense enough, heated hot enough and kept in confinement long enough, it will fuse. There are well-worked-out figures for what is needed for all three conditions, and scientists have been edging toward the critical combination. Recent work with tokamaks at Princeton University and the Massachusetts Institute of Technology has confirmed that fusion induced by magnetic confinement is a real possibility--once a better tokamak can be built. But this, experts say, is still many years away.

But magnetic confinement isn't the only route to fusion power. It's only needed when the hydrogen is heated slowly and would therefore expand and drift away while it is being heated.

Suppose the hydrogen were heated very rapidly. It might then reach fusion temperatures so rapidly that the hydrogen has no time to expand before it starts fusing. That's what happens in the hydrogen bomb. The uranium fission develops its high temperature so rapidly that any hydrogen present fuses before it can scatter.

ENERGY - JUST "BLOWN' IN THE WIND"

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

Students use information about wind power to determine the relative usefulness of energy generated by Iowa's winds compared to other locations and make a coded "mapographic" showing the difference.

OBJECTIVE

Each student 1) designs part of a "Wind Power Mapographic", 2) analyzes an article about wind power, and 3) passes a student prepared quiz on wind energy.

MATERIALS

board space, colored paper, chalk and/or markers

TIME

1 class period

LEARNING CYCLE

AWARENESS - Students get information about wind power from an I.D.E.A.S. article entitled "Wind Power" and are divided into 4 groups to develop contributions to a learning session held near the end of class.

CONCEPT DEVELOPMENT - Students develop their group assignments creating a report, a "mapographic" and a quiz on wind power.

APPLICATION - Students complete the map, listen to a report given by group 1 and take a quiz on wind power (passing level determined by the teacher according to the questions used).

SUGGESTED EVALUATION - The instructor makes copies of the quiz questions made up by students not actively participating in the groups. These students should also devise a grading scale to be used for grading the results of the quiz. Each student is given the quiz and grades are posted. Extra credit can be earned by the student explaining what the mapographic shows about wind energy.

FOLLOW-UP/BACKGROUND INFORMATION

This activity is designed to occur in one class period with group activities going on simultaneously and non-participating students grouped to make a quiz (with teacher assistance) to be used as a concluding activity. The article on wind power is provided.

ACTIVITY

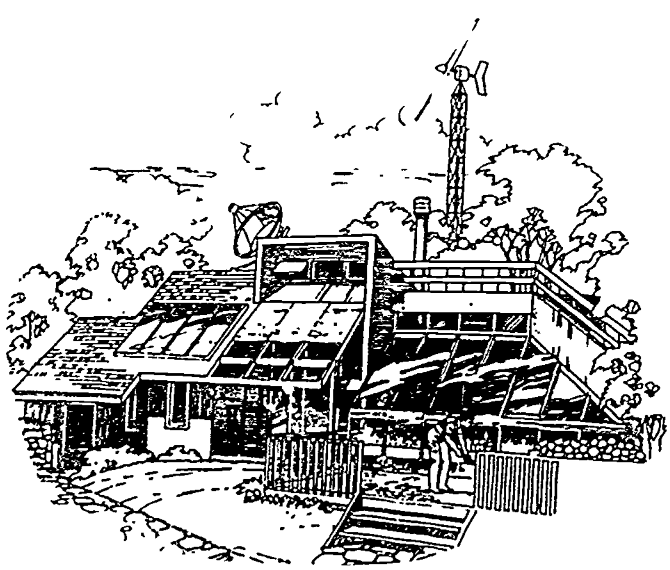
Students are given a copy of "Wind Power" provided by I.D.E.A.S. and asked to read, analyze and determine how important wind power is to Iowa compared to other states indicated on the articles chart. The class is divided into 4 groups to do the following tasks:

Group 1 Will report on what wind power is, how much is needed to produce energy, and where information about wind power can be obtained.
Group 2 Draws an outline map of the U.S. on the board to be used to make a "mapographic" of the relative importance of wind power to various parts of the U.S.
Group 3 Determines what locations would be best for the generation of wind energy and color codes each according to how well wind energy could be used in each location.
Group 4 Takes the information provided by group 3 and places it on the board map making the color code legend viewable to the entire class.

After the class views and reports on their handy work they are given a quiz about wind power which was made up by those in the class who did not seem to have enough to do during the activity.

SOURCE OF ACTIVITY

This activity was originated by S. E. Heiting



Wind Power

Wind energy is the kinetic energy of moving gas that causes a reaction whenever its flow is interrupted. A windmill functions much like a water wheel, but air is only 1/800 as dense as water and its flow may be less constant than that of streams tapped for hydroelectric power. Nevertheless, the ocean of air has more than twenty times the potential for power generation than does all hydropower resources of the U.S. (See ENERGY RESOURCES' table: Power per Acre on Continental U.S.)

Wind power is an indirect product of the sun. Solar radiation warms the surface of Earth unevenly (because of clouds and differences in surface materials and terrain). Earth, in turn, conducts and radiates heat unevenly to the air. The uneven heat distribution causes pressure differences, setting convection currents in motion. Warm air from the tropics moves toward the poles, and cold polar air moves toward the equator. This massive general circulation modified by Earth's rotation and its revolution around the sun creates belts of prevailing global winds.

The strength and steadiness of wind is a local variable that must be tested before use of a windmill is seriously considered. Unless there are daily winds of 5-13 mph and occasional stronger winds of 13-23 mph, the site is not suitable for wind-powered electrical generation. Anemometers can be used to determine the wind-power potential of a particular location or for $6.50 any citizen can order "Wind Tabulation, Percentage Frequency of Wind Direction and Speed" for the nearest weather station from the National Climatic Center, Federal Bldg., Asheville, N.C. 28001. Some typical wind averages are:

Fargo, N.D.	14.4
Wichita, Kansas	13.7
New York, N.Y.	12.9
Des Moines, Iowa	12.1
Milwaukee, Wisc.	12.1
Indianapolis, Ind.	10.8
Denver, Colo.	10.0
Kansas City, Mo.	9.8
Tucson, Arizona	8.1
Los Angeles, Cal.	6.8

Of course, even after we finally attain controlled fusion in the laboratory, it may take as long as 30 years to translate that into large f sion-power stations. There may be many engineering difficulties between a small demonstration that pleases scientists and a large, reliable supply that runs the world.

It may well be 2020, then, before we are a fusion society. It would be wise to conserve oil supplies and to substitute other energy sources (coal, shale, wind, flowing water, tides, hot springs, and so on) to keep up going until fusion can take over.

And we might also strive to develop solar energy, making use of the nuclear fusion power that already exists and that we call the sun.

One of the physical laws relevant to windmills suggests that bigger winds are much better. Kinetic energy is proportional to the cube of wind velocity, so the stronger the wind, the more power we get from it. If a certain speed gives 2 kilowatts of energy, doubling that speed gives 16 kilowatts.

Bigger is also better for the windmill itself. Power output depends on the area of the propeller and a high enough tower to reach the main windstream. Even in flat areas, a tower of 35-50 feet is usually necessary for consistent performance. All equipment must be sturdily built. Reliable windmills cost more initially, but can be expected to last longer and to reduce danger of sheared-off debris.

If wind power is used to generate electricity, a battery-storage system is required. It produces DC current which is not always compatible with AC appliances; proper conversion devices add to the expense of the system.

One of the benefits of using wind power not yet measured in dollars is that it does not contribute waste heat, environmental damage from mining or oil spills, or radioactive waste products to contaminate the environment. Windmills may not have much "eye appeal" on the landscape, though, and they may affect TV reception in some areas.

Windmills to pump irrigation water, to grind grain, or to heat water by direct mechanical action have less critical requirements than those for electrical power generation and they have been used successfully for centuries, notably in Persia (now Iran) and Holland (the Netherlands).

Sailing ships also took advantage of prevailing winds. Men have circumnavigated the Earth in vessels developing as much as 13,000 horsepower per ship. Germany is presently constructing an up-to-date "Dyna Ship" with dacron sails that, it is hoped will get 95% of its energy from the wind. An auxiliary engine is planned, however, to take over as necessary.

TRANSPORTOONS

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students are presented with statistics about various kinds of energy use and draw a cartoon or bumper sticker that makes an energy transportation point learned from the information read.

OBJECTIVE

Each student 1) identifies a fact about transportation for illustration, 2) draws and labels a "transportoon," and 3) explains the cause/effect relationship between energy and transportation.

MATERIALS	TIME
straight edges, drawing paper, markers, colors, pencils	1 class period

LEARNING CYCLE

AWARENESS - Students are given I.D.E.A.S. information about transportation to read and compare. They should select one fact to work with and present in a drawing.

CONCEPT DEVELOPMENT - Students draw a cartoon ("transportoon") or design a bumper sticker about the data selected and provide titles, labels and captions.

APPLICATION - Drawings are shared and the students pick the one which they feel represents a transportation-energy problem in the United States today and for the future.

SUGGESTED EVALUATION - The instructor evaluates each students' performance according to the following: a) how clearly the student made a visual point about energy-transportation and captioned it for the viewer, b) how precisely the student related a cause/effect relationship between transportation and energy.

FOLLOW-UP/BACKGROUND INFORMATION

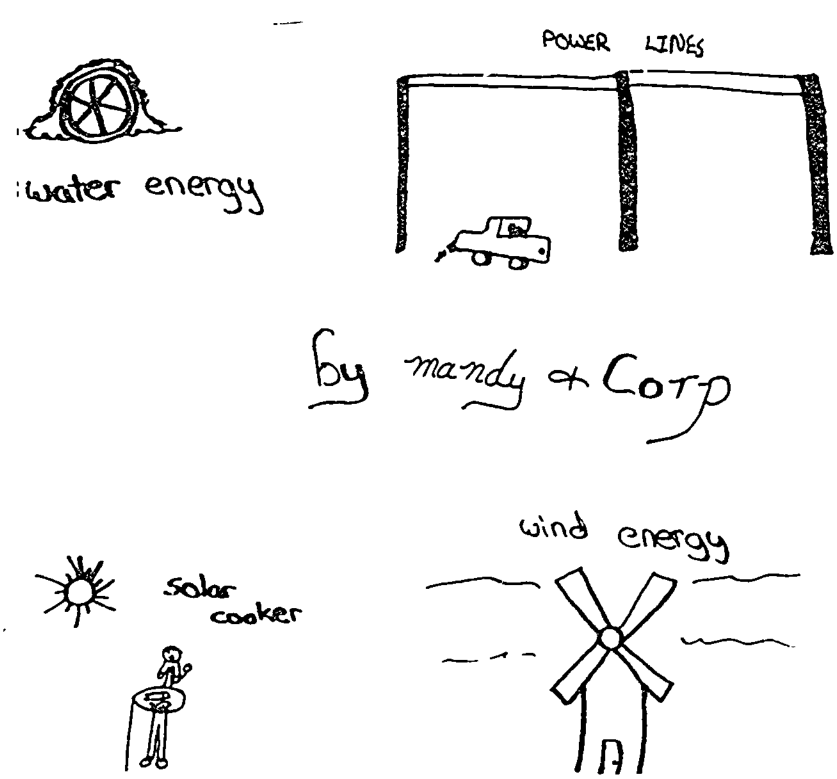
I.D.E.A.S. article on Transportation Facts follows.
Students are assigned homework that has them determine the cause/effect relationship of the problem identified in class. Each student could write a statement that suggest what should be done about the problem.

ACTIVITY

Students are given a copy of "Transportation Facts" to examine and directed to pick one statistic from all data read and to draw a cartoon or bumper sticker about it. Each student should label their drawing giving it a meaningful title and provide a caption at the bottom which briefly describes or confirms the point being made. Students share their "masterpieces" and decide which one of the pictures presented shows the most serious transportation/energy issue or problem in the U.S. today. Students are given a homework assignment which has them write a statement relating the cause/effect relationship between energy and transportation.

SOURCE OF ACTIVITY

This activity was created by S. E. Heiting.



Transportation Facts

The U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1979, Washington, DC states that:

300 million gallons of gasoline are burned in American automobiles every day.

The United States imports as much crude oil as it produces.

Transportation accounts for about 13% of consumer spending. About 94% of these expenditures were for user-operated vehicles.

U.S. drivers put about 1.4 trillion miles on their odometers every year.

More than eight of every ten households owns at least one passenger car.

More than 40% of passenger car travel is related to earning a living. Nearly eight of every ten employed persons travel to work in automobiles.

Some 95% of all households with incomes more than $15,000 own a car, and nearly 50% of the households with incomes topping $20,000 own two cars.

About 60% of the U.S. population is licensed to drive motor vehicles.

A U.S. Census Bureau survey finds 86% of job commuters in 21 metropolitan areas use private cars or trucks. Eighteen percent share a ride by car or truck, 12% rode buses, street cars, commuter trains, subways or elevated rail cars. Sixty-eight percent of the commuters drove alone.

26% of all energy consumption in Iowa and the United States is attributed to transportation.

And for 1979, The Iowa Department of Transportation tells us:

There are about 2.3 million registered motor vehicles in Iowa (excluding motorcycles) that travel about 19 bilion miles per year.

Each registered Iowa vehicle carries about 1.4 passengers.

The average Iowan uses public transportation (when available) about 13 times per year.

ENERGY AND AGRICULTURE - AN HISTORICAL VIEW FOR THE FUTURE

SS-41

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

The students examine information about the history of agri-energy and write a short story that shows the developing use of energy on the farm, ending with a statement about energy options on the farm of the future.

OBJECTIVE

Each student 1) cites evidence of the relationship between energy and agriculture, 2) describes the development of "agri-energy" in a story, and 3) states the most important energy choice Iowa's farmers will make in the future.

MATERIALS

notebooks and writing tools

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students are given I.D.E.A.S. article on Energy and Agriculture and read about the background and future of agri-energy.

CONCEPT DEVELOPMENT - Students write a story that tells how agri-energy developed in the U. S. and how it will impact farmers future.

APPLICATION - Students share their stories and discuss the various future problems to be reckoned with in the area of agri-energy.

SUGGESTED EVALUATION - The teacher can grade the story according to the normal criteria used to evaluate student writings, taking special note of the students' clarity in showing how energy has become a much more significant factor in modern farming.

FOLLOW-UP/BACKGROUND INFORMATION

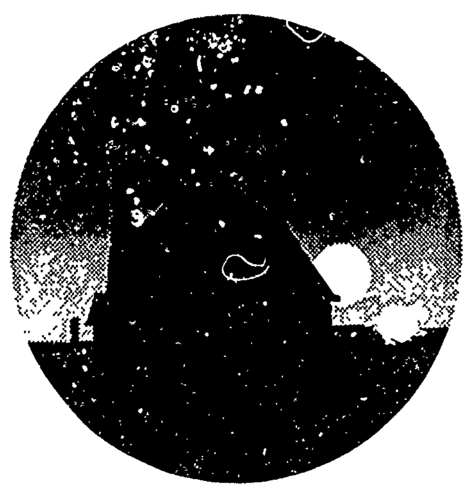
Students write a statement at the end of their stories which tells the most important choice to be made by Iowa farmers in the future. The article on Energy and Agriculture follows.

ACTIVITY

Students are given a copy of the I.D.E.A.S. article "Energy and Agriculture". After the students have read and discussed the information the teacher has each student write a two part story for which they invent an appropriate agri-energy title in class. The title should suggest the focus of the story. During the class an outline of the two parts of the story should be made with appropriate subsection titles developed along the two themes Agri-Energy of the Past and Agri-Energy of the Future. Students write the story according to their outline using fictitious characters and events to make points which are accurate from the information previously read. Students share their stories and discuss what they feel the future holds for farmers and energy. Each student is to write a statement at the bottom of the last page of their story which says what the most significant agri-energy choice will be for Iowa's future farmers.

SOURCE OF ACTIVITY

This activity was originated by S. E. Heiting



Energy and Agriculture

Introduction:

The most important form of energy is that which powers our brains and muscles and warms our bodies. It comes from food.

Food is produced by solar energy, supplemented only by the muscle energy of man and animals in most of the world. But in the United States more than anywhere else, fossil fuel energy extends and supplements what farmers can produce individually.

The number of people fed by one U.S. agricultural worker is 56; the world average is less than a tenth of that, or 5.1 persons fed by each farmer. The main reason is energy-intensive use of machinery, fertilizers, pesticides and herbicides.(5)

History:

One hundred twenty years ago, most Americans lived on energy self-sufficient farms. Woodlots supplied fuel for heating and cooking. Pastures provided energy for horses, mules, or oxen that, in turn, powered treadmills, plows, and farm wagons. Human labor and hand tools supplied the means for other work like feeding, milking, cutting, and threshing.

Kerosene lanterns were the first fossil fuel consumers on most farms. Some families were already using them in 1860.

The next step in dependency on fossil fuel increased farm productivity. Bulky steam tractors that ate coal and kerosene appeared on the scene in the twentieth century. By the end of World War I, some farmers had replaced their horses with a tractor and a Maxwell Motors truck. These mechanical horses demanded another kind of fuel--gasoline.

By the 1930's, many farms were starting to use electricity. At first barnyard "wind chargers" were the providers. By hooking his windmill to a generator, a farmer could convert the mechanical energy of the wind-turned blades into electricity for his home. But cheap and abundant supplies of coal, petroleum, and natural gas as well as new hydro-electric dams on many of the nation's rivers helped electrical power networks spread from coast to coast. Most windmills were abandoned in favor of the inexpensive convenience of a steady supply of commercial electricity.

Of course, some of these savings are offset by the increased use of herbicides, which are also made from fossil fuel, and by lower rates of seed germination. But no till methods are constantly improving and the U.S. Department of Agriculture estimates that by 2010, over 90% of all U.S. row crops will be planted using this method. This alone would mean big energy savings on the farm.

Many energy alternatives for the future—solar, efficient wind power, bioconversion—are still in the early stages of development, adoption, and use. Until they are more readily available, many farmers save energy by making more productive use of current resources. Typical conservation measures include insulating barn ceilings; clustering chicken brooders closer together to cut heat loss; sealing air leaks around barn and shed windows and doors; making fewer trips in the farm vehicles; using lower wattage light bulbs; planting windbreak; turning off any electrical equipment when it's not wholly essential. These and many other simple measures can save both energy and money.

Tommorrow's farm will probably not be like the small and self-sufficient homestead of the Civil War era, but it won't be like today's fossil fuel-intensive farm either. Energy-aware managers will orient buildings to the sun and/or protect them from wind and cold with earth berms. Devices like solar heating systems, solar stills, streamlined windmills, and bio gas converters may become commonplace. And, considering traditional human ingenuity, there may be inventions we haven't even considered yet.

Resources and Additional Information:

(1) Council for Agricultural Science and Technology, Energy Use in Agriculture: Now and for the Future (Report No. 68 Agronomy Building, Iowa State University, Ames, IA 50011) (free).

(2) Harris, Michael, "Eating Oil," Myth of the Green Revolution reprint package, 1977, c/o Reprints, Mother Jones, 607 Market Street, San Francisco, CA 94105, $1.00.

(3) Laitner, S. and Cool, R., "A Review of Ten Solar Applications in Iowa," 1979, available free from the Iowa Energy Policy Council, Lucas Building, Capitol Complex, Des Moines, IA 50319.

(4) Steinhart, C. and Steinhart, J. The Fires of Culture: Energy Yesterday and Tommorrow, Duxbury Press, North Scituate, MA, 1974.

(5) U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States: 1979, Washington, DC

HAVE A BALL AND NOT WASTE ENERGY

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Given information about energy waste, students list ways in which usable energy is lost, using the categories production and consumption and then construct a "conserv-action ball" of remedies to this energy waste problem.

OBJECTIVE

Each student 1) identifies how energy is wasted during its production and consumption, and 2) constructs part of a "Conserv-Action Energy Ball."

MATERIALS	TIME
large poster, colored slips of paper, markers	1 class period

LEARNING CYCLE

AWARENESS - Students are given an I.D.E.A.S. article about Energy, Waste and Productivity to read and discuss in terms of energy production and consumption. Groups are formed and given color coded slips of paper.

CONCEPT DEVELOPMENT - Each group is to contribute as many examples of Conserv-Action as described in the article and samples. Color coded slips with each example are arranged to make a "Conserv-Action Energy Ball".

APPLICATION - Students discuss how they are currently part of the problem of energy waste and how they could become part of the solution.

SUGGESTED EVALUATION - The instructor may choose to award points to each student according to their participation, ability to identify points from the article, and number of contributions to the "Conserv-Action Energy Ball." These points can be translated into grades according to the most appropriate method normally used by the teacher.

FOLLOW-UP/BACKGROUND INFORMATION

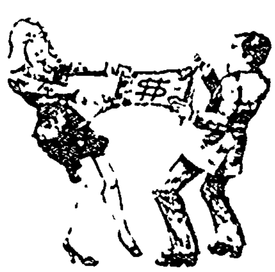
Students are given the assignment to write a report or essay about how their parents, the school and the nation could do a much better job of saving energy so that there will be less waste and more for the future use. The article "Energy: Waste and Productivity" follows.

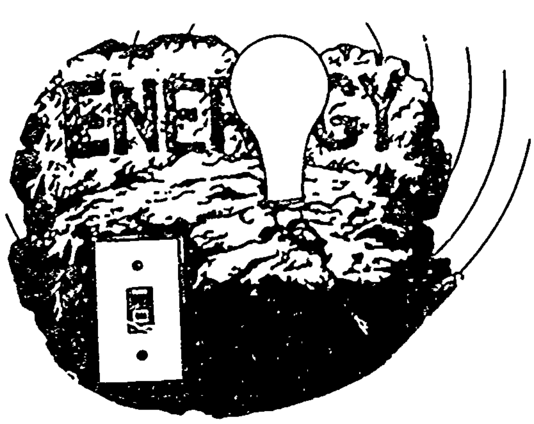
ACTIVITY

Students are given a handout from the I.D.E.A.S. called "Energy Waste and Productivit , which is read in order to list ways in which energy is wasted in the U. S, under the categories of Production and Consumption. (These terms should be described by the teacher.) Students are asked to share their category lists and discuss how much energy is wasted in the U. S. under each category. The teacher may choose to keep part of the conservation list (i.e. numbers 3-14) from the students for future reference in the construction of a "conserv-action ball". Students are put in groups to write individual examples of conserv-action on colored slips of paper (each group has a different color). Students from each group put the examples on a large round poster in a circular or "ball shape" in order to make the Energy Conservation Ball. The group that has the most samples of conserv-action is awarded points or some Energy Effort Reward by the teacher. If groups have trouble thinking of examples the teacher can provide hints from the retained examples provided by the I.D.E.A.S. article. At the end of the activit udent discuss (or are assigned) the question; "What can I do this week ontribute to conserv-action at home and in school?" Further questions about what their parents and the school (the nation) can do to better conserve our energy resources can also be included in the discussion or assignment.

SOURCE OF ACTIVITY

This activity was created by S. E. Heiting.





Energy: Waste and Productivity

Energy is lost during mining, generation, transmission, and at point of use. Direct use of a fuel is usually more efficient than burning it to produce electricity first.

Transforming a fossil fuel to electricity results in about two-thirds of the heat energy in the fuel being released to the environment where it is unavailable for any work. Conversion of uranium to electricity is even more wasteful. Thermal pollution or unnatural heating of the environment around power plants is a by-product of electrical generation. "For a limited area of highly concentrated energy use like Manhattan Island, waste heat already exceeds incoming solar energy by a sizable margin." (From Inadvertant Climate Modification, Massachusetts Institute of Technology, 1971.)

Energy waste in transportation is a major factor in the American high energy budget. Heavy, "high-performance" cars and recreational vehicles used for short-range commuting (< 2 1/2 miles) and for carrying an average of 1.2 passengers are symbols of thoughtless extravagance and isolation from neighbors. Appliances and machines that don't perform at optimal levels -- or are produced to meet artificial needs and are seldom used -- waste energy both in their production and in their use. And energy is wasted in buildings when it is allowed to leak through ceilings, walls, windows, doors, pipes, and water heaters due to poor insulation and design or due to activities (or lack of activity) of their occupants.

Energy is also wasted when it is not matched in "quality" to its task. For example, when electricity is used to heat buildings, water, and food, much of its high quality energy is wasted. Typically, a fossil fuel is used to boil water at the power plant, to make steam to turn turbines to generate electricity. Then electricity often must be transmitted over considerable distances before it is used to boil water again in the home. In each step there is considerable loss of energy before the intended task is done.

Nuclear fuel is used to achieve a temperature of several thousand degrees in an expensive, complicated reactor in order to boil water to steam at 212°F. The concentrated heat from this fuel source can boil more water in a given time span than can an equal quantity of fossil fuel, and the electricity generated is well suited to special tasks, like lighting and some exacting industrial processes. But using expensive electricity to heat or cool buildings to 70°F or to boil water whenever lower-quality, less-expensive technologies can do those jobs is wasteful.

President Carter stated, in 1977, "Our energy waste in transportation is 85%; in generating electricity, 65%. Overall, 50% of our energy is wasted."

David R. Brower wrote (1973) that China's several hundred millions of people use less electricity for all purposes than the U.S. uses for air conditioning alone.

Denis Hayes, director of Solar Energy Research Institute, has noted that Americans wasted more fuel in 1975, than was used by two-thirds of the world's population.

Is there a more positive way to talk about this problem of inefficient energy uses? Mona Martin of the League of Women Voters of Iowa prefers to use the term "energy productivity" to describe ways in which the economy improves through energy conservation measures. Energy productivity means squeezing more consumer goods and services out of each unit of fuel used, whether it is a barrel of oil, a ton of coal, or a pound of uranium. Insulation, more efficiently designed appliances and buildings, improved engines and furnaces and other modifications by sophisticated technology can improve the net yield of our energy consumption. Such energy productivity will moderate energy demand while permitting "business as usual" according to a study published in 1978, by the National Academy of Science's Committee on Nuclear and Alternative Energy Systems.

Simply using less fuel per person is an even more direct form of conservation. Relying more on human services and extending the life-cycle use of vehicles, appliances, and buldings are effective strategies for extending the usefulness of non-renewable resources. Thrift, craftsmanship, durability, reliability, cooperation, and neighborliness all belong in conservation strategy. Avoiding energy waste not only saves money, but also is an investment in a more gradual energy transition, and healthier use of our bodies in a cleaner environment.

To emphasize that people are more important than hardware, perhaps conservACTION is the term educators should use. It would avoid confusion with:

1. The scientists' "conservation of energy" (meaning accounting for where it went, a different concept entirely from those of usefulness, productivity, or efficiency).

2. The passive notion of "doing without" or avoidance, a negative image for what can be a positive challenge.

What are examples of conservACTION? You and your students can probably brainstorm hundreds of them once you start considering personal activities that are energy-efficient or that reduce energy losses. Here are a few examples to get you started:

1. Bicycle, rollerskate, or walk to school and work if possible. If not, use public transportation or join a van pool.

2. Provide instruction on how to keep a bicycle in good repair; how to tune a car, how to caulk a window, how to weatherstrip a door. Have students complete such tasks under supervision.

3. Learn how to interpret energy-efficiency labels provided with appliances and other power equipment. Buy or rent the most efficient model. Investigate ways to extend its usefulness by sharing it or renting it to others.

4. Give high priority to gas mileage when buying a new car. Avoid power-consuming options.

5. Make as much use of natural lighting as possible. Use smaller light bulbs and turn off all unnecessary lights.

6. Plant a vegetable garden to save both fuel and money. Avoid transportation, processing, packaging, and storage costs of mass produced produce.

7. Eat more fresh fruits and vegetables, other foods that need no cooking.

8. Insulate your home.

9. Use drapes, shades, or insulating shutters to cover windows in your home and school during winter nights.

10. Grow plants for indoor decoration, humidification, and air purification.

11. Plant a leafy shade tree to the south of your home and/or school.

12. Plant an evergreen hedge on the north side of your home. Prune it as needed to encourage dense growth.

13. Learn to play a musical instrument, to dance, to sing, to help produce plays, to make or repair clothing or furniture, to refurbish toys, to master chess or bridge.

14. Cook foods in <u>covered</u> pans only. Experiment with low-heat cooking. Build and use a solar oven.

PUZZLING OVER ENERGY

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

Students work in competitive groups to solve the Energy Express(ion) Activity in I.D.E.A.S. and design a new energy crossword puzzle or hidden energy words puzzle that connects to an energy conservation message determined by the group.

OBJECTIVE

Each student designs part of their groups' energy puzzle, states an energy message or theme, and explains which energy messages are most significant.

MATERIALS

notebook, writing tools, graph paper, I.D.E.A.S. article that follows

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students work in groups to solve the Energy Express(ion) handout on a competitive basis. Each group determines an important energy conservation message, theme, or lesson to use.

CONCEPT DEVELOPMENT - The groups develop a puzzle of words connected to the energy conservation theme selected and provide a finished copy (with answers on a separate page) to the teacher.

APPLICATION - The teacher redistributes the puzzles for different groups to solve and figure out the hidden theme incorporated into the puzzle.

SUGGESTED EVALUATION - The instructor can grade the statements submitted according to how clearly each student identified an energy theme that relates to them personally, to the community-state, and to the nation.

FOLLOW-UP/BACKGROUND INFORMATION

The energy conservation themes are put on the board for each student to use in statements (or an essay) indicating which message significantly applies to them personally, to the school, and the nation. A list of future actions needed for more efficient energy use can be made and posted by groups or individuals for extra credit.

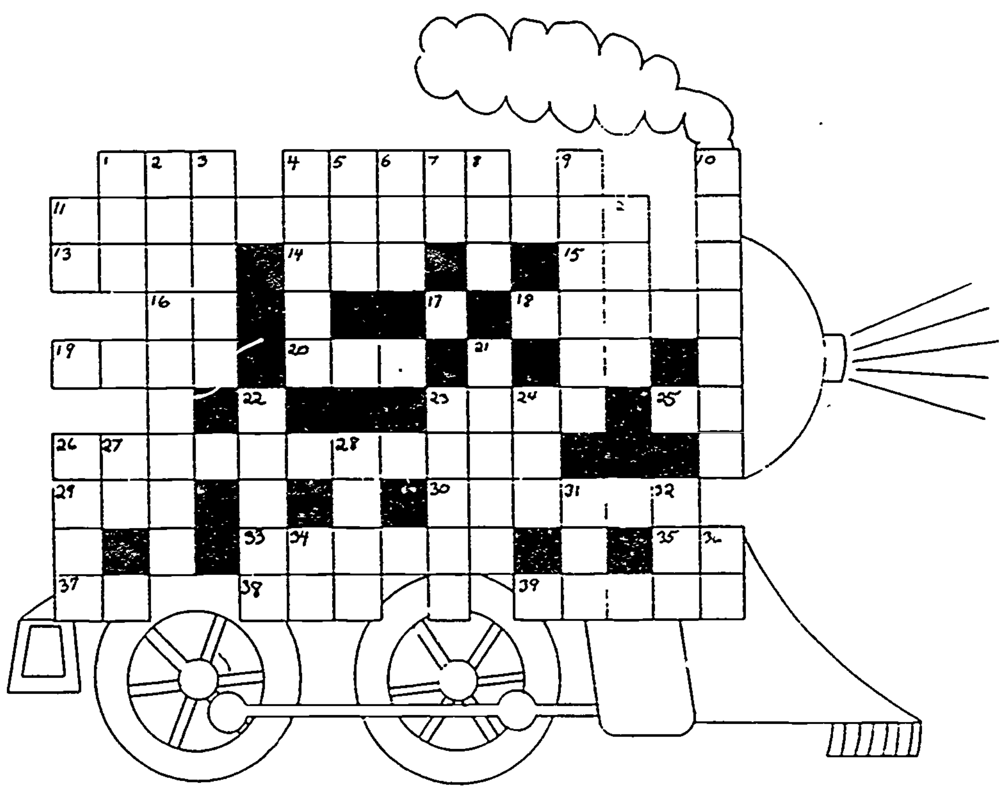
ACTIVITY

Students are grouped and given a copy of The Energy Express(ion) from the I.D.E.A.S. to complete as fast as possible. The first group to get done is awarded extra credit or some prize or privilege appropriate for the class situation. Each group is then to decide on an important secret energy conservation message or lesson to use as a theme for the construction of a new crossword puzzle or hidden word puzzle. The puzzles can be limited according to the time available to work on them. Each group completes their puzzle and exchanges it with another group. Groups solve the puzzle and figure out the energy conservation message (theme) which has been incorporated into the puzzle. Each conservation lesson is put on the board and the groups discuss and defend the importance of each theme. Students write statements indicating which energy conservation message means the most to them personally (which they could do something about) and which is most meaningful for the school and nation to pay attention to.

SOURCE OF ACTIVITY

This activity was originated by S. E. Heiting.

Words About Energy - II



The Energy Express(ion)

Directions:

Put a little energy into expanding your vocabulary. Then you'll be able to keep on the track and steam ahead by observing these signals:

ACROSS:

1. To choose freely.

4. What a kite or glider will do in a good wind.

11. Moving because of the application of heat (adj.).

13. Exhausted, run out, hollow (phonetic spelling).

14. The side sheltered from wind.

15. Sometimes this is an energy-saving response.

16. Worker providing medical services at low-energy cost (abbr.)

17. Initial of a scientist who devised a centigrade thermometer.

18. How to survive in challenging times.

19. Stored solar energy resource most used by less developed countries.

20. Roentgen equivalent man, (abbr.) unit of biological dose of radiation.

23. Mode of transportation that is an energy-efficient freight mover.

25. The most basic energy-producing business (abbr.).

26. Power for small motors.

29. Engineers' measure of heat: the amount of heat required to raise one pound of water 1° F.

30. Metric unit of time; fraction of a minute.

33. Person who lives in the countryside, known as a back-to-the ____________.

35. Domesticated animal that is a major power source in some developing countries.

37. Warm prevailing wind.

38. Unit of weight (British system) (abbr.).

39. Energy-saving devices; furniture usually found wherever people live or work.

DOWN:

1. Unit of electrical resistance.
2. Naturally occurring mixture of crude oils.
3. Turn toward a particular direction or course; as in, "Car dealers report that the buyers' ____________ is toward small cars."
4. Renewable energy on which all living things depend.
5. Kind of poem. Shelley wrote one ". . . to the West Wind."
6. Intelligent response to calls for conservation; a vote in favor of energy saving.

7. Symbol of radon gas, a by-product of radioactivity.

8. Useful tool for processing man's oldest fuel.

9. Invisible energy source that can provide electricity or hot water in some locations.

10. Electrical potential expressed in volts.

11. Thermal energy (abbr.).

12. Solid, non-renewable, fossil fuel.

21. Very heat-absorbent liquid.

22. Equipment for separating fresh water from salt or alcohol from grain; may be directly solar-powered.

23. What warmer fluids have always done.

24. International Yodeling Contest (abbr.), a low-energy production of musical entertainment.

26. What the tide does daily.

27. The kind of energy eye-witnesses depend on (abbr.).

28. Charged particles involved in chemical and electrical energy transfers.

31. Number of times a human being can completely stop using energy.

32. Department of Transportation.

34. "Absolute" (abbr.).

36. Unknown quantities.

Teacher's Guide to Words About Energy - II

Answer Key

		1	2	3		4	5	6	7	8		9			10
		O	P	T		S	O	A	R	S		W			V
11	T	H	E	R	M	O	D	Y	N	A	M	I	C		O
13	E	M	T	E		L	E	E		W		N	O		L
			R	N		A			C		A	D	A	P	T
19	W	O	O	D		R	E	M		W			L		A
			L		S				R	A	I	L		A	G
26	E	L	E	C	T	R	I	C	I	T	Y				E
29	B	T	U		I		O		S	E	C	O	N	D	
	B		M		L	A	N	D	E	R		N		O	X
37	S	W			L	B	S		N		S	E	A	T	S

WHAT'S THE DIFFERENCE ?

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Students use I.D.E.A.S. article to conceptualize life without electricity and discern the difference it makes in their lives.

OBJECTIVE

Each student 1) critically discusses the article assigned, 2) states questions for the role playing activity, and 3) describes their "lack of electricity experience" in an article.

MATERIALS

I.D.E.A.S. article and follow up materials follow this activity.

TIME

1 - 2 class periods

LEARNING CYCLE

AWARENESS - Students read the Jensy Patterson information and discuss their impression about her life in Africa without electricity. Questions are written and put on the board with additional questions from the teacher.

CONCEPT DEVELOPMENT - Students are divided into 2 groups and asked to simulate the roles of reporters and a Peace Corps person. Members of both groups write a newspaper article about life without electricity.

APPLICATION - Students are instructed to try avoiding the use of electricity after school until they return to school the next day at which time they discuss the difference it makes.

SUGGESTED EVALUATION - The teacher can base an evaluation on each students' participation in the discussion, the questions written, and the article written about life without electricity. Credit for creative titles and a written log kept by students who attempt to live without electricity for a day may also enhance the grade.

FOLLOW-UP/BACKGROUND INFORMATION

Students should keep a log or list of all the times they were (or would have been) affected by the total lack of electricity. Ask them what the experience suggests about their (our) future.

ACTIVITY

Students read the I.D.E.A.S. article entitled "Life Without Electricity, A Peace Corps Experience", Social Science 7-12. The class discusses the article sharing their feelings and impressions about the experience of Jensy Patterson. Each student is asked to write two or more questions they would like to ask Jensy about living without electricity. Students share one of the questions and they are recorded on the board. The teacher adds some follow up questions (teachers guide) to the students questions and uses them as the basis for separating the class in two groups; those willing to try to live without electricity (for a short time period) and those who would not be willing to give up electricity, even for a short period. Each group brainstorms answers to key questions they or the teacher selects from the list on the board. Answers are shared and students from the "electricity always" group act as reporters interviewing members of the other group about their supposed life without electricity. After this activity each student is asked to entitle and write a newspaper article about life lacking electricity in which they express what difference there would be between their current situation as an electricity user and life without it. Student are asked to experience life without electricity by trying to avoid using it (as much as possible) after school until they come back to school the next day.

SOURCE OF ACTIVITY

This activity was developed by S. E. Heiting

Life Without Electricity
A Peace Corps Experience

Introduction:

After graduation from the University of Iowa, Jensy Patterson joined the Peace Corps in the summer of 1978. She was sent to Kenya, East Africa where she became one of four teachers staffing a 90-student Harambee high school. The rural village that is her home now lies in mountainous terrain near Lake Victoria and Kisii in western Kenya. The area has only two seasons, the rainy and the dry. Daytime temperatures do not change much throughout the year, but nights during the dry season can be chilly. Here are some of Jensy's comments on her new life without electricity, excerpts from a letter she wrote to a snowbound friend in Iowa:

The Letter:

Keroka, Kenya, January 22, 1979

For your own knowledge, I'll try to describe some of the energy uses here. Of course, there is no electricity. There is some in Kisii town which is about 12 miles away.

Everyone lives in small mud and thatched huts. The only permanent buildings around are the school and my house. Even the small dukas (shops) down the road are made of tin.

Firewood is commonly used if the dead wood can be found. (I came back one weekend to find many of my trees chopped down.) It's hard for these people on the top of the mountain and on the sides because the trees help prevent erosion, yet they need the wood for cooking and occasionally for warmth. They cook in their huts on the floor or in chiko--a small round metal container. It sits on the ground and is similar to our barbecue stoves. The old men in the market make them and sell them for about 15/= to 25/= ($2-$3).

December is also charcoal making month. All over the hills you can see smoke billowing. They chop the wood and cover it with dirt, leaving some small holes, and then light it to remove the impurities. After about 18 hours they have charcoal. This is sold for about 20/= ($ ____) for a large burlap bag. This is what is most commonly used in the chiko cookers. They use kerosene to light them. This is also used in their lanterns.

Candles are also used for light, but not often. (I do use them, but they are expensive here.) Kerosene costs about 11/= ($1.50) for five liters. I also use a pressure lamp which is about 600 candle power, but these are very expensive. Mine cost about 300/= ($43). I almost feel bad about having it, but figure the cost of my eyesight is worth a lot more than the impression these people will get of me having so many things.

A few, very few, wealthy people use a gas cooker. There are also pump stoves run on paraffin and some people use these, but I prefer the charcoal.

After awhile, all this becomes a way of life. I really enjoy not having electricity. Life is very simple without it. People usually go to bed early here too. 9:00 p.m. is "getting very late, madam!"

Kenyans depend on the sun for so much--time, drying clothes, crops. It seems the days are getting longer here too.

Of course there is no running water either. I'm the only one within several miles who has a rain tank. The school provided it, but it leaks and thus I too am dependent on the "river" (small stream actually) for my daily water needs. Because of my cooker I can warm my bath water but most either bathe in the river or out of a bucket; both are chilling experiences, believe me!

Because there are no street lights there is very little transport on the road after 6:30 - 7:00 p.m. The African's eyesight must not adapt too well to driving at night.

Torches (flashlights) are a part of every household. Batteries are very expensive. I have gone through so many. In physics I taught my kids that if you put the cells in the sun when they are weak, this exposure will repolarize them so that they can be used again. They were thrilled.

In all of Kenya there is only one "laundromat." It's in Nairobi and you can bet four of the six machines are always broken. Everyone does laundry by hand, then lays it on the grass to dry. I've learned to fold mine so they don't have too many wrinkles. There are charcoal irons though.

Of course, with no electricity there is no refrigeration. Many simply don't need it. My eggs last about three weeks and up on my hill my fresh butter will stay hard for two weeks. I'm extremely atypical though. No one else has the coolness I have.

There is milk in cartons I buy called UHT--it's ultra heated. Also margarine comes in a can and dried milk is popular. Many people enjoy the "sleeping milk" which is sour and curdled and kept in gourds. Kenyans think that the soured milk is very sweet and they simply can't understand why I don't like it. They use fresh milk only in tea.

Hope this gives you some picture of life without electricity. Cold sodas are unheard of as is beer. You get used to things!

As always,

Jensy

Teacher's Guide to Life Without Electricity: A Peace Corps Experience

There are many areas for discussion or for written question-and-answer responses suggested by this letter. Choose some that reflect your own interests and the subject matter of your course. Or ask a teacher from another discipline to participate in a wider ranging class discussion on ways and means of getting along on a low-energy budget.

Examples of questions you may use are:

1. What renewable sources of energy are mentioned in the letter?

   (Firewood and wood charcoal; sun; also students possibly may mention candles and gas which may be "renewable," depending on the raw material base for each. Candles can be made of beeswax or tallow, which are "renewable" or from paraffin, a non-renewable petroleum by-product. Natural gas, L.P. gas, or propane is associated with oil production from underground reservoirs and is not renewable. Methane or "biogas" from anaerobic digestion of organic wastes is renewable. In fact, the candles and gas to which Jensy refers are petroleum by-products and are therefore non-renewable.)

2. What non-renewable energy sources are mentioned in the letter?

   (Cooking gas, batteries, kerosene, paraffin, candles)

3. Which of the above energy sources did your grandparents use 40-50 years ago?

4. Which of the energy sources mentioned above do you use regularly now?

5. What do you think Jensy likes best about her low-energy-use situation?

6. What does she like least?

7. How has lack of electricity changed her living habits?

   (Note references to cooking and food storage; laundering; sleeping schedule; transportation.)

8. If you were to take Jensy's place in Kenya, what would present the greatest challenge to your present lifestyle?

9. What would be necessary for your survival in a remote Kenyan village? Would you have to take some articles from home with you?

10. Locate Kisii, Kenya on a map of Africa.

    What is its latitude? (0.5° S)
    What is its longitude? (nearly 35° E)
    What is its elevation? (high plateau, mountainous terrain, more than a mile high)

11. What does the above information tell you about insolation (incoming solar radiation) in that part of Africa?

    (Near the equator, solar insolation is maximum. The sun is directly overhead twice yearly and the lowest "winter" angle is comparable to the angle of the summer sun in Iowa. The high elevation means that the atmospheric blanket of air is thin. By day, less insolation is lost to atmospheric screening, but more heat is lost at night than would be true in the lowlands. Cool nights and snow on the highest peaks are possible.)

12. How does the local climate near Kisii moderate basic energy needs (compared to Iowa)?

    (Little additional heat is needed for keeping people warm. Well-sealed homes that need artificial heating and cooling are not necessary for survival. However, heat for purifying water and milk is even more important for good health than here because tropical microorganisms are very numerous. Long growing seasons make long-term food storage less important than in Iowa, but heat is necessary for some forms of preservation--including tea production. Less clothing is needed for personal warmth. Transportation vehicles, where available, run more efficiently in warm climates than in cold ones. Animals require less food to maintain body temperature and growth rate than they do in more variable climates. Trees grow faster so, if replanted, replace firewood faster. Daylight hours are never much longer nor much shorter than 12 hours so opportunities for evening activities are very limited unless some other source of light is available, even at the peak of summer.)

ENERGY QUESTIONNAIRE

SUBJECT Social Studies LEVEL 6 - 8

ACTIVITY IN BRIEF

Using I.D.E.A.S. background information, students create an energy survey which provides data to be tabulated, analyzed and evaluated. Students individually decide if the data indicates a people attitude problem concerning todays energy use.

OBJECTIVE

Each student 1) constructs part of an energy survey, 2) analyzes data from the survey and evaluates the responses, and 3) explains their answer to a question about the survey results.

MATERIALS	TIME
board space, survey materials (copies)	2 class periods

LEARNING CYCLE

AWARENESS - Students examine questionnaire material and discuss how the survey will be set up and used. The format is put on the board.

CONCEPT DEVELOPMENT - Students work in groups to develop statements to be put on the board appropriate to the questionnaire format. Duplicated statements are eliminated.

APPLICATION - Students administer, tabulate, analyze and evaluate the survey responses. Discussion of the results is followed by each student responding to the question; "Do we have an energy attitude problem?"

SUGGESTED EVALUATION - The teacher can grade each student according to their participation in discussions, construction of the survey and administering (tabulating) the questionnaire. Each student should submit a written response to the application question which can be evaluated for credit.

FOLLOW-UP/BACKGROUND INFORMATION

Each student should end up doing 5 or fewer questionnaires. Count the total responses for each statement to see if the totals are reasonably close (margin of error).

Questions		1	2	3	4	5	6	7	8	9	10
Agree	Male										
	Female										
Disagree	Male										
	Female										
Unsure	Male										
	Female										

ACTIVITY

Students are given I.D.E.A.S. information from the Social Science 7-12 section that follows. After a brief discussion of the material, the class is divided into groups of 3 and told to determine three statements which can be answered by the responses agree, disagree, and unsure. The teacher roughs out a questionnaire format on the board and each group fits their statements into the format on the board. Redundant statements are eliminated (or combined). Students determine a reasonable random sample for their school or community population and are each given a number of questionnaires to get filled out. A master tabulation chart is put on the board (see FOLLOW-UP/BACKGROUND) and totals entered. Students are assigned one statement to analyze from the chart. Students share their analyses and the class evaluates the meaning of the responses. Each student is asked to record a response to the following question. Does the survey indicate that there is a problem in peoples attitude toward the use of energy? Explain why or why not. Debate or discussion of the question can conclude this activity. What did the majority of the class say? What does this suggest about their attitude?

SOURCE OF ACTIVITY

Created by S. E. Heiting

Man, Energy and Environment
Some Attitudes and Beliefs

Background:

Planet Earth is often thought to be a mine to be explored, dug into, and reshaped for the benefit of humankind. It is a huge, non-living warehouse stocked with goodies for people who have the initiative to look for its resources and secure them for their immediate needs and comforts. Some examples of the attitudes and beliefs that typically accompany reliance on underground treasure are:

We'll never run out of energy stocks. (There are no limits.)

Scientists will find substitutes or invent better machines. (Technology can "fix" most problems.)

Bigger is better. (Overconsumption is health, virtue, or reward.)

The more I have, the better off I'll be. (Status and material security are very important.)

Growth is natural; let it go as it will. (Competition, individual strength, "survival of the fittest" determine success.)

Our country is so rich and so complex that waste is inevitable. We can afford it. (Waste is a status symbol. Effluents = affluence.)

Conservation isn't my job . . . . I didn't cause the shortages. (Personal contributions to a collective problem and its solutions are not recognized.)

There's no time like the present. I'll take my share now.

This sampling of some common responses to the "energy crises" is not one consistent viewpoint. The American, seen as an heir to limitless supplies, is considered blessed; entitled to use up resources at whatever rate chosen and not personally responsible for unpleasant side-effects. On the other hand, the individual depends on specialists to solve problems, on machines to do work, and on material things as bases for comfort and esteem. Ownership and control involve little direct responsibility.

An Energy Opinionnaire

_____ 1. Who has major responsibility for the energy crisis?
   a. Federal government
      (1) Congress
      (2) Administration
   b. Oil companies
   c. Environmentalists
   d. Organization of Petroleum Exporting Countries (OPEC)
   e. Individual consumers

2. Do you expect to have difficulty obtaining any of the energy sources listed below within the next 12 months?

_____ Gasoline
_____ Home heating fuel
_____ Electricity
_____ Recreational vehicle fuel

_____ 3. a. Can the gasoline shortage be temporarily solved by consumers using less gasoline?
   b. Have you voluntarily used less gasoline in the past 12 months?

_____ 4. If there is not enough fuel for everyone, which uses do you think are most important? (Rank 1 through 8.)
_____ a. Heating homes
_____ b. Farming operations
_____ c. Factory operations
_____ d. Business driving by private citizens
_____ e. Pleasure driving by private citizens
_____ f. National defense
_____ g. Commercial freight transportation
_____ h. Mass transit

5. If motor fuel must be rationed, which vehicles should get it first? (Rank order the choices.)
_____ a. Farm vehicles
_____ b. Private cars
_____ c. Urban mass transit
_____ d. Trucks
_____ e. Railroad freight trains
_____ f. Buses - between city trips
_____ g. Commercial airlines
_____ h. Passenger trains - between city trips
_____ i. Private airplanes
_____ j. Taxis
_____ k. Construction vehicles

COLLAGING ENERGY

SUBJECT Social Studies **LEVEL** 6 - 8

ACTIVITY IN BRIEF

Students use old newspapers and magazines to create an Energy Collage showing how energy flows from resource through consumption. From the collage, energy themes and messages are determined.

OBJECTIVE

Each student 1) defines energy and describes its uses, 2) designs and constructs part of an energy collage, and 3) lists questions about energy suggested by the collage.

MATERIALS

pins, tape, glue, background colored paper, bulletin or poster board, old newpapers/magazines

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students define and discuss energy resources and uses. They are given old magazines/newspapers to cut up and make an energy collage which is entitled by the winners of a "Title Contest".

CONCEPT DEVELOPMENT - Students work in twos to determine energy themes and messages represented in the collage. These are shared by each group with the rest of the class.

APPLICATION - Each student studies the collage and writes one or more main message questions about energy suggested by the collage.

SUGGESTED EVALUATION - The instructor can take the questions listed by the students and make an energy-short answer quiz to be taken by each student. Extra credit could be given to the winner(s) of the "Title Contest."

FOLLOW-UP/BACKGROUND INFORMATION

The main point questions are discussed by the class and connected to appropriate parts of the collage which can be displayed and used by other groups to stimulate questions about energy.

ACTIVITY

Students are asked to define energy and describe various energy resources and uses. The class is given old magazines and newspapers to use in order to cut out headlines and/or pictures which are put on a large collage poster or bulletin board. After the collage is complete, a contest is held to determine the best possible title for the collage, students work in groups of two to contribute title entries. The winners are rewarded with a solar powered clothes dryer (clothes line and pins) and each contest duet (group) is directed to determine energy messages and themes suggested by the collage. These are shared and each student is assigned to look carefully at the collage and determine a "main point question" about energy. Questions and opinions are discussed and linked to appropriate parts of the collage which can be displayed and used by other groups studying energy topics.

SOURCE OF ACTIVITY

Originated by S. E. Heiting, June, 1986.

GRADE LEVEL : [redacted]

SS-69

CASING UP NUCLEAR ENERGY

SUBJECT Social Studies **LEVEL** 9 -12

ACTIVITY IN BRIEF

Students develop a case study about the use of nuclear energy at one of the reactors in the United States.

OBJECTIVE

Each student 1) cites evidence about nuclear reactor safety from research, 2) describes part of a case study, and 3) evaluates each case study and describes their opinion about nuclear energy.

MATERIALS

notebook, writing tools

TIME

part of class periods (homework) ongoing

LEARNING CYCLE

AWARENESS - Students gather information about writing a case study and research nuclear reactors in the U.S. finding out how they are run and problems associated with them.

CONCEPT DEVELOPMENT - Students are teamed according to nuclear topics which have the most available information and develop a case study about one nuclear reactor.

APPLICATION - Students complete and present their case study according to a schedule set up by a due date lottery.

SUGGESTED EVALUATION - The instructor could collect the notes, research and documentation that each student did for the activity along with their evaluations and stated opinions about nuclear energy. Points can be given for each part completed as well as for the precision of research done and the opinions expressed.

FOLLOW-UP/BACKGROUND INFORMATION

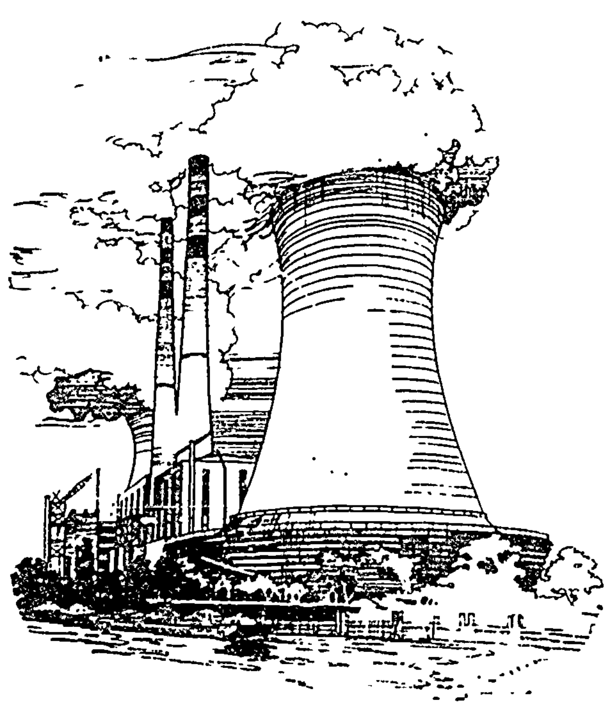
Students evaluate the reported nuclear reactors according to their record of operation—best to worst. A map of these reactors (in the U.S.) can be made and each student should be asked to write down their opinion on the use of nuclear energy. Compare the safety and performance of U.S. reactors to those in the U.S.S.R. and other nations.

ACTIVITY

Students are given instruction about the elements of a case study and assigned nuclear reactors operating in the U.S. as a research topic. Information about the most publicized nuclear power plants can be shared, and case study teams set up. Each student is to keep their own notes, research, and documentation to show what they contributed to the case study. Research can be assigned as homework, or done in the library during class time. However some class time should be allowed so that the teams can confer, compare notes, and develop the case study. Due dates should be set for completion and presentation of the case study by each team. A lottery system could be used to see which is due 1st, 2nd, etc. Students can evaluate each case study to formulate a list of nuclear reactors, with the best to worst safety record. The Duane Arnold, Palo, IA. reactor should be included and used for comparison on the ratings list. Students are asked to record their personal attitude about the use of nuclear energy at the end of the activity.

SOURCE OF ACTIVITY

Originated by S. E. Heiting, 1986.



"AGRENERGY"

SUBJECT Social Studies **LEVEL** 9 -12

ACTIVITY IN BRIEF

Students create an interview form in order to survey farmers and gain primary source data to write an article about the impact of energy needs on agriculture (agrenergy).

OBJECTIVE

Each student 1) designs part of an interview form about energy use on farms, 2) analyzes the interdependence of energy and agriculture (agrenergy), and 3) describes agrenergy in a written article.

MATERIALS	TIME
questionnaire format, paper, writing tools	3 class periods

LEARNING CYCLE

AWARENESS - Students gather information about energy use in agriculture from readings or guest speakers. Students record information in their notebook and are shown the basic elements of an interview.

CONCEPT DEVELOPMENT - Students develop questions or statements for an interview form about energy use on the farm using the information in their notebooks.

APPLICATION - Students conduct the interviews with local people connected to agriculture and analyze the results.

SUGGESTED EVALUATION -- The instructor could use the students' questions on the survey as quiz questions, testing each students' knowledge of the interview results. Each student should turn in an article about "agrenergy" for evaluation and credit.

FOLLOW-UP/BACKGROUND INFORMATION

Students write an article for a newspaper or farm journal about the impact and importance of energy to agriculture. Selected articles should be submitted to the school or local newspaper for publication.

ACTIVITY

The teacher directs the class to gather information about energy use in agriculture from various sources including the library and resource people. An interview form should be made so that students can get feedback directly from farmers if possible. Students are given basic information about how an effective interview is conducted and allowed to develop the specific questions, statements and format appropriate for an "agrenergy" interview. People involved with agriculture are selected and respond to the survey. Responses are analyzed and evaluated. This information is used by the class to write articles about the significance of energy in agriculture. These products are shared with the school and community via available newspaper publications or newsletters. Background about energy and agriculture in Iowa, and nationally, is available from the Iowa Department of Natural Resources-Energy Division.

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Conservation Deadline" written by Carl Bollwinkel, Ellen Ernst, Betty Keyoth, and Marie Sides.

HYPING IOWA - IOWA PROMOTION

SUBJECT Social Studies LEVEL 9 -12

ACTIVITY IN BRIEF

Students are to pretend to be involved in a statewide project to promote their state. Their part is to create a TV commercial concerning the state's potential gasohol resource.

OBJECTIVE

Each student 1) lists factors involved in the production of gasohol, 2) constructs part of a script from information researched, and 3) critically discusses which script would make the best commercial.

MATERIALS

notebooks, pencils

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students assume the role of Iowa promoters of gasohol. Each student researches how gasohol is made and makes a chart showing the steps involved. The products are shared and discussed.

CONCEPT DEVELOPMENT - From their research, the students develop a script for a commercial that promotes the state's potential to produce energy using agricultural resources (like corn or sugar beets).

APPLICATION - Students (individuals or groups) present scripts for a promotional commercial to the class. Students vote on which scripts would make the best commercial, or combine the best elements presented into one commercial.

SUGGESTED EVALUATION - The teacher can give credit to those students who participate in the activity and discussion. Grades can be given to each individual in the groups that completes a script. More credit can be given for successful completion of roles used in the commercial.

FOLLOW-UP/BACKGROUND INFORMATION

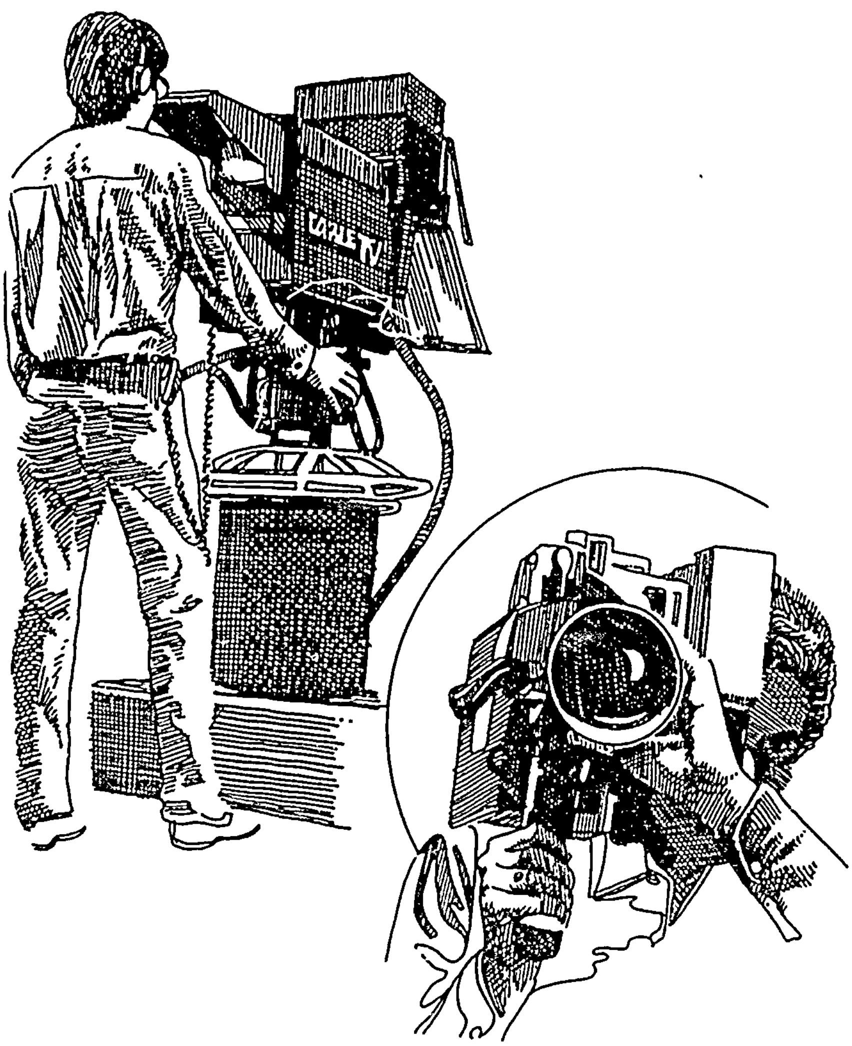
Students assume the appropriate roles as indicated by the best commercial script and make a video tape of the commercial.

ACTIVITY

The teacher informs students that they are to pretend to be promoters of Iowa's gasohol resources. Each student is to research the various elements needed to produce gasohol, and make a graph or diagram showing what is involved. The charts are presented to the class to be used in developing a script for a TV commercial, that would promote Iowa's potential as producer of this energy resource. Student's scripts are judged or combined into a limited number of finished scripts to be videotaped. Students are given roles to act out in the commercials which are videotaped after they have had a chance to practice. The videotapes are edited (music background "jingles" are added) and the commercials are played for the class and invited guests.

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Stay Tuned" written by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides.



ENERGY ISSUES STRATEGY

SUBJECT Social Studies LEVEL 9 - 12

ACTIVITY IN BRIEF

Students become aware of energy issues and problems related to the world and define ways to deal with them internationally..

OBJECTIVE

Each student 1) identifies and prioritizes top international energy issues, 2) critically discusses solutions to world energy problems, and 3) designs a plan of action to deal with energy issues.

MATERIALS	TIME
notebooks, writing tools	2 class periods

LEARNING CYCLE

AWARENESS - Students are given various resources which show international energy issues and problems currently existing in the world.

CONCEPT DEVELOPMENT - Students discuss and list various problems presented, and prioritized the list identifying the most significant problems today (the top 3-5 issues)

APPLICATION - Students are divided into discussion groups to develop possible solutions to the top international energy issues identified.

SUGGESTED EVALUATION - The instructor can use the questions posed at the end of the activity as the basis for a quiz on international energy. If the students have participated well in the discussions the instructor may have each student do a self or peer evaluation based on what they learned about current world energy problems.

FOLLOW-UP/BACKGROUND INFORMATION

Students develop a proposed plan of action which details steps that the U. S. and other nations can take to help resolve the energy problems discussed. Students should record what they and other individuals can do to make the plan work.

ACTIVITY

The teacher selects the best available resources to present current energy issues to the class. Students take notes on the issues and discuss the problems presented prioritizing them and identifying the top international energy issues of today. Students are divided into discussion groups and develop possible solutions to the top international energy problems identified. Students write out a proposal for a plan of action which details steps that the different nations can take to help resolve the energy problems discussed. Students then record what they and other individuals can do to make the plan of action work. Finally, a discussion is conducted which comes up with answers to the following questions:

What is the most pressing energy problem in the world today?

How can governments most effectively deal with this problem?

How are nations of the world interdependent when it comes to energy?

What is the future of international energy resources and use?

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Environmental Issues for Young Adults" written by Gerry MacMillan.

ENERGY OPINIONS NEEDED TO MAKE THINGS RUN BETTER

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Reactions to controversial energy statements are used to encourage students to form opinions about issues, look at various energy impacts and take on some responsibility for action.

OBJECTIVE

Each student 1) identifies and explains their opinion on a controversial energy statement, and 2) analyzes ways to communicate their energy opinions to decisionmakers.

MATERIALS	TIME
posters with statements printed on them	2 class periods

LEARNING CYCLE

AWARENESS - The teacher writes controversial energy statements on the board or puts up posters with no explanation given, to remain visible for 2-4 days (or more).

CONCEPT DEVELOPMENT - The students are asked to express ideas and opinions on statements posted, select the most controversial and write a personal opinion about it.

APPLICATION - Students discuss, share ideas, and develop a list of ways to express their opinions. Students are encouraged to draft a letter-to-the-editor type of response to the energy issue chosen.

SUGGESTED EVALUATION - The instructor collects a completed written opinion from each student and gives each statement a C-, C, or C+ grade, then returns it to the student to be improved. The students should rethink and rewrite the statement and turn it in with a list of improvements made. The teacher can update the grade appropriate to improvements made.

FOLLOW-UP/BACKGROUND INFORMATION

Students write to government officials and are encouraged to share any feedback. Possible statements might include the following:

"We must ban all nuclear energy to survive the 20th century!".

"Solar power could solve our energy problems!"

"Current energy producers are ripping us off!"

"The U.S. must use less energy so underdeveloped nations will have more!"

"Wasting energy is good for the U.S. economy!"

ACTIVITY

The teacher writes some thought provoking energy statements (see samples in FOLLOW-UP/BACKGROUND section) on the board or post them in the room. There is no explanation given and the statements remain visible for several days. Students are asked to express their ideas about the statements and choose the one which seems most controversial. Their personal opinion about this issue is to be recorded. Class discussion is conducted on the issues presented and opinions are shared. Every student is encouraged to express an idea or opinion and find support for it. The class develops a list of ways students can express their ideas and opinions to decision makers (students selecting the same issue can work in groups). Expand the discussion to include ways students can become more involved with these issues. Have students write their ideas in the form of an editorial or conduct a debate on issues that develop two distinct sides. Following these activities, students should be provided with names and addresses of decision makers who can be written to so that the students can actually "address their energy grievances." Students should be encouraged to send letters and share feedback.

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Your Opinion Please", created by Carl Bollwinkel, Ellen Ernst, Betty Keyoth and Marie Sides, c. 1983.

LIGHTING UP THREE MILE ISLAND TO FUEL ROLES OF CONCERN

SUBJECT Social Studies LEVEL 9 -12

ACTIVITY IN BRIEF

Students learn about Three Mile Island using a simulation. After role playing the groups concerned, a possible resolution to this energy dilemma is developed.

OBJECTIVE

Each student 1) determines part of a resolution to the Three Mile Island case study, 2) relates her/his feelings about the decision made in the simulation, and 3) describes the benefits and dangers of nuclear energy.

MATERIALS	TIME
copies of case studies and background information concerning the Three Mile Island incident of 1979 that follows.	2 class periods

LEARNING CYCLE

AWARENESS - Students are divided in groups and assigned roles to play. They are given information about Three Mile Island and develop their role in the simulation.

CONCEPT DEVELOPMENT - A public meeting is held. Views are aired. A conference committee is formed and each group develops a position resolution to be considered by the decision committee. Personal opinions are recorded in students notes.

APPLICATION - The decision (conference) committee makes and announces their resolution to issues raised, and details how their decision should be carried out.

SUGGESTED EVALUATION - The instructor may have each student write a "synthesis essay" about the positive/negative effects of nuclear energy. The essay should reflect two points of view and a conclusion drawn by the student as to the use of nuclear energy.

FOLLOW-UP/BACKGROUND INFORMATION

Students react to the decision statement in view of their recorded opinion and attitude. An OUTLOOK case study has been included for this activity, however, current literature is coming out on the Three Mile Island Incident and should be available in most libraries. How would a similiar situation work using the Chernobyl incident in the U.S.S.R.?

ACTIVITY

The class is divided into three groups. The first represents the Nuclear Industry (electric company), the second represents Government (State and Federal officials) and the third group represents the Citizens in the surrounding community directly affected by the operation of the nuclear reactor. Students are given information about the Three Mile Island incident (case studies may be available from activity entitled "Energy Ledger" or see support section). Students read information about Three Mile Island and develop their roles for the simulation, each group develops a position on the issue from their groups frame of reference. An open meeting is held and each group's point of view is expressed. One or two students from each group is selected to form a fourth "decision making (conference) committee". These representatives confer with their groups to determine a proposal to remedy the situation which by now should address at least two major questions: 1) Who should pay to clean up the accident? and 2) Should the other reactor at Three Mile Island be kept in operation? Students should record their own feelings about these questions in their notebooks, as the conference committee comes to a decision on issues raised and conditions under which the decision will be carried out. The class is informed of the decision made and asked to write a personal response in their notebooks. Students can investigate if there are any nuclear reactors in their state and what the safety record has been. The benefits and dangers of nuclear energy makes a good follow-up essay or test question.

SOURCE OF ACTIVITY

Adapted by S. E. Heiting from an OUTLOOK activity called "Stink or Swim" created by Bob Lancaster, Marilyn Sand, and Steve Heiting.

For the Teacher

Created By:
Terry Tovar
Steve Heitting
Bob Lancaster
Marilyn Sand

For Your Information

Students could develop a case study about the Three Mile Island Nuclear issue or other nuclear reactor incidents (like Brown's Ferry, Fermi, Diablo Canyon or Duane Arnold Energy Center at Palo, Iowa).

Three Mile Island Case Study

Nearby residents were always worried about periodic emissions of radioactive gas at Three Mile Island (TMI), Pennsylvania. The cause was determined to be from a faulty valve through which radioactive coolant leaked into the containment building. The problem was detected and an operator manually shut the valve off but by then much of the fluid had overflowed onto the floor where it eventually evaporated. This evaporation released from 30-35 millirems of radiation per hour at the gate plant and 20-35 millirems across the river toward a nearby town. Although the millirems dropped rather quickly by the town, it still was very dangerous. The residents were receiving 5-7 millirems an hour (20 millirems is equivalent to two chest x-rays).

The accident at TMI is internationally known as the most serious accident that has occurred at a commercial nuclear power plant in the U.S. Now, not only are local residents demanding something be done about the one billion dollar clean up bill, but also about the problem of nuclear waste generated by such plants that remains poisonous for thousands of years. The question asked today is "will the number one plant at TMI keep operating?" The government has received pressure from industry to keep it open and pressure from the public to keep it closed. Not one nuclear reactor has been ordered and built since the accident at TMI. Nuclear power has been called the energy of the future, the question is what kind of future is ahead of us with the unsolved problem of radioactive waste disposal.

Follow-up Suggestions

Find out what the government is doing currently about the Three Mile Island situation

Analyze viewpoints of residents of TMI, or Palo, Iowa, concerning the use of nuclear energy.

Determine the pros/cons of the issue concerning the use of nuclear power in the U.S.; the world.

Resources

"The Three Mile Accident." **Science News**, April 7, 1979, vol. 115, p. 227.

"In the Wake of Three Mile Island." **Science News**, May 5, 1979, vol. 115, p. 292.

"Three Mile Island Is Still a Problem." **Newsweek**, March 1, 1982, vol. 99, p. 8

"Thornburgh Gets a Hearing." **Science**, October 9, 1981, vol. 214, p. 162.

Berger, John. **Nuclear Power: The Unviable Option.** Palo Alto, CA. Laurel Books, 1977

Consult the most recent Iowa Public Television Schedule Book.

TRANSPENERGY - REVISITED

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students investigate the importance of energy used in every day transportation employing a "transpenergy" measuring tool.

OBJECTIVE

Each student 1) designs part of a survey on "transpenergy," 2) collects data about "transpenergy" from the survey, and 3) states a recommendation about transpenergy.

MATERIALS

interview forms

TIME

2 - 3 class periods

LEARNING CYCLE

AWARENESS - Students discuss what "transpenergy" is and list variables involved in their daily school use by determining answers to questions posed by the teacher.

CONCEPT DEVELOPMENT - Students develop a survey format to be used to determine the "transpenergy" of students/staff on a daily basis. Enough survey copies are made to survey 10% to 20% of the school population.

APPLICATION - The survey is administered, each student being responsible for getting results, tabulating them and evaluating the data. Students should combine and share information.

SUGGESTED EVALUATION - The teacher should grade each student on their participation in various activities connected with this project. A chart listing possible ways to earn credit points could be posted in the room and filled out for a specific grade as each activity is completed.

FOLLOW-UP/BACKGROUND INFORMATION

The class determines a list of logical implications suggested by their survey analysis and prepares a chart to show these implications as well as a recommendation for more efficient transpenergy to/from school. The recommendations are passed along to school officials with a request for some response on their part.

ACTIVITY

"Transpenergy" means the interconnections between transportation and energy. Students should discuss and list what different kinds of transportation and energy are used daily to get to school. Questions to investigate include:

How many students/staff live outside the city?

What types of energy are being consumed?

What modes of travel are being used?

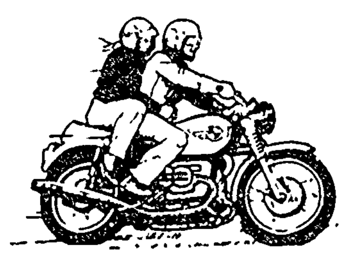
What is the combined mileage for travel (city versus rural commuters)?

Who uses more energy for travel to school; people within or those outside the city limits?

Students develop a survey to be used to determine the transpenergy of city and rural students/staff thus creating a measuring tool. The survey is administered, tabulated and the resulting data is analyzed. List results concerning miles traveled for various groups using different means of transportation and compute the cost at current rates. The students should list implications suggested by their data and develop a plan which would improve the energy efficiency of transportation to school. A chart should be made showing the specifics of the plan. If appropriate the chart and the classes recommendation concerning daily transpenergy to/from school can be presented to school officials. If this recommendation was implemented, what changes would occur in the student's/staff's daily life?

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from on OUTLOOK activity called "Transpenergy-Where We Go With Our Energy Flow", created by Marilyn Sand, Bob Lancaster and Steve Heiting.



DESIGNER ENERGY

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students analyze possible energy alternatives for use in an ideal home of the future and develop a matrix to compare various sources of energy to be in an American Energy Dream Home.

OBJECTIVE

Each student 1) designs part of a matrix to compare energy sources, 2) describes the elements of a future energy dream home, and 3) what the "NRG Dream Home" would look like.

MATERIALS	TIME
notebooks, matrix paper, poster paper	2 - 3 class periods

LEARNING CYCLE

AWARENESS - Students are told what a future ideal home would require in terms of energy and determine the format for a matrix to be used to analyze various factors connected to designing the ideal home.

CONCEPT DEVELOPMENT - Students develop a group matrix on an energy source assigned and combine the different components into a master matrix to be posted or drawn on the board.

APPLICATION - Using the master matrix students develop various designs for the American Energy Dream Home and share their plans making the necessary decisions needed to develop a master plan for "the" ideal energy home of the future.

SUGGESTED EVALUATION - The teacher could grade participation in this activity and each students' final product "The NRG Dream Home" design judged in consideration of materials and energy resources possibly available in the future and the efficiency (NRG conservation system) of the energy system being used.

FOLLOW-UP/BACKGROUND INFORMATION

Master Matrix Sample

Concerns	Fossil Fuels	Nuclear	Solar	Other Sources
Economics Cost				
Environmental Costs				
Other Considerations				

The students can draw individual perceptions of what the ideal Energy Home of the Future would look like.

ACTIVITY

Students are informed that the "American Energy Dream Home" of the future will be conveniently warm in the winter, cool in the summer, well lighted year around and equipped with all the most modern conveniences at a low cost. Students are directed to compare various sources of energy which includes:

Economic Costs - dollar cost, economic implication of supply and demand, convenience and distribution.

Environmental Costs - land use, air and water pollution, safety and aesthetics

Other Criteria - developed by the class or teacher.

The class is divided into groups to investigate each energy source that could be used and asked to design a matrix to compare sources of energy. After the groups complete their matrix, they are combined into a master matrix (see FOLLOW-UP/BACKGROUND INFO) and put on the board or a poster for display. Using the matrix, the students should develop an ideal energy system for the Energy Dream Home of the future which considers the concerns vs. the costs. After decisions are made as to the trade-off, priorities and practicalities involved, the students should share their designs, critique each others and try to determine one master plan that would work best. Students can draw (blueprint) what this home would look like and share their visuals with the class.

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from an OUTLOOK activity called "Waking Up From the American Dream", created by Roya Stanley, Marilyn Sand, Bob Lancaster and Steven Heiting.

ENERGY "PRODUSTRIBUTION" IMPACTS

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Using a cartwheel diagram, students chart the impact of production and distribution factors ("produstribution") connecting different U. S. energy industries.

OBJECTIVE

Each student 1) constructs part of an energy cartwheel chart, 2) identifies the priority energy producers, and 3) evaluates the #1 energy producer identified.

MATERIALS

diagramming materials

TIME

2 class periods

LEARNING CYCLE

AWARENESS - After getting background on energy produstribution, students are shown a general cartwheel format and asked to group design one using US-NRG as the middle point.

CONCEPT DEVELOPMENT - The students create a group cartwheel and share with the class. The teacher has each group contribute to create a large master cartwheel and coded produstribution/impact system on the board.

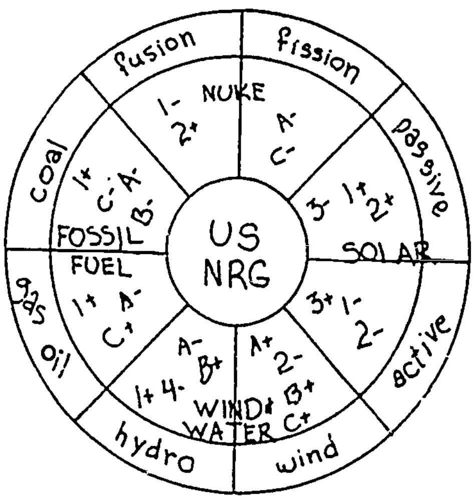
APPLICATION - Students copy the master cartwheel and after applying the code system, they prioritize the producers total usefulness telling if the #1 choice is currently being used more/less than other energy resources.

SUGGESTED EVALUATION - The instructor gives credit to those students who actively participated in the construction of the cartwheel chart. Assessment of answers made by each student to the concluding question could also be used for grading purposes.

FOLLOW-UP/BACKGROUND INFORMATION

The following is not a right answer and probably more complex than will be determined in class, but does show the potential the cartwheel has.

Sample cartwheel design



Code for Production/Distribution	Code for Impacts
1.production costs	A.Environmental
2.distribution costs	B.Consumer Safety
3.jobs created	C.Worker Safety
4.resource availability	D.Govt.Regulations

Each number and letter used with a plus or minus to indicate if each factor has a positive or negative affect as rated by students. Ratings are individual and should have support rationale.

ACTIVITY

The students are given background information about various energy producers and asked to list possible production, distribution (produstribution) factors as well as possible environmental, social and political impacts. Students are shown the general cartwheel design and directed to construct (in groups) a cartwheel diagram using US-NRG as the hub (see FOLLOW-UP/BACKGROUND). The groups report and show their cartwheel charts to the class The teacher puts a large outline of a cartwheel on the board and each group contributes, filling in the information needed to cover the major energy producers. A master code system (see FOLLOW-UP/BACKGROUND) can be used by students to individually rate each cartwheel category. The students copy the cartwheel developed by the groups and are directed to apply the code system. After the ratings are shared and discussed, the students are asked to prioritize the various energy producers total usefulness in light of the ratings they made for each. The #1 energy producer identified by most class members should be examined according to the following question:

Is the number one selection currently being used more or less than other energy resources? Why or why not?

SOURCE OF ACTIVITY

This activity was adapted by S.E. Heiting from an OUTLOOK activity called "The Produstribution of Automobiles" created by Marilyn Sand, Bob Lancaster and Steve Heiting.

ENERGY FOR FOOD DISTRIBUTION

SUBJECT Social Studies LEVEL 9 - 12

ACTIVITY IN BRIEF

Students will investigate the relationship between energy and food distribution.

OBJECTIVE

Each student 1) describes ways to become more food independent, 2) explains the relationship between food costs (production) and energy.

MATERIALS

poster, mural materials

TIME

1 - 2 class periods

LEARNING CYCLE

AWARENESS - Student are told the relationship between food and transportation costs and asked to consider what would happen if the transport system broke down. Groups are formed to consider what would happen.

CONCEPT DEVELOPMENT - The groups develop plans for local food self sufficiency considering the problems involved and savings in food costs as a result of reduced transportation.

APPLICATION - The groups make reports and the main proposal points are put on the board. Lists are made showing what percentage of food could be locally grown and what energy savings would result.

SUGGESTED EVALUATION - The teacher can evaluate the participation of each student regarding group asignments, chart construction and the completion of statements showing food cost vs. energy use. A short answer or essay test could be developed using the students' statements.

FOLLOW-UP/BACKGROUND INFORMATION

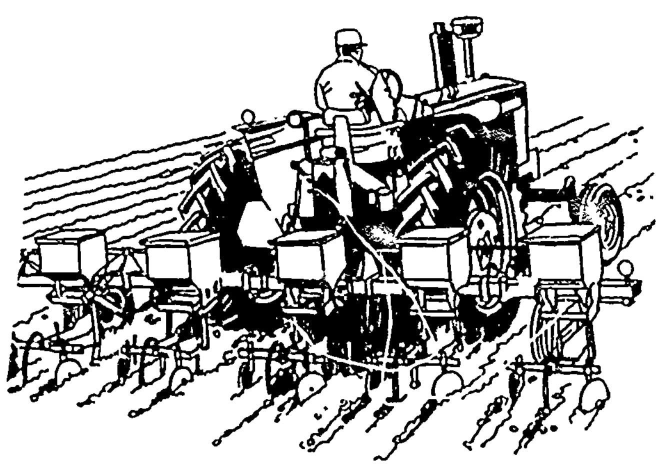
Each student writes statements about the effect energy has on food costs and how these costs can be reduced. A large poster or mural can be made by the class showing the connection between the production, distribution and consumption of food and energy costs.

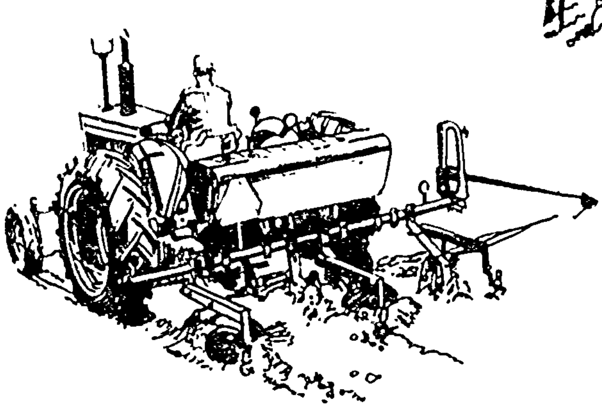
ACTIVITY

Although the Midwest produces an abundance of food, much of an Iowan's diet is made up of food shipped into the state. One estimate indicated that the average molecule of food travels 1300 miles before it is eaten and that every two dollars we spend on energy to grow food, another dollar is spent to distribute the food. Students are to consider what would happen to the food supply i the transport system came to a stop. Groups should be made to propose plans for survival by becoming food independent. The plan should describe what problems would be encountered in attempting to become food independent and what percentage of their nutritional needs could be provided locally. Each group makes a report and main points are noted on the board. The plans are compared and lists are made showing what amount (percentages) can be locally produced and what energy savings would be involved. Students will then write 2 statements concerning the effect energy for transportation has on the cost of food and how these costs could be reduced. The class can work together on a large poster or mural which shows the various energy costs connected to the production, distribution and consumption of food in the Midwest.

SOURCE OF ACTIVITY

This activity was adapted by S. E. Heiting from an OUTLOOK activity called "Where Has All the Flour Gone?", created by Bob Lancaster, Steve Heiting and Marilyn Sand, 1983.





IOWA'S ENERGY POTENTIAL

SUBJECT Social Studies **LEVEL** 9-12

ACTIVITY IN BRIEF

Students investigate issues connected to using Iowa coal resources and prepare a chart showing the various aspects, tradeoffs and questions associated with this topic.

OBJECTIVE

Each student 1) collects information about Iowa coal, 2) draws part of a chart about Iowa's coal production, and 3) describes their opinion about the future of Iowa's coal industry.

MATERIALS	TIME
large poster, newspaper print, markers	2 class periods

LEARNING CYCLE

AWARENESS - Students are given some introductory information and energy topics/issues to be investigated by groups formed for each. Students are provided with time and resource material to research their topics.

CONCEPT DEVELOPMENT - The students draw or write indications of pros/cons for the issues they covered on a large chart and share the groups decision as to the feasibility of using Iowa coal.

APPLICATION - A list of questions about the use of Iowa coal vs. other alternatives is made and discussed. The class determines a final decision about the topic in consideration of the various aspects and questions debated.

SUGGESTED EVALUATION - The instructor can use participation points along with an evaluation of each students' writing about the future of Iowa's coal industry.

FOLLOW-UP/BACKGROUND INFORMATION

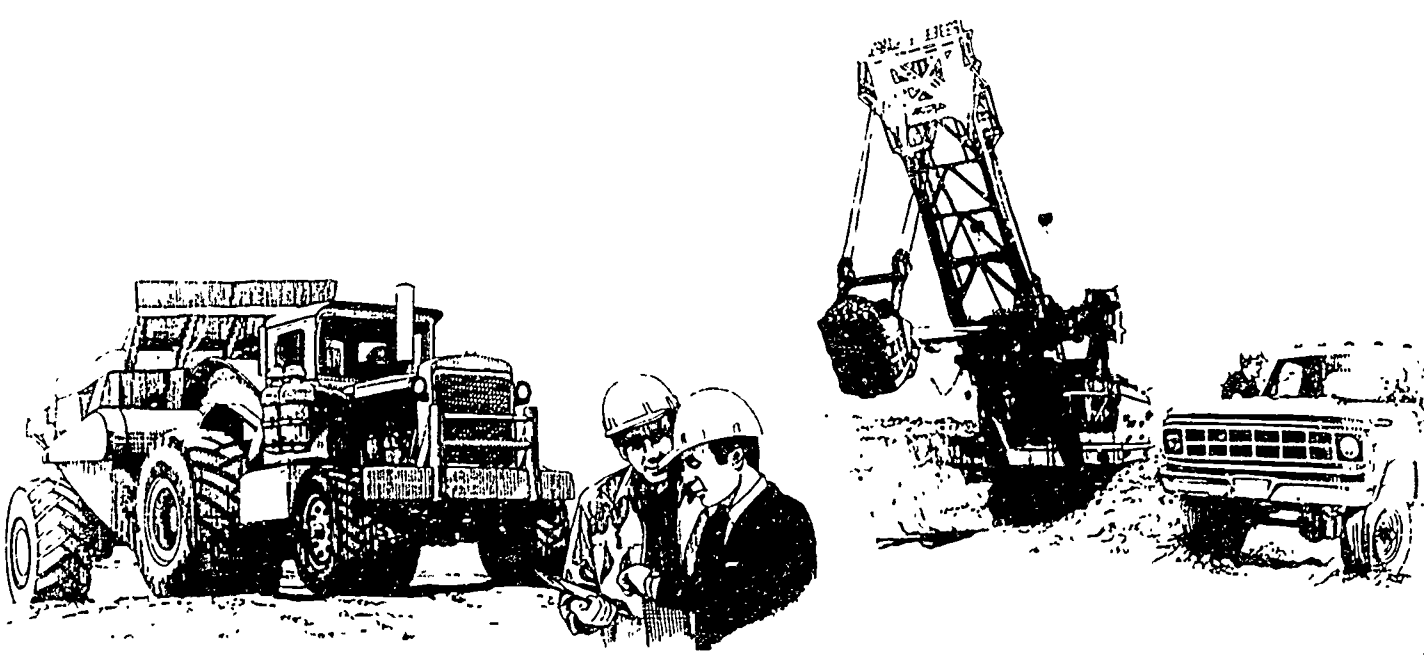
Each student records their own personal attitude on the class decision and expresses what they feel should be the direction of the nations energy policy during their lifetime. These value statements can be shared and discussed or posted as statements of opinion on a bulletin board.

ACTIVITY

Iowa has an estimated 6.5 billion tons of identified coal reserves. Many people feel that it is important to become more energy independent since Iowa imports 90% of the energy it uses. Opponents cite problems from strip mining, acid rain and transportation of coal. Students, working in groups, look up information connected to these issues and the following topics: mineral make-up (content) of Iowa coal, coal liquification, coal gasification, land reclamation, surface water and air pollution, mine safety, socio-economic changes in the producing region and government regulations. Each group contributes to a large chart made to show the pros/cons involving these topics. As the chart is developed, each group presents their part of the visual and shares the groups opinion (decision) on if their study indicates it would be a good idea to develop Iowa's coal resource. After all reports are given the class raises questions to be considered concerning the tradeoffs and environmental impacts of using more Iowa coal. Other alternatives should be discussed and a final class decision made (perhaps by ballot) based on the "big picture". After all questions have been addressed, each student should record their personal response to the class decision, expressing their attitude about the use of Iowa's coal resources and what they believe should be the direction of the nation's energy policy in their lifetime.

SOURCE OF ACTIVITY

This activity was developed by S. E. Heiting from and OUTLOOK activity called "Iowa Coal - Resource of the Future", created by Bob Lancaster, Marilyn Sand and Steve Heiting.



IMPACT OF NUCLEAR FUSION

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students determine what would occur nationally if nuclear fusion was providing 50% of the U.S. electrical energy needs at half the (otherwise) cost.

OBJECTIVE

Each student 1) describes nuclear fusion and alternatives to fossil fuels, 2) determines a national energy policy for their life time, and 3) critically discusses the impact their hypothesis would have on the nation.

MATERIALS

notebooks, chalkboard

TIME

1 - 2 class periods

LEARNING CYCLE

AWARENESS - Students are presented with the hypothesis that nuclear fusion energy will provide 50% of U.S. electricity by the year 2010 and asked to consider the implications in political, economic, social and environmental categories.

CONCEPT DEVELOPMENT - Students, working in groups, develop an Energy Impact Report on their assigned category and share their conclusions with the class, listing impacts on the board.

APPLICATION - Groups compare the lists and discuss what sort of total impact the hypothesis would have on the nation. Students individually prepare a report in which alternative energy resources are considered in developing a national Energy Policy for their life time.

SUGGESTED EVALUATION - The instructor can use the report each student turns in about the amount of future U.S. energy that needs to be provided by alternative sources of energy as a basis for evaluation.

FOLLOW-UP/BACKGROUND INFORMATION

Students are given the following guideline question to answer at the end of their reports. "What amount of the total U.S. energy needs should be provided by what alternative forms of energy, assuming that the economic use of fossil fuels will end by the year 2100?"

ACTIVITY

Students are presented with the statement that in the year 2010 the U.S. has developed the means to produce fifty percent of our national electrical needs through the use of nuclear fusion reactors. Students are asked to determine the impact of this eventuality in the following categories: Political, Economic, Social and Environmental. Each category is defined and groups are formed to cover each. Students are given information such as the article by Isaac Asimov called "Nuclear Fusion..." in I.D.E.A.S., and other appropriate data. They report their findings to the class listing the impacts on the board. The students discuss the feasibility of commercial fusion energy by 2010 and are asked to do out of class research comparing the impacts of nuclear fusion with the possible development and use of other forms of non-fossil fuels. Each student is to turn in a report in which they decide what the national energy policy should be during their expected life span. A guideline question to be addressed is, "What amount of the total United States energy needs should be provided by alternative forms of energy assuming that the economical use of fossil fuels will end by the year 2100?"

SOURCE OF ACTIVITY

The Asimov article is included with the activity entitled "Clearing Up the CON-FUSION." This activity was originated by S. E. Heiting.

WHAT THE WORLD NEEDS NOW

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students examine data concerning per capita energy use by various nations to make an Energy Ethic Mapographic which shows disparity in energy use between nations. An Energy Ethics Statement is developed which suggests a change in thinking needed in the future.

OBJECTIVE

Each student 1) graphs energy use on a "mapographic," 2) lists implications of the current disparity in energy use, and 3) determines "What the World Needs Now" in an ENERGY ETHICS STATEMENT.

MATERIALS

world maps, I.D.E.A.S. article, notebook

TIME

1 class period

LEARNING CYCLE

AWARENESS - Students read the article "How Many Hidden Helpers Do You Have?" and use the information to work on a mapographic showing the energy disparity around the world.

CONCEPT DEVELOPMENT - Mapographics are made, discussed and questions raised in the article are answered in a general class discussion.

APPLICATION - Students list the implications of the information discussed in their notebooks under the following categories - social, economic, political and environmental.

SUGGESTED EVALUATION - The instructor could ask each student to turn in: 1) what they did to complete the mapographic; 2) their list of implications; and 3) their Energy Ethics Statement. These completed products would serve as a basis for grade assessment.

FOLLOW-UP/BACKGROUND INFORMATION

Students are reminded that the U.S. Government has stated its intent to use military action to protect its import energy resources. Information needed for this activity follows.

ACTIVITY

Students are given I.D.E.A.S. information called "How Many Hidden Helpers Do You Have?". This information is read, charts examined and a copy of a world outline map is provided for the students to design a color coded "mapographic" showing where the most and least energy is consumed. Maps are discussed and the questions presented in the article are answered. The students are directed to list the implications of the current disparity in energy use under each of the following categories - Economic, Social, Political and Environmental. The implications are shared with main points being put on the board by the teacher. Each student is to write an ENERGY ETHICS STATEMENT which suggests what "the world needs now" and in the future in order to provide a reasonable distribution of energy resources for a more peaceful planet. Students may need to be reminded that the U.S. has made it clear in the past that it would be willing to use military action to protect our energy interests in the Middle East.

SOURCE OF ACTIVITY

This activity was created by S. E. Heiting

World Map from Mac the Knife™ / A Macintosh™ Clip-Art Treasury
©1984 Miles Computing, Inc. / Drawn originally by Cliff Joyce

How Many Hidden Helpers Do You Have?

There are several ways of saying that Americans use more energy than do people in other countries. One way is to say that the United States, with 5% of the world's population*, uses about 34% of its commercial energy resources. Another way is to state that the 78×10^{15} BTU of commercially supplied energy to 217×10^{6} persons in the U.S. in 1978 is a per-person ration of 3.6×10^{8} BTU. Still another expression of the same data is that each American, on the average, bought 250,000 Calories-worth of fuel per day to maintain his standard of living.

In many countries there is little commercial energy available and the main sources of power are people and firewood. The People's Republic of China is an example of a country that relies heavily on people-power for agriculture, city transportation, and major construction projects.

To make energy consumption figures more "alive", let's put them into human perspective. Assume that every person needs, on the average, 2500 Calories per day for maintaining a productive pace. That's about 10,000 BTU since each kilocalorie or food Calorie = 4 BTU. Over a year's time, this typical person's energy consumption would be 365×10^{4} BTU or one "person-unit" and the resulting work output could be called "one person-power". Then, converting the 1978 commercial energy use per capita of 3.6×10^{8} BTU into "person units":

$$\frac{3.6 \times 10^{8} \text{ BTU}}{365 \times 10^{4} \text{ BTU}} = \frac{36000 \times 10^{4}}{365 \times 10^{4}} = 98.63 \text{ or } 99 \text{ "person units".}$$

In other words, each of us (on the average) had the equivalent of 99 "persons" or "energy helpers" working for us in 1978. No other country in the world is so dependent on fossil fuels.

Americans consume nearly twice as much energy as the English and the Germans; three times as much as the French; eight times as much as the world average; twenty-three times as much as the Chinese; a thousand times as much as the Nepalese.

**Based on figures for 1978 published in the 1979 World Almanac, U.S. population was 217×10^{6} and world population was 4.22×10^{9} persons.*

One of the physical laws relevant to windmills suggests that bigger winds are much better. Kinetic energy is proportional to the cube of wind velocity, so the stronger the wind, the more power we get from it. If a certain speed gives 2 kilowatts of energy, doubling that speed gives 16 kilowatts.

Bigger is also better for the windmill itself. Power output depends on the area of the propeller and a high enough tower to reach the main windstream. Even in flat areas, a tower of 35-50 feet is usually necessary for consistent performance. All equipment must be sturdily built. Reliable windmills cost more initially, but can be expected to last longer and to reduce danger of sheared-off debris.

If wind power is used to generate electricity, a battery-storage system is required. It produces DC current which is not always compatible with AC appliances; proper conversion devices add to the expense of the system.

One of the benefits of using wind power not yet measured in dollars is that it does not contribute waste heat, environmental damage from mining or oil spills, or radioactive waste products to contaminate the environment. Windmills may not have much "eye appeal" on the landscape, though, and they may affect TV reception in some areas.

Windmills to pump irrigation water, to grind grain, or to heat water by direct mechanical action have less critical requirements than those for electrical power generation and they have been used successfully for centuries, notably in Persia (now Iran) and Holland (the Netherlands).

Sailing ships also took advantage of prevailing winds. Men have circumnavigated the Earth in vessels developing as much as 13,000 horsepower per ship. Germany is presently constructing an up-to-date "Dyna Ship" with dacron sails that, it is hoped will get 95% of its energy from the wind. An auxiliary engine is planned, however, to take over as necessary.

HIDDEN HELPERS RATIOS

Visualize a ration of 2500 Calories/day as equivalent to the average well-fed person's consumption in food. Call this one human "person power". Then the average daily energy consumption of people in various countries can be compared to having armies of hidden helpers moving and shaping the environment.

Energy Helpers Per Person/Day*	Country	Region
99	U. S.	North America
51	Australia	Oceania
46	Sweden	W. Europe
45	W. Germany	W. Europe
40	Britain	W. Europe
40	U.S.S.R.	E. Europe
33	France	W. Europe
28	Japan	Asia
27	New Zealand	Oceania
25	Italy	W. Europe
19	Israel	Middle East
16	WORLD AVERAGE	
14	Argentina	S. America
12	Iran	Middle East
9	Mexico	C. America
8	Korea	Asia
6	Brazil	S. America
5	China	Asia
4	Egypt	Africa
2	India	Asia
1	Viet Nam	Asia
0.2	Kenya	Africa
0.1	Nepal	Asia

**U.S. ratio is based on 1978 statistics for energy consumption released by DOE. Other countries' ratios are based on energy consumption statistics published by United Nations in 1977.*

Did you realize that we have so many hidden helpers? In many ways our energy helpers have served us well, carrying us rapidly around the world; bringing delicacies from long distances, like coffee from Africa and pineapples from Mexico and the Phillipines; producing durable goods, plowing fields, carrying messages, preparing and storing foods, resculpturing the earth and extending our grasp into space.

But what will we do now if the energy helpers die off? Or if less-developed nations demand their share of this labor pool? Or if scarcity makes energy helpers more and more expensive on the world market? Or if the waste products of energy production overtax the environment? (If all people consumed energy at the U.S. rate in 1978, the world market supply would have to have been 680 times greater.)

Our formerly reliable and invisible helpers are now standing up to be counted. There may be enough to meet our needs tomorrow, but what will be available for your children and grandchildren depends on how we manage these assets today.

EDUCATED ENERGY GUESS

SUBJECT Social Studies LEVEL 9 - 12

ACTIVITY IN BRIEF

Students make an energy hypothesis statement and locate quotations that would support and reject the statement. Students determine if the evidence justifies accepting or rejecting the energy statement and modify the hypothesis accordingly.

OBJECTIVE

Each student 1) states an hypothesis about energy, 2) proposes and justifies reasons for or against their hypotheses, and 3) designs their own "NRG Quote."

MATERIALS	TIME
poster or bulletin board, I.D.E.A.S. information which follows.	1 class period

LEARNING CYCLE

AWARENESS - Students write an energy hypothesis statement which indicates something of the students energy awareness and select quotes which support and not support the hypothesis.

CONCEPT DEVELOPMENT - Students decide if their hypothesis statement is accurate and write modifications as needed. Students originate their own energy quote based on their hypothesis.

APPLICATION - Students share their created quotes and they are posted on a bulletin board for Notable Energy Quotes.

SUGGESTED EVALUATION - The instructor evaluates students' work according to how precisely they were able to identify quotes on each side of their hypothesis. Credit for originality and creativity of their "NRG Quotes" should also be considered.

FOLLOW-UP/BACKGROUND INFORMATION

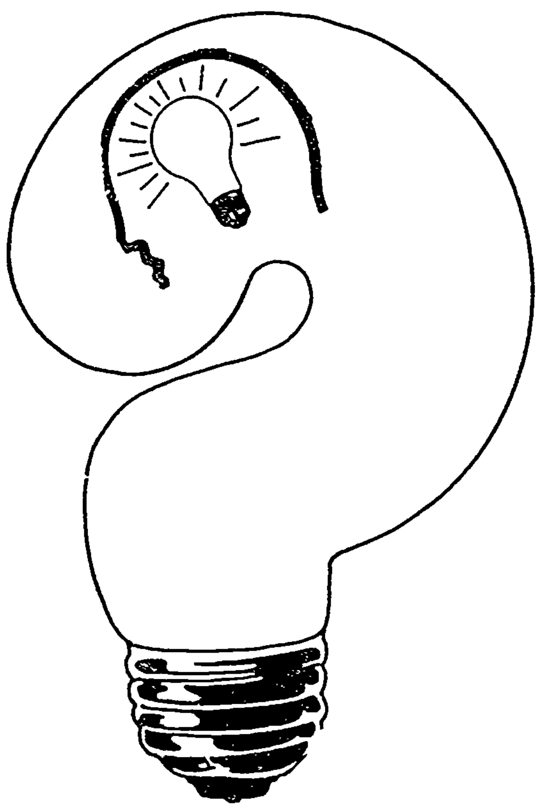
Students discuss the implications of their findings as they relate to U. S. energy use. Together the class should decide which quote (or create a composite quote) best represents the current U. S. energy condition.

ACTIVITY

After a discussion or unit on energy, students are asked to write a hypothesis which states something they think may be true about the U. S. energy situation today. Students then read a number of quotations provided by I.D.E.A.S. "The Energy Debate. The students select 3-5 quotes which support and do not support their hypothesis. The library or classroom resources are used to help students determine if the hypothesis is defendable. Students weigh the evidence and decide if their hypothesis statement is accurate. Students state why they are accepting or rejecting the hypothesis. Modifications of the hypothesis should be made if needed. Students share the conclusions of their work and discuss what the implications of their findings mean in terms of current U. S. energy use. Each student is directed to originate their own energy quotation to be posted or displayed on a board labeled "Notable Energy Quotes".

SOURCE OF ACTIVITY

Developed by S. E. Heiting



The Energy Debate:

Everything is connected in ways we cannot begin to imagine. The hunger problem is not the hunger problem. It is the poverty problem. It is the pollution problem. It is the energy problem. It is the war problem, the arms problem. All those problems are inextricably connected, and you don't solve one without solving them all. Things that will work for one will work for all.

Dana Meadows--systems analyst speaking at the 1978 World Hunger Symposium

---

The sun radiates energy at a rate of 400,000,000,000,000,000,000,000,000 watts. Half a billionth of that gets to the earth. Of that fraction, about a third bounces off immediately and almost another third remains at the surface to drive the climate. Living things, intertwined by their individually tiny but collectively vast flows of energy, have been evolving for several billion years within the constraints of energy income available to them. They work very well and know exactly what to do, even though they have never been to engineering school.

Jim Harding, 1975

The United States puts 45% of its total energy into vehicles: to make them, run them, and clear a right of way for them when they roll, when they fly, and when they park. Most of this energy is to move people who have been strapped into place.

For the sole purpose of transporting people, 215 million Americans allocate more fuel than is used by 1,300 million Chinese and Indians for all purposes. Almost all of this fuel is burnt in a rain dance of time-consuming acceleration.

Ivan Illich, Energy and Equity, 1974

I blame squarely the West for certain models that they have introduced to us; one is the consumer society, the other is gigantism. We are still stuck with them. The gigantism: big dams, big projects, roads, cars for everybody. We cannot afford cars for everybody; not even one person in one hundred has a car. We must have mass transportation. We took the wrong road for a number of years. We are now realizing we're on the wrong road but it takes a long time to make a turn.

Ajit Bhattacharjea--Editor, Indian Express newspaper, New Delhi, India

---

The diversity of soft technology makes it particularly easy to recycle existing industry, especially the car industry which doesn't have a good long term future. General Motors, I understand, has recently converted a car radiator factory to make solar collectors which are, more or less, car radiators inside out.

Amory Lovins, 1978

The whole universe, including that which we call physical, can be treated in terms of information, and it is clear that information is constantly increasing. The supply is essentially unlimited, for we can always generate new information in the universe of the self--make new discoveries, new choices, put old things together in new ways--and this is bound to influence the future. To influence the future consciously, then, taking responsibility for the outcome of this influence, is to participate fully in the ultimate adventure.

George Leonard, The Silent Pulse, 1978

A General Public Utilities survey shows that 58% of its customers have altered household routines to help cut down the use of electricity in the day time. This means more nighttime laundering, baking, and dishwashing.

Wall Street Journal, August 24, 1978

Material thrift has become almost impossible; the system conspires against it. As a society, we assign the highest value to our leisure and therefore a lower value to all things that might demand our time and attention. Disposable, self-cleaning, self-defrosting, easy-to-use, ready-to-wear, ready-to-eat, three-in-one, all-purpose--these are the adjectives that get our consumerist juices churning. No matter that the time most of us save we then fritter away in front of the garrulous TV.

Carll Tucker in Saturday Review, August, 1979

Warning: This air conditioner is hazardous to your health and to the environment. This model, used in normal operation in your locale (1000 hours in the summer months) will require the consumption of a pound of coal (or equivalent fuel) per hour of operation. This air conditioner will consume a half ton of coal during the summer, most of which comes from strip mining. In addition, the generation of pollutants from the electric power plant where the coal is burned may cause disease and property damage. The Surgeon General . . . advises use of trees for cooling and shading, natural ventilation when possible, and alternatively, when necessary for mechanical ventilation, the use of electric fans which consume one tenth the energy required for this machine.

Air conditioner label suggested by Wilson Clark in Energy for Survival, 1975

Any dramatic rise in water usage will force . . . hard choices . . . . It takes only seven gallons of water to refine the equivalent of a billion BTU's from Standard Oil of California's Richmond oil refinery. But it takes twice that much water to get the same energy from nuclear reactors and three to four times as much that amount to get it from oil shale. In addition, many of the "new generation" fuels, like geothermal, also consume much more water when they are used to generate power.

Kathleen Wiegner in Forbes, August 20, 1979

The Second Law equation says that energy cannot be recycled, and that matter can only be recycled by expenditures of energy--always at less than 100% efficiency. When we ignore the Second Law of Thermodynamics, we do so to the dismay of our land and air and water. These are the components of the biosphere that must act as a blotter for the Second Law wastes we generate as we use energy.

Jean Matthews in Trends, May 1979

One of the peculiarities of the human animal is his lack of group providence . . . as a social creature he will not accept any warnings that interfere with daily business.

Donald E. Carr

We should build the south side (of the house) loftier, to get the winter sun, and the north side lower to keep out the cold winds.

Xenophon, Greek historian, 400 B.C.

Few will have the greatness to bend history itself, but each of us can work to change a small portion of events, and in the total of all these acts will be written the history of this generation.

Robert F. Kennedy

Man on a bicycle can go three or four times faster than the pedestrian but uses five times less energy in the process. He carries one gram of his weight over a kilometer of flat road at the expense of only 0.15 calories. The bicycle is the perfect transducer to match man's metabolic energy to the impedance of locomotion. Equipped with this tool, man outstrips the efficiency of not only all machines, but all animals as well.

Ivan Illich

Our most optimistic estimates indicate that solar electric generating capacity might represent about one percent of the total installed capacity by the year 2000. Despite accelerated research and development efforts in alternative energy forms, sources other than fossil and nuclear fuels will be supplying only about ten percent of electric generation by the year 2000—and more than half of that will be hydroelectric.

H. V. Young
Edison Electric Institute

REAL ENERGY COSTS

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students read information about the energy manufacturing costs, answer questions and make recommendations to increase efficient use of energy in everyday life.

OBJECTIVE

Each student 1) states answers clearly to questions posed at the end of an NRG reading, and 2) designs a plan to reduce the total amount of energy wasted.

MATERIALS

poster board, markers

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students read handout information from I.D.E.A.S. about the amount of energy used in production vs. consumption and report answers to questions at the end of the reading, "Energy in Manufacturing—I".

CONCEPT DEVELOPMENT - Question groups create recommendations to reduce the amount of energy waste and place their suggestions on an Energy Efficiency Board to be shared with the class.

APPLICATION - Each student designs a plan to reduce the total amount of energy used (wasted) by producers and consumers.

SUGGESTED EVALUATION - The teacher should consider the following in assessing each students' grade for this activity: 1) The clarity of response to questions assigned. 2) The participation level in class discussions and suggestions made. 3) The reasonableness of the plan to reduce NRG waste.

FOLLOW-UP/BACKGROUND INFORMATION

The plans are shared and various aspects combined into a class "Anti Energy Waste Recommendation" to be put on the Energy Efficiency Board. A copy of "Energy in Manufacturing-I" follows.

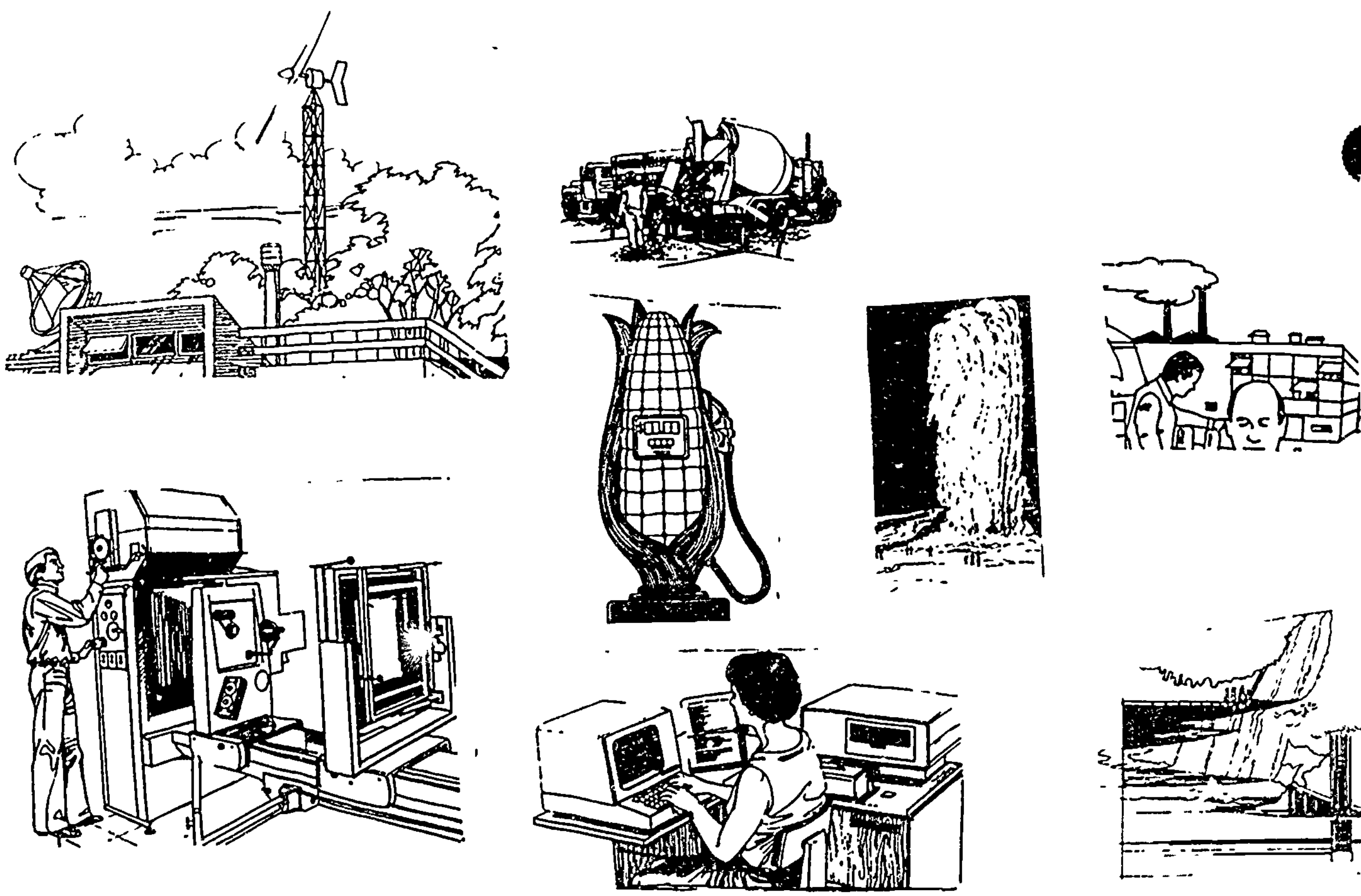
SS-108

ACTIVITY

Students are given copies of "Energy in Manufacturing - I" From I.D.E.A.S., Social Studies Section. After reading the information the students are divided into five groups, one for each of the questions at the bottom of the handout. Each group develops an answer to the assigned question and reports to the class. After discussing the reports each group creates two or more recommendations which states how producers and consumers can more efficiently use energy. The recommendations are put on an "Energy Efficient Board", a poster having two categories: 1) Energy Production/Distribution Costs and 2) Energy Consumption Costs. Using the poster, each student designs a plan for a total reduction in energy waste. The plans are shared and compared in order to determine a class plan to put on the Energy Efficient Board.

SOURCE OF ACTIVITY

This activity was originated by S. E. Heiting



Energy in Manufacturing--I

An electric carving knife takes twenty times as much energy to manufacture as it will use in a year. The chart shown below gives this same ratio for some other common household items. It tells how much energy it takes to manufacture a product compared to how much energy the product uses in a year.

For many power-driven gadgets, the main energy expense is in their production, sales, service and ultimate disposal; and not in their use. A good deal of the energy capital invested in a household is not used very well. People often buy expensive and complicated appliances and then use them only occasionally.

$$\text{Ratio: } \frac{\text{Energy to Manufacture}}{\text{Energy to Run for One Year}}$$

electric knife	20
electric can opener	17
garage door opener	50
garbage disposal	30
power mower	3
roto-tiller	25
shredder	20
snow-blower	25
trash compactor	20

From Household Energy Game, University of Wisconsin, Sea Grant College Program, Madison, WI 53706.

Questions:

1. What are the alternatives to using each of the household appliances mentioned above?
2. What are the other costs (besides energy) of the appliances mentioned--economic, environmental, social?
3. What are the benefits of these appliances?
4. Which appliances can you most easily live without?
5. Which can possibly be rented or shared with neighbors for more efficient use?

MAKING ENERGY ISSUES "RADIOACTIVE"

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students study and select an energy topic to develop into a radio broadcast - news item or commercial to be critiqued by the class as to their energy point and purpose.

OBJECTIVE

Each student 1) identifies and discusses energy issues and problems, 2) describes the effectiveness of an energy radio broadcast, and 3) explains their answer to a concluding question.

MATERIALS

resources suggesting energy issues, tape recorders

TIME

2 class periods

LEARNING CYCLE

AWARENESS - Students identify and discuss the meaning of ten energy issues/problems and form groups of three to develop a radio (or TV) news item or commercial about energy.

CONCEPT DEVELOPMENT - Each group creates a broadcast about a selected (or assigned) energy issue in which a main point or opinion is expressed.

APPLICATION - After making up a critique or evaluation form, students listen to and rate each broadcast according to set criteria concerning the effectiveness of the taped energy effort.

SUGGESTED EVALUATION - The instructor could use the evaluation done by students on the critique form along with an assessment of each students' response to the final follow-up question. Credit would also be appropriate for participation in the media production.

FOLLOW-UP/BACKGROUND INFORMATION

The instructor is given the ratings, determines which group was rated highest (2nd highest?) and gives " a battery of" awards. Each student answers the follow-up question: Does the media pay enough attention to energy issues?, and defends their answer.

ACTIVITY

Students are given (or determine) ten energy issues or problems to be dealt with by groups of three. The groups are given the task of originating a radio news spot or commercial advertisement which brings across their thinking about the selected energy issue they have worked with. These radio broadcasts are tape recorded and played back to the class (if possible, they could be made into TV broadcasts using video tape equipment). The class prepares a "critique form" to be used to rate the effectiveness of the broadcast. How well did it make a valid point about energy today? Each group's rating (from the critique form) is submitted to the teacher who determines the group(s) that had the most highly rated broadcast. Each member of the winning group is awarded a regular (not alkaline) battery with the message being to conserve even battery energy. A follow-up question to be assigned would be, Does the media pay enough attention to energy issues? (They should defend/support their answers.)

SOURCE OF ACTIVITY

Created by S. E. Heiting

ENERGIZED TEACHERS

SUBJECT Social Studies **LEVEL** 9 - 12

ACTIVITY IN BRIEF

Students develop an energy lesson to be taught to grade schoolers and arrange to demonstrate, field test or actually teach the unit.

OBJECTIVE

Each student 1) constructs an "NRG" lesson plan to be shared with the class, 2) critically discusses and revises the plan as needed, and 3) evaluates the effectiveness of the lesson plan.

MATERIALS

energy resource information, copies of a developed "accountability sheet"

TIME

time will vary

LEARNING CYCLE

AWARENESS - Students work in groups of 2-4 to determine an appropriate grade school energy topic and fill out an accountability form which describes the energy issue, teaching strategy and materials.

CONCEPT DEVELOPMENT - Each group completes their energy topic lesson plan and shares it with another group, gets feedback and makes revisions.

APPLICATION - The finalized lesson is demonstrated, field tested or actually taught to an appropriate group as conditions allow.

SUGGESTED EVALUATION - The instructor reviews the self evaluations and compares them to the objectives stated and observations made by the student. Credit for the design of the lesson plan, the attempt to implement it, and the completed self-evaluation should all be considered in the total assessment.

FOLLOW-UP/BACKGROUND INFORMATION

Each member of the group writes about their teaching experience and evaluates their groups' performance. Students are directed to rewrite their objectives and rate themselves according to how well they did, citing experiential evidence to support their rating.

SS-114

ACTIVITY

Students are put in groups of 2-4 to determine an appropriate energy topic for grade school pupils. Each group is required to fill out an accountability sheet (prepared by the teacher) which stipulates what grade level, energy topic approach and teaching tools/materials will be used to teach the lesson. After the groups complete their "lesson plan" they share them with one of the other groups for feedback, criticism and improvement revision. A final lesson plan is described to the class and submitted to the teacher. The groups are given an opportunity to demonstrate, field test or teach their lesson to an appropriate group of students. Each member of the group shares (in writing) their experience and self-evaluates the groups' effectiveness. Students are directed to record their objectives (what they were trying to accomplish) and rate themselves on how well they accomplished them. These ratings should be clarified by supporting evidence from the teaching experience.

SOURCE OF ACTIVITY

Originated by S. E. Heiting, June 1986.