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AUTHOR	Albert, Harold E., Ed.	
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ABSTRACT

This collection of energy teaching units is the contribution of participants in a U.S. Department of Energy sponsored institute for secondary science and social studies teachers. The objectives of the Institute were to: (1) provide an overview of past, present, and future energy problems, and (2) stimulate teachers to use this information in their own courses. The units are for a broad range of disciplines and include topics such as: fossil fuels, energy conservation, nuclear power, economics of energy, coal mining, future trends, U.S. energy policy, electricity generation, and chemical aspects of energy production. Each unit includes objectives, daily activities and bibliography. (TM)

Putting "Energy" In Your Course: 1978

Developed by the Participants in the Energy Short Course for Secondary Teachers at Clemson University Summer 1978

Harold E. Albert, Director
Professor, Political Science

Fred J. Keller, Associate Director
Professor, Physics

Clemson University

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PUTTING "ENERGY" IN YOUR COURSE: 1978

A collection of energy teaching units designed by the participants of the Energy Institute for Secondary Science and Social Science teachers.

Summer, 1978

Clemson University
Clemson, S.C. 29631
Department of Political Science

Edited by
Harold E. Albert
Professor, Political Science
Clemson University
Director, 1978 Energy Institute

Introduction

The U.S. Department of Energy sponsored an Energy Institute at Clemson University for secondary science and social science teachers during the summer of 1978. Dean H. Morris Cox of the College of Liberal Arts, and Department Head Charles W. Dunn of the Political Science Department made available the first class facilities used for the Institute.

The first objective of the Institute was to provide an overview of past, present, and future energy problems. This was done through a series of lectures, tours of electrical generating facilities, and films.

The second objective was to stimulate teachers to use this information in their own courses. This was done through their exchanging ideas during the "coffee breaks, meal times, and their preparation of teaching units which were edited and presented herein.

The range of teaching units is very broad, and use of this manual can be helpful to teachers of all subjects. Copies will be supplied to all participants and to other teachers or librarians as long as the supply lasts.

Harold E. Albert
August 1978

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ENERGY UNIT ON ENERGY

Chemistry: 11th Grade

by

Ann L. Addison
Lower Richland High School

INTRODUCTION

I believe the following statements to be true: 1) Many students do not believe there is an energy crisis because they are uninformed of certain facts; 2) We, as teachers, have a responsibility to develop an informed future electorate and to develop a personal sense of responsibility in our students; 3) We need to help students learn to make decisions based on the best information available by offering opportunities to make decisions in a less threatening situation.

The following outline is offered for use in any classroom situation. Suggestions to adapt it to many subject areas are listed at the end of the outline. In general, the unit outline will: a) present the facts as briefly as possible; (the unit may be extended by expanding on each day and covering more material); b) allow several days of class discussion; c) test by requiring students to express their personal opinions. A description of a possible testing situation follows and if a teacher desires to use this idea, it should be fully explained to the students at the beginning of the unit.

A place in the room should be provided for a collection of current news articles on energy and a collection of pamphlets on any topic related to energy. Posters should be used and students should be encouraged to develop posters for classroom and school use.

The test will be a position paper entitled Energy-My Ideas. It will be written in class using the students own notes - not those of a friend. A general outline suggested for use by the students follows:

I. Energy from the past.

II. Energy of today.

These should make up no more than ½ of the paper.

III. Energy sources and problems of the future, my personal ideas. This should make up at least ½ of the paper.

During the unit, vocabulary words will be identified each day and listed on a poster in the room. During the days of discussion a selection of essential words from this list will be made with student input. These words should represent a cross section of the total list and should not be too extensive. The words selected as essential may be a way of varying the emphasis for different subject areas and may also be used to vary the level of testing for different grouping situations. Each student should be given a list of the vocabulary words divided into the essential and extra credit words.

On test day, the students will be given another copy of the vocabulary list along with paper on which to write. The paper is to prevent the advance composition by another person. During the test the teacher should walk around the room making sure that the students are not copying from a pre-prepared paper. The students will be directed to use correctly the essential words, underlining each word the first time it is used. All extra credit words used can be indicated by double lines or lines of a different color. If the students limit their papers to the essential words, the grade should be a "C". Each teacher may assign a numerical grade equivalent of the middle of their "C" range if they desire. The use of extra credit words will be encouraged by giving additional points for the use of each additional word. These points should be added to the points assigned for the "C" grade to determine the final grade on the paper. Grades for papers not using all the essential vocabulary words are left to the discretion of the teacher using best estimate of the individual students abilities. NO OPINI OF THE STUDENT SHOULD BE CONSIDERED AS A PART OF THE GRADE.

The teacher should make note of misspelled words and grammar mistakes.

DAY ONE

This day will begin by giving a survey to determine students' opinions about the energy situation in our country. It will also determine what they think the solutions might be. After taking the survey, the teacher will explain the testing procedure and show the film - The Great Search.

DAY TWO (This may take several days depending on the abilities of the group)

This day should be spent discussing energy terms such as: definition of work, power, calories, BTU, potential energy, gravitational energy, electrical energy, chemical energy, nuclear energy, kinetic energy, mechanical energy, sound energy, radiant energy, thermal energy, energy conversions and the basic laws of energy. The differences between renewable and nonrenewable energy resources should be discussed.

The rate of use of energy in the United States should be explained. The concept of exponential growth can be explained using the exercise of calculating the amount of money one would make if you started by receiving one penny on the first day and doubling the amount each day for thirty days.

The basic design of an electric power plant should be shown and explained. At this point an extra day can be set aside for a field trip to a coal fired generating plant, if desired or possible.

DAY THREE

This day will be spent discussing the resource coal using the following topics:

1. Sources of coal from different types of mines;
2. Chemical content and processing of coal before shipping;
3. Shipping of coal;
4. Uses of coal for purposes other than production of electricity;
5. Dangers in all phases of coal production and use;
6. Pollution and environmental concerns from mining and use of coal;
7. Economic and political controls on coal;
8. Future uses of coal.

DAY FOUR

This day will be spent discussing the resource petroleum, being sure to include the following topics:

1. Sources of petroleum from both onshore and offshore production;
2. Chemical content and refining of crude oil;

3. Shipping of oil;
4. Uses of petroleum other than to produce energy;
5. Pollution from mining and use of petroleum;
6. Dangers in all phases;
7. Economic and political controls;
8. Our purchases of petroleum from other countries;
9. The future of petroleum.

DAY FIVE

The general topic for today is nuclear fission being sure to include the following:

1. Definitions of nuclear terms such as alpha particle, background radiation, beta particle, chain reaction, control rod, coolants, fission, gamma rays, half life, light and heavy water, isotope, neutron, nucleus, proton, rad, radiation, radioactive waste, rem, spent fuel, and X-ray.
2. Sources of uranium 235, 238 and how it is processed;
3. Chemical content of fuel and how it changes during the production of electricity;
4. Differences between nuclear power plants and coal fired plants;
5. Other uses of uranium 235 and 238.
6. Waste from fission plants, its storage and reprocessing;
7. Costs of fuel in comparison to other fuels;
8. Dangers, including SL-1 accident and leaks from fuel storage;
9. Pollution and environmental concerns;
10. Economic and political controls;
11. Future of fission reactors.

DAY SIX

This day will be spent discussing nuclear fusion and the breeder reactor projects.

The breeder reactor will be discussed emphasizing that it is a research project only and not used for the production of electricity here in the United States. Other countries do have reactors like this in production. The source of fuel, chemical content and processing of the fuel as will as the dangers in all phases. Environmental concerns should be discussed. Economic and political controls should also be mentioned.

Nuclear fusion will be explained emphasizing the types of fuel, chemical content and sources of the fuel, waste and dangers during all phases of production, pollution and environmental concerns and the economic and political controls. This also is a research project and is not near production stage.

DAY SEVEN

All other forms of energy sources should be discussed including their sources, present-day uses, future uses, costs, and pollution problems. The suggested list of these sources is: solar, geothermal, winds, gradients, tides plus agricultural waste products.

DAY EIGHT

Conservation of energy is a true source of energy today and in our future. The many ways of conservation in the home, industry and in transportation should be discussed. A check list on conservation in the home will be sent home with each student to encourage better conservation immediately.

DAY NINE

The energy outlook for the State of South Carolina - this will be the topic given to an invited guest speaker. Ed Richardson, the speaker, is from the S.C. Water Resources Commission.

DAY TEN

A speaker will be invited to speak on Environmental Concerns of nuclear fuels. A good source for such a speaker is the Environmental Coalition, 1226 Bull Street, Columbia, S.C. phone 799-0321.

DAYS ELEVEN AND TWELVE

A minimum of two days will be set aside for class discussion where each student will be encouraged to express their own opinions and ask any questions they might have concerning any topic discussed.

DAY THIRTEEN

Test day.

GENERAL BIBLIOGRAPHY

Energy Conservation in the Home, U.S.Department of Energy, October, 1977. This guide was prepared as an Energy Educational/Conservation Curriculum Guide for Home Economics Teachers by the University of Tennessee Environment Center and College of Home Economics Knoxville, Tennessee. Copies may be obtained by writing -

U.S. Department of Energy
Technical Information Center
P.O. Box 62,
Oak Ridge, Tennessee 37830

Factsheet, (1-19) National Science Teachers Association. This is a series of 19 separate pamphlets covering different topics on energy. Copies of these may be obtained by writing -

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

SPECIFIC BIBLIOGRAPHY

(order is same as order in days used)

DAY ONE

Energy Conservation in the Home, p. 247. This is the survey instrument suggested.

The Great Search, Buena Vista Films. This is a cartoon history of energy prepared by Walt Disney.

DAY TWO

Energy Conservation in the Home, pp. 261-285. This is a discussion of the basic energy concepts. The material here has

an additional bibliography with footnotes.

Dr. Malcolm Skove - Alumni Prof., Physics, Clemson University. "Exploitation of Energy Resources" July 18, 1978. These notes explain exponential growth and give examples plus a simple formula to determine doubling time.

Exxon Company, USA's Energy Outlook 1978-1990, May 1978. This is a supply of information on US demands, consumption, supply and Government policies on energy.

DAY THREE

The World Book Encyclopedia, "Coal" (1976 ed) Vol. III, p 566-586. A comprehensive discussion of aspects of coal.

Factsheet 15: New Fuels From Coal. A discussion of the projected manufacture of methane and other fuels from coal.

Royce N. McNeill, Coal Mining. July 21, 1978. These notes are a comprehensive discussion of the mining of coal.

DAY FOUR

Harper, William B. "Petroleum", World Book Encyclopedia, (1974 ed) Vol. XIV, 292-312. A comprehensive discussion of petroleum from mining to use. There is also a listing of products made from petroleum and other related articles on petroleum found in World Book.

Dr. David Snipes, Assoc. Prof., Geology, Clemson Univ. "Fossil Fuels: Discovery and Extraction" July 20, 1978. These notes have several good slides that may be ordered to show the types of places oil can be discovered.

Dr. Richard Rice, Assistant Professor, Chemical Engineering, Clemson Univ. "Fossil Fuels - Conversion to Useful Energy" July 21, 1978. These notes give the principle compounds in crude oil and how they are extracted by refining.

Ed Richardson, Head, Environmental Affairs Div., S.C. Water Resources Comm. "Oil Spills and Other Pollution in the Food Chain" July 21, 1978. These notes discuss the use of bacteria to clean up oil spills and provide slides showing oil rigs.

Dr. Thomas Overcamp. Associate Professor, Environmental Systems Engineering, Clemson University. "Combustion, Chemical & Thermal Pollution". July 21, 1978. These notes cover the substances that pollute our environment and how they are treated.

DAY FIVE

John Elliott, Principal Engineer, Duke Power Co. "Fission", July 24, 1978. These notes justify Duke Power Co. in using nuclear fuel and compare the costs of different fuels. He also explained how the reactor is different from the coal fired generating plant.

Factsheet - 12 Conventional Reactors. This discusses the general use and problems of using fission reactors to produce electricity.

Dr. Everett Sheldon, Environmental Protection & Energy Conservation Coordinator, Savannah River Plant. "Nuclear Wastes". July 25, 1978. These notes describe how the Savannah River Plant reprocesses fuel and stores it. They also cover the products made at the SRP.

Lyerly and Mitchell, Nuclear Power Plants; United States Atomic Energy Commission, October 1968. This is one of many booklets of the "Understanding the Atom series. Complete sets are available to schools and public libraries. Requests should be mailed on school stationery to USDOE, P.O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Power and the Environment: Questions and Answers
Nuclear Radiation and Health
Nuclear Safeguards. These are booklets published by Duke Power Company and are available on order from the Company - P.O. Box 2178, Charlotte, N.C. 28201.

Your Visit To Keowee-Toxaway, Duke Power Company. This is a booklet given out when you visit the Keowee-Toxaway nuclear power plant. It contains a description of the power plant and has a glossary of electrical terms and nuclear terms.

DAY SIX

Walter Kelly, Instrumentation Engineer, Clinch River Breeder Reactor Project. "Breeders" July 25, 1978. These notes discuss how breeder reactors work and about other countries' progress in this area.

Clinch River Breeder Reactor Plant Project - Design Description booklet. For more information contact: Breeder Reactor Corporation, P.O. Box U. Oak Ridge, Tennessee, 37830.

G.H. Nielson, Thermonuclear Division, Oak Ridge "Fusion" July 25, 1978. This was a crash course in fusion physics and a description of the present research at Oak Ridge.

Factsheet 13 - Breeder Reactors

Factsheet 14 - Nuclear Fusion
These give concise summaries of each of these sources of energy, there advantages, and disadvantages.

DAY SEVEN

SOLAR

John McKelvey, Head, Physics Department, Clemson University. "Solar" July 27, 1978. These notes discuss how solar energy can be used and the many misconceptions about it.

Factsheet 4 - Electricity From the Sun I (Solar Photovoltaic Energy)

Factsheet 5 - Electricity From the Sun II (Solar Thermal Energy conversion)

Factsheet 7 - Solar Heating and Cooling

GEOTHERMAL

Dr. Harold Albert, Professor, Political Science, Clemson Univ. "Geothermal" July 27, 1978. These notes explain the source of geothermal energy and go into the many problems associated with this form of energy.

Factsheet 8 - Geothermal Energy

GRADIENTS, TIDES & WINDS

Dr. Fred Keller, Professor, Physics, Clemson University. "Gradients, Tides, Wind". July 27, 1978. These notes give some history of gradients, and explanation of how tides can be used to generate electricity. The advantages and disadvantages are mentioned.

Factsheet 3 - Wind Power

Factsheet 6 - Solar Sea Power (Ocean Thermal Energy Conversion)

AGRICULTURAL WASTES

Dr. Clyde Barth, Professor, Agriculture Engineering, Clemson Univ. July 27, 1978. These notes give interesting ways of converting cattle and poultry wastes into usable energy.

Factsheet 1 - Fuel from Plants. (Bioconversion)

Factsheet 2 - Fuel from Wastes. (Bioconversion)

DAY EIGHT

Dr. W.S. Piper "Conservation Energy -- The Bridge Fuel for America's Energy Future". July 25, 1978. These notes explain how much energy can be saved in several different ways.

Energy Conservation in the Home

p. 43-47 -------- Insulation
p. 71 -------- Home Furnishings and Conservation
p. 130 -------- Appliances
p. 197 -------- How to read the meter
p. 223 -------- Residential Checklist

DAY NINE AND DAY TEN

Speakers

DAYS ELEVEN AND TWELVE

Class Discussion

FOSSILS OF YESTERDAY-FUEL TODAY, SHORTAGES OF TOMORROW

Earth Science: 8th Grade

by

Betty H. Boggs
Laurens Junior High School

INTRODUCTION:

Although the supply of natural resources is limited, they are being used at increasing rates. We must learn to live within the limits of the earth's resources, to conserve our present supply, and to develop those sources of energy that are not finite and will not prove lethal. Our technological economy, which has depended upon energy, must be reexamined and other alternatives considered. Throw-away life styles must give way to mechanisms for recycling. Not only is electricity for household heating, gasoline for automobiles, and energy for industry affected by limited energy sources, but mass transit, population control and community development are also factors in the energy crunch.

OBJECTIVES:

A. To make students aware of the various forms of energy that have been used by Americans.

B. To help students see how technology has replaced old forms of energy with new ones.

C. To make students aware of the necessity of developing alternative sources of energy.

D. To create a desire in students to be more conservative with energy reserves remaining on the earth.

BEHAVIOR OBJECTIVES:

A. Students will identify the kinds of energy.

B. List the kinds of fuels that originate from fossils of yesterday.

C. List ways in which fossil fuels are used.

D. Describe ways electricity is generated.

E. Cite reasons our energy supply is being depleted.

F. Report on the feasibility of fusion, solar, geothermal, bioconversion, ocean waves and currents as sources of fuel.

G. Make models or posters of the many sources of energy.

CONTENT:

A. Forms of energy (Day I)

B. Organic material forms three kinds of fuel (Day II)

C. Coal and its uses (Day III)

D. Carbon products that work for man (Day IV)

E. What is petroleum? (Day V)

F. What if it ends? (Day VI)

G. The generation of electricity (Days VII, VIII, IX)

H. The utilization of solar, wind, geothermal, bioconversion, ocean current and waves. (Days X, XI, XII, XIII, XIV, XV)

Day I

OVERVIEW:

Energy is the name given to the ability to do work. All human life depends on the energy in the universe. The amount of energy falling on the earth's surface each year is equal to that supplied by 250 million tons of coal or about 100,000 tons of coal for each person on earth.

Mechanical energy is found in machines. Chemical energy is released when matter changes chemically. Electrical energy can be turned into many other forms of energy. Atomic energy is released when atoms split or combine. Solar energy is the radiant energy given off by the sun.

STUDENT ACTIVITY:

Ask students to imagine how man got the idea of using energy. Try to describe the kind of energy man used?

Show film "The Great Search". Ask the students to evaluate the film.

Days II, III, IV

OVERVIEW:

During late paleozoic time, fish dominated the seas and amphibians or reptiles dominated the land. Many varieties of invertebrates were present, as they are today. But invertebrates were no longer the dominant life forms.

In addition to changes in life forms, physical changes in the earth also occurred toward the end of the paleozoic era. Vast swamps, much like the Everglades of Florida, covered the interior of continents during the Pennsylvannian period. After burial, vegetation of these swamps became the great coal fields of the world.

This sounds hard to believe, does it not? How can something which is not alive be working? The puzzle is really a simple one to solve. Organic matter, matter which comes from living things, can be used by man to do work for him. All organic matter contains carbon. It is this element, carbon, which is really doing the work. Let us see what kind of work that is and how it is done.

To do work, we need energy. To get energy, we usually burn some material. This material we burn is called a fuel. The combustion of the fuel gives off energy which can do work. There are fuels in each physical state--solid, liquid and gas. Fuels are burned in engines for work and transportation. Fuels are burned in homes to give heat and cook food.

ACTIVITIES:

Using an overhead projector, have students look at: (1) the formation of coal. (2) the kinds of coals: Its name--physical and chemical properties and its ability to burn. (3) Using a map show the location of large coal reserves in the United States. Discuss the method of mining coal, both on the surface and underground. Discuss the various means of transporting coal from the mine to the consumers. Discuss the major uses of coal today. Assign students projects: (1) Make a display showing a shaft mine. (2) Make a display showing the many aspects of mining coal. (3) Display or show the movement of the coal from mine to bin. Have several students do research dealing with these subjects:

(1) Products from Coal
(2) Problems in the Coal Industry
(3) How Coal is Used as Fuel
(4) Safety Measures in Coal Mining
(5) Coal Mining as a Vocation

Day V

OVERVIEW:

"Petroleum" is a word that comes from two other words: Petra (rock) and oleum (oil). It is also called crude oil. It is a natural oil which is found trapped in the earth. It is formed in rocks called oil shale, a kind of sedimentary rock. A chemical analysis show the composition of petroleum to be made up of compounds called dehydrocarbons. During the paleozoic era, all kinds of microscopic plants and animals lived in shallow seas. They died and decayed. Their cells and contents were trapped below the sediment of the seas. Millions of years of pressure and chemical changes made these materials turn into fossil fuel. We call this fuel crude oil. The oil seeped into rock layers and was trapped there. Geologists study the kinds of rocks and fossils in a neighborhood. When they have found the right kind of rocks and right kind of fossils, they begin to drill the wells. Drills are forced down into the earth and through domes of rock. Sometimes the trapped gasses force the oil up and the well begins to "gush". Crude oil is carried through pipelines from wells to a chemical factory called a refinery. Crude oil is refined into gasoline, kerosene, and other products.

ACTIVITIES:

Begin the discussion with a target question: "How did petroleum get into the ground?" Discuss the refining of crude oil. Use slides to illustrate how oil must be drilled down through the limestone to reach oil. Use slides to show how offshore oil wells work and the OCS orders that are required to make them safe. Have students do library research work on the following topics:

(a) The advantages of using gasoline as a source of energy.
(b) The advantages of using kerosene as a source of energy.
(c) The problems we are confronted with if we rely on products of crude oil for future uses.
(d) Have students prepare display posters or models of oil wells, a refinery, and several items which either use some form of petroleum for energy or is a product of petroleum.

Day VI

OVERVIEW:

Americans are so used to limitless energy supplies that they can hardly imagine what life might be like when the fuel really starts to run out. Time asked science writer Isaac Asimov for his version of an energy poor society that might exist at the end of the 20th century. The following portrait, Asimov noted, need not prove to be accurate. It is a picture of the worst, of waste continuing, of oil running out, of nothing in its place, of world population continuing to rise, but then that could happen couldn't it?

ACTIVITIES:

(a) Pass out article copies to students.

(b) Encourage students to read this and pretend this is actually happening.

(c) Ask students to summarize all the changes that would be made in their lives.

(d) Ask students to explain how an effective energy policy could prevent this.

(e) Ask yourself if this is the way the future would really be, or why.

(f) After reading, answer the following questions:

(1) What does the author say would cause the vision to become real?

(2) What are the great mineral mines and hardware shops of the nation?

(3) What was rationed and how do rations equalize sacrifice?

(4) Name four advantages that this energy-poor life has to offer.

Days VII, VIII, IX

OVERVIEW:

Electricity is a form of energy. We know what it is by what it does. Electricity gives us light, heat and power. It brings us radio, television, motion pictures and telephones. Electricity comes into our homes and school rooms on wires. Electricity is power light, heat, communication and transportation.

ACTIVITIES

(1) Allow students to read and discuss "The Story of Energy."

(2) Allow students to observe and discuss the film "Electricity: the way it works."

(3) Allow students to observe and discuss the film. "Atomic

Power Today--Service with Safety."

(4) Read and discuss the booklet: "Energy: Why We Must Conserve It Now."

Days X, XI, XII, XIII, XIV, XV

OVERVIEW:

Since we have been dealing with fossil fuels as sources of energy and established the fact that fossil fuels are finite, we must give some attention to future means of supplying our country's need that will be both economically and technically sound.

ACTIVITIES

This will be energy awareness week. Discuss the feasibility of (a) Bioconversion (b) Wind Power, (c) Solar Energy, (d) Geothermal Energy, (e) Energy conservation in Homes, Industry, Transportation, and Schools, Breeder reactors, Nuclear fusion.

EVALUATION:

Review all material covered. Have a comprehensive quiz. Display all models, posters, research paper in areas where they can be viewed by all members of the faculty, the student body and visitors who enter our building. We will have an assembly program with qualified speakers on the energy problem. This will be called "Energy Awareness Week."

Sources of information used in this unit.

Books and Articles

World Book Encyclopedia, "Energy Unit" pages 224-226, Volume VI, Field Enterprises Ed. Corp. Chicago. This unit gives the definition of energy, its forms and the many sources of energy.

Bishop, Lewis and Bronaugh, Focus on Earth Science (2nd Edition), "The Paleozoic Era" pages 420-435. Charles E. Merrill Publishing Co. A Division of Bell and Howell Company, Columbus, Ohio. In this era, there were many changes taking place on the earth, many fern trees and marine were buried, decayed with little or no oxidation occurring and formed great coal fields. The marine organisms, under heat and pressure, formed petroleum.

OxenHorm, Joseph and Idelson Michael N, Pathway in Science Book I, "Fossil of Yesterday-Fuel Today and What is Petroleum" (Chapter 6&7). Boble Book Company Inc., New York 10010.

<u>Coal Fact Package</u> from the National Coal Association, 1130-17th Street N.W. Washington, D.C. These two sources of information explain how organic materials form fuel. List the three kinds of fuels, solid, liquid and gas. They give both the chemical and physical properties of each fuel and their uses. Transparencies will be copied of the illustrations in these two sources.

<u>The Story of Electricity</u> -- Describes the operation of an electric utility, from the generation of the electricity to the distribution of that electricity to home and businesses. Available from: Educational Services, Duke Power Company, Post Office Box 2178, Charlotte, North Carolina 28346

<u>Energy: Why We Must Conserve It Now</u>. The booklet puts energy use into historical perspective, points out present uses for energy and makes projection for future demand and supply. Available from: Educational Services, Duke Power Company, Post Office Box 2178, Charlotte, North Carolina 28346.

<u>Time</u>, "The Nightmare of Life Without Fuel," by Issac Asimov.

<u>Factsheets</u> 1-13. This material was produced by the National Science Teachers Association.

<u>Films</u>:

"The Great Search" -- A Walt Disney film. Makes some excellent fundamental points about man and energy and manages to entertain as well. 13 minutes.

"The Might Atom" -- Traces the history of electricity from the discovery of static electricity to the modern day process of electrical production.

Joey's World -- The film explores both the energy demands and energy supply for that world while pointing out these various factors which influences our present energy crisis.

"Paradox of Plenty" -- This film explores various energy option solution to the energy problem: Coal, nuclear the breeder, solar, fusion and conservation are explored as possible solutions.

ENERGY EDUCATION: CONSERVING IN THE HOME

General Science: 9th Grade

by

Elvertta Coker
Mayewood School

OVERVIEW:

Energy education is the awareness of energy, its characteristics, sources, and its contribution to human survival. It is education for the awareness of the relationship between man's use of energy and his value system--that which he feels are necessities and luxuries and their dependence on energy. It is education for awareness of the global nature of the problem, the uneven distribution of fossil fuels, their limited quantity, their demand by all countries, and the need for alternatives.

Energy education fosters the change from an "Era of Mindless Waste" to an "Era of Wise Use." It is generally agreed that we must conserve in order to "buy time" while non-finite sources are being developed. It is also agreed that other sources must be developed for economical use, for example, the sun, wind, tides, geothermal energy, nuclear fusion and others. Energy is necessary for survival (knowledge); we can only survive if we conserve (skill); we will only conserve if we want to (value).

INTRODUCTION

Many design and construction features exist which can be incorporated into residential structures (the home) to reduce their energy consumption. The shell of a home protects the occupants from the outside elements and influences what goes on in the home by defining the interior space. Since the primary use of energy in the home is for heating and cooling, considerable energy savings can be achieved by improving the shell of the home. A savings of 20 to 40 percent of current energy consumption in the average home could be economically achieved by improving the shell with insulation, caulking, weatherstripping, and storm windows. There are times when the weather will provide interior comfort, and there are means of adapting the home to utilize the outside air. However, there are times, especially in winter, when energy needs to be used to maintain reasonable comfort.

Conservation of energy may be obtained by carefully considering the site and orientation of the home. The site is the place where the home is to be built or where it already stands. The proper orientation is determined by the climate and vegetation as well as the landscaping around the home.

The insulative value of interior furnishings has often been overlooked. In a time of plentiful resources, there was no impetus to select interior furnishings for their energy savings capabilities. The savings afforded by enlightened choice and use of furnishings can be significant. Furnishings can augment the insulative value of the home, can help control the impact of the sun, and can reduce loads on heating and cooling equipment.

TIME ALLOTMENT:

This unit is designed for 5 days of study.

OBJECTIVES:

(1) The first objective is that students will become more aware of the energy conserving features in residential structures (homes).
(2) The second objective is that students become more concerned with methods of improving energy conservation by improving residential structure.
(3) The third objective is that students will be able to recognize that interior furnishings of homes may be used to conserve energy.
(4) The fourth objective is that students will learn that site and orientation of home may aid in conservation of energy.
(5) The fifth objective is that students will learn that vegetation around the home may provide insulation and thus conserve energy on heating and cooling.

EVALUATION:

Students will be evaluated by a quiz at the end of the unit. The questions will consist of information taken from each day's activities.

DAY 1: Lesson 1

IS YOUR HOUSE DRAFTY?

MATERIALS USED IN THIS LESSON:

Matches, one candle

BACKGROUND:

Infiltration is the passage of air into and out of a residence through a variety of openings (doors, windows, cracks, vents, dampers, etc.). In a single family residence, infiltration is the largest load factor for both heating and cooling, about 55 and 42 percent, respectively. The amount of infiltration varies greatly from house to house because of differences in construction and the habits of the occupants. The American Society of Heating, Refrigerating, and Air Conditioning Engineers researchers determined that the optimum rate of infiltration for residences hould be about one conplete air change every 10 hours with no wind or indoor-outdoor temperature differences. With differences in temperature and slight winds, the change could be as great as 1.5 or one-and-a-half complete air changes per hour. Some people fear a "too tight" house that will not admit fresh air. This is not the case even in the tightest homes. Sometimes the interior air may seem stale; if it does, open a window for a few minutes. The number of door and window openings and closings, the use of exhaust fans, the use of fireplaces, the movement of air within the house all affect infiltration. Aside from these sources are the narrow openings around doors, windown, ceiling, walls, and floors.

DEVELOPING THE LESSON:

After giving students background information in infiltration, advise them to do a study of their homes (or classroom). This study should only be done in the presence of an adult to make certain that the lit candle is handled with care.

After the candle is lit, it should be used in an upright position near doors, windows, fireplace, and floors to see the movement of the flame. If the flame moves swiftly, this indicates too much draft.

DAY 2: LESSON 2

INSULATION CAN CONSERVE ENERGY

MATERIALS USED IN THIS LESSON:

- 100 Watt bulb in ceramic socket.
- A variety of insulating and non-insulating materials such as wood, aluminum foil, fiberglass (3" or 4"), glass, metal, newspaper, heavy cloth, etc.
- 4 thermometers, cardboard box, watch, masking tape.

BACKGROUND:

The energy efficiency of a home can be increased 20 to 30 percent with proper insulation which will reduce the load on heating and cooling equipment. Insulating is one of the most important conservation measures for a home; it makes possible the use of smaller capacity heating and cooling equipment as well as saving on operating costs. For example, in a 1500 square foot home in a temperate climate at three cents per kilowatt hour, six inches of ceiling unsulation could save $250 annually on heating and cooling cost; 3.5 inches of wall insulation could save $100 annually and 3.5 inches of floor insulation could save $170 annually.

Insulation is any material that provides resistance to the flow of heat from one surface to another. For example, one inch of mineral wool or fiberglass has the same insulative value as 34 inches of brick.

The ability to insulate is not determined solely by thickness but also by weight and density. The effectiveness of insulation is measured in thermal resistance (the ability to stop heat flow) or "R-value." The higher the R-value, the better the resistance and the performance of the insulation. The R-value is marked on all insulation on the market. The recommended minimum R-value for homes varies from area to area. In most areas, ceilings should have an R-value of 19-38; outside walls and floors, R-11-22. The Farmers Home Administration (FmHA), the largest single financing agency for housing in the state of Maine, recommends R-38, ceilings; R-19, walls; and R-22, floors for optimum insulation.

Many kinds of insulation are available--fiberglass, mineral wool, cellulose, fiber-blown, vermiculite, polystyrene, and polyurethane.

DEVELOPING THE LESSON:

After giving students background information on insulation, allow them to do an independent study of different insulators. The independent study is entitled "What's the Best Insulator?" Using the materials listed at the beginning of lesson 2, follow this procedure:

1. Cut windows in each side of the box. Leave the top of the box solid. The botton will be open.
2. Tape 4 insulating materials over the windows on the inside of the box.
3. Tape a thermometer to the outside of each insulating material and record before temperature. (See data sheet.)
4. Place the light in the center of the box.
5. Turn the lamp on for 5 minutes.
6. Record the rise in temperature for each material. How much better is the best insulator compared to the worst?

TEMPERATURE		
Material:	before	after
wood		
aluminum foil		
fiberglass		
glass		
metal		
newspaper		
cloth		
others?		

Why is full insulation now required in new houses?

DAY 3: LESSON 3

VEGETATION AROUND HOME CAN CONSERVE ENERGY

MATERIALS USED IN THIS LESSON:

Tin can, newspaper, styrofoam cup, glass jar, plastic pitcher, measuring cup, moderately hot water.

BACKGROUND:

In addition to the esthetic value of having trees on a home site, trees can have a beneficial thermal effect on the home. In winter, evergreens can be used as windbreakers to reduce heat loss from the building. In summer, leaves absorb radiation and cool the surrounding air through evaporation. But above all, trees and shrubs can provide shade at the right season. This trait makes deciduous trees (those that shed their leaves) especially valuable when placed close to buildings since they can limit the impact of the sun in summer without interfering with winter sunshine.

Leafy vines are also valuable for sunny walls in hot weather. The proper selection of vegetation is important to insure effective results. The shape of the shadow as well as the shape and character of the vegetation itself in winter and summer must be kept in mind. For example, a shade tree may be too low to permit cooling breezes to reach the home, or a row of evergreens used as a windbreak may also block the benefits of the morning sun.

DEVELOPING THE LESSON:

After giving students background information on vegetation factors which conserve energy, allow them to do an independent study on keeping heat in the home (winter) and allowing heat to escape (summer). The independent study is entitled "Vegetation as Windbreaks". Using the materials listed at the beginning of lesson 3, follow this procedure:

1. Using the measuring cup, fill the tin can, glass jar, plastic pitcher, and styrofoam cup with equal amount of moderately hot water.
2. Measure the temperature of each. Record this temperature.
3. Check the temperature again in half an hour. Which is hottest?
4. Now try the experiment again after wrapping newspaper around each container.
5. Compare the temperature of the various containers after half an hour.
6. Compare these results to those in number 3.

Allow students to use the library to look up more information on deciduous trees, shrubs, and vines used around homes.

DAY 4: LESSON 4:

WINDOW TREATMENTS CAN CONSERVE ENERGY

MATERIALS USED IN THIS LESSON:

- 2 cardboard boxes of the same size.
- 2 100 Watt bulbs in ceramic sockets.
- 1 heavy piece of cloth, masking tape.

BACKGROUND:

Window Treatment

Energy transfer (loss or gain) at the windows may be reduced by blinds, shades, draperies, or shutters. These decorative items or devices can also control solar radiation. The insulative value of draperies and other window treatment vary from "neligible" for metal blinds to "quite good" for insulated fiberglass draperies. However, blinds are very effective shading devices. The insulative value of the window treatment is greatly increased if it is tight-fitting and forms a dead air layer between itself and the window. If the window treatment is not tight-fitting, particularly at the top, the room air will move freely by convection into and out of the space between the window and the window treatment, leaving little energy-saving effect.

During the cooler season, window treatments should be opened during sunny periods of the day; during the night and other times when the sun is not shining, the window treatment should be closed to prevent interior heat from escaping. During the warmer seasons, the use of window treatments can reduce the effects of incoming solar heat considerable. The window treatments should be closed during the sunny portion of the day and opened at night to take advantage of cooler temperatures. Exterior treatment can be more effective than interior treatment.

DEVELOPING THE LESSON:

After giving students background information in window treatment, assign them to use a mail order catalog to look up different kinds of window treatments (draperies, blinds, shades, shutters, etc.). Advise them to write down what kinds of materials these are made up of. Allow them to choose which one or more would serve as best controls of solar radiation.

As a class activity, allow students to do an independent study entitled "Do draperies Conserve Energy?". Using the materials listed at the beginning of lesson 4, follow this procedure:

1. Cut a window in one side of each box.
2. Tape a thermometer inside each box.
3. Measure the temperature of each box.
4. Cover a window in one box.
5. Place the light source six inches from each window and switch it on. Allow the light to shine one hour.
6. Note the difference in temperatures of the two boxes. Would heavy draperies at windows conserve energy?

DAY 5: LESSON 5

SITE AND ORIENTATION OF HOME CONSERVE ENERGY.

MATERIALS USED IN THIS LESSON:

4 thermometers, 4 cardboard boxes

BACKGROUND

To conserve energy, maximum use should be made of natural means to produce a healthful and livable home environment with minimum use of mechanical equipment for climate control. A primary consideration is the site--the place where the home is to be built or where it already stand. The site features may be positive or negative factors in terms of energy requirements and are always unique. The major factors of climate and vegetation determine the proper orientation (position with relation to compass) of the home's features as well as that landscaping which might reduce mechanical heating and cooling costs.

1. The building should be oriented to maximize exposure to solar radiation during the heating season.
2. The relationship of the building to outdoor spaces should maximize solar impact for snow melting, heating in winter, sunning in spring and fall, etc.
3. Orientation should permit the use of outside air movement for natural ventilation.
4. Orientation should permit the best use of trees, topography, water, and views.

DEVELOPING THE LESSON:

After giving students background information on site and orientation of home, allow them to do an independent study of the use of solar radiation to heat the home. This study is entitled "The House Facing the Sun".

Using the materials at the beginning of lesson 5, follow this procedure:

1. Cut one window in one side of each of the four boxes.
2. Turn one box window facing north, one south, one east, and one west.
3. Allow boxes to stand 15 minutes. Check the temperatures of the four boxes. Are they the same? Which shows most increase in temperature?

EVALUATION OF STUDENTS:

A. Students may be evaluated with the following quiz.

QUIZ

Directions: Complete by filling in the blanks with your best answers.

1. Infiltration is the passage of air into and out of a residence through a variety of openings.
2. Insulation is any material that provides resistance to the flow of heat from one surface to another.
3. The energy efficiency of a home can be increased 20 to 30 percent with proper insulation.
4. In winter, evergreens can be used as windbreaks to reduce heat loss from homes.

5. The effectiveness of insulation is measured in thermal resistance or R-value.
6. A deciduous tree sheds its leaves in the fall.
7. The higher the R-value of insulation, the better the performance of the insulation.
8. Window treatments are useful in homes to control solar radiation coming into the home.
9. The site of the home is the place where it is to be built or where it stands.
10. The orientation of the home is its position in relation to compass.

B. As a second evaluation, give some thought to having to construct a home using information covered in 5 day lesson.

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Educators guide to Free Films
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Educators Progress Service, Inc.
Randolph, Wisconsin.

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Energy, 1961, 16 mm, sound, 27 min., American Gas Association.

Focus on Energy, 1972, 16mm sound, 13 min. American Gas Association.

Money to Burn, 16 mm sound, 12 min. Brooklyn Union Gas.

Three E's, 16 mm sound, 28 min, Exxon Company, U.S.A., 1973.

ENERGY USED TO PRODUCE ELECTRICITY

Earth Science: 8th Grade

by

Linda Combs
Rawlinson Rood Junior High School

Introduction

It is probably a matter of time before all our electricity will be produced from coal and nuclear fission. The supply of oil and natural gas is so limited we can no longer afford to use them so inefficiently. The President's energy policy will assure this change is made. Most authorities agree there is a 200 year (or more) supply of coal left to be mined. This fact and the prospect of using uranium in a breeder reactor will insure an almost endless supply of fuel for producing electricity. With conservation efforts and the two resources mentioned, we have time to develop sources for the future. Perhaps it will be use of solar cells or use of another form of nuclear energy-fusion power.

Content Outline

I. Use of coal in producing electricity
   A. Steam generating plant
   B. Amount of coal used today
   C. Reserves of coal for the future

II. Air pollution resulting from burning of coal
   A. Kinds of pollutants
   B. Control of pollutants

III. Geology of coal
   A. Formation of coal
   B. Kinds of coal
   C. Geographic locations of coal reserves

IV. Coal mining
   A. Early methods
   B. Underground mining
   C. Surface mining and its environmental impact

V. Use of nuclear fission in producing electricity

A. Nuclear power plant operation
B. Handling of waste materials

VI. Future sources of energy for producing electricity
A. Fusion power
B. Solar energy

Activities	Resources
<u>Day 1</u> Steam generating plant	
1. Use a film to introduce electricity to the students.	"Electricity: The Way It Works" Director of Educational Services, Duke Power Co. Box 2178, Charlotte, N.C. 28201.
2. Have students draw a diagram of coal-fueled power generation. (Students may use encyclopedias or any other available resources for suggested activities.)	
3. Give students a booklet to read or give notes on understanding electricity.	<u>Ibid</u>, Keowee Toxaway "The Story of Energy".
4. The teacher may choose to use a filmstrip instead of the booklet mentioned in activity 3. This filmstrip gives a step by step process in producing electricity.	S V E, CL463-5, "Electrical Energy."
<u>Day 2</u> Amount of coal used today and future reserves	
1. Display in the classroom the poster "Using Coal". 2. Discuss with the class "coal facts". 3. Give each student a booklet to read outside of class. A good homework assignment would be to list 10 facts in their notebooks. The booklet includes information on the role of coal in meeting our energy needs.	National Coal Association 1130 17th St. N.W. Washington, D.C. 20036 Duke Power Co., B401, <u>Coal And The Energy Crunch</u>.

Activities	Resources
4. Discuss with the students facts on future reserves of coal.	World Book Encyclopedia- "Coal." Duke Power Co., B-404, The Comeback of King Coal. (6 pages) National Coal Association, Coal Facts.
Day 3 Air Pollution from Coal use	
1. Have students list from a text the pollutants emitted by the burning of coal.	Ecology Pollution Environment, W.B. Saunders Co., Philadelphia, pp. 84-85. (1972) Focus On Earth Science, Merrill Publishing Co., Columbus, Ohio, 1972, p.376.
2. Discuss with students problems and issues in controlling air pollution.	Duke Power Co., B-502 The Scrubber Dillemma. (10 pages) Ecology Pollution Environment, pp. 98-100 and p.103.
Day 4	
1. Either arrange for a tour of a coal fueled power plant or seek a speaker to come and summarize to the class production of electricity and pollution control.	Duke Power Co. (any local company would probably gladly cooperate in this situation)
Day 5 Formation of coal, kinds of coal, and geographic distribution of coal.	
1. Read from a text or have students get information from an encyclopedia.	Earth Science The World We Live In, D. Van Nostrand Co., Inc., Princeton, N.J., 1965, p. 49.
2. Have students write a summary paragraph on the formation of coal in their notebooks.	Focus On Earth Science, P. 151 The World Book Encyclopedia, "Coal."

3. List for students and define the kinds of coal, or if a text is available, this would be a good homework assignment.

The Book of Popular Science, "Coal."
The World Book, "Coal."
Focus On Earth Science, p.151.
Earth Science, p.36.

4. Have students draw into their note-books the outline map of the U.S. and color code the distribution of the different kinds of coal.

National Coal Association, Map of Coal Areas in the U.S.
The World Book. "Coal."

Day 6

1. Review students and evaluate their progress. Students enjoy playing games with questions and answers in which the class is divided into two sides. Tic tac toe is a good one and so is baseball.

Day 7 Coal Mining

1. To introduce coal mining secure a speaker or a slide presentation.

Duke Power Co., CP-7 "Coal: Mining And Use" (slides, question-and-answer).

Day 8 Early methods and underground mining

1. Discuss early methods of coal mining. Let students contribute to how they "think" it was done before sharing information from resources.

The Book Of Popular Science, "Coal."

2. Have students list and describe in their notebooks three kinds of underground mines.

The World Book, "Coal."
The Book Of Popular Science, "Coal."

3. Students may draw diagrams of the three kinds of mines.
4. Let students discuss reasons it is difficult to get miners to work in the underground mines. Assign outside reports to volunteers on black lung disease and on mine safety.

Activities	Resources
Day 9 Surface mining and environmental problems	
1. Relate to students information on surface mining.	Duke Power Co., B-503, Surface Mining. The Book Of Popular Science, "Coal."
2. Use a film that deals with surface mining and reclamation of the land.	Duke Power Co., film 401 "Energy Vs Ecology". (28 mins)
Day 10	
1. Let students discuss the environmental impact of "strip" mining. Let them decide whether the trade-offs are worth it. (Students will be interested to know surface mines now pay 50 cents per ton to the government for reclaiming land. In the past mining companies have not done the job on their own.)	
2. Evaluate students learning at this point.	
Day 11 Nuclear fission	
1. Use a film to begin the study of nuclear fission. It deals with nuclear power in a non-technical manner and includes safety and waste handling.	Duke Power Co., film 400, "Now That The Dinosaurs Are Gone". (26 mins.)
2. Have students read from a source on nuclear power.	Focus On Earth Science, P. 383.
Day 12 Nuclear fission	
1. Have students read from a booklet on how electricity is produced from fission.	Duke Power Co., Keowee-Towaway booklet, The Story Of Energy, pp. 6-11.
2. Present to the class opposing views on nuclear power and problems with radioactive waste.	Ecology Pollution Environment, p. 67-75.

Activities	Resources
Day 13 Nuclear fission	
1. Summarize nuclear power with another film. (narrated by Mr. Wizard)	Duke Power Co., film-"Nuclear Power: Questions and Answers"
2. Other films could be chosen if necessary.	State Dept. of Educ. AVA Library, 1513 Gervais St., Columbia, S.C. 29201. "Atomic Power Today: Service with Safety" or "Energy: A Matter of Choices".
3. Evaluate students learning at this point.	
Day 14 Future sources of energy	
1. Use a filmstrip to introduce future alternatives of energy. (explores solar and other sources of energy)	S V E, Future Alternatives.
2. Relate to students information on use of solar energy in the future.	ERDA, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn. 37830 (Solar Energy)
3. Read and discuss energy produced by nuclear fusion.	Focus On Earth Science, p. 383. Science, Nov. 1, 1974, Fusion, pp. 397-407.
Day 15 Future energy sources	
1. Use filmstrip to discuss what lies ahead. It dramatizes a need for conservation and urgency of finding new energy resources to replace dwindling reserves of fossil fuels.	S V E, Energy: What Lies Ahead, CL 463-8.
2. If possible get a speaker to culminate this study of future sources of energy. (Potentials of the alternate energy sources will be included.)	Duke Power Co., CP-1, "Energy" (includes slides, question-and-answer)

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A SURVEY OF OUR ENERGY SITUATION

Chemistry: 11th, 12th Grade

by

Mary Lou Edens
Seneca High School

Sources and conversion of fossil fuels

Purpose: To have students realize the technical, social, economic and ecological involvements with fossil fuel discovery, recovery and utilization.

Time: 1 to 3 class periods according to the length of student reports and discussion. Don't let it ramble.

Methods: Have individual or pairs of students give five to ten minute reports on:

1. Coal discovery and mining
2. Coal mining impact on the environment
3. Oil discovery and production
4. Oil spills, boom towns and other oil production impacts
5. Coal and Oil use costs in money and environment.

Be sure student reporters use the latest available information. Notify the school librarian of the students' needs. Recommend use of audio visuals where applicable and available.

Encourage student listeners to ask questions at the end of the reports and to take notes which differentiate fact and opinion.

As reports are being given, check that the geology of the resource is mentioned, any new words are defined, the time and cost to the beginning of production is discussed, the production methods and environmental impacts are enumerated, the good and bad points of use are used and the results of production completion are included. Also, the relative costs of the two main fossil fuels and the amount of the resource still available needs to be brought to the students attention.

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Lab Experiment - Distructive Distillation of Coal

Purpose: To have the student see through experiment that coal can be broken into simpler molecules and that small pieces react faster than large ones.

Note: Use disposable containers or test tubes which can be used year after year for this purpose, they will never get fully clean.

Time: 1 lab period.

Method: (Be sure room is well ventilated) (Materials list is underlined)

A. 1) Distribute to each working lab position 3 or 4 small lumps of coal.
2) Place a glass tip that is hollow in a one holed stopper and the stopper in a pyrex test tube.

(Alternative methods of setting up apparatus may be used as long as the container can stand the heat and the top is stoppered in some fashion with an exit point.) The teacher should check the apparatus for air leaks and to emphasize safety.

3) Place a lump of coal in the test tube or container. Place the lid or cork on the apparatus. Heat the coal. Note the products and describe the appearance to them on the sides of the test tube.
4) Try to ignite with a match or wood splint the tip of the exit valve.

B. 1) In an open crucible place a lump of coal. Heat it uncovered with a burner until it ignites. Note the time for ignition. Ask students to suggest other tests that can be done to test the speed and efficiency that the coal lump burns with. Include any practical ones in your lab.
2) In the crucible, after cleaning as best you can, place pulverized coal. Pulverize it in a mortor with a pestle. Heat as with t[illegible] preceeding test.

Bibliography:

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Nuclear reactions, fission and fusion as a source of energy.

Purpose: To examine nuclear reactions as an energy source and the hazards involved.

Time; 1 or 2 class periods, according to the length of reports and subsequent discussion.

Methods: Have individual or pairs of students give 5 to 10 minute reports on the following topics:

1. Fission - how it works and what it costs to get started.
2. Fusion - how it works and what it costs to get started.
3. Uranium discovery, mining and refining.
4. Breeder reactors
5. Environmental dangers of fission, fusion, breeders and

waste storage.

Be sure student reporters use the latest available information. Recommend the use of audio - visuals where applicable and notify your librarian of the students' project.

Be sure student listeners take notes, separate fact from opinion and ask questions at the end of reports or to clarify a point, during a report.

As the reports are being given, check that the geology of the resource, the useful life of the uranium isotopes, the limited supply of uranium, the power plant parameters and the environmental dangers are all included.

Bibliography:

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Computations and workday I: Calculation of calories, mRem doses and electric power bills.

Purpose; To do some calculations dealing with energy use and consumption and to document some terms.

Time: 1 or 2 class periods according to practice time involved.

Method: Begin by introducing and discussion the terms:

a. watt is 1 joule/sec
b. kilowatt is 1000 watts
c. kilowatt hour is 1 kilowatt used for one hour (this is enough energy to lift 4000 lbs over 200 yards.)
d. calorie is the heat required to raise the temp of one gram of water one degree Celcius.
e. kilocalorie or Calorie is 1000 calories.
f. REM is a radiation unit used in relation to effects of radiation on man.

500 REM kills the average man
200 REM makes the average man sick with nausea and fatigue.
25-50 REM gives slight, temporary blood change.
0-25 REM gives no detectable effects
10,000 REM destroys tissue

g. mRem is a milliREM or .001 REM.

Then do actual calculations using calories. Since a calorie equals the temperature change times the mass times the specific heat, the following can be calculated. (Specific heat of water remember is 1).

1. If 40. g of water is heated 10.°C, how many calories are absorbed?
   Answer: calories equal 40. g x 10.°C x 1
   calories equal 400 calories (4.0×10^2 calories)

2. If 50.2 g of water has a temperature of 20.°C and is placed in the Sun until its temperature is 35°C, how much heat has it absorbed?
   Answer: calories equal 50.2 g x 15°C x 1
   calories equal 753 calories (750 calories)

3. If 10. g of candle wax burns to heat 25 g of water from 20.°C to 45°C, how many calories are exchanged per gram of wax?
   Answer: Total calories equal 25. g x 25°C x 1
   Total calories equal 625 calories (620 calories)

calories/gram equal 620 calories/10. g
calories/gram equal 62 calories/gram of wax

4. If 4 g of coal burn and change the temperature of 75 g of water from 20. °C to 43. °C, what is the heat emitted per g of coal?

Answer: Total calories equal 75 g x 23 °C x 1
Total calories equal 1700 calories (1725 calories)

Calories/gram of coal equal 1700 calories/4 g
Calories/gram of coal equal 400 calories/gram (425)

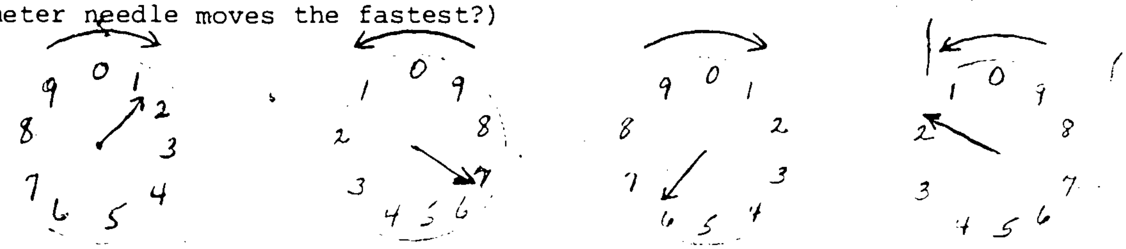
Next do some comparison costing.

1. At 3.10 cents per kwh, calculate the cost of running the following electrical items for the time shown.

		COSTS in cents		
Item	Wattage	1 hour	1 day	1 year
light bulb	40 watts	.12	2.976	1086.24
light bulb	60 watts	.186	4.464	1629.36
light bulb	100 watts	.31	7.44	2715.6
washing machine	512 watts	1.5872	38.0928	13903.872
refrigerator	326 watts	1.0106	24.2544	8852.856
dryer	4,856 watts	15.0536	361.2864	131869.53
color TV (solid state)	200 watts	.62	14.88	5431.2

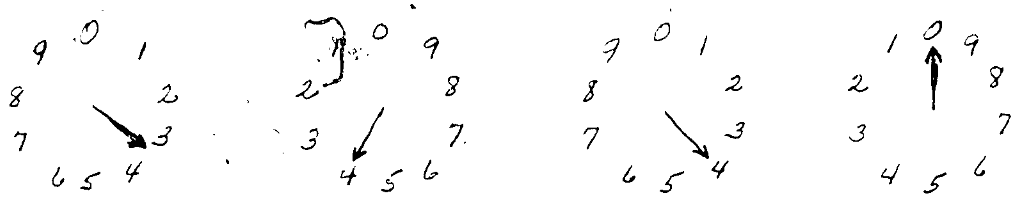
Be sure to point out that it is unlikely that any electrical item would be in use for a whole day or year, but that this is to give a general idea of the cost in electricity and money using electricity entails.

2. Reading meters and figuring an electrical bill. Meters usually have four dials. Notice the direction of the needle movement and the magnitude of the digits on the meter face. (Which meter needle moves the fastest?)



1000 kwh 100 kwh 10 kwh 1 kwh

The preceeding meter reads 1662 kwh.



What does the meter read? ____________ kwh. (3440 kwh)
Using the following rate schedule (or better yet your own local schedule - this is Duke Power's residential schedule in August 1978)

$4.27 for the first 80 kwh or less used per month.

3.10	cents	per	kwh	for	the	next	220	kwh	used	per	month
2.97	"	"	"	"	"	"	50	"	"	"	"
3.62	"	"	"	"	"	"	950	"	"	"	"
3.28	"	"	"	"	"	"	200	"	"	"	"
2.58	"	"	"	"	"	"		"	"	"	"

calculate the electric bill for the set of meters described in the problem.

Answer: The difference between 3440 and 1662 is 1778 kwh.

So:	4.27	for the first 80 kwh leaving 1698 kwh
	6.82	for the next 220 kwh leaving 1478 kwh
	1.485	for the next 50 kwh leaving 1428 kwh
	34.39	for the next 950 kwh leaving 478 kwh
	6.56	for the next 200 kwh leaving 278 kwh
	7.1724	for the last 278 kwh
for a total of	60.695	or $60.70 electric bill.

Lastly, calculate your individual yearly dosage of radiation from the following chart taken from: "How much radiation will the public receive from the Clinch River Breeder Reactor Plant?"

	Common Sources of Radiation	Your Annual Inventory in mRem
Where You Live	Location: Cosmic radiation at sea level	44
	Elevation - Add 1 for every 100 ft of elevation at your location	___
	House Construction - brick - 45, stone -50, wood - 35, concrete - 45.	___
	Ground - US average	15

What You Eat Drink Breathe	Water, food, air - US average		25
	Weapons test fallout		4
How You Live	X-Ray Chest	9	___
	Gastrointestinal tract	210	___
	Jet airplane travel: for every 1500 miles add	1	___
	TV viewing - for every hour per day add	.15	___

Your Total radiation dose ___

(The total average annual dose is 148 mRem.)

Bibliography:

Clinard, Lil, Energy Conservation in the Home, An Energy Education/ Conservation Curriculum Guide for Home Economics Teachers, U.S. Dept. of Energy, Oct. 1977 (USDE, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn., 37830) pp 255-257. These pages contain a list of home electrical items and their wattages.

"How Much Electricity Does Your Family Use At Home in One Day?" Science Activities in Energy, Electrical Energy, Plan 16, Oak Ridge Associated Universities. A means of calculating the amount of electrical energy used in students' or average homes.

"How Much Radiation Will the Public Receive from the Clinch River Breeder Reactor Plant?", Clinch River Breeder Reactor Plant Project. (P.O. Box U, Oak Ridge, TN 37830). This little pamphlet contains a chart for calculating your yearly radiation dose.

Margotto, Diana, "Kill A Watt", Award Winning Energy Education Activities, pp 24-29, National Science Teachers Association. This lesson plan goes more deeply and gives more examples on calculating wattages, kilowat hours and electric bills.

Laboratory experimentation II: Calorie comparison per gram of fuel

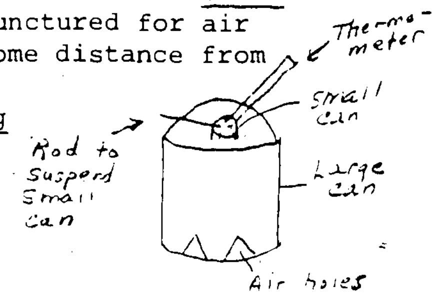
Purpose: To calculate the calories produced from burning 1 gram of coal, 1 gram of oil and 1 gram of other hydrocarbons.

Time: 1 lab period

Safety points: All flammables should be kept away from flames until they are to be ignited. Remind students that putting water on an oil fire is not a good idea (why?). Also, remind the students of proper fire procedures in your lab.

Students should not stand over anything burning.

Method: 1. Construct a calorimeter. Suggestion: Place a small metal can in a large metal can which has been punctured for air circulation. The small can must be supported some distance from the bottom of the large can. See figure 1. Fuels are placed on a tin can lid or evaporating dish in the bottom of the large can and the small can suspended above. The heat from the burning fuel rises to heat water in the can.



Place the fuel in the large can. Be sure the assembly is ready to go. Keep all fuel equidistant from the can. Try to keep it fairly close, however. Jack up the fuel if distance needs to be regulated.

2. Finding the heat per gram of coal burning. Pulverize coal. Weigh out a small amount (2 - 5 g) of coal and place it on the fuel holder. Weigh 50 to 100 g of water in the small can. (Weigh can, add between 50 and 100 ml water and weigh again, the difference between the two weighings is the weight of the water.) Arrange apparatus. Ignite coal. Measure the temperature change of the water, noting the highest temperature reached.
Calculate the calories gained by the water:

Calories equal temperature change x mass of water x 1

Calculate the calories gained per gram of coal:

$$\text{Calories/gram of coal equal } \frac{\text{calories gained by water}}{\text{mass of coal burned}}$$

3. Repeat 2 using oil instead of coal. Remember oil is liquid, be sure its container is suited for holding liquids.

4. Repeat 2 with other hydrocarbon fuels (wood, sterno?). Check with your teacher to be sure of safety.

Note: In the above lab the materials list is underlined.

Also needed would be mortor and pestle, thermometer, matches and burner.

Reports and discussion III: Sources and conversion of solar, geothermal, tides and wind energy into electrical or heat energy.

Purpose: To look at various alternate sources of energy, their availability, likelihood of utilization and the problems with use.

Time: 1 to 3 days. Don't let this bog down or become cyclic.

Method: Assign student or student pairs reports on: Solar Energy, Geothermal Energy, Tidal Energy and Wind Energy. Have them prepare and deliver 5 to 15 minute talks on these topics. Be sure the students discuss the energy source, the technology necessary for utilization, the efficiency, utilization and potential problems of each energy alternative.

Inform your school librarian of the student project reports.

Bibliography:

"Electricity from the Wind: Turbines", Time. 111:53, Feb. 13, 1978. A summary of how wind can be converted into electricity in a practical manner.

"Energy Production in Hot Water", Chemistry. 51:25, Jan. 1978. A discussion of the amount of energy used to heat water and alternative methods of heating it.

Fowler, John M., "Electricity From the Sun I", Factsheet 4 & 5. National Science Teachers Association. (DOE - Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830). A very good discussion of ways and means and problems of using solar energy.

Fowler, John M. and Kathryn Mervine, "Geothermal Energy", Factsheet 8. Ibif. A discussion of geothermal energy as a practical source for electrical and heating energy.

Fowler, John M., "Solar Heating and Cooling", Factsheet 7. Ibid. A discussion of the utilization of solar energy for heating and cooling of homes and buildings.

Fowler, John M. and Kathryn Mervine, "Solar Sea Power", Factsheet 6. Ibid. A discussion of how the upper level tropical water, a solar energy collector, and the lower level waters different temperatures could be used for energy purposes.

Fowler, John M. and Kathryn Merbine, "Wind Power", Factsheet 3. Ibid. A discussion of the historical, present and future uses of wind power as a source of energy.

Here Comes the Sun". Science News. Total issue 113:16, April 22, 1978. A discussion of the Sun as a source of energy, our ultimate source. Excellent and complete survey.

Persico, J.E., "Scientists Urge President: Stop Reliance on Coal and Nuclear Fuel; Go for the Development of Uniform Solar Power", Science Digest. 82:8-9, Oct. 1978. An argument for the research and development of solar conversion mechanisms for energy conversions is discussed in this article.

Schultz, M., "Bold New Look at a Bright New Sun", Popular Mechanics. 149:104-6, March 1978. A discussion of the energy that the Sun can bring to the Earth and its importance as a future energy source.

Laboratory experimentation III: Solar Absorbtion

Purpose: To study solar energy as a source of heat.

Suggestion: Divide this lab into several group projects and have the results reported to all.

Time: Part of one period for preparation (painting) and 1 lab period for experiment.

Method: (Materials are underlined)

1. Paint one set of small pie pans white, another set black. Be sure the paint is not water soluble.

2. When they are dry, place an equal amount of water in each with a small cup or crucible in the middle (no water in crucible). Over this place clear plastic wrap, attached to the outside of the container. Place a small rock or marble in the center. Place apparatus in the sunlight.

Retrieve and measure the water temperature and amount of water collected. (Thermometer needed)

Is Bigger Better?

1. Paint a set of large pie plates black.
2. Using the small black pie pans from A, place 100 ml of water in both large and small pans - one large and one small to a set.
3. Place clear food wrap over the pans, tape tightly, if necessary. Place in sunlight on an insulator for 10 minutes.
4. Pour the water into styrofoam cups and take its temperature. (Thermometer needed). Is there a difference? Why?

Solar Storage:

1. Place four small cans - one each filled with sand, salt, water and crumbled paper - in a cardboard box painted black. Place a thermometer in each can.
2. Close the box and place it outside for ½ hour.
3. Remove the cans and record the highest temperature of each. Note the temperature falling in each can. What time pattern would be useful to check the temperature decline in the materials in the cans? Prepare a data chart to follow while you are waiting the ½ hour.
4. Graph the temperature data. Which material stores the solar energy the best?

Bibliography:

"Solar Energy", Plans 1, 3, and 11 in Science Activities in Energy, Oak Ridge Associated Universities. (The American Museum of Atomic Energy, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, TN 37830). This is from a series of 12 simple lab ideas dealing with solar energy. No special equipment is needed.

Kolbe, H., "Practical Solar Collector You Can Build", Mechanics Illustrated. 74: 43-5, June 1978. A description of a solar collector being built. It gives a good idea of some of the problems and how they are being solved or avoided.

Reports and Discussion IV: Consumption and conservation.

Purpose: To look at how we use our energy sources and how we can conserve.

Time: 1 to 2 class periods.

Method: Using a panel of students with overhead or handouts on way we consume energy, discuss the ideas presented. How do we use energy? Are we wise in its use? (an excellent source of these charts is "Energy outlook 1978-1990", Exxon CO.) What are the largest uses of energy? What are the most flexible uses of energy? Should we conserve? What would conservation do to use? How can we conserve?

Bibliography:

Energy Conservation in the Home, An Energy Education/Conservation Curriculum Guide for Home Economics Teachers, University of Tenn. Environment Center and College of Home Economics, U.S. Dept. of Energy. This is an excellent and endless supply of suggestions for conservation in everyday living. Just loads of things anyone or, hopefully, everyone can do to conserve.

"Environmentalists on Coal", Science. 199:956-8, March 3, 1978. Is coal our answer or is it a real problem as well as answer.

"Energy Outlook 1978 - 1990". Exxon Co. This pamphlet gives a set of graphs and explanations of our relative uses of and supplies of energy.

Fowler, John M., "Energy Conservation - Homes and Buildings", Factsheet 9. National Science Teachers Association. (DOE - Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830) A discussion of how we waste and how we can conserve energy in homes.

Fowler, John M., "Energy Conservation - Industry", Factsheet 10. Ibid. How industry can or could conserve energy.

Fowler, John M., "Energy Conservation - Transportation", Factsheet 11. Ibid. Another industrial and individual energy use is surveyed for ways and means of conservation.

"Snail Darter: Winning the Battle but Losing the War?", Science News. 113:310, May 13, 1978. A discussion of our priorities in dealing with our energy problem.

"Our Energy Goals: How Clear Are They?", Science News. 112:231, Oct. 8, 1977. A good discussion of the problem of making policy and getting the cooperation necessary to follow that policy.

Evaluation

Purpose: To find what students have learned and to have students review this material to derive some decisions of their own.

Method: A written test is suggested which will include term definitions, process discussion, diagram drawing or labeling, calculations with calories and the electric bill and a discussion of the Energy Crisis, Energy Conservation or the like.

Evaluate the specific questions on correct responses and the discussion on ideas backed by factual information. Be sure students are aware that a discussion question will be asked and factual information must be included.

NUCLEAR POWER AND RADIATION

Physical Science: 9th Grade

by

George B. Edwards
McCormick High School

RATIONALE:

In this unit we will have some very interesting and important information about the radioactive elements. Before this unit we would have already covered information relative to the atomic structure for elements. Therefore, it will not be difficult for the students to understand this unit on Atomic Energy and its uses in a modern society.

This unit will deal mainly with how radioactivity was discovered, the names of some radioactive elements, and the part of the atomic structure which is involved in the process of radioactivity. We will also be concerned with the types of radiation that is given off by radioactive elements, their different effects, their significance, and harmfulness. We also shall see how atomic energy will be used in the future as energy.

There should be complete student involvement in this unit. The students will investigate various areas of nuclear energy and then give a report on them. Also the students will be required to fill out a self-evaluation sheet.

RESOURCES: Days 1-4

Modern Physical Science. The Discovery of Radioactivity, pages 420-426.

World Book Encyclopedia, Vol. 16. Radioactivity, pages 94-95.

Modern Physics. Nuclear Power, pages 119-127.

Filmstrip and Film:

The Story of Radium - filmstrip

Particle Accelerators - film

Demonstration: How to use a geiger counter (if one is available).

Days 1,2

Behavioral Objecitves:

Using the prescribed resources the student will be able to develop an understanding of the basic particles of matter and the concepts of atomic structure, also they will be able to identify the contributions which were made by various scientists toward the study of radioactivity.

Handouts:

1. Review sheet on atomic structure.
2. Name of three types of radiations and their definitions.
3. Definition of terms related to radioactivity.

Teaching Strategies:

It is important that students obtain a concept of the structure of an atom and its nucleus. Concepts of atomic energy is most important for future development of this topic.

Assign various students homework about one of the pioneers in atomic energy, such as Henri Becqueral, Madame Curie, or Albert Einstein.

Day 3

Objective:

To develop an understanding of the nature, types, general properties, and detection of radioactivity.

Short Filmstrip: The Story of Radium

Teaching Strategies or Activities:

If available show student some radioactive materials. Also this will be an excellent time to introduce the geiger counter (if it is available for use in the classroom). Work out half-life of several elements and determine the radioactivity which is spent after a certain length of time. With supplied information, have students work out half-life problems in class and for homework.

Day 4

Objective:

To develop a clear understanding about nuclear equation, isotopes, atom smashing machines and atomic particles.

Handouts:

1. Symbols to classify according to type of radiation.

2. Equations to write and complete for nuclear reactions.

Teaching Strategies:

Show film, Particle Accelerators, then work out carefully the equation of nuclear reactions. Have students work several equations at their seats. Then begin a class discussion about the atom smashing machine, the different types, linear, syn-chron, etc. Review the equation on nuclear energy.

RESOURCES: Day 5

Modern Physical Science. What is Nuclear Fission, pages 430-431. Plutonium is also Fissionable, page 434. Nuclear Fusion, pages 438-441. What is a Nuclear Reactor, pages 433-435.

Modern Physics. Nuclear Energy, pages 119-127.

Factsheet. No. 14 Nuclear Fusion. National Science Teachers Association.

Day 5

Objective:

To gain an understanding of fission, fusion and the nuclear reactor.

Teaching Strategies:

Begin the lesson with an excellent film called Making Fusion Work. Have students report on the scientific work by early atomic scientists such as Enrizo Fermi, Otto Hahn and Fritz Strassmann. Review the vocabulary items associated with fusion, fission, and nuclear reactor.

RESOURCES: Day 6

Modern Physical Science. Uses for Nuclear Reactors, page 435.

Modern Physics. Uses for Nuclear Energy, page 126.

World Book Encyclopedia. Atomic Energy, Volume I.

Factsheet. No.14, Nuclear Fusion. National Science Teachers Association.

Day 6

Objective:

To understand the uses of nuclear energy in a modern society.

Teaching Strategies or Activities:

Have students report on the uses of nuclear energy in the following areas: 1) water supply, 2) genetics, agriculture, 3) medicine, 4) atomic power for electricity, and 5) transportation.

Have a class discussion and get the pros and cons on the above areas.

BIBLIOGRAPHY

Books and Articles

"Atomic Energy", World Book Encyclopedia, (1971 Edition), Vol. A, 832 ff

Brooks, William O., George Tracy, Harry E. Tropp, and Alfred E. Friedl. Modern Physical Science, New York: Holt, Rinehart and Winston, Inc., 1966. A book designed to enchance and make science meaningful to students.

Galembo, Milton, Ed. by Jack Robbins and Burton E. Newman. Modern Physics, New York: Cambridge Book Company, Inc. A book used to simplify other basic textbooks.

Hill, Faith Fitch, and Peter B. Barcaski. Spaceship Earth: Physical Science, Atlanta: Houghton Mifflin Co., 1974. An investigative approach to understanding science.

"Making Fusion Work". Developing the many Sources of Energy, Vol.1 Exxon Company, U.S.A. Asource book on energy. National Science Teachers Association, Factsheet, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn.

Films and Filmstrips

"Atomic Radiation" (12 min.) Encyclopedia Britannica Films, Inc., 1150 Wilmetta Ave., Wilmetta, Ill.

"Particle Accelerators," (color) McGraw-Hill Book Co., Text-film Dept., 330W. 42nd St., New York, N.Y.

"The Road to Energy," U.S.A., Modern Talking Picture Service, 2323 New Hyde Park Road, New Hyde Park, New York 11040.

"The story of Radium" (color), Walt Disney Productions, Educational Film Division, 500 S. Buena Vista Ave. Burbank, California.

SELF-EVALUATION 1

1. What contribution was made by the following scientist toward the study of radioactivity?

   (a) ~~Henri Becquerel~~ ______________________

   (b) Marie Curie ______________________

2. Name the three fundamental parts of an atomic structure:

   a. ____________ b. ____________ c. ____________

3. What are the two fundamental positions on an atomic structure?

   a. ____________ b. ____________

4. Which of the two fundamental positions of an atomic structure is involved in the process of radioactivity?

   ____

5. State the incident which led to the discovery of radioactivity.

   ____

   ____

6. Name the three different types of radiation which is given off by radioactive elements.

   a. ____________

   b. ____________

   c. ____________

7. List the names of the two types of radiation which will harm the body.

   a. ____________

   b. ____________

8. What is the name of an instrument which can be used to detect radiation?

   ____

ELF-EVALUATION 1 (cont'd)

9. Label the positions in the following atomic structure diagram.

____

____

10. Place the three fundamental parts of an atom in their proper positions in or on this atomic diagram.

____

__________ ______________________

SELF-EVALUATION 2

1. Write the symbol for the following types of radiation:

   a. Alpha particle ______

   b. Beta particle ______

   c. Gamma Rays ______

2. State what happens when an element loses the following types of radiation.

   a. Alpha particle ______

   b. Beta particle ______

   c. Gamma Rays ______

3. Explain how an ordinary element can be changed into a radioactive element. ______

4. What is the difference between the following terms:

   Radioactive element ______

   Transuranium element ______

5. List the names of five radioactive elements:

   a. ______ d. ______

   b. ______ e. ______

   c. ______

6. List the names of five transuranium elements:

   a. ______ d. ______

   b. ______ e. ______

   c. ______

7. Write the nuclear equation to represent the nuclear reaction which occurs when ${}_{92}U^{238}$ loses an alpha particle.

______

SELF-EVALUATION 2 (cont'd)

8. Write the nuclear equation to represent the nuclear reaction which would occur if ${}_6C^{14}$ lost a beta particle.

____

ECONOMICS OF ENERGY

Economics: 10th Grade

by

Charles W. Galloway
North Augusta Junior High School

INTRODUCTION

The fact that the United States at the present time consumes over 30 percent of the world's total energy production has become a well publicized bit of statistical information. Throughout most of the twentieth century the United States has been a net explorer of energy, reflecting not only the quantity of the nation's energy resources, but also their quality. In the past, the American fuel producers were able to produce oil, coal and natural gas at a relatively low cost compared to most other parts of the world and played a dominant role in world fuel prices and trade. This longstanding historical pattern did not prepare the American public for the events that began to appear with increasing frequency in the last several years.

The United States, as a highly industrialized and energy-intensive nation, is going to have to adjust to a whole new set of economic conditions. Solutions to economics and social problems that have been found partly through the use of large quantities of cheap energy will no longer be available to us. What appears to be a basic turning point in the history of American resource utilization offers an opportunity for us to apply many concepts or perspectives of economics to dramatic events taking place in the real world of today. The people and government of the United States now face a series of critical choices in the face of scarcity - this is the essence of economics.

OBJECTIVE

The purpose of this unit is to provide students with some essential facts and economic principles which may help them analyze the problem more intelligently. Definitions and explanations will be given on important basic terms and principles, to describe energy usage in the United States, given the facts about our reserves of oil, and discuss the general supply situation. The demand side of the picture will be explained, along with the role of economic growth and the functioning of the price mechanism.

This teaching unit is designed for five (5) days. The first three (3) days will be allocated to lectures and discussions. The last two (2) days will be allocated to student activities.

FIRST DAY

Provide the student with a firm grasp of the basic energy concepts and definitions as it deals with energy supply.

1. DEFINITIONS

   a. What is energy? Represents the ability to do work. This capability can be employed in many ways, and energy can be found in many forms.

   b. Potential of energy for work may be found;
      (1) Chemically - Carbon-bearing substances such as food and the fossil fuels.

      (2) Physically - in the atomic structure of matter.

      (3) Position - such as water located on a high plateau or behind a dam.

   c. Kinetic Energy - potential energy placed in motion. Many kinds of flowing energy-light, sound, heat, and electricity.

2. HOW WE USE ENERGY. It is important in our choice of the form in which we will try to obtain energy or how we might alter its form before final use.

   a. The use of energy falls into three (3) categories.

      (1) Work - is accomplished best by using compact, transportable petroleum liquids and gases, or by converting the raw energy into efficient, flexible electricity.

      (2) Comfort uses - Where energy warms or cools our bodies, we are less concerned about the physical form of raw energy since we convert it to circulating warm or cold air or liquids.

      (3) Processing purposes - the form of energy used may or may not be critical. In this case, the heat is used to bring about a physical or chemical change.

   b. The combination of the form of the energy, the type of use, and the level of our technology has been the controlling factor in the particular energy supply that has been important in the various ages of human existence.

3. UNITS OF MEASUREMENT

a. Since energy comes in solids, petroleum liquids, gases, and flows, we have to contend with a whole variety of units of measurement such as tons, barrels and cubic feet.

b. British Thermal Units (BTU) - for measuring heat-producing capacity.

c. Mechanical Power - usually defined in terms of horse-power.

4. RESERVES AND RESOURCES

a. Display a map of the world and out-line those areas where there are known coal beds or sedimentary basins favorable for the accumulation of petroleum and natural gas.

5. ENERGY SUPPLY

a. Converting underground resources into usable supplies involves a complicated mixture of incentives, effort, skill and just plain luck.

b. Discuss the investors attitude toward risk and expected returns.

c. Point out that prices, costs and earnings are all heavily influenced by a wide range of governmental policies, including price controls, tax measures, public land policies, environmental regulations, controls over energy imports and support of domestic operations.

d. On the critical issue side, discuss what do we do now, to stimulate the necessary changes. One avenue is to accelerate, broaden private research and development, supported by a wide range of appropriate government efforts.

SECOND DAY: ENERGY DEMAND

The Joint Economic Committee of Congress termed energy "the ultimate raw material which permits the continued recycle of resources into most of man's requirement for food, clothing and shelter" and stated "the productivity (and consumption) of society is directly related to the per captia energy available." To shed light on this critical issue, discuss the current patterns of energy usage, historical trends, and projections of demand into the future.

Discuss the current pattern of energy use as it pertains to the residential-commercial sector, transportation, electricity generation and industrial uses.

Discuss the energy and economic growth since the end of World War II. Note that the increases in energy consumption were much more rapid than the growth of population.

Discuss why many economists consider the price mechanism as the best instrument for allocating resources. This does not imply that the price system always provides socially ideal (or even politically acceptable) results; but because it leaves buyers and sellers free to make voluntary decisions, some feel that it increases the likelihood that we will approach the highest level of economic well-being.

THIRD DAY: POLICY ISSUES

In determining energy policy we must be fully aware of the economic forces at work. One way to gain insight into the complex web of energy policy questions is to ask which group carries what degree of responsibility for the "energy problem" with which we are currently confronted. All are being charged with having contributed in various ways, to aggravating, if not bringing on, the current shortages. Discuss the role of each of the following groups:

a. Oil Industry - the charges against the energy suppliers (primarily the large integrated oil Companies) are many.

b. Environmentalists - the charge against environmental groups is that they are opposed to just about every proposal to expand energy supplies.

c. Energy Consumers - Americans have been called "energy gluttons" who drive overweight cars at excessive speeds, live in under-insulated houses, and use inefficient manufacturing processes.

d. Government Policies - Prior to the recent energy crisis and the establishment of a Federal Energy Administration there were over 70 federal agencies concerned with various aspects of energy policy.

FOURTH DAY: MOTIVATING THE STUDENTS

In order to introduce energy problems and concepts, administer the following "Energy Conservation Survey."

ENERGY CONSERVATION SURVEY

Let us assume that it is necessary to cut back our use of energy substantially. The following proposals are offered to accomplish this task. Rate each proposal as follows:

a. I strongly agree with the proposal.

b. I agree with the proposal.

c. I can't make up my mind on it.

d. I disagree with the proposal.

e. I strongly disagree with the proposal.

WE SHOULD:

1. Increase the price of gasoline by 50 cents a gallon to cut down on gasoline use.

2. Increase the age at which a person can get a driver's license from 16 to 19.

3. Lower air pollution standards so industries can burn higher sulfur coal rather than oil or natural gas.

4. Ban all students from driving to school if bus transportation is available.

5. Ban all driving of private cars on Sunday.

6. Ration gasoline so every driver can obtain only a certain amount.

7. Ban the use of recreational vehicles such as camper, minibikes, snowmobiles and pleasure motorboats.

8. Reduce city street lights by at least 25 percent.

9. Ban auto racing to save fuel.

10. Ban use of all nonessential household appliances such as electric garage-door openers, electric can openers, color TV's, electric toothbrushes, garbage disposals, blenders and stereo systems.

11. Double the price of electricity and natural gas to discourage household use.

12. Require all schools to have a three month winter break rather than a three month summer break to save fuel.

13. Ban the use of air conditioners in all buildings with windows.

14. Reduce oil imports by 20 percent.

15. Reduce oil and natural gas supplies to all industries by 20 percent.

16. Lower pollution standards on new cars so they can get better mileage.

Tally student answers. Note and discuss areas of agreement and disagreements using these discussion questions.

1. What are the economic effects or consequences of each of these proposals?

2. How practical is each of these proposals?

3. How enforceable is each of these proposals?

4. Which groups of people are hurt most by each of these proposals? Which groups are hurt less?

5. What values affected the students' choices of what proposals to adopt?

6. Can the price system or rationing better allocate scarce energy resources?

7. Do we need to accept more pollution as we meet our energy needs?

8. What personal sacrifices are students willing to make in order to save energy?

9. What energy uses are necessities? Which are luxuries?

FIFTH DAY: ENERGY CONSUMPTION - DEMAND

The energy crisis is one of supply and demand. We can solve the crisis by increasing supply, reducing demand, or both. Whether increasing production or reducing consumption should have greater priority is an important question for classroom discussion.

Students may not realize how important energy is in their daily lives. To emphasize this point, have them write a brief summary of their previous day's activities, and in so doing list all the products and services they used that used energy. Students probably will identify many direct uses of energy but will miss several indirect uses such as that used to manufacture the goods or perform the services that eventually are consumed. The list of energy uses can lead to a discussion on how consumers can use energy more efficiently.

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Miller, Roger Leroy, ECONOMICS TODAY, Canfield Press, Harper, Row, Publishers, Inc., New York, 1976, pp 1-3, pp 451-461. Deals with the scarcity society, resources of the common heritage of mankind and we should utilize our resources.

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Szuls, Tad, THE ENERGY CRISIS, Franklin Watts, Inc., New York, 1974. Explores the extraordinary history of the energy crisis, and in the process uncovers a quagmire of governmental neglect and corporate greed.

U.S. Department of Energy, U.S. ENERGY POLICY - WHICH DIRECTION? Prepared by National Science Teachers Association 1978. Copies may be ordered from U.S. Department of Energy, Technical Information Office, P.O. Box 62, Oak Ridge, Tennessee 37830. A study of Executive decision-making.

A NEW SOURCE OF ENERGY - CONSERVATION

Course designed for PRACTICAL BIOLOGY COURSE in high school for students who are basically non-readers.

by

Phyllis T. Gee
Logan Alternative School

INTRODUCTION:

Energy education is one of the basic goals for students. By helping individuals become aware of energy's characteristics and its sources, an opportunity to develop a better understanding of self and environment is available.

By integrating energy education throughout the school year, the quality of life, health and well-being will be a personal responsibility that reflects our national concern. It is not just a science course, but every subject can and should easily incorporate environmental education. Students can be encouraged to investigate their own communities and their homes in an effort to relate to the human ecosystem. Luxuries and necessities can be evaluated with the amount of energy required of each. Students will then be better prepared to clarify personal values and to develop attitudes for responsible decision making.

DAY ONE

Utilizing the available vocabulary and summary provided with the film, introduce the film - "The Great Search" by Walt Disney. Class discussion follows the viewing of the film.

Distribute the hand out "Dairy of a Colonial Farmer", taken from AN ENERGY HISTORY OF THE UNITED STATES, grades 8-9, January, 1978, National Science Teachers Association. Review when completed.

DAY TWO
DAY THREE

Distribute hand out on "Value Judgements".

Individualized instruction is the approach suggested. For the next two days have learning stations around the room that the students rotate through. They may begin at any point and spend as much time as they wish. Examples of these learning stations are as follows:

Filmstrips with individual filmstrip previewers
Tape player with earphones and tapes
(Tapes are either ordered from sources listed in the back or they are personally made and can coordinate with transparencies.)
8mm film loops and projector (one concept/silent)
16mm film projector and films with headphones
Resource center other than room/Library
Individual discussion with instructor and/or another student.

Any one of the following topics will be found at one of the above listening stations.

I. What is Energy?

A. Brief history
1. Age of electricity
2. Exploding population
3. Pollution

B. Earth's atmosphere
Storage bank for many elements that are necessary for survival of living organisms.
i.e., Oxygen, carbon and nitrogen are three atmospheric components most important in the biosphere. Each of these is used, released and reused in cycles.

C. The United States energy problem

II. Kinds of Energy

Muscle/animal
Kinetic/mechanical
Chemical
Nuclear
Radiation energy
Electrical energy
Potential energy

III. Sources of Energy

Coal
Natural gas
Crude oil
Solar
Wind power
Tides

IV. Definitions

Provided are a variety of ways that students can obtain the required information. Most of them have been listed previously. The list of terms will be defined through a glossary provided and the individual learning stations. An example is FACTSHEET, No. 18, National Teachers Association/U.S. Energy Research and Development Administration.
The depth at which these terms are defined will depend on each individual class and their potential, assuming that this has already been established.

A HIGH INTEREST CLASS COULD EXTEND THIS PORTION TO INCLUDE SEVERAL MORE DAYS.

DAY FOUR

RESOURCE PERSON

There are many local and state agencies that make a resource person readily available. One such example is RESOURCES FOR ENVIRONMENTAL EDUCATION, South Carolina Department of Education, Cyril B. Busbee, State Superintendent. This is a survey of state and federal agencies and organizations. It gives specific information on how to obtain everything from a speaker to printed materials for the students, as well as the teachers.

Columbia, South Carolina, Chamber of Commerce is another such source for speakers and materials. Mr. Milton Kimpson and Mr. Barry Cato have been very helpful. Ms. Alice Linder, Environmental Education Consultant, South Carolina Department of Education, is most anxious to be of assistance.

DAY FIVE

TOUR: Westinghouse Nuclear Fuel Division

Contact Person: Energy Information Office
Ms. Leah K. McNeill, Communications Administrator
Drawer R. Bluff Road, Columbia, S.C. 29250

Environmental categories include non-renewable resources (fossil fuels), radiological contamination and transportation. Qualified speakers are available on nuclear energy, solar, geothermal, wind, etc.

DAY SIX

Again, depending on the individual class, one or more of the following student activities will be encouraged to get the student personally involved in conservation.

I. Learning activity on Meter Reading
"Kill A Watt" By Diana Margotto, Washington Jr. High School, Green Bay, Wisconsin, AWARD WRITING ENERGY EDUCATION ACTIVITIES, E R HQ - 0011, 1977, National Science Teachers Association.

2. Thermostat Setback
Demonstrates what effect this has on energy consumption. ENERGY CONSERVATION IN THE HOME, by the University of Tennessee Environment Center and College of Home Economics, Knoxville, Tennessee, U.S. Department of Energy.

3. Bulletin Board
Magazines, newspapers and advertisements are brought to class by the students to create a collage of energy terms and illustrations.

4. Make a display of disposable products - used once and thrown away. Demonstrates waste of natural resources.

5. Read power consumption data on appliances. Make a chart showing how much energy is consumed by each appliance in your home.

6. To conserve gasoline, adopt a policy with priorities and regulations as fair as possible to everyone without the use of an automobile.

These are just a few of the student activities that can be carried out in the classroom. Available sources will be listed at the end of this paper. It is imperative that these activities include extended projects throughout the school year in hopes of encouraging the need for a more conservative lifestyle of living.

To mention a few: A scrapbook to be kept during the year and evaluated periodically. This could include advertisements that encourage wasteful usage of natural resources, letters to the editor that show increasing concern of citizens, cartoons, pictures, highway patrol reports, industry, agriculture, etc.

Organized student committees which will work with the school in conserving energy, local businesses, and communities.

BIBLIOGRAPHY

TEXTS

BIOLOGICAL SCIENCE AN INQUIRY INTO LIFE, prepared by the Biological Sciences Curriculum Study, Harcourt Brack Jovanovich, Inc., New York, Chicago, San Francisco, Atlanta, Dallas, 1973. Textbook,

pp. 834-900. "A Perspective of Time and Life - Molecules to Mankind".

Smallwood, William L., Green, Edna R., BIOLOGY, Silver Burdett, Morristown, New Jersey, 1974. "Problems of Man", pp. 656-693. (Many other supplementary texts are used as resources in the classroom study. These are available in the individual schools or the library.)

Source Books and Resource Centers

Busbee, Cyril B., State Superintendent, S.C. Department of Education, THE ENERGY BOOK, includes individualized student activities, small group and class activities, home check lists, avaliable films, and selected resources and references. Very helpful.

ENVIRONMENTAL EDUCATION, A SOURCE BOOK FOR EDUCATORS, Very informative source for instructor, includes a model environmental education program.

RESOURCES FOR ENVIRONMENTAL EDUCATION, Survey of state and federal agencies and organizations. Human resources, printed and audiovisual materials and places for field study.

Clemson University
This is one example of how state universities can be of service. Dr. Harold Albert, Professor of Political Science, has put me in touch with resource people who are willing to share outlines on coal mining or transparencies that cover economics or production of natural resources. This is my main source of transparencies to be used with this particular lesson plan. Information on Solar Research Homes also is available.

ENERGY CONSERVATION IN THE HOME, An energy education/conservation curriculum guide for home economics teachers, prepared by The University of Tennessee Environment Center and College of Home Economics, Knoxville, Tennessee, October, 1977. United States Department of Energy will make copies of this available from Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee, 37830. This is an excellent guide.

National Science Teachers Association
AWARD WINNING ENERGY EDUCATION ACTIVITIES For Elementary and High School Teachers, Energy Research and Development Administration, E R HQ - 0011. This booklet contains brief descriptions of the winning entries to the NSTA Teacher Participation Contest, Spring, 1976.

FACTSHEET, John M. and Kathryn Fowler

Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy, prepared for U.S. Department of Energy.

Examples:

AN ENERGY HISTORY OF THE UNITED STATES, grades 8-9, January, 1978. HCP/U 3841-0004

ENERGY, ENGINES, AND THE INDUSTRIAL REVOLUTION, grades 8,9. EDM-1032

HOW A BILL BECOMES A LAW TO CONSERVE ENERGY, grades 9, 10, 11, EDM/1033

MATHEMATICS IN ENERGY, grades 8-9, December, 1977. HCP/U3842-0002

U.S. ENERGY POLICY-WHICH DIRECTION?, grades 11 and 12, January, 1978, HCP/U 3841 - 0003

TRANSPORTATION AND THE CITY, grades 8,9. EDM - 1031

These include graphs and diagrams with the outline of course work. They are excellent resources for instructor.

Keowee Towaway Vistors Center, Duke Power, Box 308, Clemson, S.C. 29631. Here again, is an example of programs offered to better inform the public of progress being made in our world. Films and presentations are available, including tours.

Richland County School District One
Resource Center

Audiovisual materials and equipment may be ordered in advance to insue proper utilization of time and topics. Descriptions of Films, filmstrips, tapes, filmstrip/record combination and transparencies will make it easy to adapt these materials into their proper place during the lesson.

Once you have communicated with any one of these resource centers available, there will be no end to the materials that will enchance the education of our precious environment.

It is intended that resources will supplement this lesson plan so that it will extend throughout the school year, as well as through other subjects.

Student Hand-Out 4

Read the selection below. Then fill in the chart using the information from the Diary.

Diary of a Colonial Farmer

5:00 am	Got up and fed the oxen, pigs and chickens. Wife started fire and cooked breakfast. A cold morning. Frost everywhere. Milked the cow.
6:00 am	Ate pork and buttered cornbread for breakfast. Have to make another chair so our youngest child will have a place to sit. Maybe I can do it tomorrow.
7:00 am	Hitched up the oxen to the plow. Started to plow half our field. Will have to get ready to plant wheat and corn. Hope to plow the other half next week.
11:00 am	Weather finally warmed up some. Wife and children spent the morning hoeing in the garden. Soon the time will come to plant onions, melons . . . Finally, finished plowing. Took oxen back to the barn.
12:00 pm	Finally had lunch. Still thinking about making that needed chair. Had fruit, salted pork and cornbread for lunch.
12:30 pm	Went to work in the orchard. Hope the blackbirds don't eat too much of the fruit. Have to cut off all the dead limbs on the fruit trees. Only worked on some of the trees. After cleaning up the lunch dishes, wife spent the afternoon spinning thread. We all need some new clothes for summer. I'm thinking about trading a pig for new shoes for the family. Haven't got time to make shoes. Children finally got to go fishing.
4:30 pm	Too tired to trim any more fruit trees. Had hoped to remove some tree stumps from the field. Maybe I can get to that before too long. Neighbor Thomas will help. Last week I helped him pull up stumps. Wife began to prepare supper. I'm glad children caught fish. We'll have them for supper with some

boiled cabbage.

5:00 pm — All of us had supper. Still thinking about making that chair. Wife and children got supper dishes cleaned up. Children brought in some firewood. I milked the cow and fed the livestock again.

7:00 pm — Started to get cold again. Said evening prayers and children went to bed. I repaired a broken plow and wife patched some clothes. Reminded myself to get wood for that chair I must make.

8:30 pm — Wanted to cleam my rifle first, but instead used the remaining light from the fire to write in my dairy and read the bible.

9:15 pm — So tired. Went to bed.

"The Life of the Farmer",
The Americans, Edwin Fenton.
Editor, Holt, Rinehart and
Winston, New York, 1975, pp 45-46.

Answers to Student Questions
Activity 4

Energy and Cultural Patterns: The Colonial Farm

Using the information from the diary, the picture of the farm family and the previous reading, complete the following chart.

1. What sources of energy were available to the settlers?
   (Wood, water, animal and human power.)

2. Show how the following tasks were done by the settlers. What energy was used in these tasks?

   a. Producing food
      (Children fish; father clears land by oxen and hoes by hand)
   b. Preparing food
      (Wood fire for cooking, all food prepared at home, woman churns butter at home.)
   c. Building homes and barns
      (Human energy.)
   d. Lighting and heating homes
      (Wood [illegible] carried.)

e. Preparing clothing
(Woman spins by hand and makes shoes by hand.)

f. Making furniture
(Father carves the furniture by hand.)

3. List two jobs performed by each member of the family.

a. Mother
(Spins and cooks.)

b. Father
(Clears land, farms.)

c. Children
(Carry wood, fish.)

4. In the colonial period, what made one family wealthier or better off than another?
(The number of people who could work, the health and strength of the family members, the amount of land the family could cultivate.)

VALUE JUDGEMENTS

This exercise is designed to give you some insight into your own values. There are no right or wrong answers.

WHICH DO YOU CONSIDER TO BE THE MOST IMPORTANT

_________ Pure water

_________ Clean air

_________ Reduction in noise levels

_________ An understanding of ecology

_________ Conservation of our natural resources

_________ Developing an environmental lifestyle

_________ Elimination of litter

_________ Stabilized population growth

_________ Refrain from using pesticides

_________ Wise consumer practices

_________ Diminish our energy consumption (electricity)

_______ Rational and usage

_______ Lessen private and commercial solid waste production

_______ Control thermal pollution

_______ A sensitivity to one's surroundings (environmental awareness)

SCALE: 1 = most
15 = least

COAL MINING: A TEMPORARY SOLUTION TO THE ENERGY CRISIS

Physical Science: 9th Grade

by

Florence S. Grant
Burke High School

Time required: Approximately three weeks.

INTRODUCTION

With our oil reserves being almost depleted, coal is becoming increasingly useful in America today. Currently, coal produces almost half of the electricity in the United States; it represents our most abundant fuel resource. In the future, man must develop new technology in order to release more of the potential energy that coal captured eons ago.

This lesson plan is designed to enable high school students to become informed of the role coal has played in our lives during the past, in the present, and its future possibilities.

LESSON OUTLINE AND CLASS DISCUSSION:

I. Coal Formation:

1. Coal is sometimes called buried sunshine. This is because coal captured the sunlight that fell on ancient forests long before man appeared on the earth. When we burn coal today, we are releasing this captured energy from the sun. Basically, coal is the buried remains of tropical plant materials that grew a long time ago when many swamp sections of the earth were covered with very dense vegetation. As the tree-ferns and mosses died and fell, layer upon layer piled up and decomposed. Eventually, these materials became covered with soil and rock. Pressure, heat, and chemical changes slowly continued to convert these remains into what we now call coal. It is believed that this formation of coal began 310-million years ago, during the beginning of the Pennsylvanian Age of Geologic time.

II. Kinds of Coal:

1. The extent of pressure, temperature, and time have developed four basic classifications or ranks of coal:

a. lignite - is the lowest classification; often called brown coal because of its color. Lignite is the parent form of all coal. It has high moisture content and relatively low heat content.

b. subbituminous - has one-half the moisture of lignite and slightly higher heat content.

c. bituminous - has a higher percentage of fixed carbon, less moisture, and better heat value.

d. anthracite - has the highest percentage of fixed carbon; relatively small amount of gaseous (volatile) matter, and is of high heat content.

III. Geographic Distribution:

1. Coal is found in every continent of the world. Approximately 1/8 of the area of the United States is underlain by coal-bearing strata. The largest quantities of coal are found in the northern hemisphere, Asia, and Europe. Coal has been mined in approximately 60 countries in the world. Thirty-four of the fifty states have significant amounts of coal. Coal is mined in about twenty-five of these states.

2. Principal Coal-producing Areas in the United States.

a. Appalachian - Extends from Alabama to Pennsylvania to Ohio.

b. Midwestern - Illinois, Indiana, western Kentucky, Iowa, Missouri, Kansas, Oklahoma, and Texas.

c. Northwestern - Parts of North and South Dakota, eastern Montana.

d. Rocky Mountain - Western Montana, Wyoming, Colorado, Utah, and New Mexico.

e. Pacific Coast - Chiefly in Washington.

3. Other large-producing Countries:

a. China

b. Germany (East and West)

c. Soviet Union and Poland

IV. Coal Mining History:

Early usage: The Chinese used coal, perhaps 1000 years before the Christian Era. According to Proverbs 6:28, even King Solomon used coal. There is evidence in Wales that the Bronze Age people used coal for funeral pyres and it was also used by the Romans. King Edward I of England made it a penalty of death for anyone to burn coal.

1. Early usage in the United States:

a. There is evidence that coal was used by the Indians. The first recorded actual usage was in Virginia in 1702. The earliest commercial mining was in 1750 from the James River coal field near Richmond, Virginia. The first recorded anthracite discovery was in Pennsylvania in 1728, but the first actual usage was not until 1769.

b. Coal consumption in America had an extremely slow start because the abundant forests supplied nearly all the needed fuel. Then, too, charcoal was cheaper and better known than coke.

c. Once coal consumption succeeded that of wood, the development of railroads, steel mills and other large consumers of fuel was such that coal mining became increasingly important. The industrial development increased after the Civil War and the consumption continued to climb rapidly until World War I.

d. The decline of coal was caused by its high cost and the lower cost of natural gas and oil.

V. Early Methods of Mining Coal:

1. In the first coal mines, all coal was hewed by hand from the solid bed by pick and bar. It was then shoveled into baskets, boxes, or wheelbarrows and dragged by man-power, women included, to the outside. Later, cars were developed, but were still drawn by humans. As time went on, dogs, ponies, or horses did the pulling or cars over rails. These animals were taken into the mines and spent the remainder of their lives there; some were born there and never saw daylight. Eventually, black powder was used to blast down the coal, but the drilling and cutting were still done by hand.

2. The first rail was used to transport coal and the first electric locomotive for underground use was developed in 1883.

VI. Modern Methods of Mining Coal:

1. Modern mechanization of operations which started before 1900, involves punching machines and chain-type cutters for undermining the coal seam before blasting, electric and compressed air locomotored, and experiments with continuous mining machines.

2. During the 1920's loading machines were successfully used in some mines and its use developed rapidly.

3. Then in the 1930's, rubber-tired shuttle cars began the conversion from track-mounted loaders, cutters, to off-track types utilizing crawlers or rubber tires.

4. After World War I, tungsten carbide bits were introduced for drilling both coal and roof, for cutting machines, and for continuous mining. These bits made it possible to drill holes in rocks to support the roof by bolting instead of with posts and crossbars, thus affording more clearance for man and machine to operate, dustless clean up, and increased safety to man. No development in the past thirty years has been more important than roof bolting.

5. Underground transportation has eliminated the shuttle car through the increasing development of portable conveyors behind the continuous miner that affords almost continuous transportation of coal to the fixed conveyor system.

6. Another development of the past 30 years has been the use of "scoops" used for loading and hauling in the seams and for clearing the floor, carry supplies and men in all thicknesses of coal.

VII. How Coal Is Mined:

1. Surface mining is used when coal beds lie close to the surface of the earth and comprises over 50% of total U.S. production.

2. Underground mining involves three different types of mines:

a. drift mine - One in which a horizontal, or nearly horizontal, seam of coal outcrops to the surface in the side of a hill or mountain, and the opening into the mine may be made directly into the coal seam.

b. slope mine - In this type of mine, an inclined opening is employed to tap the coal seam or seams.

c. Shaft mine - The coal is reached by a vertical opening from the surface to the coal seam or seams.

3. In modern mining systems, underground mining is usually classified according to the type of equipment used; such as:

a. coventional - The coal face is cut and the block or blocks outlined is then drilled. The drilled holes are usually charged with explosives and the coal is then gathered up by a loading machine. Ventilation is assured and the process is repeated.

b. continuous - A single machine called a "continuous miner" breaks the coal mechanically and loads it for transport. Roof support and ventilation are assured and then the coal face is ready for the next cycle.

c. longwall - large blocks of coal are outlined and completely removed in a single continuous operation.

VIII. Transportation of Coal:

Coal is usually transported by railroad cars or barges. Coal may be shipped by pipelines in a soupy mixture called slurry, which can be burned without first separating and drying the coal. Trucking of coal directly from the mines is feasible when there are no railroads close by. About 75% of all coal is removed by rail; coal is the railroad's biggest customer.

IX. How Coal is Used in Electric Generators:

1. Coal is used to produce almost half of the electricity used in the United States. The electricity is generated by the conventional methods. The difference is that coal is used as the boiler-fuel. Soft coal is crushed into a powder and blown into the furnace with a blast of air. In this manner, the coal burns like gas, with greater efficiency.

2. Most authorities agree that we have enough coal to last for more than three hundred years. For this reason, as far as coal is concerned, we can be assured of electrical energy; nonetheless, conservation of energy remains a necessity.

X. Future Technologies Based on Coal:

1. Fluidized Beds - Powdered coal is fluidized by hot air jets, and burns; the heat of combustion is transferred to a nest of pipes in the bed, which forms a boiler, in which steam is raised to power a conventional steam turbine.

2. Underground gasification - Involves shattering the coal with chemical explosives, retorting it by starting a methane flame, sustaining combustion with a supply of oxygen and water and

piping the resulting gas (mostly methane) to the surface.

3. Nuclear gasification -- To use heat from a nuclear reactor to heat the coke ovens of a conventional gasification plant.

ACTIVITIES

1. Motivation: Have on display samples of coal by-products (empty containers will do) of well-known items such as a plastic doll, detergent, moth balls, nylon, perfume, nail polish, saccharin, and a piece of linoleum. Ask students to record the name of the source of the derivative of these products. Retain these responses for discussion at the conclusion of the unit.

2. Teacher Demonstration: Coke can be made in the laboratory by connecting a pyrex test tube with another test tube fitted with a two-hole stopper and a piece of glass tubing drawn to form a jet. Nearly fill the pyrex tube with pieces of bituminous coal. Heat the tube strongly with a bunsen burner. Then light the coal gas that comes from the jet tube. A tar-like liquid condenses in the vertical tube. This liquid contains ammonia, oils, and tar. After heating the coal for about ten minutes, break open the pyrex tube and examine the coke. Ignite it and have students observe how it burns.

3. Transparencies of a map of the coal reserves of the United States should be available. These maps may be obtained from:

National Coal Association
1130-17 Street, N.W.
Washington, D.C. 20036

4. Have students prepare these displays for the classroom bulletin boards:
   a. Types of Underground Mines
   b. The journey coal takes from the mine to the electricity in a typical home.

5. Have a group of students discuss:
   a. 1970 and 1977 Clean Air Act
   b. Surface Mining Control and Reclamation Act of 1977
   c. Mine Health and Safety Act of 1977

6. Collect samples of coal for student identification.

7. An American Asset. A 28-minute, 16mm, color film describing the methods of producing and using the nation's most plentiful fuel -- coal -- may be obtained from:

Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, N.Y. 11040

8. Have the class visit an electric generator plant.

9. Have students research coal mining history of the industry, health, and welfare of the miners, changing economy of coal mine areas, coal pollution, ownership of coal mines, and technique and problems of strip mining.

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McNeil, Royce, Lecture: "Coal Mining" Clemson University, July 21, 1978.

Startwell, Joyce G. and Richard P. Abell. "A Teacher's Guide to the Energy Crisis," Today's Education, Volume LXIV, number 1, January-February 1975, pp. 90-95.

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ENERGY TODAY, WITH A LOOK TOWARD THE FUTURE

Geography: 9th Grade

by

Charlotte Justice
Rawlinson Road Junior High School

Course Description

The Estimates of our known fuel supply are as follows:

Coal --------- 300-500 years

Oil ---------- 30-50 years

Hydro -------- (all tapped)

Uranium ------ 40-60 years

The message is - our supplies are definitely limited.

The course is designed for ninth grade students of all ability levels, but it can easily be adapted to include grades ten through twelve. The time span can range from one to several weeks depending upon the number of activities and the depth to which they are researched. The purpose of the course is to study the basic forms of energy that we utilize today, but more important to realize that these sources are limited. What are our alternatives? Will our power sources change in the future? If so, then what will they change to?

Outline

I. What Kind of Fuel do We Have Now? (1day-1week)
   A. Oil
   B. Coal
   C. Water
   D. Uranium

II. A Need to Conserve (1day-1week)
   A. Home
   B. School
   C. Transportation

III. Alternative Fuel Supplies (1day-1week)
- A. Solar
- B. Wind
- C. Geothermal
- D. Tidal
- E. Fission
- F. Fusion
- G. Nuclear

IV. A Way to the Future (1-2days)
- A. Theory
- B. Hypothesis
- C. Reality

I. What Kind of Fuel do We Have Now?

Suggested Activities	Resources
State your objectives of the course	
Have students write a short paper on whether they think there is an energy crisis, Why?	
3. Show an introductory film on energy	"The Great Search" Duke Power Company P.O. Box 2178 Charlotte, N.C. 28201
4. Have students read comic book on energy.	<u>Mickey Mouse and Goofy Explore Energy</u> Walt Disney Educational Media Company 500 S. Buena Vista St. Burbank, Calif. 91521
5. Either make available or have the students research these fuels, as their use in generating power and to see how much we consume of each:	
Oil	<u>Energy</u>, Wilson, Mitchell. Time-Life Books, New York, 1968, pg. 102-115.
Coal	<u>The Energy Trap</u>. Halacy, D.S., New York: Four Winds Press, 1975.
Water	<u>Energy</u>, Wilson, Mitchell. New York: Time-Life Books, 1968, pg. 178-179.

Suggested Activities	Resources
Uranium	Energy and the Future. Rothman, Milton A., New York: Franklin Watts Inc. 1975. pg. 34-43.
6. Have the students find out what our known reserves are on the four fuels listed above.	
7. Show a film that distinguishes between: Renewable fuels-food and wood (short term) non-renewable sources-Coal and oil (millions of years)	"Energy: the Fuels and Man" National Geographic Society Educational Services Department 78 Washington, D.C. 20036
8. Have students give a survey in either their school, community, or church etc. to ten people, on whether or not they think there is an energy crisis.	
9. Take class on a field trip to either a coal powered electric plant or a hydro electric plant.	
10. Using a series of pictures (drawings, etc.) show the historical sequences of sources of energy used from early man to the present. You may want to divide the class into the four different energy sources.	
II. A Need to Conserve	
1. Have students read about efficiency in the home.	An Energy Education/Conservation Curriculum Guide For Home Economics Teachers by the Univ. of Tenn. Environmental Center and College of Home Economics Knoxville, Tenn. October '77 U.S. Department of Energy.
2. Have the students check their home to see if there is any way that they could conserve. Have them suggest ten ways their own home could be made more	

Suggested Activities	Resources
efficient. Check: a. the House Shell (site, construction, insulation, doors, windows, etc.) b. Types of Environmental Control Systems. (heat pump, electric, oil, gas, etc.)	
3. Have the students go home and count the number of light bulbs in their house and their wattages. Compare all the results in class the next day.	
4. Have the students take the energy test to see if their home is efficient. (223-227)	
5. Have the students make up their own home conservation tests and have them give it to five neighbors. Bring the information back to class and discuss the results.	
6. Have students read Factsheet No. 9 and then compare homes in their neighborhood, for efficiency.	Factsheet, National Science Teacher's Association. DOE -- Technical Information Center, P.O. Box 62, Oak Ridge, Tenn. 37830.
7. Have the students read how to select a home for themselves in the future. (Apartment, Mobile Home, Old Home, New Homes, etc.) pp. 113-118.	An Energy Education/Conservation Curriculum Guide For Home Economics Teachers.
8. Have the students lists five ways that they think energy could be conserved in the classroom, either directly or indirectly. Ex. Turn one set of lights off when students are not reading, don't throw away clean paper, etc.	
9. Visit other businesses (Dept. Store, Grocery) to see how they are conserving energy.	
10. Study various ways to conserve in the field of transportation. (Busing, [illegible]	
11. Have stu[illegible] con-di[illegible]s [illegible] [illegible] to see [illegible]	

Suggested Activities	Resources
practice some form of conservation in transportation.	
12. Perform simple classroom experiments on how to conserve energy.	Conservation Science Activities in Energy. The American Museum Of Atomic Energy, Oak Ridge Associated Univ. P.O. Box 117, Oak Ridge, Tenn. 37830
13. Have students read comic book "Mickey Mouse and Goofy Explore Conservation"	Walt Disney Educational Media Company
III. Alternative Fuel Supplies	
1. Have students research or supply information for the following possible energy sources:	
a. Solar	The Energy Trap. Halacy, D.S., New York: Four Winds Press, 1975. pp. 104-114.
b. Wind	Energy and Power. Coates, Norman, New York: G.P. Putnam's Sons, 1976. pp.7-23
c. Geothermal	World Book Encyclopedia
d. Tidal	Energy and the Future. Rothman, Milton, New York: Franklin Watts Inc., 1975. pp. 97-106
e. Fusion	The Energy Trap
f. Fission	Energy. Wilson, Mitchell, New York: Time-Life Books, 1963. pp. 154-165.
g. Nuclear	Duke Power Speaker
2. Show a film Kit that takes the basic elements- water, earth, wind, and sun and explores how they can be used as possible energy sources: Filmstrip Kit: This World of Energy I. Energy in the Earth II. Using Energy III. Fossil Fuel IV. Nuclear Power V. Energy for the future	National Geographic Society Educational Services Dept. 78 Washington, D.C. 20036

Student Activities	Resources
3. Supply material for the students to read on alternate Energy sources.	Catalog of free educational films and literature for the classroom. Duke Power Company P.O. Box 2178 Charlotte, N.C. 28201 Energy Curriculum Materials Education Programs Div., U.S. Department of Energy Washington, D.C. 20545 Factsheet, Nos. 3,8.
4. Have the students prepare a paper on, "Wind, Geothermal, and Tidal will not be great contributors of power in the future. Why?"	
5. Invite a speaker into the class who is an expert on one of the seven alternate Energy Sources.	
6. Have an Environmentalist in to speak to the class on energy, note the different slant that he places on the Energy Crisis and the solution.	Dr. Joe [illegible] Winthrop Co[illegible]
7. Take the class on a field trip to the construction site of a nuclear power plant or a completed one.	
8. Show the students a Film.	Energy: The Problems and the Future. National Geographic Society, Educational Services Dept. 78 Washington, D.C.
9. Visit a solar operated facility in your area. (house, office, school, etc.)	Clemson University.
10. Show a film on solar energy.	Filmstrip: Harnessing the Sun. National Geographic Society.
11. Have the students make projects, taking one of the seven alternate energy sources and preparing a display on that source.	

Suggested Activities	Resources
IV. A Way to the Future 1. Have students answer this question, "If you had to decide which needs energy the most, would it be business, hospital, schools, homes, etc.? Why?" 2. Assume you are a Congressman, Write a Law which would reduce Fuel consumption and be equitable and fair to all sectors of society. 3. Invite a speaker in to present a view of what our future is. Have the students prepare questions to ask the speaker. 4. Have students volunteer to choose the energy source in the future that they prefer, research it, and then stand before the class 'pretending' to be an expert. Have the class question him about his choice and try to persuade him to change his mind. 5. Hold a class debate on which energy source to use in the future. 6. Have the students prepare a paper choosing the energy source they feel will be the best answer to the future.	

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Ninth grade textbook with chapters on: Fission and Fusion, Conservation, and a little on solar..

Coates, Norman. Energy and Power. New York: G.P. Putnam and Son's, 1967. The book discusses the various sources of energy for travel and industry and describes the future potential sources of energy.

Halacy, D.S. The Energy Trap. New York: Four Winds Press, 1975. This book examines the causes, issues, and probable outcome of the current and worsening energy crisis and describes alternative future sources of adequate energy.

Rothman, Milton A. Energy and the Future. New York: Franklin Watts, Inc., 1975.
The author introduces the student to the question of energy and takes a look at the sources; Fission, Coal Plants, Breeder Reactors, Ocean Currents and Waves etc.

Sterland, E.G. Energy into Power, The Story of Man and Machine. New York: The Natural History Press, 1967.
The book previews the story of man and machine and the energy sources used to power them, (sun, wind, water).

Tracey, George R. Modern Physical Science. New York: Holt, Rhinehart and Winston, Inc., 1974.
Ninth grade textbook is divided into chapters, several of which are relevant (Matter and Energy, Atomic Energy, Fission and Fusion).

[illegible]son, Mitchell. Energy. New York: Time-Life Books, 1968.
An introductory study describing how matter is transformed into energy, basic types of energy (oil, fission, tidal, steam, solar) and the role of energy in the universe.

THE ENERGY CRISIS
DOES IT EXIST? WHERE ARE WE HEADING

A unit on energy
designed to be included in courses of
World Geography, Economics, or Twentieth Century U.S. History,
for grades 9, 10 and 11

by

Charlotte B. LeGrand
W.J. Keenan High School

THE ENERGY CRISIS: DOES IT EXIST? WHERE ARE WE HEADING?

This unit is designed for several different courses to better inform students of the energy problems facing the United States and/or the world today and in the foreseeable future. It is divided into four activities, the first three of which will be more or less the same for all courses, and a fourth which will be varied to fit the particular subject area of the course in which it is included.

ACTIVITY ONE: IS THERE AN ENERGY CRISIS?

This activity introduces students by survey, film, reading and discussion to the seriousness of the energy problem. Specifically, it focuses attention on the possibility that we may really run out of energy as we know it today. A film and a reading introduce the idea of an energy crisis facing the nation and the world. In their discussion the students will deal with an issue that may change our whole way of living by the time they are adults.

MAJOR PARTS OF THE ACTIVITY:

1. Energy Attitude Survey: Students complete an energy attitude survey to determine their attitudes about conserving energy including the roll of the individual, of business, and of government. Time: ½ period.

2. Is There an Energy Crisis? Use a film to give some of the facts of energy situation. Several good films are available and are listed in the bibliography of this unit. Time: ½ period.

3. The Energy Future: A reading from *Time* magazine "The

Nightmare of Life Without Fuel," by Isaac Azimov, should generate an active discussion of the reality of the energy crisis and allow the students using their present knowledge to propose some possible silutions. Time 1 - 2 periods.

GUIDELINES FOR THE TEACHER:

DAY 1:

Distribute duplicate copies of the energy attitude survey, one to be turned in, unsigned, for compilation, and the other to be retained by the student for future use. If the class tends to lose things, it might be helpful to provide them with file folders or envelopes for materials to be used in the unit, assuring them of the confidentiality of material so filed.

After all students have completed the survey forms, collect unsigned copies. Show film of your choice. Depending on time available, a brief introduction may suggest some points to watch for. If any time remains after the film, it may be used for discussion. The major discussion will be held on day two.

DAYS 2 and 3:

Begin the class by reviewing the chief ideas brought out by the film of the previous day. This can best be done by asking questions, but if the students do not remember, it may be necessary to give them the facts you want them to know. Encourage them to take notes on the discussion to keep in files or notebooks. Listing ideas on the blackboard or overhead projector may help them organize their notetaking.

Depending on the amount of time remaining, and the ability of the class, the reading may be done aloud in class, silently in class, for homework, or any combination of these.

Suggested questions for discussion of the reading, from National Science Teachers Association and U.S. Department of Energy interdesciplinary materials, U.S. Energy Policy-Which Direction?, are:

1. What does the author suggest might cause the nightmare to become real? (par. 1.)
2. What is meant when the cities are described as being "the great mineral mines and hardware shops of the nation?" (par. 3)
3. In describing the end of the automobile the author says "rationing was introduced to equalize sacrifice" (par. 4). What do you think was rationed? How do rations "equalize sacrifice"?

4. What are some advantages that the author sees for life in 1997?
5. Why is life worse for the suburban dweller than for the city dweller? (par. 8)
6. The author says (par. 10) that the United States is still purchasing "some trickle" of oil from abroad. How is this oil paid for? How does this affect the life of the people?
7. What energy sources does the author suggest for 1997? Which is most important?
8. What does the author mean by the last five lines, beginning "And what can we do . . . ."

If testing is desired, additional time may be allowed.

ACTIVITY TWO: A WORLD OF ENERGY

In this activity, students study the availability and utilization of present and potential energy sources. The number of resources studied can be adjusted to fit the need, understanding and ability of the class and the time allowed by the teacher. As a minumum, the following sources should be studied: coal, oil, natural gas, nuclear fission and fusion, and solar. Hydro, nuclear breeders, waste products, geothermal, wind, tides, etc., may be added if time, resources, and interest allow.

When they finish this activity, the students should have some awareness of the advantages and disadvantages, as well as the expected commercially useful supply of each energy source studied. The time required for this unit can be adjusted to fit the interest and needs of each individual class. It may last from five to seven days, or more if desired.

MAJOR PARTS OF THE ACTIVITY:

1. A Survey of Energy Use and Supply. Using transparencies and graphs the teacher will give the class a quick survey of the subject showing where our present energy comes from and how it is used. Time: ½ period.

2. Group Study. Students work in groups to become experts on one energy source. The length of time allowed for the group study will depend on the attention span of the class, the resources available for research and the willingness of the students to work outside of class. A minimum of two and one-half periods should be allowed even if substantial work is done outside. Reports may be done individually or as a group.

3. Report on Energy Sources. This part is devoted to delivering, analyzing and discussing reports prepared in part two. Ten to fifteen minutes should be allowed for each source studied. Time: 1 - 3 periods.

4. The Energy World. Students complete charts of the energy sources studied. Time: 1 period.

GUIDELINES FOR THE TEACHER

DAY 1:

Using transparencies prepared in advance, the teacher should give a brief lecture on the United States use of energy and the major sources. Circle graphs are suggested as simple to understand and explain but any type of graph available may be used. The lecture should be kept to no more than half the class period.

The second half of the period is spent in dividing the class into groups for part two. Group membership should be on the basis of individual interest as long as groups are kept approximately equal in size. It is recommended that at least one capable student be included in each group if the class is heterogeneous in order that adequate information will be gathered on each energy source for the reports and charts to be completed. Group leaders should be selected by group members.

DAYS 2 and 3 or more:

Students will use classroom and library resources, as well as community and home resources if desired, to become experts in the sources, production, advantages, disadvantages and feasibility of their energy source. Each student may cover the entire subject or the group may divide the topic among its members.

Charts should be given to each group on the last day of this study period to be completed for their topic. Charts should have six columns labeled as follows: Energy Source, Potential energy output in BTU/yr., Stage of Technology, Probable Years of use remaining, Advantages, and Disadvantages.

DAY 4 or more:

Each group will be allowed to present a summary of their topic. This can be done in several ways. One student may report for the entire group, each student may present a share of the report, or the teacher may ask the group questions. In either case, all group members should be seated as a "panel of experts" and allowed to answer questions from other members of the class.

Individual reports may also be collected and graded. The group may also be given a grade on their total presentation.

DAY 5 (Or whenever the reports are complete).

In order to organize the facts for future reference, charts should now be completed for each energy source studied. They may be presented on the overhead projector, or the teacher may collect and provide completed materials for students to copy.

ACTIVITY THREE: IF YOU ARE NOT PART OF THE SOLUTION

In this activity the students look at the alternatives they have studied in the previous activity to try to arrive at some suggestions for better utilization of the U.S. and/or world energy supply.

It is suggested that the teacher try to remain impartial and not bias the discussion pro or con any particular solution. It may, however be necessary to play "devil's advocate" by asking them questions to insure that all issues will be considered.

MAJOR PARTS OF THE ACTIVITY

1. Energy Conservation Survey. This should be distributed at the end of Activity Two so that it can be completed for homework. This will allow the students to get a clearer idea of their own energy-use habits. One period may be allowed for discussion of results

2. A Federal Energy Plan. In a one period lecture illustrated with the overhead projecter the major points of the proposed U.S. Energy plan should be presented.

3. Will It Work? Should It be Changed? Using the transparencies from the previous lecture, go back over the President's plan allowing the students to approve, disapprove, suggest changes or alternatives. Time 1-2 periods.

GUIDELINES FOR THE TEACHER

DAY 1

Energy conservation surveys distributed at the end of the previous exercise should be brought to class and students encouraged to share their findings with the class. A group of students may be asked to compile the results overnight or it may be compiled by the teacher.

DAY 2

The President's energy plan and the congressional opposition should be presented in a lecture illustrated with outline notes that students can copy and file.

DAY 3

Using information from Activity two and their own energy survey, the students should evaluate the President's program item by item, making changes or proposing alternative plans where they feel the program is wrong. All suggestions should be considered. Additional time may be allowed depending on student interest and involvement.

ACTIVITY FOUR: WHERE ARE WE HEADING?

This activity will be varied to fit the course in which the unit is being used. Three periods should be sufficient for this activity but it is not necessary to limit it if the teacher wishes to expand. All summary activities will be a combination of teacher lecture and student discussion, concluding with a guest speaker and a repeat of the original energy attitude survey, from Day One, Activity One.

FOR WORLD GEOGRAPHY COURSES (GRADE NINE)

In these courses I would attempt to use the unit to suggest increasing world interdependence, with perhaps a look at the United States' use of power and living standard as compared to other uses and living standards around the world. The world-wide need for resource conservation might also be stressed.

For the guest speaker, try to get someone from the department of International Studies who can address the issue of interdependence or a speaker on conservation of resources.

The third and final day would be a repeat of the energy attitude survey. Earlier survey forms would then be returned and a discussion held on the changes that had taken place during the study.

FOR ECONOMICS COURSES (GRADE TEN)

Look at the economic implication of the energy issue, dealing with supply and demand, equilibrium and the use of price incentives. The economic impact on the individual should also be discussed, referring to the proposed energy plan and to the future without energy.

The guest speaker could come from a University Department of Economics or from a public utility or perhaps the Public Service Commission.

The third day would be the same as for the Geography class.

FOR TWENTIETH CENTURY UNITED STATES HISTORY (GRADE ELEVEN)

Look at the effect that the energy alternatives and the economic impact might have on the future of this country as related to political, social, economic and industrial issues.

Invite Ed Richardson or someone from the Barnwell Nuclear Reprocessing Plant in to bring the issue down to a South Carolina perspective.

Again, the third day would be the same.

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TEACHER RESOURCES

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Capsule Summary-The Case for the LMFBR. Westinghouse Electric Corporation, Advanced Reactors Division. A pro-breeder flyer.

Clinch River Breeder Reactor Plant Project-Design Description. Breeder Reactor Corporation, P.O. Box W, Oak Ridge, Tennessee, 37830. A clear illustrated description of the breeder reactor.

Coal Facts. National Coal Association, 1130 17th Street, NW, Washington, D.C. 20036. A collection of materials from the coal industry covering gasification, coal producing areas, charts, reprint from World Book Encyclopedia, and a teachers guide for a classroom unit.

Conservation Energy. Alliance to Save Energy Information Briefs, Alliance to Save Energy, 1925 K Street NW. Suite 507, Washington D.C. 20006. (Membership $15.00). A newsletter of information on energy with emphasis on conservation, published monthly.

Energy Book, The. South Carolina Department of Education, Columbia, S.C. A book of suggested activities for individual students, small groups and class activities, ways of using the newspaper, energy surveys, and suggested resource materials.

Energy Conservation in the Home; An Energy Conservation Curriculum Guide for Home Economics Teachers. Prepared by the University of Tennessee Environmental Center and College of Home Economics for the United States Department of Energy. Includes background on energy and conservation, with specific emphasis on housing, food, clothing, personal care and entertainment. Includes energy activities for class use.

Energy Outlook, 1978-1900. Exxon Company, USA, Public Affairs Department, P.O. Box 2180, Houston, Texas, 77001. A book of charts and graphs which could be used for transparencies. Covers demand, conservation, supply, utility demand, coal demand, U.S. gas and oil supplies.

Environmental Education; A Source Book for Educators. South Carolina Department of Education, Columbia, S.C. A book of information and sources to help teachers include environmental concerns into the classroom. Lists state and federal agencies with state offices which have environmental concerns."

Factsheets. National Science Teachers Association. Available from Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee, 37830. A group of 19 brief folders that cover all types of energy sources in concise form as well as conservation, a glossary and bibliography.

Hirschfeld, Fritz. "Looking at the Energy Realities with Congressman Mike McCormack" Mechanical Engineering, May, 1978, p. 22. A look at the energy situation through the eyes of one of the Congressmen most involved in the Congressional action.

How a Bill Becomes a Law ro Conserve Energy. Grades 9, 11, 12. Interdesciplinary Student/Teacher Materials in Energy, the Environment and the Economy. U.S. Department of Energy and National Science Teachers Association. A teaching unit studying the passage of the 55 mph speed limit as it was acted on by Congress, to integrate facts about energy into history, government and civics classes.

Kendall, Henry. "Special Report: Quiet Violence" Supplement to Calypso Log, Vol. 3 Number 3. The Cousteau Society. Expresses concerns of environmentalists over nuclear energy.

McNeill, Royce N. Coal Mining. A paper written for Summer Short Course on Energy, Clemson University, Clemson, S.C. July, 21, 1978.

Mickey Mouse and Goofy Explore Energy. Walt Disney Educational Media Company. Part of a multimedia kit available from Walt Disney Education Media Company, 500 South Buena Vista Street, Burbank, CA 91521. Kit title, Wide World of Energy. Comic book available from Public Affairs Department, Exxon, USA. Comic book approach to problems of energy, attractive and easy to read format.

Keowee-Toxaway Visitor Center Packet- Duke Power Educational Service, Duke Power Company, P.O. Box 2178, Charlotte, N.C. 28201. Includes catalog of free educational films and literature, the Keowee Toxaway Center story and The Story of Energy.

Science Activities in Energy. The American Museum of Atomic Energy, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, Tennessee, 37830. Activity sheets for student use on various topics including Solar Energy, Mechanical Energy, Chemical Energy, and Conservation.

Solar Research Home. Clemson University, College of Agricultural

Science and USDASEA, Rural Housing Research Unit. Design and description of two solar houses under construction at Clemson at the present time.

Tips for Energy Savers. Student booklet and Teachers' guide. Federal Energy Administration, Conservation and Environment, Washington, D.C. 20461. Gives detailed suggestions for energy conservation and how to fit into several curricula.

Transportation and the city, Grades 8, 9. Interdisciplinary Student/Teachers Materials in Energy, the Environment, and the Economy. U.S. Department of Energy and National Science Teachers Association. A teaching unit studying the problems of urban transportation, planned to be used in middle school classes in history and government.

U.S. and Foreign Breeder Reactors. Project Management Corporation. Breeder Reactor Corporation. Describes breeder reactor development in United States, United Kingdom, France, West Germany, Benelux countries, U.S.S.R. and Japan.

U.S. Energy Policy - Which Direction? Grades 11, 12. Interdisciplinary Student/Teacher Materials in Energy, the Environment, and Economy. U.S. Department of Energy and National Science Teachers Association. A teaching unit studying presidential decision-making to be used in junior and senior history and government classes.

AUDIO-VISUAL MATERIALS.

Lectures, Transparency Masters, and Slices. Energy Institute. Clemson University, July 16-28, 1978. Available on tapes from Dr. Harold Albert, Political Science Department, Clemson University, Clemson, S.C. 29631. Edited tapes, copies of transparencies and slides for the course are available for purchase or loan.

FILM STRIPS, WITH AND WITHOUT SOUND, AVAILABLE FROM RICHLAND COUNTY SCHOOL DISTRICT I.

Energy Crisis: What Can We Do? 2 filmstrips with record. Discusses the validity of the shortage, examines energy conservation measures and illustrates the vast amount of oil that can be saved when conservation practices are in use. Introduces energy economics.

Energy: Impact on Values and Lifestyles. Filmstrip with cassette. Not available for preview at this time.

Natural Gas-Science behind your burner, University Films. (KEENAN MEDIA CENTER). Traces natural gas from your stove back to the well, showing transportation, drilling and a map of major U.S. area.

FILMS: AVAILABLE FROM RICHLAND COUNTY SCHOOL DISTRICT I

Energy. 25 minutes, color, 1974. The Screen News Digest presents a penetrating examination of the search for new means of meeting America's continuing energy challenge.

Energy Challenge, The. 25 minutes, color, 1975. The causes and effects of the energy shortage problems and opportunities-plans and proposals-are discussed and documented in this film in an effort to place the issue in perspective.

Energy Crisis, The. 13 minutes, color 1972. The film reviews the different energy sources and indicates the length of time we may be able to depend on them. It shows ways of generating electrical power including steam, hydro and nuclear and shows limitations of each.

Energy: The Dilemma. 20 minutes, color, 1974. Discusses past, present, and future energy growth pattern. Explores problems, of supply and demand, depletion of fossil fuels, our dependency and economic and social problems. Stresses societies need to develop ways of using less energy.

Energy for the Future. 17 miuntes, color, 1974. Establishes the need for diverse sources of energy to supplement and eventually replace fossil fuels. Examines energy alternatives for the future including processed coal. shale oil, geothermal, nuclear fission and fusion, wind and solar heat. Shows experimental facilities currently operating with energy supplied by sources other than fossil fuels. Indicates environmental and social consequences that may result from development of new of energy sources.

Energy: Less is More. 20 minutes, color, 1973. Investigates the need for slowing the growth of energy consumption and shows ways in which this can be done.

Energy-New Sources. 20 minutes, color, 1974. Examines the potential and limits of new technologies including solar, fusion, and geothermal. Presents an argument for developing a variety of options. Stresses societies' need to develop ways of using less energy.

Energy; The Nuclear Alternative. 20 minutes, color, 1974. Explores fission power, how it works and the controversy over safety and radioactive wastes. Stresses need to develop ways of using less energy.

Energy; 2000. 25 minutes, color, 1977. The Screen News Digest examines in depth the short term and long term search for alternate energy sources to meet America's needs in the year 2000 and beyond.

Geysers and Hot Springs. 10 minutes, color, 1969. Uses animation and live action to show the source and characteristics of hydro-thermal activity and shows some of the use man has made of this energy source.

The Sun, Its Power and Promise. 24 minutes, color, 1976. Shows how humans have paid tribute to the sun, examines the sun's role in the creation of familiar energy sources such as food, wind, petroleum, coal, and natural gas. Points out the need for new and cleaner sources of energy. Evaluates the potential of such alternate sources as nuclear and geothermal energy. Takes a close look at the source of solar energy, the sun itself, surveys the present and potential uses of solar energy.

ENERGY: A SHORT COURSE

Physical Science: 9th Grade

by

Harold E. Oberg
Mullins High School

This unit is designed as an introduction to energy awareness in an effort to illustrate an answer to "Why do we have to study science?"

Our present energy "crisis" is, in reality, a problem with several answers which affect the future of Man. Our youth need to develop an awareness that technology (science) and socio-economics must be integrated into any effort to provide energy for today and tomorrow.

Physical science is a course that defines energy and shows that simpler, but basic, aspects of Man's use of energy to do work in a more effective manner. Physical science does not, nor cannot, provide us with all of the answers to our energy problem; physical science may give us clues to more educated approach to our energy-needs problem.

DAY 1

1. Energy awareness through a discussion and definition of terms.

A. What is "energy"?
   1. "ENERGY" is "the ability to do work". Energy lets us move objects (forces).
   2. As we "use" energy, we change it from one from to another. We do not destroy the energy.
   3. Energy and matter are linked by $E=mc^2$, which means that a very small amount of matter is capable of producing a very large amount of energy (Asimov)

B. What are the forms (kinds) of energy?
   1. POTENTIAL ENERGY is the energy that is stored in an object's position (e.g. a rock on a ledge) or condition (e.g. a coiled spring).
   2. KINETIC ENERGY is the energy of moving objects.
   3. CHEMICAL ENERGY is the energy found in the bonds

of substances (i.e. the electrons of atoms and molecules). This energy may be either kinetic or potential, as in the burning of fuels.

4. MECHANICAL ENERGY is the energy of an object's movement or position. Machines provide us with mechanical energy.
5. HEAT ENERGY is the energy of moving molecules. This is probably our most important energy form.
6. LIGHT is the energy of tiny "wave packets" called "photons". This is the form of energy that the Sun transmits to us.
7. SOUND is the energy of vibrating objects.
8. ELECTRICITY is the energy of moving electrons (or charges). We find this a very useful energy for concentrating, storing, or sending over distances.
9. ATOMIC (NUCLEAR) ENERGY is the energy found in the nucleus of an atom. This is the most concentrated form of energy that we know exists.

C. What are the sources of our energy forms?
   1. Nuclear changes within the Sun (fusion) and the Earth (fission) supply us with "primary energy" that is transformed into all of our useful forms.
      a. The Sun's light is produced directly from the fusion of small atomic nuclei. (Asimov)
      b. The splitting of naturally radioactive atoms, such as uranium, creates much of the heat found inside the Earth. (Asimov)
   2. Man produces "secondary energies" when he uses any form of energy. All other things are capable of producing "secondary energies" for Man, too.
      a. Sunlight is converted into heat by any molecule of the Earth. Green plants convert sunlight into chemical energy through the process of photosynthesis.
      b. A chain of cycling processes whenever energy is "used" may allow some amounts to be stored. The water cycle, fossil fuel production, wood and food production in plants, and Man selecting or transforming energies; all play a role in "secondary energy" availability. (Wilson)

DAY 2

II. Man and energy.
   A. Film: "The Great Search", Buena Vista Films (Walt Disney)
   B. Earliest Man relied on the natural occurrence of

energy; he had to live wherever he could find useful energy. Civilization developed as Man learned the control and use of energy.

1. The use of fire allowed Man to live in more areas and, later, develop tools and weapons.
2. The use of moving water and wind gave man mobility to increase his influence and supplant "muscle" with windmills or water wheels.
3. Steam engine technology gave man a more reliable energy source for machines, allowed him greater variety of location, and created a stronger need for fuels as energy sources.
4. The internal combustion engine provided a more portable use of energy, giving Man greater mobility and an increased need for highly-efficient fuels, such as petroleum fuels.
5. The development of electricity as an energy source with transmission capability has led to Man's ultimate demand for energy of a highly-refined nature.

C. Mankind has chosen energy sources to meet his development of technological uses for energy. (Energy outlook)
1. Muscle power required edible foods provided by photosynthesis.
2. Fires demanded the greater concentrated energy of wood; later development of fire for refining and machinery caused a demand for charcoal and coal because such fuels concentrated energy to a higher degree.
3. Petroleum and natural gas became major fuels when Man's energy use required portable or very high yields of energy.
4. Electrical technology has given Man a highly useful form of energy that may use any fuel for conversion, plus the added availability of atomic energy as a fuel source.

D. It is significant that Man has developed civilization along with higher technologies of energy use, which placed greater demand on highly-efficient fules.

<u>DAY 3</u>

III. What has Man done?/What can Man do?
A. Man has changed his choice of energy sources with his use-demand development. This has created our current energy problem, and yet this may also offer

us an answer to that very same problem. (Reische)

1. Wood reserves are "renewable", however, sections of Europe experienced a "wood crisis" in the Middle Ages; our more desirable fossil fuels are "non-renewable", thus, Modern Man is faced with a more critical supply problem.
2. The limited reserves that our fossil fuels occur in, plus the fact that they will not be regenerated within our foreseen timespan, leaves Man no choice but; change, or fail to survive. (Halacy)

B. There are several alternatives to the present energy crisis; technology will play a definite part in each possible answer. (Halacy)

1. We can continue to use our energy sources through our present methods; first deplete oil and natural gas; then use up coal supplies; and rely on atomic, solar, wind, etc. technologies, each in turn.
2. We can gradually change now to supplement petroleum-natural gas use with coal, atomic, solar, etc. sources at our disposa.
3. We can stop all efforts to be concerned with the energy problem and allow a "natural course" of events to dictate our energy standards.

DAY 4

IV. What help does Man have in solving his energy problem?

A. Man is a logical animal with the ability to reason; the energy decision is clouded by a reluctance to change, political and economic bottlenecks, and a fear that we may irreparibly damage our environment; there is only one certainty: there will be no miracle cures, Man has to create a solution immediately.

1. Fossil fuels are finite, but they offer several limits of usefulness. (Reische)
    a. Petroleum has peaked in availability for current use-demand; various sources predict depletion within 20 to 40 years. (Freeman; Halacy)
    b. Natural gas, likewise, is expected to peak by 1990 and be depleted by 2020.
    c. Coal reserves would allow approximately 400 years of use at the current demands; this would be extra beneficial in giving us the time that we need to develop "alternatives".

B. Alternative energy sources have some potential now, but most require the development of more complex technologies and/or production sites.

1. Atomic (nuclear) technology will provide both heavy industrial energy levels, and the home consumption needs via electrical transformation.
2. Solar energy may now provide heat to directly supplement home needs, the best hope of "photovoltaic" systems is still in the future.
3. Water power conversion cannot be improved significantly in lake and river systems; there is some probability that tides may provide energy for several regions.
4. Wind conversion has a limited application, also, but it will provide regional homes with potential energy sources.
5. Geothermal reserves will be available only for a very select few areas where large enough sources may be found; the most probable application may be with localized industries.
6. Biological conversion processes will be valuable energy supplements to on-site demands, mainly at agricultural centers.

C. What are the problems, then?
1. Fossil fuels pollute the environment with waste heat, poisonous gases, and solid particles.
    a. Petroleum produces all three hazards, besides adding the danger of oil spills.
    b. Natural gas reduces pollution levels, but storing and shipping is an "explosive" issue.
    c. Coal produces all three hazards, and the mining processes are dangerous and damaging to the ecosystem.
2. Atomic energy produces much waste heat, plus adding the danger of potential long-time radioactivity. (Asimov)
    a. Fission produces dangerous long-lived materials which must be properly treated for disposal; the technology is known, but the construction of power plants takes about ten years.
    b. Fusion (nuclear joining) is yet in its infancy; it is predictable, safe, but won't be available for upwards from 40 years.
3. Solar energy is serviceable, but expensive, now; the advent of "photovoltaic" technology will be a future boon; there are environmental "bugs" concerned with sunlight factors.
4. Water and wind use is largely available to certain regions, and at only certain times; reliability is a problem, besides environmental uncertainties.
5. Geothermal sources are even more regional than water and wind; gas pollution, expensive maintainance of equipment, and potential geological problems face

use of the energies of the inner Earth.

6. Biological conversion is the most ecologically sound energy source, but it is best used in systems at the sites of production.

DAY 5

V. What can be done to save us from the "evil energy crisis"?

A. We can learn to cope with the reality of our energy needs; there will be no miracle of technology riding to our rescue as the cavalry does in the old movies; education and understanding can give us answers (or time to work on immediate solutions).

B. Education will enable clear minds to devise energy technology only if we combine the efforts of socio-economic logic with the principles of science.
   1. We must study all possibilities of coping with our energy needs.
   2. We must choose a sound, long-term system of answers to our energy problem(s).
   3. We must be willing to change by sharing and supplementing our energy use-demand situations (as previously outlined).

C. The single greatest potential solution may very will be CONSERVATION ENERGY: this plan requires intelligence.
   1. Man needs to plot the time spans of each energy source as though each were a part of a gigantic puzzle.
   2. We must begin, now, to fit the pieces into a solution that covers both today and tomorrow.
   3. The blending of our energy use-demands and currently available sources is critical; the energy saved in one area will help other areas meet their energy needs.
      a. Heavy industrial demand may be eased by changing home use times so that the two do not coincide.
      b. Wasted heat energy from industrial processes could be channelled to homes for heating.
      c. More limited alternatives, such as: solar, wind, bioconversion, could be used to supplement (or take over) area energy needs. This would increase the availability of energy pools for less fortunate users.
   4. We must be willing to share responsibility and availability for any energy proposal to succeed; whatever we save in the present will extend our life in the future.

VI. What is the role of Physical Science?

A. We teach the energy-use processes of machines and show how important efficiency is.

B. We describe the forms of energy and show how each is interrelated with the others.

C. We show some of the basics of technology as everyone may better apply an understanding of energy in the home.

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Reische, Diana, Ed. Energy: Demand vs. Supply. The Reference Shelf, Vol. 47, No. 5; H.W. Wilson, Co., N.Y.; 1975.

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UNITED STATES ENERGY POLICY

United States History: 11th Grade

by

Paul Arthur O'Grady
C.A. Johnson High School

Course Description

One of the President's main roles is chief policy maker of the country. In this role, he proposes to the Congress laws which, in his judgement, will be good for the nation. He has to take a position on questions of public concern that are confusing or dividing the people . He must have both the judgement to recognize what can be done and the political skill to achieve it. He must try to persuade the Congress and the people to support his views and to have his program enacted.

For several years, most people have gradually become aware of a growing energy problem. (A few still refuse to acknowledge there is one.) Residents of both large and small cities have experienced blackouts similar to the most recent (in July of 1977) in New York City, as well as electrical brownouts that cause lights to go dim and the television picture to become smaller. The Arab oil embargo came in the winter of 1973 along with long lines at the gasoline pump. Since that time, oil imports have risen steadily, thus making the United States more and more dependent on foreign oil to keep the industrial and transportation systems humming. The energy crisis has been felt most noticeably in the pocketbook as the price of energy in almost every form has risen sharply.

Lately, the widespread realization of shortages and diminishing supplies of common energy sources has sparked intense interest in the development of alternative sources of energy. Among the alternatives being studied, coal appears to be one of the most promising for the near future. The viability of this alternative is enhanced by the large quantities of coal that are available and by its accessibility. Accompanying the positive aspects of coal usage, however, are several significant environmental problems which arise in the mining and utilization of this natural resource. Therefore, if coal is to be used widely in the best interest of mankind, decisions concerning its use will have to be made thoughtfully with regard to many social, environmental, and economic factors.

This unit offers a specific example of what a President can do in making policy, and what was done. Since a case study is a vital part of a social studies course, this unit includes the basic elements of a decision-making case: the facts or evidence, the positions pro and con, the controversy, the political action, and the follow-up. Also, the unit will illustrate how circumstances, present and proposed legislation, political action, and the Constitution itself all become linked in the development of a national policy.

Days 1 to 3: THE CRISIS IN ENERGY, AND THE DEMAND FOR CONSERVATION IN ENERGY

Teacher Purpose

This lesson leads the students out on explorations of their own in order to learn that there are no quick and easy solutions to our energy problems and to realize that any national energy policy will be forged from compromises and trade-offs.

Student Objectives

1 - to learn the background of energy.
2 - to realize the necessity of conservation for the sake of survival.
3 - to accept conservation of energy as the challenge of the future.

Class Activities

Day 1

1 - Divide the class into four groups, Each group, having voted for one of its members as the leader, will select a topic-activity planned to define energy and to understand the production, use, and misuse of energy. As each group initiates its choice, emphasize that the topic-activity must relate the concepts of our energy plight to changes in American lifestyles. (A listing of activities is found in Today's Education, January-February, 1975.)

2 - During the latter part of class, each group-leader will report to the entire class on the topic-activity of his group and the results.

Day 2

1- Show the movie, "Living With Energy."

2 - After the half-hour-long movie, have a discussion. To stimulate it, ask questions that require more than one answer. Here are three sample questions: Who or what caused the present energy crisis? What are the consequences of the energy crisis? What can be done about the energy crisis?

Day 3

1 - Show the movie, "Pennzoil and the Energy Crisis."

2 - After the more-than-half-hour-long movie, introduce a hypothetical case: Each student's family has just learned their winter heat allocation will be reduced by 25%. Discuss (and decide, if necessary) ways to deal with the problem in this case.

Lesson Bibliography

Joyce G. Sartwell and Richard P. Abell, "A Teacher's Guide to the Energy Crisis, "Today's Education, (January-February, 1975), 90-95. One example of the activities listed in this magazine article is as follows: "First, place a cardboard box over a lit electric light bulb. Turn off the bulb after five minutes. Then measure the temperature inside the box one half-hour later. Second, attach insulating materials on all sides of the same box, place over the lighted bulb again, and then measure the box's temperature in half an hour."

"Living With Energy, "Amoco Oil Company, 26 minutes. This full-color documentary is about our energy-short environment. It shows the confluence of factors and events that created the energy crisis and how each sector of our society must learn to cope with it. This rent-free film is available at Modern Talking Picture Service, Film Scheduling Center, 2323 New Hyde Park Road, New Hyde Park, New York 11040.

"Pennzoil and the Energy Crisis," 37 minutes. This full-color film is a candid discussion of the energy shortage in America. It discuss the causes, effects, policies, controversies, misconceptions, truths, and myths involved. This rent-free film is available at Modern Talking Picture Service, 4705-F Bakers Ferry Road, Atlanta, Georgia 30336.

Homework Suggestion

Bring in news-clippings relating to the energy crisis.

Days 4 to 8: THE PROBLEMS AND PROMISES OF COAL

Teacher Purpose

This lesson teaches the locations of major coal deposits throughout the world and within the United States. It dwells on the methods of mining coal, both underground and surface.

Also, this lesson teaches the various means of transporting coal from the mine to the consumer. After familiarizing the students with the major uses of coal today, it dwells on the environmental effects of mining and burning coal.

Finally, this lesson enables the students to work on the problems, and to reflect on the promises, of our most abundant energy source.

Student Objectives

1 - to recognize the importance of coal in today's world.
2 - to identify the basic types of coal.
3 - to describe the basic methods of mining coal.
4 - to analyze, through supportive evidence, the advantages and disadvantages of increasing coal production.
5 - to make a policy recommendation either to increase or or not to increase coal production.

Class Activities

Day 4

1 - Using materials begotten from the National Coal Association (1130 Seventeenth St., N.W., Washington, D.C. 20036), use your overhead projector to show the class a map of coal reserves throughout the world, and a map of coal reserves within the United States.

2 - Using the same materials plus independent research of your own, give a lecture elaborating on three factors: the different ways geologists can discover where coal is located, the basic methods of mining underground and surface coal, and the different methods whereby coal is transported from the mine to the consumer.

Day 5

1 - Suggest to the class that, due to the assignment in #2 coming up, notes be written (quickly) while the movie, "An American Asset," is shown.

2 - After the half-hour-long movie has been seen, tell the students to write a summary of what they learned in the movie.

Day 6

Take the class to the library where each student will write a report in answer to any one of the following questions previously written on the chalkboard:

1) How and when is coal believed to have been formed in the earth?
2) Why was coal not widely used until long after its discovery?
3) What are some of the chief products of coal, and some of the problems of the coal industry?
4) What progress has coal mining made in the United States since 1800?
5) What has been the role of unions in the history of the coal industry?
6) What are the means whereby coal is used as a principal source of heat for industries and residences?
7) What happened since early 1975 that caused a dramatic turnabout in the coal industry?
8) What are the objections to stripmining coal as a principal fuel for electrical generation?

Day 7

1 - Now that we are at the midway part of the unit, show the movie, "Up the Power Curve," for the sake of a review of what has been learned so far.

2 - Using the chart format, have each student write two columns: one is on the social benefits of increased coal use, and the other on the social harms of increased coal use. Then, each student will switch with each other their charts, and discuss the comparisons and contrasts of what they listed.

Day 8

Each student will present to class a recommendation, having been written in one paragraph during the first few minutes of class, for or against the use of coal.

Lesson Bibliography

Norman Metzger, Energy: The Continuing Crisis, New York: Thomas Y. Crowell Company, 1977. This energy book, a jaundiced view on energy supply and the control of its demand, energetically considers how we got into trouble in the first place, what is to

be done, and whether material scarcities will repeat the unpleasant history of energy scarcities.

"An American Asset," National Coal Association, 28½ minutes. This full-color film depicts the many and vital roles of coal in our economy. It shows the modern methods and machinery used in mining and transporting coal. Also shown is the coal industry's commitment to a good environment and the scientific research taking place with respect to coal. This rent-free film is available at Modern Talking Picture Service, 1889 I-85 South, Charlotte, North Carolina 28202.

"Up the Power Curve," 10 minutes. This full-color film depicts energy as a subject of universal concern. Ideas for the conservation of energy are freely exchanged. This rent-free film is available at the afore-mentioned address.

Hoyt Clarke Hottel and J.B. Howard, New Energy Technology: Some Facts and Assessments, Cambridge, Massachusetts: MIT Press, 1971. This technical book is a useful guide to energy technology, and includes a particularly incisive discussion of coal conversion.

Days 9 and 10: FROM COAL TO OIL

Teacher Purpose

This lesson focuses on the resources for the shift from coal to oil as the primary energy source, and on the effects that this change had on the cultural patterns of the United States.

Also, this lesson touches on the role of oil and oil-based products in our nation today, and poses the question of what will happen if oil prices continue to rise.

Student Objectives

1 - to learn the reasons for the development of oil as the primary source if energy in the United States.

2 - to explain the effects of oil-based industries on the present American culture.

3 - to realize the relationship between transportation and the economic, social, and family patterns in the United States.

Class Activities

Day 9

1 - Each student will take turns in writing the name of an

oil-based product on the chalkboard. Each student will do so again. By then, there should be at least fifty products listed on the chalkboard. At his desk, each student will write in two columns, one headed "luxurious" and the other headed "necessary," each listed product under the appropriate heading.

2 - When #1 has finished, tell the class that, because the amount of oil available in the United States has been cut in half, each student must eliminate half of the items on his written list. When all eliminations have been completed, the whole class may engage in an expectedly controversial discussion on what items are supposed to be necessary, what are supposed to be luxurious, which items should have been eliminated, which should not have been eliminated, etc.

Day 10

Divide the class into six groups, each of which will do a specific assignment in the library as follows:

Group 1 - Write a short essay on how oil was developed.
Group 2 - Write a short essay on how oil affected the populations of cities.
Group 3 - Write a short essay on why oil was often referred to as "black gold."
Group 4 - Draw a large graph on United States production and consumption of petroleum from around 1860 to 1975.
Group 5 - Draw a large graph on United States oil imports from 1960 to 1977.
Group 6 - Draw a large graph on Arabian and Persian Gulf oil prices from around 1959 to 1977.

Lesson Bibliography

M.A. Adelman, The World Petroleum Market, Baltimore and London: Johns Hopkins University Press, 1972. This demanding book delves unashamedly into the complexities of the oil market. It is a text for those who believe that oil scarcities are basically due to political and economic phenomena, rather than being shaped by physical scarcities.

Fred C. Allvine and James M. Patterson, Highway Robbery: An Analysis of the Gasoline Crisis, Bloomington and London: Indiana University Press, 1974. This documented book argues that the elements that made OPEC'S move so successful were largely created by the desperate efforts of the "majors" to throttle competition at the gasoline pumps.

Robert Engler, The Politics of Oil: A Study of Private

Power and Democratic Directions, New York: Macmillan, 1961. This valuable book articulates the history of the not-always-happy relation of the oil and natural gas companies to the public's welfare.

Homework Suggestion

Make some cards and play a game.

Divide the class into groups of three players each. Before they make the cards, the following are the instructions for playing the game:

1) To win the game, you must have five cards in a row in your hand.
2) Those cards marked "0" cannot be used as one of the five cards.
3) The five-in-a-row cards you must have are either 1 through 5, 2 through 6, 3 through 7, 4 through 8, or 5 through 9.
4) Shuffle the cards.
5) The dealer gives five cards to each player, and places the rest of the cards face down on the table.
6) The dealer plays first by picking one card from the deck on the table; he chooses one of the six cards in his hand to put in a discard pile face up on the table.
7) The player to the left of the dealer picks up the top card from either the discard pile or the deck; after picking up a card, the player then decides which card to put in the discard pile.
8) Take turns until one player has five cards in a row.
9) The teacher awards a prize to the winner!

At home, the first of the three players in each group will make:

1) Six cards with the number "1" written in the top right corner, and "I turn off lights." on the body of each card;
2) Six cards with the number "2" written in the top right corner, and "I save hot water." on the body of each card;
3) Six cards with the number "3" written in the top right corner, and "I walk to school." on the body of each card;
4) One card with the number "0" written in the top right corner, and "I leave the lights on." on the body of the card;
5) One card with the number "0" written in the top right corner, and "I drive fast." on the body of the card; and

6) One card with the number "0" written in the top right corner, and "I waste hot water." on the body of the card.

At home, the second of the three players in each group will make:

1) six cards with the number "4" written in the top right corner, and "I never waste gas." on the body of each card;
2) six cards with the number "5" written in the top right corner, and "I dress warm in winter." on the body of each card;
3) six cards with the number "6" written in the top right corner, and "I don't leave the TV on." on the body of each card;
4) one card with the number "0" written in the top right carner, and "I make my Mom drive me everywhere." on the body of the card;
5) one card with the number "0" written in the top right corner, and "I waste energy." on the body of the card; and
6) one card with the number "0" written in the top right corner, and "I don't care." on the body of the card.

At home, the third of the three players in each group will make:

1) ..."7" ... "I close doors tight." ...;
2) ..."8" ... "I dress cool in summer." ...;
3) ..."9" ... "I save energy." ...;
4) ..."0" ... "I leave the doors open." ...;
5) ..."0" ... "I turn up the heat." ...; and
6) ..."0" ... "I leave the TV on." ....

Play the game in class in addition to, or as a substitute of, one of the class activities listed as #3 on the pages denoted as "Day 13" and "Day 14."

Day 11: A NIGHTMARE: LIFE WITHOUT FUEL

Teacher Purpose

This lesson presents students with a view of the future when there are not enough energy resources left to provide Americans with the kind of life they have become accustomed to. It discusses the implications of decreasing domestic supplies of oil and increasing dependence on imported oil; and it raises points to be used as a springboard for a discussion of the reasons why an energy policy can affect the way of life of all Americans.

Student Objectives

1 - to compare and contrast present and future energy sources.

2 - to explain how decreasing energy supplies affect all social and economic levels of American life in the nightmare future.

3 - to explain how an energy policy can affect all Americans.

Class Activities

1 - Read "The Nightmare of Life Without Fuel," by Issac Asimov. (It can be reprinted by permission from Time (April 25, 1977, p. 33)).

2 - List four advantages that Asimov said energy-poor life has to offer.

3 - Discuss why life would be worse for the suburban dweller in 1997 than for those living in the city.

Lesson Bibliography

Time (See above parenthetical statement).

Barry Commoner, "The Link Between Energy Policy and Unemployment," Nation's Cities, February, 1977, 13-15. This article, in a magazine published by the National League of Cities, explains why, "So long as we rely on nonrenewable sources of energy we will run out of our ability to afford it long before we run out of the energy itself."

Day 12: WAYS FOR THE UNITED STATES TO REDUCE ITS DEPENDENCE ON FOREIGN OIL SOURCES

Teaching Purpose

This lesson is a natural follow-up to the previous lesson's story by Isaac Asimov, since students might be expected to ask "How bad is the energy crisis?" and "Could things really get this bad?" This lesson teaches a whole set of political implications which will arise from dependence on imported foreign oil. It emphasizes coal as an alternative to our heavy dependence on one main fuel, plus the resulting host of environmental problems that would demand solving (i.e., the good thing about coal is that there's lots of it; the bad thing is we might have to use it).

Student Objectives

1 - to describe the present United States supply and demand for energy by acquiring information from graphs.

2 - to infer from prepared material the nature of the United states energy crisis.

3 - to make tentative hypotheses about the part coal should play in the formation of a national energy policy.

Class Activities

1 - Have a student lead the class in a recall session during which the main points about lifestyle changes that would occur in an energy-poor age are discussed by drawing from the list of changes mentioned in the previous lesson's story.

2 - Have each student answer a ditto sheet of typed questions on two graphs: one on United States oil imports from 1960 to 1978, and the other on Persian Gulf oil prices form 1960 to 1978.

3 - Have each student write an essay by summarizing the energy crisis while including statistics from the afore-mentioned graphs and two tables: one on United States lifetimes of ultimately recoversable resources, and the other on World lifetimes of same.

Lesson References

National Science Teachers Association, "United States Energy Policy: Which Direction?" Oak Ridge, Tennessee: United States Department of Energy, 1978. This package has graphs and tables relating to the topic of this unit, and specifically includes the ones mentioned in this lesson.

Donald E. Carr, "The Lost Art of Conservation," Atlantic Monthly, December, 1975, 59-70. This article explains how much energy we waste due to errors of design, duplications of function, faulty insulation, bureaucratic muddling, and even mistaken assumptions about energy needs; and it challenges us to save energy by recognizing and correcting these errors.

Eugene P. Wigner (1963 Nobel Prize for Physics Laureate), "Weighing Our Energy Options," Prism, January, 1976, 51-54. This article, written in a magazine published by the American Medical Association, explains why, if we want to keep all our machines running, we cannot afford to rely on any single source of power.

James P. Johnson, "The Fuel Crisis, Largely Forgotten, of World War I," Smithsonian, December, 1976, 64-70. This article describes how normal business ceased in the industrial East and how Americans lost millions in earnings, as a heatless, lightless public suffered during the First World War.

Homework Suggestion

Make a crossword puzzle. The following are examples of sentences from the key with underlined words to be put in the puzzle: "The first successful oil well was drilled in the United States in 1859." "The thick liquid that is pumped from underground pools is called crude oil." "Nuclear energy is energy released when an atom is split apart."

Day 13: THE SOURCES AND USAGES OF THE PRESIDENT'S POWERS

Teacher Purpose

This lesson introduces the students to the duties and responsibilities of the President of the United States of America. While it is obvious that he is Chief of State, the idea that he has many other roles may not be. This lesson shows that the President's power is derived from both Constitutional and traditional sources with his persuasive powers coming into play as a means for political action.

Student Objectives

1 - to distinguish between the Constitutional and traditional roles of the President.

2 - to explain how the President's powers are based upon his ability to use persuasion.

3 - to identify the forces which limit the President's powers of persuasion.

Class Activities

1 - List some of the responsibilities of the President of the United States of America. Have a student record the ideas and then read back the list while the rest of the class attempts to classify them under such appropriate headings as: Chief of State, Diplomatic Duties, Commander-in-Chief, Chief Executive, Chief Lawmaker or Legislator, Head of His Political Party. Complete a chart on these various roles.

2 - List the Presidential roles in two columns: one for those roles which stem from the Constitution, and one for those roles which are grounded in custom and tradition.

3 - List the Constitutional checks and balances for each of the Presidential roles.

Lesson Reference

Any appropriate textbook of your choice.

Day 14: A NATIONAL ENERGY PLAN FOR THE FUTURE

Teacher Purpose

This lesson is dependent upon the assumption that the previous four lessons have increased the awareness of the students about the scope of the energy crisis and also the bleakness of a world without energy. This lesson teaches how forecasting and planning interact and how the development of an energy plan becomes necessary if forecasted events are to be averted. This lesson focuses on the interaction of freedom, science, and government, each of which must be considered in the formation of an energy plan that will support our domestic way of life.

Student Objectives

1 - to differentiate between the terms of forecasting and planning, and among the terms of near-term, mid-term, and long-term futures.

2 - to develop a forecast of events and a plan for reaching the forecasted future.

3 - to explain how the present energy plan stimulated by the President has developed provisions for near-term, and long-term contingencies, and how these term plans interact.

Class Activities

1 - Differentiate between forecasting and planning ahead, and among near-term, mid-term, and long-term futures.

2 - List near-term strategies with an emphasis on conservation of energy in both industry and transportation.

3 - Discuss mid- and long-term strategies with an emphasis on development of synthetic fuels.

Lesson Reference

Any appropriate textbook of your choice.

Day 15: COMPOSING AN ENERGY POLICY

Teacher Purpose

This lesson traces the evolution of President Jimmy Carter's energy policy during the initial part of his Presidency. It teaches how the system of Presidential advisors operates, and how a specific decision goes through a series of steps toward its conclusion.

Also, this lesson analyzes the power of Presidential advisors, and identifies the areas of conflict within a bureaucracy. It shows how a policy, once decided upon, is presented to the public and to Congress.

Student Objectives

1 - to identify the steps in Presidential decision-making.

2 - to analyze the importance of Presidential advisors in the process of decision-making.

3 - to understand the areas of conflict which can arise during a decision-making process.

Class Activities

1 - This being the final day of the unit, show "When the Circuit Breaks," a wrap-up movie reviewing the issues involved in this course.

2 - Use the lecture-discussion method to enable the class to know:

A- the specific steps in the process of Presidential decision-making,
B- the groups in the school or the local city government that are charged with making decisions,
C- the major factors that influence the passage and/or modifications of legislation in Congress,
D- the methods used to get public support for the energy plan composed by the staff of President Carter, and
E- the latest developments regarding the President's energy policy.

Lesson (and Course) Bibliography

"When the Circuit Breaks," United States Energy Research and Development Administration, 27½ minutes. This full-color film has some important things to say about the energy crisis and our continuing energy problems. It diucusses our increasing energy demand, our diminishing domestic supply, and the many opportunities for conserving energy while we search for new energy sources. This rent-free film is available at Energy Research and Development Administration, Film Library, P.O. Box 62, Oak Ridge, Tennessee 37830.

John C. Fisher, Energy Crisis in Perspective, New York: Wiley-Interscience, 1974. This basic book emphasizes the electrical portion of the energy situation and gives the history of electrical energy, the economies possible with different technologies, and the consequences for energy use of social changes in our population.

Allen L. Hammond, William D. Metz, and Thomas H. Maugh, Energy and the Future, Washington, D.C.: American Association for the Advancement of Science, 1974. This technological book is a fundamental and readable guide to the complexities, promises, and drawbacks of energy technologies as diverse as magnetohydrodynamics and the liquid metal fast breeder reactor.

Richard B. Mancke, The Failure of United States Energy Policy,

New York and London: Columbia University Press, 1974. This useful book details the often unfortunate, even counterintuitive, effects of state and federal policies on the availability of energy.

Richard Schoen, Alan S. Hirshberg, and Jerome M. Weingart, New Energy Technologies for Buildings, Cambridge, Massachusetts: Ballinger Publishing Company, 1975. This analytical book details how and why technological success may have little relation to commercial triumphs.

U.S. ENERGY INDEPENDENCE: IS IT POSSIBLE IN 1978?

Debate: Grades 9-12

by

Gladys B. Robertson
Mauldin High School

CONTENT RATIONALE

The National High School Forensic League (NFL) has chosen the general field of "Energy" to be the 1978-79 High School Debate Topic. Until the middle of the season, sometime in December or January, high school debaters will be debating the specific resolution, "RESOLVED: THAT THE FEDERAL GOVERNMENT SHOULD ESTABLISH A COMPREHENSIVE PROGRAM TO SIGNIFICANTLY INCREASE THE ENERGY INDEPENDENCE OF THE UNITED STATES."

The rationale, then, for this course of study is to give background information to the Mauldin High School Debate Team that will serve to enhance the awareness of Team members about energy, to involve them in the topic analysis, to direct them to individual study, and to initiate their finding significant solutions to the energy crisis in the form of debatable case material, namely Affirmative and Negative Briefs.

In order to specify a time frame for the specific unit of study contained herein, it is necessary to indicate the year's overview of work. Broadly, this is what will be covered by the Debate Team in their class for BEGINNING AND ADVANCED DEBATE which meets daily for fifty-five (55) minutes:

August 23-25: Orientation, Introductions, Review, Planning

August 28
September 1: Unit I: ENERGY: TERMINOLOGY, DEFINITIONS

September 4-8: Unit II: ENERGY: A HISTORIC OVERVIEW IN U.S.

September 11-15: Unit III: ENERGY: IS THERE A CRISIS?

September 18-22: Unit IV: ENERGY: ITS RELATIONSHIP TO THE WORLD ECONOMY

September 25-29:	AN ENERGY INSTITUTE AT MAULDIN	
	Monday: Tuesday: Wednesday: Thursday: Friday:	
October 2-6:	Unit V:	ENERGY: POSSIBLE SOLUTIONS TO THE PROBLEM
October 9-13:	Unit VI:	THE AFFIRMATIVE CASE: RATIONALE
October 11-20:	Unit VII:	THE NEGATIVE RATIONALE: DISADVANTAGES AND PLAN ATTACKS
October 23-27:	Unit VIII:	THE DEBATE PROCESS
October 31-November 3:	DEBATE: TECHNIQUE, STRATEGY, ANALYSIS	
November: December: January: February:	DEBATE: TECHNIQUE, STRATEGY, ANALYSIS, ENERGY INDEPENDENCY UPDATES	
March: April: May:	RECRUITING FOR 1979 - 80 ENERGY DISCUSSIONS, CHANGE IN RATIONALE	

The subdivisions of each of these broad areas will include day-by-day lectures, discussions, and student-involvement, along with assignments through specific bibliographical notations for further student research. These areas will also be developed through guest lecturers and outside speakers, especially during the week of the "Energy Institute" which includes films, guest speakers, and group discussions. Students will also be given assignments for gathering team materials; they will write letters, get themselves on mailing lists, and each one will be assigned to cover monthly periodical updates; for example, one will be assigned to keep up with Nation Magazine, another with U.S. News and World Report, another with the Wall Street Journal, etc.

A great deal of the unit content, especially the guest lecturers along with noteworthy sources of available materials, is largely the result of the 1978 Short Course on Energy at Clemson University, sponsored by the U.S. Department of Energy.

A skeletal overview will be given for each Unit and Unit V has been developed herein in detail. The broad overview includes:

UNIT I: ENERGY: TERMINOLOGY, DEFINITIONS

I. What is Energy?
II. What types of Energy exist?
III. What definitions must be defined?
IV. What terminology is used to measure Energy?

UNIT II: ENERGY: A HISTORIC OVERVIEW IN U.S.

I. Wood for Energy was used.
II. The steam Engine was developed.
III. Coal was employed in the generation of steam.
IV. Petroleum was discovered and utilized.
V. Current sources vary with petroleum predominant.

UNIT III: ENERGY: IS THERE A CRISIS?

I. The cost and supply duration of the fossil fuel, oil.
II. The cost and reserve duration of the fossil fuel, coal.
III. The significance of hydro-electric fuel.
IV. Solar Energy's possibilities.
V. The cost and duration of Uranium to produce nuclear power through nuclear fission.
VI. The drawing-board stage of nuclear fusion.
VII. Wind, tidal, geothermal, residual waste recycling and other technical possibilities.

UNIT IV: ENERGY: ITS RELATIONSHIP TO THE WORLD ECONOMY

I. What was the impact of the Oil Embargo of 1973?
II. How does the OPEC cartel/monopoly affect the U.S.?
III. What is the significance of the exponential consumption of the basic fossil fuels?
IV. What economic burden does the recognition of finite fuels place upon the U.S.?
V. What is the effect of the "Energy Crisis" on the GNP?
VI. What is the significance of the U.S. current trade deficit?
VII. What is the result when a country imports more than it exports?
VIII. What is the result of the Soviet Union's being the leader in oil production on the Free World?
IX. What is the significance of the dollar devaluation abroad?
X. What is the role of the large multinational, international oil companies?

AN ENERGY INSTITUTE AT MAULDIN HIGH SCHOOL

Monday: Physics Lecture: Laws of Thermodynamics
Tuesday: Economics Lecture: Laws of Supply and Demand, the Trade Deficit, Balance of Payments, the GNP
Wednesday: Films (Short Period)
Thursday: Ed Richardson, The S.C. Water Resources Commission
Friday: All Day Workshops, Duke Power, Pro Nuclear Power

COMPLETE UNIT V, ENERGY: POSSIBLE SOLUTIONS TO THE PROBLEM, IS ATTACHED AS A TEACHING UNIT.

UNIT V: ENERGY: POSSIBLE SOLUTIONS TO THE PROBLEM

I. THE CURRENT PROBLEM IS THAT FOSSIL FUELS UPON WHICH THE UNITED STATES IS DEPENDENT FOR ITS ENERGY GENERATION ARE COSTLY AND RAPIDLY DEPLETING AND ARE NONRECOVERABLE.

A. Petroleum is a depleting/nonrecoverable fossil fuel that will be used up in forty to fifty years.

1. U.S. Production of oil in 1978 = 10.6 million barrels/day.
2. U.S. Consumption of oil in 1978 = 18.67 million barrels/day.
3. U.S. Importation of oil in 1978 = 7.8 million barrels/day.

B. Petroleum Importation results in some economic problems for the U.S.

1. Oil Imports in 1977 = $45 billion
   a. Exponential growth has passed the doubling period.
   b. Extrapolated figures are that cumulative payments for oil between 1974 and 1980 may reach $250 to $300 billion for the U.S.
2. Balance of Trade affects the economy adversely.
   a. 1977 U.S. imports exceeded exports by $26.6 million.
   b. 1977 Balance of Payments deficit was $31.4 billion.

C. Petroleum lies untapped in some areas of the United States, but because of government regulations, it has not been produced.

1. There is the possibility of enhanced recovery from existing wells by dislodging oil trapped in geologic

formations.

2. There is the possibility of developing offshore oil reservoirs.
3. There is the possibility of exploiting oil from shale rock or tar sands.

D. Petroleum not only serves to generate electricity, but it is also a major source of production of fuel for transport vehicles and many synthetic products.

1. telephones
2. enamel
3. football jerseys
4. shoes
5. cosmetics (mascara)
6. aspirin
7. oxygen masks
8. pencils
9. volley balls
10. Dune buggy bodies
11. tubs
12. deodorant
13. antibiotics
14. crabgrass killer
15. football pads

II. PART OF THE SOLUTION TO THE PROBLEM IS, THEREFORE, TO CEASE DEPENDENCE UPON PETROLEUM.

A. This means developing other resources.
B. This means using what is available in the U.S.

PRESENTATION METHOD: Lecture and class discussion.

ASSIGNMENT: Read, "The United States Oil Industry" Current History. May/June, 1978. pp. 194 - 197+.

Read, "The Economic Impact of American Oil Dependency," Current History. July/August, 1978. pp. 1 - 4+.

Write: Ed Richardson, Chief
Environmental Affairs Division
Water Resources Commission
3830 Forest Drive
P.O. Box 4515
Columbia, S.C. 29240

S.C. Petroleum Institute
716 Palmetto State Life Bldg.
Columbia, S.C. 29201

HANDOUT: List of uses of petroleum

BIBLIOGRAPHY:

E.J. Cahill and D.E. Bayu, "North Slope Oil and U.S. Energy Supply," Journal of Energy and Development. Spring, 1977. pp. 257-66. A discussion of the pipeline operation relating to the Alaskan oil find.

L. Greenwood, Associated Press Dispatch, "Mexican Oil Wealth Rivals Saudi Arabia," The Greenville News Piedmont. June 11, 1978. Wire news release of national interest about the possible oil find in Mexico.

Robert A. Leone, "The Real Costs of Regulation," Harvard Business Review. November-December, 1977. 55:57 - 58. Discussion of the current controls over oil companies..

Jesse W. Markham, Anthony P. Hourisham, and Francis L. Sterling, Horizontal Divestiture and the Petroleum Industry. (Cambridge, Mass.: Ballinger, 1977.) pp. 1 - 5. An introduction to divestiture and the oil industry.

Robert W. Rycroft, "U.S. Energy Demand and Supply," Current History. March, 1978. 74: 100 - 101+. Reviews the role of oil and the oil industry in the making of a National Energy Plan.

________________ "The U.S. Oil Industry," Current History. May/June, 1978. 74: 193-197+. Gives a concise overview of the oil industry in the U.S.

Leonard Silk, "Planning and Dependence on Impoered Oil," The New York Times. April 7, 1977. p. D5. Gives statistics about U.S. oil consumption.

John Tirman, "The Real Cost of Production," Nation Magazine. May 6, 1978. 226:527+. Shows how the major companies would profit from the President's proposed National Energy Plan and indicts the Federal Government to act.

"Offshore Oil Roulette: Costly Shots in the Deep," Business Week. June 12, 1978. pp. 150-51. Discusses the cost and possibility of oil off the U.S. Atlantic Coast.

U.S. Senate Committee on Energy and National Resources, Subcommittee on Energy Research and Development: PETROLEUM INDUSTRY'S INVOLVEMENT IN ALTERNATIVE SOURCES OF ENERGY. (Washington, D.C.: U.S. Government Printing Office, 1977.) pp. 8-9. Discusses the major impact of the Oil Industry's input into alternative energy sources.

Day 2

1. THE CURRENT PROBLEM IS THAT FOSSIL FUELS UPON WHICH THE UNITED STATES IS DEPENDENT FOR ITS ENERGY GENERATION ARE COSTLY AND RAPIDLY BEING DEPLETED AND ARE NONRECOVERABLE.

   A. Natural gas is a depleting nonrecoverable fossil fuel that will be used up in fifty to sixty years according to specualtions, although it has not yet reached its exponential growth.
      1. In 1977, Natural Gas accounted for 40% of residential energy consumption.
      2. There has been strong price regulation by the Federal Power Commission.

   B. It is advantageous to use natural gas.
      1. It is clean.
      2. It does not cost as much as oil.

   C. There are two disadvantages.
      1. It is limited in supply and nonrecoverable.
      2. It cannot be transported well.

II. PART OF THE SOLUTION OF THE ENERGY PROBLEM IS, THEREFORE, TO FIND AN ALTERNATIVE TO NATURAL GAS.

I. THE CURRENT PROBLEM IS THAT FOSSIL FUELS UPON WHICH THE UNITED STATES DEPENDS FOR ITS ENERGY GENERATION ARE COSTLY AND RAPIDLY BEING DEPLETED AND ARE NONRECOVERABLE.

   A. Coal is an abundant fossil fuel which can be mined and used to generate electricity, but it is also depleting and nonrecoverable.
      1. It has some distinct advantages.
         a. It is available for at least 300 to 400 years.
         b. It can be stored.
         c. It can be transported although this is the greatest cost to the consumer/electric company.
      2. It has some distinct disadvantages.
         a. It is becoming more expensive yearly.
         b. It is dangerous to mine.
         c. It is environmentally detrimental

   B. Coal presently accounts for 20% of the energy produced in the United States although it is the most abundant fuel resource.
      1. More than three trillion tons of coal lie buried beneath the United States.

2. It i ıs used to produce almost half of the electricity in the U.S.
3. Byproducts are plastics, paints, cosmetics, pharmaceuticals.
4. Over 170,000 men were employed in coal mines in the United States; others will be needed.
5. Coal gasification is a process by which gas can be made from coal.

II. PART OF THE SOLUTION OF THE ENERGY PROBLEM IS TO FURTHER UTITLZE EXISTING DOMESTIC COAL THROUGH AMELIORATION OF THE ENVIRONMENTAL PROBLEMS RESULTING FROM COAL COMBUSTION.

PRESENTATION METHOD: Lecture and Class discussion

ASSIGNMENT: Read, "The American Coal Industry," Current History. May/June, 1978. pp. 206+.

Read, "Putting Energy in the Secondary School Curriculum," a Lecture delivered by Royce M. McNeill, Summer, 1978, Clemson University.

HANDOUTS: "Coal Facts" Packet of materials sent by the National Coal Association.

BIBLIOGRAPHY:

J. Alterman and J. Darnstader et.al., How Industrial Societies Use Energy: A comprehensive Analysis. (Baltimore, Md.: Johns Hopkins Press, 1977.) Comparative data given to defend the U.S. against charges made by other nations about energy addiction.

Herman T. Franssen, Congressional Research Service, "U.S. Energy Demand and Supply, 1976-1985, Limited Options, Unlimited Constraints," (U.S.Government Printing Office, 1977.) p. 2. Discusses the importation of LNG and the government goals for regulation of the gas industry.

Fern Racine Gold and Charles R. Ebinger, "The Government's Role in the Energy Crisis," Current History. July/August, 1978. 77:27-30+. More discussion of the regulatory policy of the government on oil and gas production and distribution.

Robert Hall and Robert Pindyck, "The Conflicting Goals of Natural Energy Policy," Public Interest. Spring, 1977. Discusses the possibility of lobbying input into the Policy.

Robert S. Pindyck, "The Natural Gas Industry," Current History. May/June, 1978 74:215-217+. Discussion of regulation of natural gas and the shortage.

"A Natural Gas Compromise," Wall Street Journal (including editorials from the New York Times and the Washington Post). January 16, 1978. Indictment of the politics involved in policy making.

"1,001 Years of Natural Gas," Wall Street Journal. April 27, 1977. Editorial outlook about the industry and the future.

"Oil Industry Keeps Quiet About Alaskan Gas Field," Associated Press Dispatch, Anderson Independent and Daily Mail, July 30, 1978. Reports possibility of gas field in Alaska.

Victor D. Chase, "Rusty Iron May be the Key to Cheaper Gas from Coal," Popular Science. January 1977. 210:91-94. Discussion of coal gasification process, one of many.

Chu-Yuan Ching, "China's Energy Resources," Current History. March 1978. 74: 121+. Discusses China's decline in coal reserves and production.

Jonn M. Fowler, "New Fuels From Coal," Fact Sheet. National Science Teachers' Association, 1977. Gives status of coal mining, production, economics, and other factual information.

Richard Gordon, Economic Analysis of Coal Supply: An Assessment of Existing Studies. (Palo Alto, California: Electric Power Research International, 1977) A review of recent analyses.

Richard Newcomb, "The American Coal Industry," Current History. May/June, 1978. 74:206-209+. A concise survey of the coal industry in the U.S., its problems, its future, and its economics.

John U. Nef, "An Early Energy Crisis and the Consequences," Scientific American. November, 1977. 237:140-57. Discusses the replacement of wood by coal, shows false extrapolation about the future of wood.

PACKET FROM THE NATIONAL COAL ASSOCIATION:

"Coal," A Reprint from The World Book Encyclopedia by the National Coal Association through Field Enterprises. Washington: 1977.

"Coal as an Energy Resource: Conflicts and Consensus," Washington: National Academy of Scientists, 1977.

"What Everyone Should Know About Coal Gasification," Greenfield, Mass.: Channing L. Bete Co., Inc., 1977.

Day 3

I, THE CURRENT PROBLEM IS CONTINGENT UPON THE FACT THAT FOSSIL FUELS UPON WHICH THE UNITED STATES IS DEPENDENT FOR ITS ENERGY GENERATION ARE COSTLY AND RAPIDLY BEING DEPLETED AND ARE NONRECOVERABLE.

A. URANIUM IS ONE OF THOSE FOSSIL FUELS THAT IS RECOVERABLE.

1. Uranium is available for forty to sixty years.
2. Oak Ridge has available $25 trillion dollars worth.
3. The Nuclear Power Breeder Reactor makes it feasible to have an unending supply of fuel to power electrical plants; through the process of transmutation, U235 ultimately can be Plutonium which is a manmade fissionable material.

B. THE FISSION PROCESS IS USED TO PRODUCE PLUTONIUM FROM URANIUM 238 which can be reused in the Light Water Reactor.

1. There are approximately 840,000 tons c uranium in reserves in 1978.
2. All uranium contains an average of 97% U238 and 3% U235.
3. U235 is needed to make 239 which in turn transm into Plutonium which is usable as nuclear react r fuel.

C. THE LIGHT METAL FAST BREEDER REACTOR CAN BE ACTIVATED WHENEVER THE GOVERNMENT GIVES THE ORDER.

1. The Clinch River Breeder Reactor Project is ready to reprocess spent fuel.
2. Fuel is available in storage facilities such as Barnwell which has been shut down by the government.

D. THERE ARE TWO DISADVANTAGES TO THE DEVELOPMENT OF NUCLEAR POWERED ELECTRICAL GENERATING PLANTS.

1. Radioactive waste is dangerous and environmentalists hastily react against further production.
2. Storage of spent fuel is dubious: pros and cons.
   a. Pro-Nuclear people advocate two possibilities:
      1. Store/bury waste underground safely in salt formations.
      2. Store underground in sturdy tanks.

   b. Anti-nuclear people refute arguments of safety:

1. The waste spill in 1973 is cited. (Hanford)
2. The SL-1 accident is cited (Idaho Falls)

3. Nuclear Proliferation is a reason for not producing nuclear powered electrical units.
   a. Pro-nuclear people argue that Plutonium that is used for the generation of electricity is not explosive material.
   b. Anti-nuclear people argue just as strongly that plutonium of any grade, in either metal, oxide or nitrate form, can be put in a form suitable for the manufacture of nuclear explosive devices in a matter of days or weeks.
   c. India exploded a bomb with material taken from a civilian research reactor that had been supplied with American heavy water.
   d. West German Federal Republic was selling "full fuel cycle" to Brazil:
      (1) enrichment technology (transmuting P to U235)
      (2) reactors
      (3) reprocessing technology

PRESENTATION METHOD: Have two students read dialogue between Congressman Mike McCormick and Fritz Hirschfeld reprinted from Mechanical Engineering, May, 1978.

Lecture and Class Discussion.

ASSIGNMENT: Read, "Nuclear Power: A Boon or a Menace?" Current History. July/August, 1978, pp. 19-22+.

Read, "Nuclear Plant Survey," Electrical World. January 15, 1978, pp. 39-49.

HANDOUTS: Packet of Information, Clinch River Breeder Reactor Project, 7 brochures.

Wall Street Journal Article, "Nuclear Power Has Major Role," July, 1978.

BIBLIOGRAPHY:

Martin L. Baughman, "Energy and the Electric Utilities," Current

History. May/June, 1978. 74:210-214+. Concise, clear explanation about the conversion of Uranium.

Fritz Hirschfeld, "Looking at the Energy Realities with Congressman Mike McCormick," Mechanical Engineering. May, 1978. Candid discussion of nuclear energy with scientist-turned-congressman McCormick, on the pro-nuke side.

Henry S. Rowan and Beverly C. Rowen, "Nuclear Power: A Boon or a Menace?" Current History. July/August, 1978. 75:19-21+. More Anti-nuke than Pro; however, gives both perspectives.

"Nuclear Energy: Paradise Deferred," Saturday Review. January 22, 1977. Special edition, seven articles on nuclear energy.

"Review of the National Breeder Reactor Program," Report by the Ad Hoc Committee to Review the Light Metal Fast Breeder Reactor Program of the Joint Committee on Atomic Energy. U.S. Government Printing Office, January, 1976.

"What Price Energy?" Newsweek. 89:12-16, May 2, 1977. Implicit editorializing but factual.

"The Energy War," Time. 109:56-67, April 4, 1977. Statement about the alternatives and politics involved.

PACKET OF MATERIALS FROM THE CLINCH RIVER BREEDER REACTOR PROJECT:

"Clinch River Breeder Reactor Plant Project" Pictorial and concise explanation of the Project.

"Facts and Figures About the Clinch River Breeder Reactor Plant Project."

"How Much Radiation Will the Public Receive?" A comparison chart.

"Design Data for the CRBRP"

"Capsule Summary: The Case for the LMFBR"

"Project Management Corporation's Annual Report 1977"

"Paper: U.S. Foreign Breeder Reactors"

Days 4 and 5

THE PROBLEM IS THAT RAPIDLY DEPLETING SOURCES OF FOSSIL FUELS CANNOT BE RECOVERED AS A SOURCE OF ENERGY GENERATION. AN

IMPORTANT PROSPECT, HOWEVER, IS THE FACT THAT BESIDES THE FOSSIL FUELS, THERE ARE ALTERNATIVE SOURCES OF ENERGY WHICH CAN BE USED TOGETHER TO OFFER POWER SOURCES TO THE U.S.

I. THERE ARE RESIDUAL WASTE PRODUCTS AVAILABLE AS ENERGY SOURCES.

A. CROP RESIDUES:
1. Examples are:
a. corn stalks/cobs
b. soybean stalks
c. cotton stalks
d. cotton gin trash
e. grain straw
f. spoiled grain
g. spoiled hay
h. bagasse
i. walnut hulls
2. Five possible methods of utilization:
a. direct combustion
b. animal feed
c. methane production
d. gasification
e. alcohol production
3. Quantitative value:
a. corn = 7900BTU/lb.
b. soybeans = 7800BTU/lb.
c. cotton = 8000BTU/lb.

B. FOREST RESIDUES:
1. Examples are:
a. treetops
b. sawmill wastes
2. Methods of utilization same as crop residues.
3. Quantitative analysis based on 4 day energy supply:
a. gas: $6X10^9$ cu. ft.
b. electricity: 1100×10^{12} BTUs
c. oil: 190×10^6 bbls.

C. ANIMAL RESIDUES: (CATTLE AND POULTRY)
1. Methods of utilization:
a. used as a crop nutrient (fertilizer technology)
b. used as energy, converted to methane
(1) Example: Oklahoma generation of gas from manure of 100,000 cattle can heat 300,000 homes in Chicago.
(2) Example: Missouri storage of methane in canvas tank for future use/transportation.
c. used for refeeding when mixed with other products, i.e., with corn.

d. used for refeeding the soil in solid or liquid forms, spread through the air or injected into the ground.

2. Quantitative analysis:
   a. 1 chicken = 100 lbs/yr.
   b. 1 hog = 1½ to 2 T/yr.
   c. 1 steer = 8 to 10 T/yr.
   d. 1 dairy cow = 15 to 20 T/yr.
   e. Total Production 1½ to 2 billion T/yr.

D. RURAL RESIDENCE RESIDUES
   1. Gasification (physical process)
   2. Methane Production (biological process)
   3. Compost

E. POWER GENERATION RESIDUES
   1. Wasted heat could be used to heat soil.
   2. Wasted heat could be used for food processing.
   3. Wasted heat could be used in livestock and poultry production.

F. MUNICIPAL AND INDUSTRIAL WASTES
   1. Treated wastewater and sludge utilization:
      a. irrigation water
      b. fertilizer
      c. compost
   2. Solid waste utilization:
      a. animal feed
      b. methane production
      c. gasification
      d. direct combustion
      e. alcohol production
      f. compost

II. SOLAR ENERGY IS A VIABLE/DUBIOUS SOURCE OF ENERGY FOR THE FUTURE.

A. ADVANTAGES:
   1. It offers a huge supply of clean energy, though not pollution free.
   2. Energy source is reliable, not subject to curtailment arising from political or labor disputes.
   3. Energy is not subject to arbitrary price management.
   4. Large cooling water supplies are not required; waste heat rejection is not a problem.
   5. There are not problems of long-term waste management.

B. DISADVANTAGES:
   1. It is likely to be not available when needed the most.
   2. There are severe problems of storage and distribution.
   3. Low energy density requires large collecting areas.
   4. The high cost of collection and utilization is present.

5. MUCH MORE TECHNOLOGY IN THE AREAS OF CELLS AND COLLECTION ARE NECESSARY.
   a. Existing collectors are only 60% efficient.
   b. Solar cells are only 20% efficient.
   c. Storing solar energy would cost $160 billion which is 13% of the GNP.

C. COMMON MISCONCEPTIONS:
   1. "It's always there!"
   2. "It's non-polluting."
   3. "It lasts forever." (fauna and flora upset)
   4. "It's free!"

III. GEOTHERMAL ENERGY IS ANOTHER ALTERNATIVE SOURCE OF ENERGY.

A. There are some specific areas where geothermal has regional value:
   1. California, 80 miles north of San Francisco, is the largest geothermal base.
   2. Hot water geothermal is available in Cerro Prieto, Mexico, and some is predicted to be in the Salton Seas.
   3. Potential fields are in Wyoming, Nevada, and on the Southern tip of California.

B. Quantitative Analysis:
   1. 1 Quad = 10^{15} BTU's
   2. U.S. consumption of energy = 75 Quads/yr.
   3. USGS = Geothermal Resource Base = 600,000 Quads
   4. Geothermal can offer possible 5 Quads/yr. by 2000 whereas they produce 1/50 of a Quad in 1977.

C. Disadvantages (especially of geysers)
   1. Non-condensable gasses in steam
   2. Debris and water (removed by centrifugal separation)
   3. Dust deposits in path of steam impedes flow, damages turbine blades and shrouds.
   4. Hydrogen sulfide in air attacks copper, copper alloys, silver electrical parts
   5. Amonia, boron contaminates crack (resize)
   6. 115^{0}F summer requires special ventilation of equipment.
   7. 20^{0}F winter freezes steam
   8. Winter roads to the fields are impassable
   9. Monel blades must be replaced with 12% chrome stainless steel
   10. There is a mineral buildup on blades
   11. Concrete bases deteriorate from amonium bicarbonate in steam condenser
   12. Production is exceedingly noisy

D. Advantages:
   1. The Department of Energy is increasing funding to $55.9 million in 1977 from 1976's $42.2 million
   2. Geothermal energy is already being used and in production

IV. NUCLEAR FUSION IS A DRAWING-BOARD POSSIBILITY FOR FUTURE ENERGY GENERATION THAT IS COMPATIBLE WITH EXISTING POWER DISTRIBUTION PATTERNS IN A CLEAN, SAFE MANNER. It is an energy form that binds light isotopes such as deuterium and tritium together to produce plasma.

A. THE FEDERAL GOVERNMENT FEELS THAT FUSION IS WORTH DEVELOPMENT BECAUSE IT HAS INVESTED MILLIONS IN THE RESEARCH PROJECT AT OAK RIDGE. There is no fusion-guaranteed energy today, but it is expected that a sample production will be available by the year 2000.
   1. Current research involves fusion reactors.
   2. Fusion Reactor technology still elementary.

B. PROBLEMS IN THE RESEARCH:
   1. The confinement parameters of time and density are major problems; if left to its own devices, plasma will disperse and lose all its energy.
   2. Some possible confinement systems are being tried:
      a. Tokamak, ISX magnetic fields
      b. Mirrors
      c. Laser implosion

V. GRADIENTS, WINDS, AND TIDES ARE POSSIBLE SOURCES OF PARTIAL ENERGY GENERATION.

A. Ocean Temperature Gradients are actually solar collectors in the ocean.
   1. D. Arsonval developed meters in 1890
   2. Limitations:
      a. very big, bulky machine required
      b. difficult to withstand the salt water
      c. fishing, however, would be good

B. Ocean Tides are a source of gravitational energy, a good but small source with only 25% efficiency, already being used.

C. Winds offer another small source of energy that is clean, non-depletable, but very expensive in terms of capital expenditures and environmental problems.

D. Waves can be used to generate energy in four ways:
   a. Salter's ducks
   b. Contouring rafts

c. Oscillating water columns
d. Russell Rectifier

E. Ocean Currents such as those from the Gulf Stream, at 15 mph, may also be considered.

VI. CONSERVATION ENERGY IS THE BRIDGE FUEL FOR AMERICA'S ENERGY FUEL.

A. THE ALLIANCE TO SAVE ENERGY, ASE, OFFERS A PROGRAM FOR AMERICANS TO OFFER THEM ENERGY PROGRAMS FOR THEMSELVES:
1. A heightening of public awareness is needed.
2. The development of educational programs is needed.
3. The promotion of wise energy usage is needed.
4. The sharing of information is needed.
5. The encouragement of local volunteer action is needed.

B. THE ESSENTIAL PART OF THE GENERAL PUBLIC DOES NOT BELIEVE THAT THERE IS AN ENERGY CRISIS; therefore, non-partisan advocacy of conservation is needed.

C. METHODS OF CONSERVATION:
1. Ride in car pools.
2. Use fuel-efficient cars.
3. Use untapped source: conserve at home.
   (a) turn off lights
   (b) turn down thermostats
   (c) turn down how water heaters
   (d) do washing at non-peaking hours
   (e) save as much heat and air-conditioning as possible by not using units and turning them off during day
4. Reduce wasted energy in industry and institutions
5. Use efficient home-heating/cooling systems.
6. ASHRAE 90-75: buy/build homes that meet environmental demands.
7. Insulate homes to meet standards for saving energy.

PRESENTATION METHOD: Lecture and Class Discussion. Students will give their pros and cons about alternative sources of energy in addition to adding to the list given.

ASSIGNMENTS: Read, "Alternatives to the Energy Crisis," Current History. July/August, 1978, pp. 16-18+.

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R. Hamilton, "Can We Harness the Wind? National Geographic. Dec., 1975. 148:812-29. Pictoral and informative, though dated article about usage of the wind already in effect.

David R. Ingles, "Wind Power Now," Bulletin of the Atomic Scientists Oct., 1975. 31:20-26. Overview of usage of wind for power.

Dorothea H. El Mallakh, "Energy Options and Conservation," Current History. March, 1978. 74:113-116+. Discusses balance of energy supply and demand with reference to conservation; thesis that conservation will be directly related to the change in these areas.

R.F. Post, "Nuclear Fusion," Annual Review of Energy. Vol. 1. Palo Alto, California: American Review, Inc., 1976. Introduction to the research in fusion technology.

M. Wolf, "Photovoltaic Solar Energy Conversion," Bulletin of the Atomic Scientists. April, 1976. 32:26-35. Introduction to solar conversion and its possibilities and difficulties.

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"Capturing The Sun Through Bioconversion," Proceedings of a Conference, March 10-12, 1976. Washington: Center for National Studies. Discussion of recycling of residual wastes.

"The National Energy Plan," Superintendent of Documents, United States Government Printing Office, Washington, April , 1977.

"Tips for the Energy Saver," Federal Energy Administration, Conservation and Environment. Washington, United States Government Printing Office.

ENERGY UNIT

for

SENIOR HIGH SCHOOL CHEMISTRY

BY

Naomi M. Seifert
Spartanburg High School

Rationale:

Based on the premise that only the informed can make rational judgements, this unit is designed to make the secondary school chemistry student familiar with some aspects of the overall energy spectrum.

Overview:

This unit includes:

1. establishment of the fact that there is an energy crisis,
2. information about availability of energy resources,
3. chemical aspects of processing, combustion and waste disposal of energy producing fuels.

Notes to the teacher:

1. Although written as a three week unit, the nature of the material will lead to much discussion, thereby making it difficult to impose an absolute time limit.
2. It will be necessary to accumulate numerous resource materials beforehand for personal and student use. Several sources of materials are mentioned in the annotated bibliography.
3. Suggested resources mentioned in the daily lessons are described briefly in the annotated bibliography.

DAY 1

Ask the question, "Do you think that there is an energy crisis?" After hearing several students' opinions, submit evidence that there is an energy crisis. This can be accomplished by means of a film and/or an illustrated lecture.

Suggested Resources:
Film: "Paradox of Plenty"
Exxon Company, U.S.A., Energy Outlook 1877-1990.
Exxon Company, U.S.A., Energy Outlook 1978-1990.

DAY 2

1. Pass out and explain briefly a topical outline of the unit and a glossary of basic energy terms and measurement units.

2. Assign as a long term project a research paper of a more in-depth study of one of the unit topics or of some other approved energy related topic.

3. Make the students aware of the resource materials available in the classroom and in the school and community libraries.

Suggested Resources:
N.S.T.A., Factsheet 18, Alternative Energy Sources: A Glossary of Terms
Chemistry and Physics Textbooks.
Lapedes, Daniel N., Encyclopedia of Energy.

DAY 3

By means of an illustrated lecture, discuss the occurence and methods of recovery of fossil fuel.

Suggested Resources:
Lapedes
National Coal Association, Coal Facts.

DAY 4

Have the students perform a simple fractional distillation as an introduction to petroleum chemsitry.

Suggested Resources:
Organic Chemistry Laboratory Manual.

DAYS 5 and 6

Using schematic diagrams of the processes and molecular models wherever possible, discuss the following aspects of petroleum chemistry:

1. The composition of crude oil.
2. The distillation process.
3. Hydrocracking.
4. Catalytic cracking.
5. Catalytic reforming.
6. Isomerization.
7. Environmental effects.
8. Hydrodesulfurization.
9. Hydrodenitrogenation.
10. Combustion.

Suggested Resources:
Chemistry Textbooks.
Lapedes

DAY 7

To increase understanding of the heating effect of a fuel, have the students conduct a laboratory investigation of the heat of combustion of a candle.

Suggested Resource:
Chemistry Laboratory Manual.

DAY 8 and 9

1. Using schematic diagrams of the processes, discuss the following aspects of coal chemstry:

a) Composition of coal.
b) Purification of coal.
c) Combustion of coal.
d) Conversion to liquid fuels.
e) Gasification of coal.

2. Show a film illustrating the method of production and the uses of coal.

Suggested Resources:
N.C.A. Coal Facts.
Lapedes.
N.S.T.A. Factsheet 15, New Fuels from Coal.
Film: "An American Asset".

DAY 10

After viewing the film "Bridge to Tomorrow", have the students write a one or two page essay expressing their thoughts and/or opinions on one of the following topics:

1. Total Electrification.
2. Fossil fuel Conservation for Transportation.
3. Nuclear Reactors: Yes or No.
4. Alternative Energy Sources.

Suggested Resource:
Film: "Bridge to Tomorrow".

DAYS 11 and 12

Discuss the following aspects of nuclear energy:

1. The occurence and processing of nuclear fuels.
2. Nuclear reactions.
3. Nuclear wastes.
4. The breeder reactor.

Suggested Resources:
Chemistry Textbook.
Lapedes.
N.S.T.A. Factsheet 12, Conventional Reactors
N.S.T.A. Factsheet 13, Breeder Reactors
N.S.T.A. Factsheet 14, Nuclear Fusion
Westinghouse Electric Corporation, The Case for the L.M.F.B.R. and The Breeder Reactor: Vital to a Strong America.
Clinch River Breeder Reactor Plant Project, Information pamphlets concerning the reactor.

DAY 13

Conduct a nuclear power question and answer session. As a possible aid for this session, use the film, "Nuclear Power: Questions and Answers" or have a guest speaker.

Suggested Resource:
Film: "Nuclear Power: Questions and Answers".

DAY 14

Using transparancies to illustrate, discuss some of the other alternative sources of energy. Include advantages and disadvantages of each.

Suggested Resources:
N.S.T.A. Factsheet 1, Fuels from Plants: Bioconversion
N.S.T.A. Factsheet 2, Fuels from Wastes: Bioconversion
N.S.T.A. Factsheet 3, Wind Power
N.S.T.A. Factsheet 4, Electricity from the Sun I: Solar Photovoltaic Energy
N.S.T.A. Factsheet 5, Electricity from the Sun II: Solar Thermal Energy Conversion
N.S.T.A. Factsheet 6, Solar Sea Power: Ocean Thermal Energy Conversion
N.S.T.A. Factsheet 7, Solar Heating and Cooling
N.S.T.A. Factsheet 8, Geothermal Energy
N.S.T.A. Factsheet 16, Energy Storage Technology
N.S.T.A. Factsheet 17, Alternative Energy Sources: Environmental Impacts
N.S.T.A. Factsheet 18, Alternative Energy Sources: A Glossary of Terms
N.S.T.A. Factsheet 19, Alternative Energy Sources: A Bibliography

DAY 15

Suggested Activity:

Discuss some aspects of energy conservation.

Suggested Resources:
Federal Energy Administration, Tips for Energy Savers.
N.S.T.A. Factsheet 9, Energy Conservation: Homes and Buildings
N.S.T.A. Factsheet 10, Energy Conservation: Industry
N.S.T.A. Factsheet 11, Energy Conservation: Transportation

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Films:

An American Asset avialable through National Coal Association or through Modern Talking Picture Service. A 28 minute film discussing production and uses of coal.

Bridge to Tomorrow available through local power companies. A 27 minute film concerning energy development, the importance of energy and its impact on society.

Nuclear Power: Questions and Answers available through local power companies. A 25 minute film narrated by Mr. Wizard (Don Herbert) dealing with some common concerns about nuclear power.

Paradox of Plenty available through local power companies. A 21 minute film that discusses the present energy problem and various energy options.

Written Materials:

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Exxon Company U.S.A. Energy Outlook 1978-1990. May 1978. These graphic representations of U.S. energy demand and supply are available from Exxon Company, U.S.A., Public Affairs Dept., P.O. Box 2180, Houston, Texas 77001

Federal Energy Administration. Tips for Energy Savers. This pamphlet available from Consumer Information, Public Documents Center, Pueble, Colorado 81009, contains energy saving tips for in and around the home, on the road and in the marketplace. A teaching guide is also available.

Geddens, Paul H. The Birth of the Oil Industry. Arno Press: New York, 1972. Birth is an illustrated account of pioneering in the oil industry prior to the twentieth century.

Gooder, E.M. Hydrocarbon Fuels, John Wiley and Sons: New York, 1975. This textbook, designed for students concerned with utilization of hydrocarbon fuels, contains information about petroleum resources, fuel chemistry and physics, fuel processing, handling and performance.

Hallman, H. Energy in the World of the Future, M. Evans and Co. Inc.: New York, 1973. This readable account of energy sources problems and future possibilities contains an extensive, although somewhat outdated, bibliography.

Lapedes, Daniel N., Editor and Chief. Encyclopedia of Energy. McGraw Hill Book CO.: New York, 1976. The encyclopedia contains more than 300 articles designed to supply the reader with economic, political, environmental and technological information about energy.

National Coal Association, Coal Facts. A biennial report in text and tables available from National Coal Association, 1130 17th St. N.W., Washington, D.C. 20036.

N.S.F., Office of Science Information Service. Energy Information Resources, American Society for Information Services: Washington D.C., 1975. This is a list of resources for energy related information.

N.S.T.A. Energy and Education, National Science Teachers Association: Washington. This bimonthly newsletter provides information about energy resources that will aid the educator in developing an energy enriched curriculum. Available from National Science Teachers Association, 1742 Connecticut Avenue N.W., Washington, D.C. 20009.

N.S.T.A. Factsheet. Nineteen titles dealing with energy available from D.O.E. Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

Reisenberg, Laura B. "Sun Day: A Requiem for Coal, Gas and Oil". Chemistry 51:6, (July-August 1978), pp. 12-19. This article discusses short term, medium term and long term aspects of the 1977 National Plan for Energy Research, Development and Demonstration. It includes a discussion of solar economics and alternatives and a list of resource materials.

Westinghouse Electric Corporation. The Case for the L.M.F.B.R. This capsule summary providing information about the liquid metal fast breeder reactor and other informative pamphlets are available from Westinghouse Electric Corporation, Advanced Reactors Division, P.O. Box 158, Madison Pennsylvania 15663; and/or from Information Division, Clinch River Breeder Reactor Plant Project, P.O. Box U, Oak Ridge, Tennessee 37830.

FUEL SOURCES AND BIOLOGICAL SYSTEMS

Biology: 9th Grade

by

Martha N. Stansell
Liberty High School

I. Fuels from today's plants

A. Wood

1. Scarcity of wood was responsible for the world's first energy crisis.

2. The heat content of wood can be calculated using simple materials and methods.

B. Bioconversion

1. Methane gas can be produced by converting sewage-grown algae and water hyacinths.

2. Wood waste and agricultural waste can be converted to methane and alcohol.

II. Fossil fuels

A. Coal

1. Coal was formed under special conditions, primarily during the Carboniferous period.

2. There are four varieties of coal, each having specific characteristics and uses.

3. There are advantages and disadvantages to using coal to produce electricity.

B. Oil and natural gas

1. Oil and natural gas are produced under special conditions of pressure in specific types of geologic formations.

2. The heat value of oil can be calculated using simple materials.

3. There are advantages and disadvantages in using oil and natural gas for power generation.

III. Solar Energy

A. For photosynthesis

1. The raw materials, products, and basic reactions of photosynthesis will be studied.

2. Plant pigments can be separated in the laboratory by the use of paper chromatography.

B. For power

1. Indirect sources of solar energy include winds, waves, and ocean currents.

2. Direct uses of solar energy include solar photovoltaic energy and solar thermal energy.

3. Solar energy can be used for heating and cooling in our homes.

IV. Nuclear Energy

A. Fission

1. Fission fuels are activated by the action of a free neutron, which causes the nucleus to split and emits other neutrons - a [illegible] reaction.

2. Heat from fission [illegible] to heat water which turns turbines, and power is produced.

B. Fusion

1. Fusion is the joining of very light atoms.

2. There are numerous advantages of fusion reactors, and there are also difficulties in producing power by fusion.

C. Biological effects of radiation

1. Undesirable effects depend on the amount of radiation received.

2. Positive uses of radiation include diagnostic x-ray and radiation therapy.

DAILY PLANS

DAY	TOPIC OR ACTIVITY	BIBLIOGRAPHY SOURCE
1	Handout - "The Death of Trees" Heat content of wood - Set up for laboratory activity on "How Can We Find the Energy Content In Wood"	Source 6 Source 6
2	Carry out laboratory exercise and complete data sheet.	
3	Lecture and class discussion based on handout -bioconversion	Source 8-A
4	Guest speaker - Dr. Clyde Barth Professor of Agricultural Engineering, Clemson University, Clemson, S.C. Topic-"Agricultural and Waste Resources"	
5	Formation of coal Activity-"How Coal Was Formed"	Source 7 Source 6
6.	Advantages and disadvantages of using coal to produce power	Source 10 Student Activity 4, Handouts 1 and 2
7	Formation and development of oil and natural gas Handout-"The Development of Oil"	Source 2, p.326 Source 4, p.55 Source 6
8	Laboratory activity - "The Heat Content of Oil"	Source 6
9	Advantages and disadvantages of using oil and natural gas to produce power Film - "The Great Search"	Source 10 Source 13
10	Photosynthesis - The raw materials and products	Source 3 p. 87-94

11	Photosynthesis - The cell structure and basic reactions	Source 3 p. 87-94
12	Laboratory exercise - "Pigments in Plant Leaves - Chromatography"	Source 3 Lab book
13	Solar energy for power - indirect sources such as winds, waves, ocean currents, hydro power Direct uses of solar conversion	Source 4 p. 49-54 Source 8B Source 8C
14	Class project - Construction of a solar water heater. To be completed as students have time available	Source 5
15	Solar heating and cooling	Source 8D
16	Film - "Now That The Dinosaurs are Gone" Discussion - Fission	Source 11 Source 1 p. 109-115
17	Film - "Nuclear Power: Questions and Answers" Discussion - Fusion	Source 12 Source 1 p. 116-122
18	Biological effects of radiation	Source 4 p. 130-131 Source 9
19	Field trip to Duke Power Visitor's Center, Keowee - Toxaway Project	
20	Evaluation - Using all the sources given during this unit and your own critical thinking, write an evaluation of the pros and cons of each type of fuel studied in this unit.	

BIBLIOGRAPHY

Books

1 Crawley, Gerard M.: Energy. New York, N.Y.: McMillan Publishing Co., 1975. Topics included are the scientific background of energy, it's past, present and future use, and the energy resources and problems involved.

2. Ehrlich. Paul R., et. al.: Biology and Society. New York, N.Y. McGraw - Hill Book Co., 1976. A general biology book based on the study of the functions and interactions of individuals and societies with each other and with the abiotic environment.

3. Smallwood, Wm. L., and Green Edna R.: Biology. Morristown, N.J. Silver Burdett, 1974. This book is a general text for high school use and is based on patterns of structure and function of organisms and their environmental interactions.

4. Thorndike, Edward H.: Energy and Environmental: A Primer for Scientists and Engineers. Reading, Mass., Addison-Wesley Publishing Co., 1976. This source is a comprehensive view of energy sources, technology, conservation and environmental concerns.

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5. Williamson, William R. "Solar Water Heater - A Sunny Alternative." The Science Teacher, vol. 45, May, 1978. This article has clear and simple instructions for building a solar water heater with everyday materials.

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6. "An Energy History of the United States." Prepared by the National Science Teacher's Association for the U.S. Dept. of Energy. January, 1978. A collection of interdisciplinary materials on wood, coal and oil use in America.

7. "Coal", a reprint from the World Book Encyclopedia with permission from Field Enterprises. Reprinted by National Coal Association. This booklet covers the formation, mining, processing and uses of coal.

8. Fowler, John M.: "Factsheets", prepared by the National Science Teacher's Association under contract with ERDA.

A. "Factsheet 1. Fuels From Plants (Bioconversion)." This

paper discusses resources, technology, and current practices in bioconversion.

B. "Factsheet 4. Electricity from the Sun I (Solar Photovoltaic Energy)." This source discusses present and proposed systems using solar cells and the environmental effects caused by them.

C. "Factsheet 5. Electricity from the Sun II (Solar Thermal Energy Conversion)." The technology, economics and environmental impacts of solar thermal electric conversion plants are explained.

D. "Factsheet 7. Solar Heating and Cooling." Solar collection and storage, solar cooling and the use of heat pumps are discussed in this factsheet.

E. "Factsheet 12. Conventional Reactors." The technology, economics, environmental effects and safety associated with fission reactors is the subject of this factsheet.

F. "Factsheet 14. Nuclear Fusion." Fusion resources, reactor technology and environmental effects of fusion reactors are covered.

9. "Nuclear Radiation and Health." A booklet available from Duke Power Company.

10. "U.S. Energy Policy - Which Direction?" Prepared by the National Science Teacher's Association for the U.S. Dept. of Energy. January, 1978.

Films.

11. "Now That The Dinosaurs Are Gone" 26 minutes. This film explains the rationale for nuclear power and discussess typical questions dealing with that topic.

12. "Nuclear Power: Questions and Answers" 25 minutes. Questions about nuclear safety are answered by Mr. Wizard (Don Herbert).

13. "The Great Search" 13 minutes. A Walt Disney film which makes some fundamental points about man and energy and manages to entertain as well.

All films may be ordered from Duke Power Company, P.O. Box 2178, Charlotte, N.C. 28201. Free loan basis.

ENERGY CRISIS -- YES OR NO?

General Science: 9th Grade

by

A. Mason Turner
Orangeburg-Wilkinson High School

DAY 1.

A. Give each student a copy of the Energy Opinion Poll (Handout 1) and let them fill it out (signed or unsigned). Tabulate the results later.

B. After taking up opinion poll, give out the sheet of "Statements About Energy" (Handout 2) by various important people. Let the students decide for themselves whether each statement indicates that the person making the statement believes there is an energy crisis or not, by checking the appropriate choice.

C. If time permits after students complete Handout 2, read over the statements aloud and let the students discuss why they checked the choice they did for each statement. (Expect differences of student opinion on choices.)

D. Ask students to look for news and articles about energy on TV, in the newspapers, and in magazines for the next 2 or 3 days. Ask them to tear out and bring in, or jot down a brief summary of the item, and report to the class the next day.

DAY 2.

A. Ask the students if there are any energy news reports (see item D under Day 1).

B. Finish discussing Handout 2 if it wasn't finished yeaterday.

C. Give out Handout 3 (Reasons Some People Are Concerned About Energy), and ask the students to read it carefully. Then go back over it and discuss it by asking questions about some of the items. For example, after the first 2 questions, ask "Why?" Try where possible to tie the statements to local conditions; example:

for 3 ask "Where is the nearest power plant?"

D. Then ask each student to make a list of the ways he uses energy (other than body energy). Tell them that this could include direct uses like using up gasoline driving a car, or indirect uses like wearing a shirt, which requires energy to make the synthetic fibers, weave the cloth, sew the seams, and transport the shirt from the facotry to the store.

E. After each student has finished his own list, make a class list on the board, letting students volunteer their different suggestions. Make sure that key uses like heating, cooling, transportation, lighting, and cooking are included. Also, try to include a number of appliances and home equipment they use or help use like hair dryers, TV's, lawn mowers, clothes washers, etc. Other indirect uses might include a variety of possibilities like using up aluminum or glass drink containers which take a lot of energy to make, and eating food which the farmer had to supply a lot of energy to produce.

DAY 3.

A. Ask again if the students wish to report any news items on energy they found.

B. Ask students to write an imaginative short story about what it might be like 30 years from now if our energy supplies became extremely short (give suggestions like: How would we stay warm in winter or cool in summer? How would we get to school or work? What about electric lights? TV? Jobs in plants? Recreation? Energy rationing, etc.?)

C. Ask the students to take the Energy Opinion Poll (Handout 1) again.

D. Tabulate and compare their results to the first time they took it. Show the students the overall tabulated results, and discuss them if there is an interest.

E. Have some of your students read some of the better short stories if time permits. This could be carried over until the next day.

F. Students may wish to give the Energy Opinion Poll to other students, teachers, or other adults in the community to see what attitudes prevail about the energy crisis.

Hand Out 1.

Energy Opinion Poll.

Directions: Put a check in the choice which best expresses your opinion for each question.

1. Do you think we have an energy crisis in this country?

   yes _______, no_________.

2. How would you rate our energy problems in this country?

   very serious problems ______, serious problems ______, some problems______, very few problems ______, no problems______.

3. How important do you think our energy supply is in this country?

   very important______, fairly important______, not very important ______.

4. Do you think we use much energy in this country Use very much ______, use a good bit ______, use some______, don't use much ______.

5. Do you think that you use up much energy (not counting body energy) in school, at home, and at work or play?

   use a lot ______, use some ______, use a little ______.

6. Can you think of any times you had an energy problem in your city?

   yes______, no______. If yes, describe briefly: ______________________________.

7. Can you think of any times there were energy problems in our country? yes ______, no______. If yes, describe briefly: ______________________________

8. Do you think that making energy causes pollution? Yes___, no___.

9. How often do you notice news about energy problems on TV, in the newspapers, or in magazines:

   very often____, fairly often____, occasionally ____, rarely____.

10. If a severe energy shortage developed, do you think it would change our lifestyle much?

    change a lot____, change some____, change a little ____

    not change____.

11. Do you think we waste much energy? waste a lot____, waste some____, don't waste much____.

Hand Out 2

Statements About Energy Crisis

1. Dr. Wernher von Braun, Space Scientist: "Survival of civilization as we know it requires that we continue to consume energy, that we practice conservation of our resources, that we protect our environment, and that we search for and develop new energy resources." (Von Braun believes we have: severe energy crisis____, a fairly serious energy probl ___, a moderate problem____, a slight problem____, no problem_____.)

2. James R. Schlesinger, Secretary of the Department of Energy: "The energy problem is very simple. Demand is growing rapidly. We are running out of fuel. We've got to do something about it." (Schlesinger believes we have: a severe energy crisis ____, a fairly serious energy problem____, a moderate problem____, a slight problem____, no problem_____.)

3. G.A. Thompson, Vice President and General Manager of Applied Engineering Co.: "I am not a doomsday person. I am not predicting that all of a sudden, in X number of years, energy will run out . . . . I don't subscribe to that theory, and have a great deal of faith in our system." (Thompson believes we have: a severe energy crisis_____, a fairly serious energy problem_____, a moderate problem____, a slight problem____, no problem_____.)

4. Senator Henry M. Jackson, Democrat of Washington: "The most difficult problem facing the nation today, either internationally or domestically, is the energy crisis." (Jackson believes we have: a severe energy crisis_____, a fairly serious energy problem_____, a moderage problem_____, a slight problem _____, no problem _____.)

5. Martin Lobel, Washington Lawyer: "The energy crisis is a device the (oil) industry is using to get higher prices." (Lobel believes we have: a severe energy crisis____, a fairly serious energy problem____, a moderate problem____, a slight problem ____, no problem____.)

6. Professor Edwin C. Barbe, Univeristy of West Virginia: "The day of Sunday, July 14, 1976, the 200the birthday of the United States of America, will dawn on a nation not in celebration but one that will be desperately trying to save itself from the crunch of a collapsing economy because of shortage of energy." (Barbe believes we have: a severe energy crisis_____, a fairly serious energy problem_____, a moderate problem_____, a slight problem _____, no problem_____.)

7. President Nixon: "In the years immediately ahead, we

must face up to the possibility of occasional energy shortages and some increase in energy prices." (Nixon believes we have: a severe energy crisis____, a fairly serious energy problem____, a moderate problem_____, a slight problem_____, no problem _____.)

8. David E. Lilienthal, President of Development and Resource Corporation: "That there is an energy problem is certainly clear." He added that persons who contend a crisis exists are often the ones who would profit by increased fuel prices. He said that the so-called energy crisis was an invention of journalists. (Lilienthal believes we have: a severe energy crisis_____, a fairly serious energy problem_____, a moderate problem_____, a slight problem_____, no problem_____.)

9. Richard J. Sullivan, N.J. State Commissioner of Environmental Protection: "We are not running out of energy sources at the present--we are running ahead in demand. I find it a little difficult to describe a situation a crisis when we are burning fuel in snowmobiles, minibikes, and snowblowers." (Sullivan believes we have: a severe energy crisis_____, a fairly serious energy problem _____, a moderate problem_____, a slight problem_____, no problem _____.

10. President Carter: "Our energy crisis is an invisible crisis, which grows steadily worse--even when it is not in the news." President Carter asked Congress to pass laws and the nation to support programs to conserve energy because "the alternative may be a national castrophe. With the exception of previnting war, this is the greatest challenge our country will face during our lifetimes." (Carter belives we have: a severe energy crisis_____ a fairly serious energy problem._____, A moderate problem _____, a slight problem, no problem________.

Hand Out 3

Reasons Some People Are Concerned About Energy

1. In the U.S. we use more than 30 times the energy we used 100 years ago, even though the population has increased only 7 times.

2. Energy use in this country keeps going up. On the average it is doubling every 20 years.

3. Electrical energy use is doubling even faster--every 10 years. (Most electricity is made by burning fuels like coal, fuel, oil, and natural gas.)

4. Shortages in every supplying fuels like oil, natural gas, and coal are starting to occur.

5. Although oil products (fuel oil, gasoline, diesel fuel, jet fuel, etc.) are used to produce about half of our energy in this country, our country no longer produces enough oil to meet our needs. We must import (buy from other nations) about 40% of the oil we need at higher costs.

6. Many oil wells in this country have been used up, and oil companies are drilling in the ocean bottoms off our coasts to find more oil.

7. Natural gas (burner gas or furnace gas), which supplies about one-third of our energy, is also beginning to run short in this country. Many gas suppliers will not hook up new homes because gas supplies are limited.

8. Coal, which supplies about one-fifth of our energy, is plentiful in this country. Increased use of coal, though, will cause mining problems and cause more air pollution.

9. The fossil fuels (coal, oil, and natural gas) are finite resources. That is, only certain amounts are deposited in the earth and before long they will be used up. Yet they now supply over 90% of all or our energy directly or indirectly in this country.

10. Many people believe that our inflation (increasing prices) is at least partly due to our having to buy so much oil from other nations.

11. In this country we have 6% of the world's population, yet we consume about one-third of the world's energy.

12. Nuclear energy is starting to be used more to make

electricity, yet many people are concerned about its safety. They are also concerned about the pollution it might cause from radioactive wastes.

13. Solar energy (energy from the sun) is beginning to be used, but it requires expensive equipment to heat a house or make solar electricity.

14. Most businesses and factories need a lot of energy to keep running. Energy shortages have already shut down certain plants for short times, putting people out of work.

15. Making energy also alters or pollutes our environment.

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"Energy: A Space Scientists Solutions, An Interview with Dr. Wernher von Braun," Nation's Business, Sept. 1976, p. 25 (reference for statement 1 in Hand out 2). This article is a wide ranging interview with Dr. von Braun in which he answers many questions about immediate and long range energy problems.

"Superbrain's Superproblem," Time, April 4, 1977, p. 59 (reference for statement 2 in Hand out 2). This article summmarizes the energy situation immediately before President Carter presented his plan to Congress, and explains James Schlesinger's role in Carter's plans.

"Comments on Energy," The Times and Democrat, Orangeburg, S.C., Feb. 18, 1978, p. 1B (reference for statement 3 in Hand out 2). This article gives an interview with G.A. Thompson and presents his views on some energy areas he is concerned with.

"Energy Overview," The N.Y. Times, April 17, 1973, p. 26 (reference for statements 4, 5, and 6 in Hand out 2). This article is one of 3 articles on successive days summarizing the energy picture during the period following the Arab oil embargo.

News article, The N.Y. Times, April 19, 1973, p. 1 (reference for statement 7 in Hand out 2). This article reports President Nixon's speech on energy.

News article, The N.Y. Times, April 29, 1973, p. 55 (reference for statement 8 in Hand out 2). This is a news item reporting on the energy situation.

News article, The N.Y. Times, Feb. 21, 1973, p. 89 (reference for statement 9 in Hand out 2). This article is a news item reporting on the energy situation.

"The Energy War," Time, May 2, 1977, p. 10-25. This article summarizes President Carter's energy program and the country's reaction following his speech to Congress.

Energy-Environment Source Book, National Science Teachers Assn. Project, John M. Fowler, director, 1975 (reference for Hand out 3). This book gives detailed background of energy and environment problems, including much data.

THINK POSITIVE TO CONSERVE ENERGY

Physical Science: 9th Grade

by

Lois M. Williams
St. Matthews High School

Activities	Resources
Day 1	
Give a pre-test The teacher will give an overview of energy as introduction to unit.	Suggested Test attached Energy and Environment address listed.
A. Begin with primitive man fire. B. Continue discussion to today's energy sources. C. Define "energy" as simply as possible.	Suggest "Energy is Capacity for doing work or causing motion"
D. Discuss Kinetic and potential energy. E. Demonstrate Kinetic and potential energy. F. Have class name and list for notes, examples of each.	Text
Day 2	
Use Film- A. "Bridge to Tomorrow" 27 minutes B. Teacher will review film and definitions and examples of energy from 1st day.	Free Film: Address listed
Day 3	
Read in Class: Mickey Mouse and Goofy: "Let's Explore Energy"	Free Comic: Address listed

Activities	Resources
A. Discuss with class best sources used to Generate Electricity. A. Coal	
<u>Day 4</u>	
1. Show films "Comeback of King Coal" and "Electricity, The way it Works" (16 minutes)	
<u>Day 5</u>	
2. Display a piece of coal. Have the class examine it with a hand lens	<u>Coal</u> B-401 - "Coal and the Energy Crunch". Booklets for Class are available, Duke Power Company
3. Have students put these facts into a notebook for learning a. Define coal-a soft, black or brown rock. It has an ability to burn. (Suggestion) b. Name and define the kinds of coal.	<u>Coal Mining</u> pp. 6 - 14 pp. 8.9 in appendix of coal mining.
<u>Day 6</u>	
a. Name and show on map coal mines in the U.S. b. Discuss the formation of coal. (Teacher should show diagrams of coal formation listed in resources)	
c. The teacher with the students' cooperation will list some products of coal.	<u>Coal</u> pp. 586, 580
d. Have a student bring in a report on mining of coal-the methods used. (For Extra credit) Have all students put mining methods in notebook as report is made.	
<u>Day 7</u>	
4. Electricity from coal	Text

Activities	Resources
a. Have students draw and label a graphic picture of generating electricity from coal for their notes. Display diagrams for these drawings.	"Coal and the Energy Crunch"
b. Produce electricity in class for demonstration.	<u>Science Activities</u> "Electrical Energy" 1,4,8
<u>Day 8</u>	
c. Discuss environmental problems and solutions from burning of coal.	<u>Coal:</u> <u>Environmental Education-Strategies for the Wise Use of Energy</u> "A source book for Educators"
<u>Day 9</u>	
B. Nuclear Produced Electricity	
1. Show the film-"The Mighty Atom" (16 minutes)	Film #202 - Duke Power
2. Study with the class "The Mighty Atom" booklet. Put facts in notebook.	Booklets for students: "The Mighty Atom," Duke Power
3. Have students draw and label graphic picture of production of electricity from a nuclear source.	"The Story of Energy" pp. 8, 9
4. Show films, "Atomic Power Today" and "Nuclear Power"	Films #404 and #405 Duke Power.
<u>Day 10</u>	
5. Teachers must discuss and give notes on nuclear safety. (References in list) a. Film: "The Nuclear Alternative" (20 minutes)	B-400 "The Atom and The Energy Crunch" - Duke Power S.C. Department of Education.
<u>Day 11</u>	
Importance of Electricity in Man's life Today.	
A. Teacher with students' help will list as many uses of electricity in man's life as they can. Discuss each. Have students pu[illegible]e in notebook.	"Energy Conservation in the Home"

Activities	Resources
1. Residential 2. Personal 3. Industrial	
<u>Day 12</u>	
Conservation of Energy	
A. Read the comic - "Mickey Mouse and Goofy Explore Energy Conservation" 1. Discuss this with the students. List in notebooks ways the student may conserve energy. 2. Define energy conservation	Exxon Corporation
B. Show the film - "Joey's World" (25 minutes) 1. Discuss the film	Film #301 - Duke Power
<u>Day 13</u>	
C. Show the film "Paradox of Plenty"	Film #406 - Duke Power
D. Students will list in their notebooks "What I may do to conserve energy".	"The Energy Book"
<u>Day 14</u>	
1. Discuss ways to conserve energy in home. (Some suggestions listed) a. Check hot water heater to find what temperature controls are set on. Reset to 120 one heater, 140 the 2nd heater. b. Keep refrigerator door closed c. Clean frost on refrigerator unit d. Turn cooking range off immediately after use e. Check gaskets around stove door and refrigerator door	"Energy Conservation in the Home"

Activities	Resources
f. Draw draperies in summer and open in winter.	
g. Use natural ventilation when possible.	
2. Conserve energy in car.	
3. Collect for reprocessing aluminum cans, glass bottles, and newspapers	
4. Clean up school yard	
5. Watch for heat energy lost in school plant	
6. Contact administration to correct problems	
7. Find out where reprocessable items may be carried in this vicinity	
8. Check on disposal of waste around home, city, and county	
9. Disposal of agricultural waste.	
<u>Day 15</u>	
E. Give post-test (same as pre-test)	
<u>Suggested Projects</u>	
1. Collect recycleable material. Keep receipts and list them.	"The Energy Book" "Tips for Energy Savers"
2. Regulate electric water heater. Keep record of meter readings by the week. Censor use of hot water.	
3. Check home for efficient lighting. Keep records of meter readings by the week.	Energy conservation in the home.
4. Survey and keep watch on energy waste on school campus. Keep a log of activities by dage.	
Topics are only limited by one's ingenuity.	

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Carey, Helen H. Editor, Award Winning Energy Education Activities, Energy Research and Developmental Administration, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830. Brief description of projects in energy education sponsored by ERDA, 1977.

Catalog, Duke Power Service, P.O. Box 2178, Charlotte, N.C. 28242, Attn: Joseph L. Maher Ph: 704/373-8323. The catalog is a source for films, bulletins, tours, and special programs designed and executed by Duke personnel for classroom energy studies.

Conservation Energy, Alliance to Save Energy, 1925 K, Street N.W., Suite 507, Washington, D.C. 20006. An information brief on energy conservation - a source of energy.

Create Tomorrow, Today March, 1974. This article contains guidelines and instructional tools for use by teachers K-12.

Coal, National Coal Association, Coal Building, 1130 Seventh Street, N.W., Washington, D.C. 28036.

Energy and the Environment, #0740-03011, 1977, Energy Research and Development Administrations, Oak Ridge, Tennessee 37830. An excellent overview of energy.

Energy Choices for Now; Savings, Using, Renewing 1974, National Education Association, 1201 16th Street., N.W., Washington, D.C. 20036. An introduction to energy in the environment.

Energy Conservation in the Home, October 1977, EDM-1028, U.S. Department of Energy, Knoxville, Tennessee 37830. Excellent source for many practical approaches to conservation awareness in the personal life.

Environmental Education - Strategies for the Wise use of Energy. 1974 North Carolina Department of Public Instructions, Division of Science Education, Raleigh, N.C. 27611. Guide for teachers of K-12 that very simply discusses uses of energies applicable to everyone.

Environmental Education: A source Book for Educators, S.C. Department, 1006 Rutledge Building, Columbia, S.C. 29201. A very good source book of ideas for putting environmental problems and solutions into the classroom.

Factsheets, #EDM-1043-19, D.O.E. Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830. Nineteen (19) fact-sheets on fuels from available sources and energy conservation.

Mickey Mouse and Goofy, "Explore Energy," Mickey Mouse and Goofy, "Explore Energy Conservation", Public Affairs Department, Exxon, U.S.A., P.O. Box 2180, Houston, Texas 77001.

McNeill, Royce N., "Putting Energy in the Secondary School Curriculum, "Clemson University, Clemson, S.C. 29631, Attn: Dr. Harold Albert. Contains an abundance of facts on all aspects of coal.

Science Activities in Energy, The American Museum of Atomic Energy, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, Tennessee 37820. These activities contain simple and very practical experiments on energy: Chemical energy, solar energy, and electrical energy.

"The Energy Challenge. What can we do?" Shell Oil Company, Box 2643, Houston, Texas. This pamphlet lists some practical ideas to be put into action by individuals.

"Tips for Energy Savers". Federal Energy Administration, Washington, D.C. 20461. Includes information on energy Conservation around the home, on the road and in the marketplace.

Pre-Test - Post Test

Answer with a YES or NO in the bland provided.

______1. Could we live without using energy?

______2. Does food supply body energy?

______3. Does solar energy produce food indirectly?

______4. Is wind an energy source?

______5. Does electricity supply energy?

______6. Is coal used to produce electricity?

______7. Is nuclear energy used to produce electricity?

______8. Does coal burning pollute the air?

______9. Could energy be obtained from water falling over a dam?

______10. Does a light bulb use energy?

______11. Does recycling aluminum drink cans help conserve necessary materials?

______12. Does a 100 watt incandescent bulb produce more light than a fluorescent bulb of 25 watts?

______13. Can drapery help insulate a house?

______14. Does car exhaust pollute the air?

______15. Would using cold water in doing laundry save energy?

______16. Would wearing permanent press clothing/material save energy?

______17. Would riding in a car pool save energy?

______18. Does a shower use more hot water than a tub bath?

______19. Does television give off radioactive rays?

______20. Could I conserve energy?