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ABSTRACT

This manual is a resource guide on energy conservation for teaching environmental education in grades seven to twelve. It contains 25 student activities which are grouped into four goal oriented units. The main objectives of the project are to increase the student's understanding that: (1) Natural laws limit energy availability; (2) Energy consumption affects both man and his environment; (3) Human values and attitudes affect energy usage; and (4) Energy consumption is necessary to maintain our lifestyle. (SB)

IDAHO
ENERGY CONSERVATION RESOURCE GUIDE
for
ENVIRONMENTAL EDUCATION GRADES 7-12

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"The Energy Crisis can be the most effective teaching aid of the decade"

S. David Freeman
Commissioner
Tennessee Valley Authority

INTRODUCTION

In recent years Idahoans have become increasingly concerned about the energy situation and aware of the importance of energy in our lives. Experts now tell us that unless some immediate steps are taken we will not be able to provide for our future energy needs as a nation. New research and technology can alleviate part of the problem but, more immediately, we must reduce energy use. An effective energy conservation program can result in substantial energy savings, extend the life of present energy supplies, and provide us the much needed time to explore alternatives.

Traditionally, the educational system of our country has been called on to explore and resolve societal problems. The energy situation is a unique opportunity for educators since it reflects a complex set of problems that require changes in values, attitudes and lifestyles. The instructional program in a school can examine these problems and can assist in student awareness of the alternatives and consequences of energy decisions.

This resource guide has been prepared to assist teachers in incorporating energy concerns within the school curriculum. It is intended to provide a basic framework of objectives for different subject areas and to provide examples of activities for teaching towards the stated objectives. Resources are listed to aid the teacher in developing additional activities. It is anticipated that these materials will be a starting point and that teachers will go farther in this important area of instruction.

ENVIRONMENTAL EDUCATION

Environmental education may be either a formal or informal part of a curriculum. In either case, Environmental Education is unique; it is an attitude as well as a subject area. For purposes of this guide, Environmental Education has the following characteristics:

1. Environmental Education encourages respect for ourselves, for others, and for the world around us.
2. Environmental Education encourages us to tackle problems from more than one point of view.

In short, Environmental Education asks us to examine our personal attitudes toward our environment and toward the people who share it with us.

This guide emphasizes the following environmental concepts:

1. All living and non-living things are related and interdependent.
2. The availability of natural resources influences our quality of life.
3. Many factors influence our values.
4. Unless we plan ahead, short-term gains may be long-term losses.

IDAHO ENERGY CONSERVATION RESOURCE GUIDE

PROJECT GOALS

This project has four goals. They are easily recalled by the following acronymn:

LUV Energy Conservation

LUV represents the key words in the first three goals.

These key words are:

1. Laws
2. Use
3. Values

The fourth goal is Energy Conservation

Goal 1. Natural LAWS determine the availability of energy.

There are conditions and limits to our use of energy. Activities under this goal describe what energy is, what forms it takes, and how it can be converted from one form to another. These activities emphasize that all earth's resources are limited.

Goal 2. USE of energy affects both people and their environment.

Everyone depends upon energy. Activities under this goal examine how energy use affects both our natural environment and our economic, political and cultural systems. These activities emphasize that energy use influences the lifestyle for both present and future generations. Lifestyle, in turn is influenced by our choice of technology.

Goal 3. Our VALUES determine how we use energy.

Energy problems can not be solved by technology alone. Activities under this goal encourage us to analyze our personal energy habits and to accept the responsibility for our actions. They emphasize that changes in energy use and changes in values and attitudes are interrelated. These activities offer us some tools for gathering information, for making decisions, and for providing input to our economic, political and cultural systems.

Goal 4. ENERGY CONSERVATION is necessary to maintain our lifestyle.

There are both long-run and short-run solutions to energy problems. Activities under this goal encourage the development of both new energy sources and of more efficient ways to use energy. They emphasize that energy conservation is an effective and essential tool.

Teacher Note: Use this as a pre and post survey to see if the study of this material has affected change student attitudes.

ENERGY ATTITUDE SURVEY

1. Do you believe there is an energy shortage? ___yes ___no ___ don't know

2. Do you believe you have been given a realistic picture of the energy situation facing the United States? ___yes ___no ___ don't know

3. Do you believe most Americans are energy "wasters"? ___yes ___no ___ don't know

4. Do you believe most Americans are energy "conservers"? ___yes ___no ___don't know

5. Do you believe Americans are"spoiled", self indulgent and reluctant to take responsibility for the future? ___yes ___no ___ don't Know

6. Do you believe it is the responsibility of every U.S. citizen to conserve energy voluntarily? ___yes ___no ___ don't know.

7. Do you believe Americans will conserve energy only when government controls are imposed? ___yes ___no ___ don't know

8. Would you be willing to reduce your standard of living to conserve energy? ___yes ___no ___ don't know

9. Do you believe you as an individual can make an impact on energy consumption? ___yes ___no ___ don't know

10. Would you conserve energy to save money? ___yes ___no ___don't know

11. Do you think the money saved is worth the inconvenience of conserving energy? ___yes ___no ___ don't know

12. Do you think the energy saved is worth the inconvenience of conserving energy? ___yes ___no ___ don't know

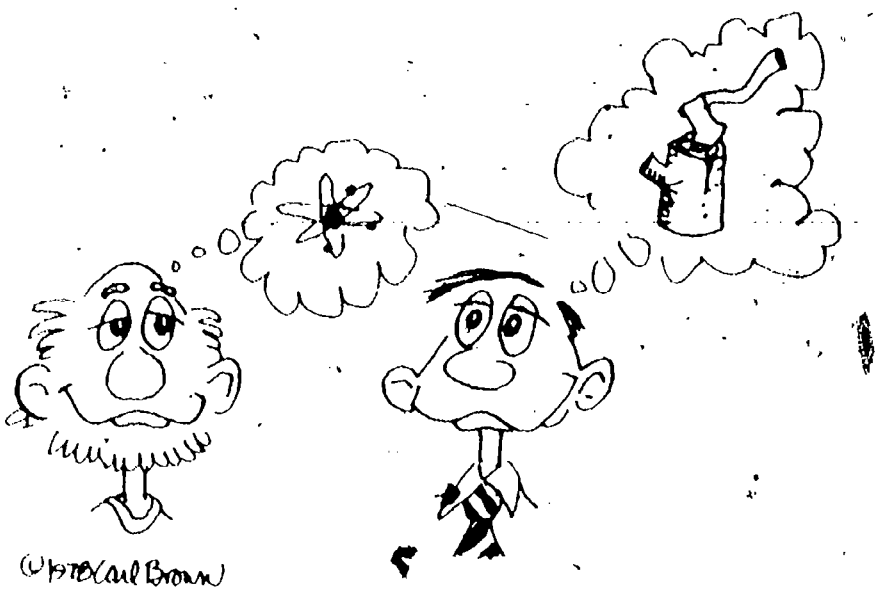
13. Do you feel technology will "bail us out" of the energy shortage? ___yes ___no ___ don't know

14. Do you feel you have any input or participation in the energy usage decisions made by your family? ___yes ___no ___ don't know

15. Are you going to do something to save energy? ___yes ___no ___don't know

Take a tally for the Energy Attitude Survey and find the percentages for each response.

GOAL 1: NATURAL LAWS DETERMINE THE AVAILABILITY OF ENERGY.



Activity 1 - Energy Sources

Objective: The student will be able to identify different energy sources and analyze their advantages and disadvantages.

Resource: NSTA Energy Fact Sheets

Procedure: Research the pros and cons of using different sources of energy.

Hold a class debate or discussion about the energy sources that are most available and appropriate for your area.

Write a report about different energy sources that you would consider using in your own home. You may want to sketch how they would be included in your overall houseplan.

Activity 2 - Wind Power

Objective: The student will be able to demonstrate that energy can be transformed from one form to another.

Resources: Library Resources: Ask for information on using wind energy.

Write to:

Public Information Division 3161
Sandia Laboratories
Albuquerque, New Mexico 87115

Project Weathervane Pamphlet
Seattle City Light
1015 Third Avenue,
Seattle, Washington 98104

Procedure: This activity can be used to motivate the students to trace power (movement of air) back to its original energy source (the Sun) and speculate on further uses of this mechanical energy.

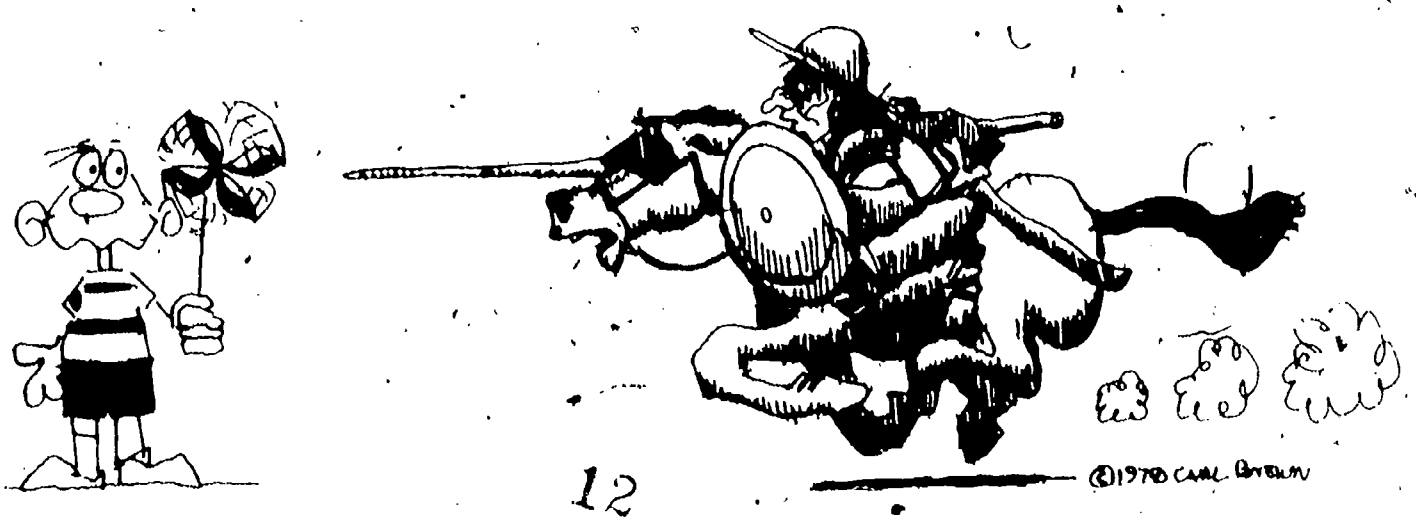
Since energy cannot be created or destroyed, let the students trace the energy pathway backwards as far as they can. We usually regard the sun as the ultimate energy source, but is the sun "creating" energy or just changing its form?

Have the students construct several pinwheels from plastic over-head projector sheets, a pin and a small stick (a pencil will do).

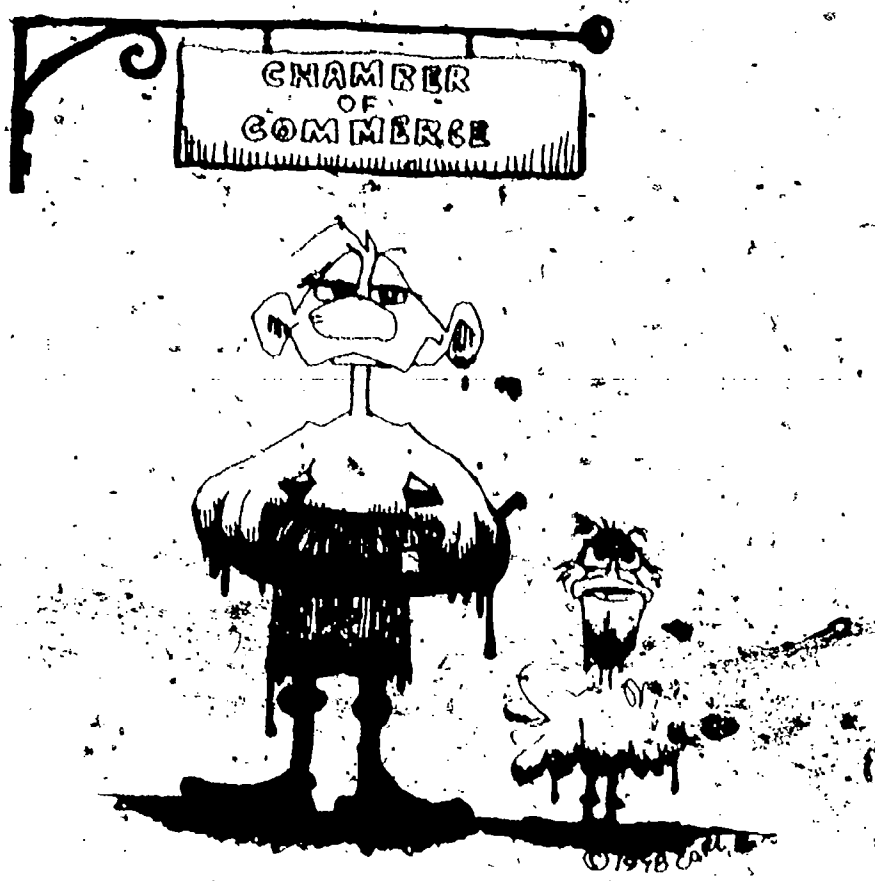
Go outside and demonstrate the production of mechanical energy. Look for the windiest spots on the schoolyard and experiment with wind speed at various elevations such as on the fire escapes as opposed to ground level.

The rotating pinwheel is mechanical energy. In what ways can this energy now be used? LET THE STUDENTS USE THEIR IMAGINATIONS.
Discuss the following questions:

1. Can a house be supplied with all its energy from a giant pinwheel?
2. What are some problems involved with wind energy?



GOAL 2: USE OF ENERGY AFFECTS BOTH PEOPLE AND THEIR ENVIRONMENT



Activity 1 Good Morning Class

Objective: The student will be able to experience how his/her actions change the environment,

Resources: "Green Box"
Environmental Education Activities
Humboldt County Schools
Eureke, California

Procedure: Homestead the classroom. In groups of six students each, select a corner of the classroom to homestead. Make it a more enjoyable place by moving books, furniture around. Consider other things in the classroom you would like to change. How can you do this and still consider the other "homesteaders" in the classroom? Energy questions could easily be brought into this activity.

Example: The power needs for each homestead and the availability in the classroom could be considered.

Activity 2 Designing your Dreamhome

Objective: For the student to be able to design an energy efficient home.

Resources:

1. Energy conservation in the home PP. 27-75 Activities A, B, C, and K.
2. "Tips for Energy Savers" PP. 9-13 and 34-35.
3. Award Winning Energy Activities PP. 30-31
4. Your Energy Efficient House: Building and Recycling Ideas.
5. Low-Cost Energy Efficient Shelter for the Owner and the Builder

Procedure: Each student will work with a partner to design a dream home. In addition to fulfilling the dreams of the student-designers, the home will be energy efficient.

1. Hold a class discussion about how the following considerations can affect the energy-efficiency of a home:
   1. Prevailing wind direction
   2. Direction of sunshine
   3. Choice of building site
   4. Evergreen and deciduous trees
   5. Shape of Home
   6. Amounts of Insulation
   7. Size and placement of doors and windows
   8. Type of building materials

2. Agree with your partner on a general design for your home.

3. Check your design against the energy considerations discussed in class. Modify your design to improve the energy efficiency of your home.

4. One partner will draw the final floor plan of the home. The other partner will sketch the outside and landscaping of the home.

5. Share your design ideas in a class discussion.

Activity 3 Food and Energy

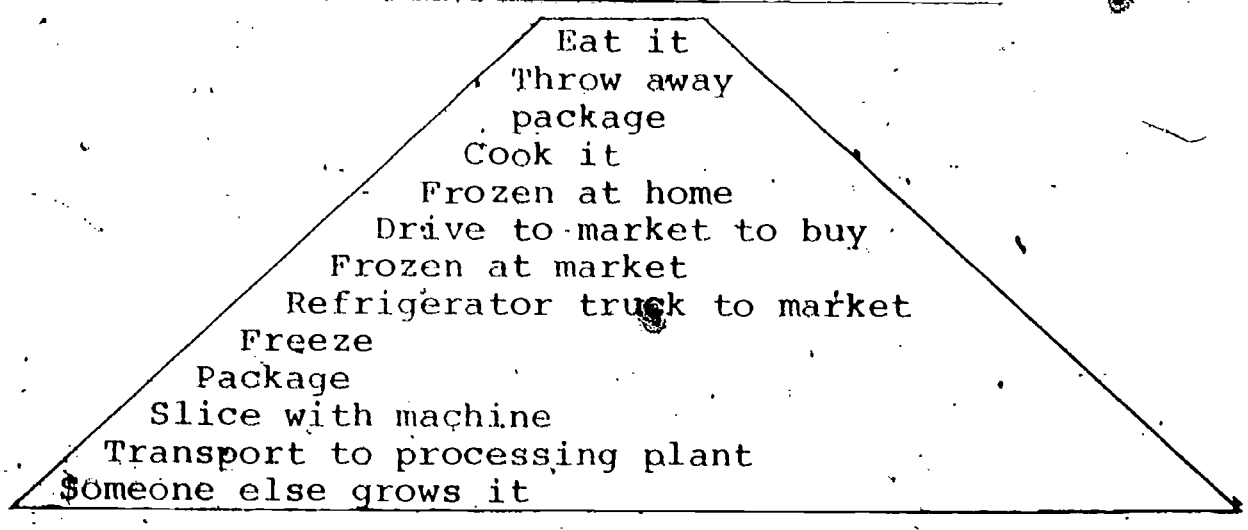
Objective: For the student to be able to describe the different amounts of energy required to supply different kinds of food.

Resources:
1. Energy Conservation in the Home, pp. 124-138. Activities L and N.
2. Energy and Man's Environment "Energy Used in Providing Food".

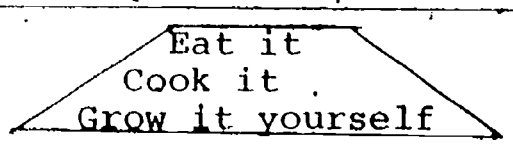
Procedure: Different foods and different methods of food preservation require different amounts of energy. Our choice of food greatly influences the energy demands of the world.

The amount of energy used to produce food can be illustrated by means of an "Energy Pyramid". Each step on the pyramid represents the use of energy. For example:

ENERGY PYRAMID FOR FROZEN CARROTS



ENERGY PYRAMID FOR FRESH GARDEN CARROT



1. Students will suggest different kinds of food (such as freeze dried ice cream or fresh fish) to be diagrammed on the chalkboard.
2. Discuss what kinds of foods conserve energy resources.
3. Are you willing to change your food habits to save energy? Why or why not?

Activity 4 Energy for your Community

Objective: For the student to be able to explain the trade-offs necessary to provide energy to a community.

Resources:
1. Energy Fact Sheets
2. Energy Environment Source Book, Chapters 2, 6, and 7.
3. Idaho Office of Energy
4. Idaho Public Utilities Commission
5. Local utility company
6. Local citizen conservation group

Procedure: Each community decides what energy sources it will develop. The community can develop local sources, such as solar energy. Or it can tap into distant sources such as foreign oil. The decision greatly influences the future of the community.

1. Find out (a) the present energy sources for your community and (b) how long the sources will meet the needs of your community. Allow at least two weeks for a reply.

2. Once you receive the necessary information, discuss the following questions:

   A. What environmental problems are caused, or may be caused by your community's present energy sources?

   B. How could your present energy sources be disrupted or destroyed?

   C. Will your present energy sources meet the needs of your generation? The needs of your children?

   D. What renewable sources of energy are possible for your community?

3. Hold a "community meeting" with your classmates.

   A. Discuss the pros and cons of different energy sources available to your community.

   B. Choose, by popular vote, an energy source (or combination of sources) that will meet the needs of your community until the year 2000.

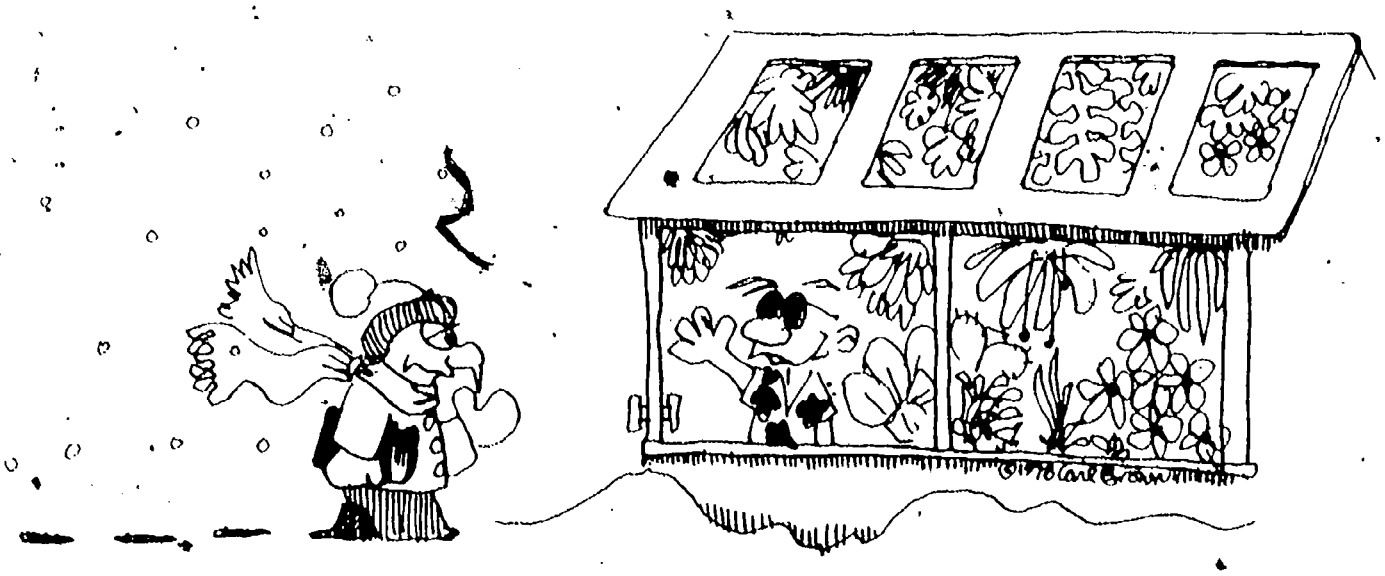
Activity 5: Which Home Would you Want?

Objective: For the student to be able to compare different types of building materials and insulation.

Resources: Energy and Man's Environment Activity #50

Procedure:

1. Build a number of tiny "mini-houses".
2. Determine variables you wish to study and vary house as needed.
   a. types of insulation
   b. types of materials in house itself
   c. number of windows
   d. building style
   e. surfaces of differing colors
   f. varied thicknesses
3. Make temperature checks inside each house at planned intervals, keep record of data.
4. Compare and choose your favorite "energy-wise" house.



Activity 6 Energy for Fun

Objective: The student will be able to explain the relationship between standard or living and energy use.

Resources: Energy and Man's Environment Activity #52

Procedure:

1. Each student will make a list of five leisure activities he/she enjoys.

2. The student will rank the activities from the most enjoyable to the least enjoyable, using this scale: 3 - most enjoyable activity; 2 - second most enjoyable activity; 1 - third most enjoyable activity; 0 - activity he/she could do without.

3. The student will place a dollar sign next to each activity that costs money each time it is performed.

4. The student will assign an energy point value to each activity. Scale: 3 - consumes major amount of energy; 2 - consumes moderate amount of energy; 1 - consumes very little energy; 0 - consumes no energy.

5. The student will assign a frequency of use point value to each activity. Scale: 3 - activity performed frequently; 2 - activity performed occasionally; 1 - activity performed seldom.

6. The students will consider that they have learned about themselves as a result of this exercise.

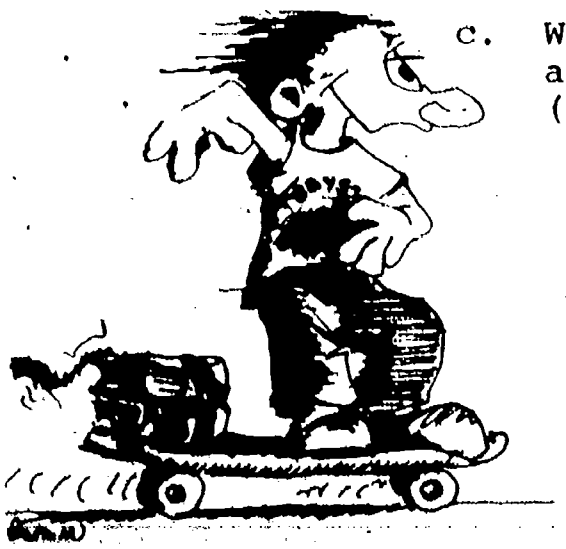
7. The teacher will explain to the class that a severe energy crisis has occurred and all people must conserve at least 50 percent of their energy use. Students will be advised to choose which activities they will eliminate or curtail in order to cut their energy consumption 50 percent.

8. The teacher will ask the students the following questions:

   a. Are you willing to reduce your energy consumption by 50 percent? Why or why not?

   b. How did you conserve energy? Which activities did you reduce?

   c. What types of activities can we do that are fun and do not require nonrenewable energy resources (gas, oil)?



GOAL 3: OUR VALUES DETERMINE HOW WE USE ENERGY.

Activity 1 "Either - Or"

Objective: For the student to be able to explain that different people have different values.

Resources: "Energy Fact Sheets", N.S.T.A.

Procedure: This activity contains three facts with two choices each. The class is asked to form a debate team to research and debate the facts and the choices.

Example of a fact and its choices:

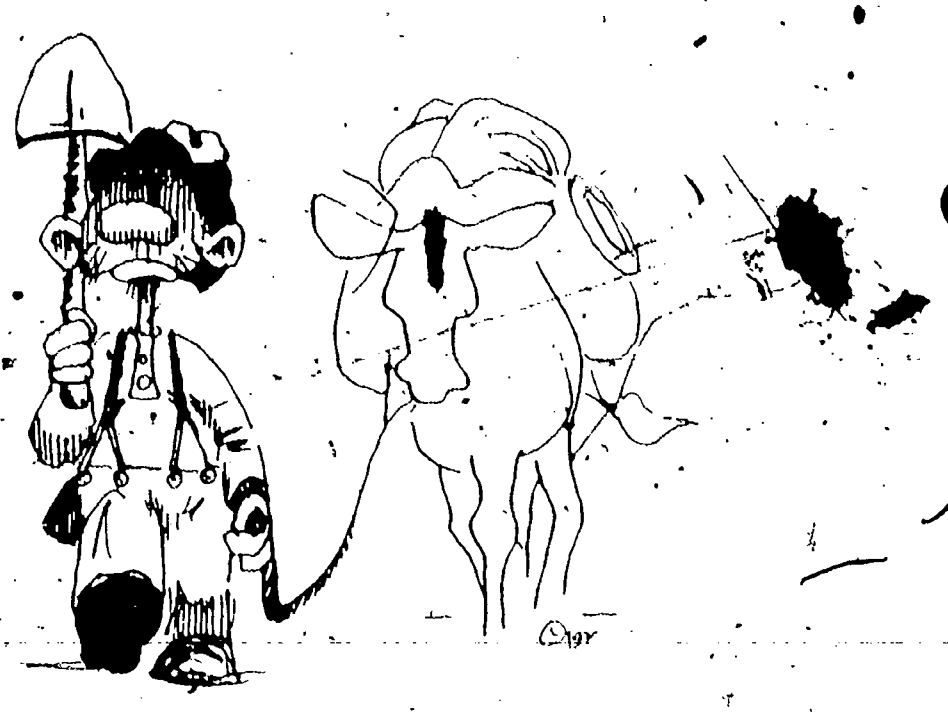
Fact: The cost of meat is high.

Choices: a. Do we encourage more hunting and fishing to supply our families a possible cheaper source of meat; or

b. Do we change our eating habits and replace meat with another source of food?

c. Do you have another solution? Explain.

The effects of energy availability upon shortages of other natural resources could be emphasized during these debates.



Activity 2 "On the Move"

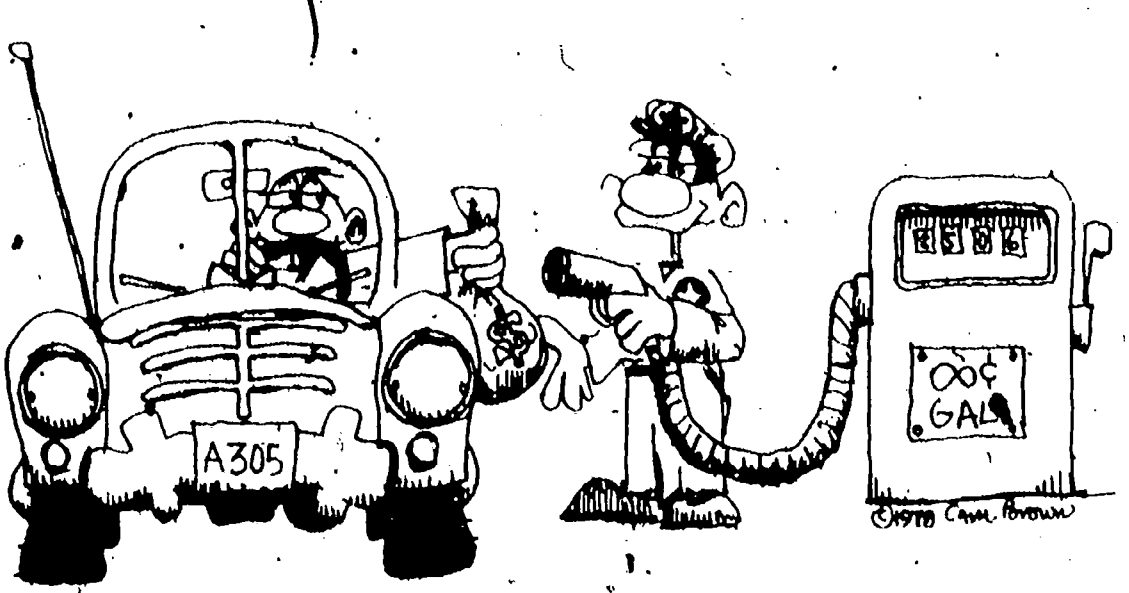
Objective: For the student to be able to analyze the energy efficiency of different vehicles.

Resource: Green Box

Procedure: A politician running for re-election on a platform of cutting down on energy use in the U.S.A. recently stated, "We need two Hondas (car type) in every garage." Does this sound like a way to use less energy?

Investigate:

Make a list of five foreign made cars and five American made cars. Keep an actual record of the amount of miles driven and the amount of gas used to travel these miles. Calculate the average miles per gallon of gas for your car. Share your findings. Now, what do you think the politician was saying?

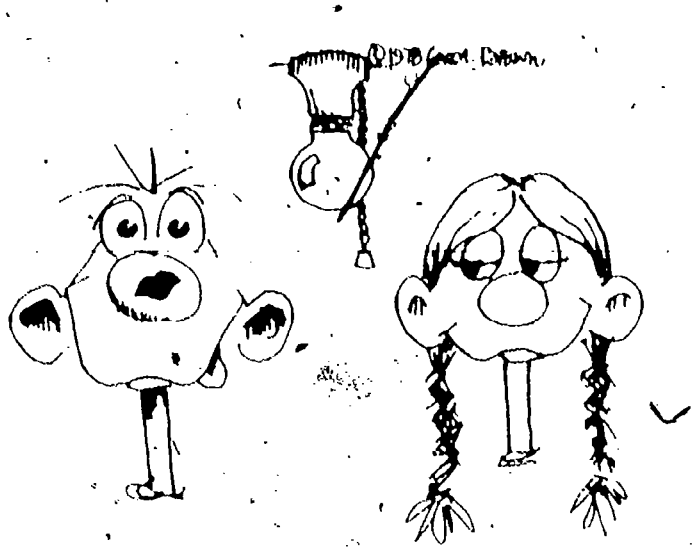


Activity 3 Twenty Things I love To Do

Objective: For the student to be able to prioritize their needs and wants

Resource: Energy Conservation in the Home

Procedure: List twenty things you like to do. Put:



B beside the things that make other people happy
H beside things that hurt other people
D beside those things that make some people happy but also makes some people unhappy
F beside those things you prefer to do alone
X beside those things you wouldn't be able to do if care isn't taken with the people in your environment

Prioritize your list.

Make up your own ratings concerning how the things you like to do affect the physical environment. Consider pollution, use of resources, energy costs, etc.

Activity 4 A Personal Energy Conservation Activity

Objective: For the student to state his/her own, personal Conservation ethic.

Resources: 1. Energy Conservation in the Home pp. 23-26 and Activity W.

2. An Environmental Syllabus grades 10, 11, 12 Unit 10.

Procedure: Each student will develop a written description of his/her own "Personal Energy Conservation Ethic".
The purpose of the "Ethic" is to guide the student's daily use of energy.

Before the actual writing, the students should discuss the following, then keep them in mind when writing their individual ethics:

1. What is an ethic?
2. What is energy conservation?
3. What are the differences between essential needs and non-essential desires?
4. What are some examples of both good and poor energy conservation actions?
5. What are you willing to do for the sake of energy conservation?

After it is written, students may want to share their ethic with the class. The class could then discuss the following:

1. What factors might change your energy conservation ethic in the future?
2. How can you encourage other people to develop and practice an energy conservation ethic?

Activity 5 Is Your School Energy Efficient?

Objective: For the student to be able to evaluate the energy-efficiency of his/her school.

Resources:
1. Energy Conservation in the Home
   Units 3, 4 and 10 & Activities S, T, and U.
2. "Energy Economy and Education" in Award Winning Science Activities. Page 19.
3. Idaho Office of Energy

Procedure: Schools waste more energy than most other kinds of buildings. This waste is caused by the design of school buildings and by the way people use school buildings.

1. For one week, keep notes on how energy is wasted in your school. Include energy wasted both by building design and by the way people use the building.
2. At the end of the week, compile your observations into a class list. Then discuss the following questions:
   a. What changes in the design of your school could save energy?
   b. What changes in the behavior of people could save energy in your school?
   c. How could people be encouraged to conserve energy in your school?

Activity 6 What We Need and Want

Objective: For the student to be able to explain how his/her values influence his/her use of energy.

Resources: Caldwell Environmental Education Project

Procedure: What We Need and Want

Have each student make a complete list of everything they need or want. The list should include everything from food items to clothing, skateboards, motorcycles, etc.

When the lists are complete, ask the students to rank each item as to whether the item is necessity, a convenience, or a luxury.

The first thing which will occur is that there will need to be some clarification of what is a need, a convenience, or a luxury. Secondly, some items are difficult to categorize, and what is a necessity to one person may be a convenience or a luxury to another.

Let this discussion flow freely, for this is where each child will begin to examine his/her values about consumer practices.

This activity should be left open-ended as there are no "right" or "wrong" answers and is intended as a lead-in for further discussion. Have the students keep their lists for future use.

Ask the students to contemplate the following questions:

1. Of the items on your list, are there items which do "work" for you?

2. Do these items consume energy to do work?

3. Could you save money or resources by doing this work yourself?

4. Would it be healthful to do this work?

   (This would be a good spot to discuss the "need" for such things as electric tooth brushes, hair dryers, curling irons, power lawn mowers, etc.)

5. Are there items on your list that you want just because this year's model is slightly better or different from last year's model? What about clothing fashions, or do you really need a new pair of skis when last year's skis are still usable?

6. Are there items on your list that you want because you think they will make you more popular or because "everybody" else has that item?

7. Of the products you want, how many will last for a long time? Can these products be easily repaired or will you throw it out if it breaks?

8. Can the product be used by someone else when you no longer want it?

Wrap up the discussion by pointing out that consuming things is not in itself an "evil" thing - in fact our economy depends on it, but if we are to insure future generations their share of resources, we need to stop wasting resources.

Related Activities:

1. Collect pictures from magazines that illustrate items which are strictly luxury items.

2. Differentiate between advertisements and commercials that develop attitudes that contribute to environmental quality and those that call on people to purchase commodities having adverse consequences.

3. Discuss what the difference might be between the role of a consumer and the role of a citizen in resource conservation.

Activity 7 A Look at Wasteful Practices

Objective: For the student to be able to describe what percentage of his/her activities fall under each of the following topics:

1. Necessities
2. Conveniences
3. Luxuries

Resources: Activity #6 "What We Need and Want"

Procedure: "A Look at Wasteful Practices"
Have the students go back to their original "need and want" lists. Ask them to count the total number of items on their lists and then count the number of needs, the number of conveniences and the number of luxuries. Calculate what percentage of their needs and wants fall into each category.

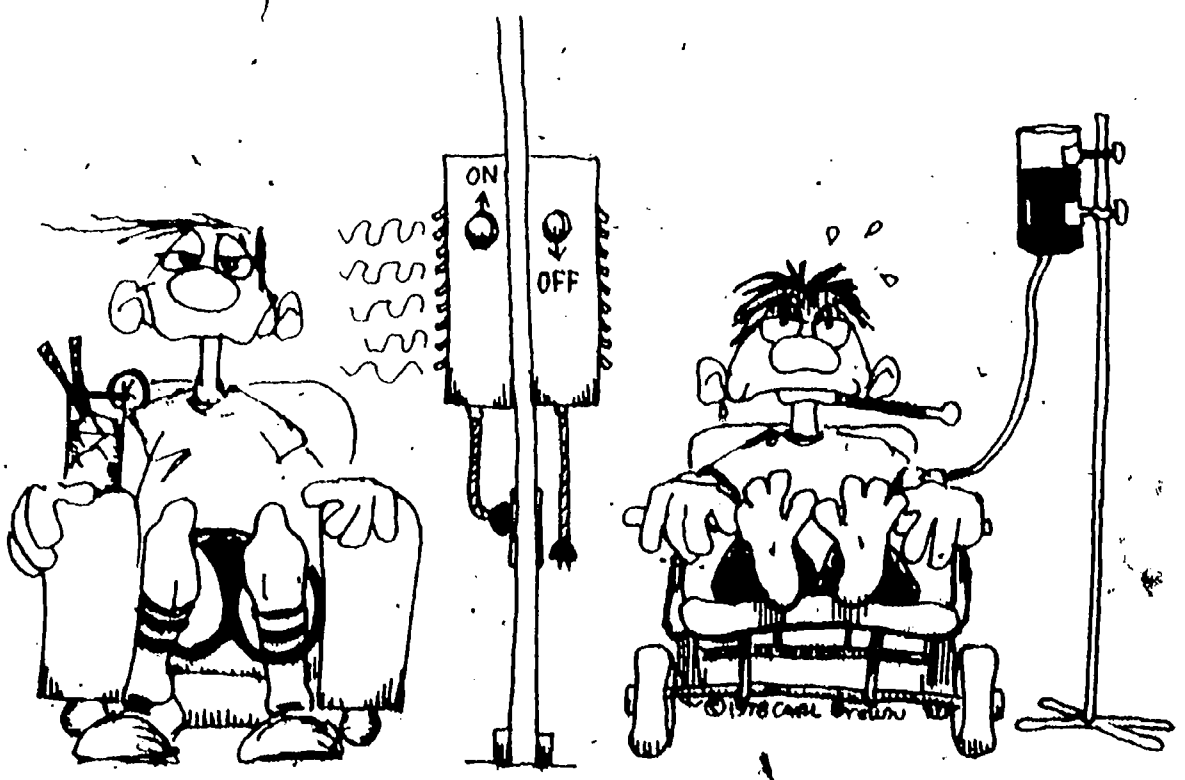
Example:

Total items of list = 19
Number which are necessities = 6
Number which are conveniences = 4
Number which are luxuries = 9

Necessities = 6/19 = 31.5%
Conveniences = 4/19 = 21%
Luxuries - 9/19 = 47.3%

Follow-up with discussion of the following questions:

1. Do the percentages surprise you?
2. Are luxuries necessarily bad?



Activity 8 Our standard of living

Objective: For the student to be able to explain how availability of natural resources, including energy, influence the quality of life.

Resources: Cardwell Environmental Education Project

Procedure: "Our Standard of Living"
Have the students research, or hold a class discussion, on how their lives would be different if they were to move from America to one of the underdeveloped countries. Compile a master list on the chalkboard of the goods and services which would not be available to them in an underdeveloped country.

The following questions can help guide the discussion:

Upon what are these goods and services dependent?

1. What is a natural resource?
2. What is a renewable resource?
3. What is a non-renewable resource?
4. What is meant by "standard of living"?
5. How is the standard of living related to natural resources?
6. What are some natural resources of the United States?
7. What are some natural resources which we must get from other countries?
8. Do all countries have equal amounts of natural resources?
9. What will happen to the demand for natural resources as the standard of living improves in underdeveloped countries?
10. What will happen to the demand for natural resources as the world population grows?
11. How do natural resources affect the economy of a nation?
12. If our economy depends upon the use of natural resources, and natural resources are in limited supply, what can we do to help conserve resources?

Related Activity:

Discuss what is meant by the statement: "Economic efficiency does not always result in conservation of natural resources". Or the statement: "Short term gains may mean long term losses."

Activity 9 The Recycling Program

Objective: For the student to be able to explain what materials are accepted by recycling centers and to be able to locate local recycling centers.

Resources: Caldwell Environmental Education Program

Procedure: The Recycling Problem

A large proportion of the materials we use can be recycled. One reason why more material is not recycled is that current waste pickup systems are not geared to separate the different materials which can be recycled.

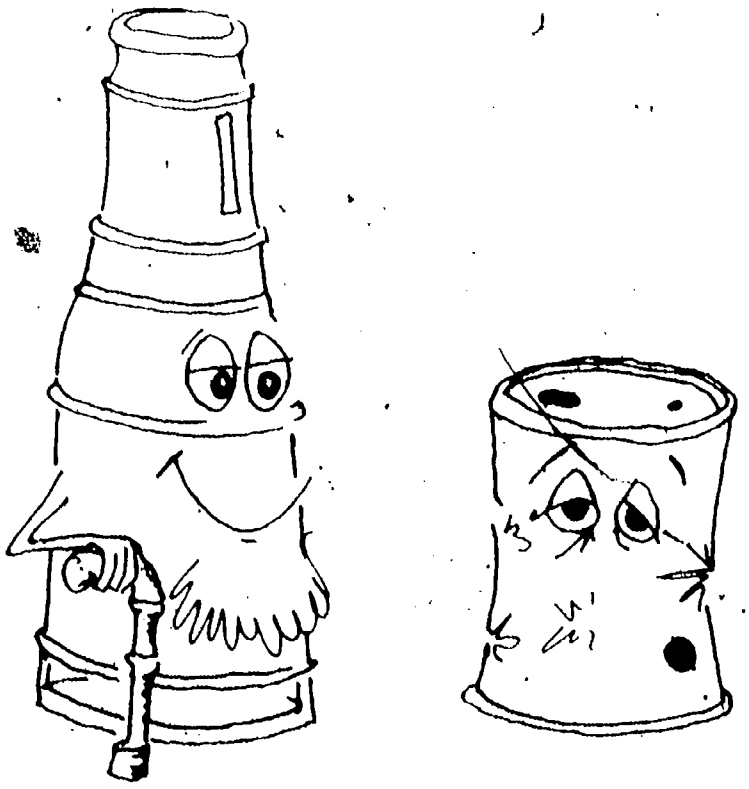
The only way to prevent these resources from ending up in the sanitary landfill is for each household to be responsible for separating and recycling the waste products.

It should be most enlightening to the students to realize how many recycling centers there are in our area and how many different things can be recycled. Attached to the end of this activity is a list of Boise recycling centers, what they will take, and the prices paid for various materials. Recycling centers in other areas of Idaho can be found in the Yellow Pages of local phone directories.

Xerox a copy of the recycling information for each student.

After the students have had an opportunity to study the recycling sheet, have them list things that their families are now throwing out but which could be recycled.

Ask each pupil to choose one thing which he/she could be responsible for recycling (they could collect from other families in their neighborhood also). Make periodic checks to see if the students are following through on their commitments and if they are, have them report their projects to the class or write an article for the school paper.



You may want to discuss why recycling programs often fail and what can be done to make them more successful.

Related Activity:

Invite a local businessman or recycling center operator to speak to the class about resource recycling.

RECYCLING CENTERS

ABC Recycling, Yamhill Road, Boise		336-2682
	Appliances	Does not buy
	Loose tin (car fenders)	Does not buy
	Car Bodies	Does not buy
	Iron	Does not buy
Boise Recycling Center	707 Lander	344-8717
	Glass	
	Tin	
	Paper (no magazines)	
	Aluminum	
General Recycle	3400 Warm Springs Ave.	336-4593
	Paper (colored)	1¢ per pound
	Newspaper	1¢ per pound
Koppel & Co. Browzeville	30th and Fairview Ave.	344-3531
	Brass	24 - 32¢ per pound
	Batteries	$1.00 - $1.50 per battery
	Car Radiators (no iron)	26¢ per pound
	Copper	25¢ - 40¢ per pound
	Scrap	$20.00 - $35.00 a ton
	Newspaper	1 1/2¢ per pound (bundled & tied)
	Computer Cards	3¢ per pound
	Lead	10¢ per pound
	Aluminum cans	10¢ per pound
	Other Aluminum	18¢ - 25¢ per pound
Northern Iron and Metal Co.	308 S. 25th Street	344-2640
	Car Tin	$10.00 a ton
	Scrap Iron	$18.00 a ton
	Aluminum	20¢ per pound
	Aluminum Cans	10¢ per pound
	Copper	30¢ per pound
	Lead	10¢ per pound
	Brass	25¢ per pound
	Car radiators	20¢ per pound
	Batteries	$1.25 per battery
Reynolds Aluminum Recycling Center	4338 Chinden Boulevard	377-0500
	Aluminum Cans	17¢ per pound
	Pie Pans	17¢ per pound
	License plates	17¢ per pound
	Storm window frames	17¢ per pound
	No cooking pots	
	No Cast or forged matals	

RECYCLING CENTERS (continued)

Operation Squirrel	612 1st S. Sunnyridge	466-9504
Glass		Does not buy
Aluminum		17¢ per pound
Newspaper		1 1/2¢ per pound
Plastic		Does not buy (uses for fuel)
Used grease		Does not buy
Cardboard		Does not buy
Computer cards (high quality		2 1/2¢ per pound
TJT Recycling Inc.	Highwy. 52 and Idaho Blvd.	336-7447
Tires		$8.00 a tire (trailer house tires)
Axels (trailer house)		$10.00 per axel
Tags (don't have brakes)		$16.00 per axel
Western Recycling	225 Broadway Ave.,	343-9036
Aluminum		15¢ per pound
Newspaper		1 1/2¢ per pound
IBM paper		2¢ per pound
Cardboard		Does not buy small amounts (baled $15.00 a ton)
IBM cards		3¢ per pound

* Prices are subject to change.

Activity 10 Crisis

Objective: For the student to be able to prioritize his/her energy consumption.

Resources: Energy and Man's Environment, Activity #58

Procedure: Students will consider the choices to be made if a large scale natural disaster were to strike the United States, severely impairing electric power sources.

1. The teacher will divide the class into small groups representing various groups such as:

   a. city government workers
   b. factory workers
   c. consumers
   d. service industry workers
   e. school employees

2. Each group will meet and list its energy needs and priorities in written form. One representative from each group will report on his/her group's decisions for the community to the class. The class as a group will determine priorities for the entire community as to who will get the available power and to what degree.

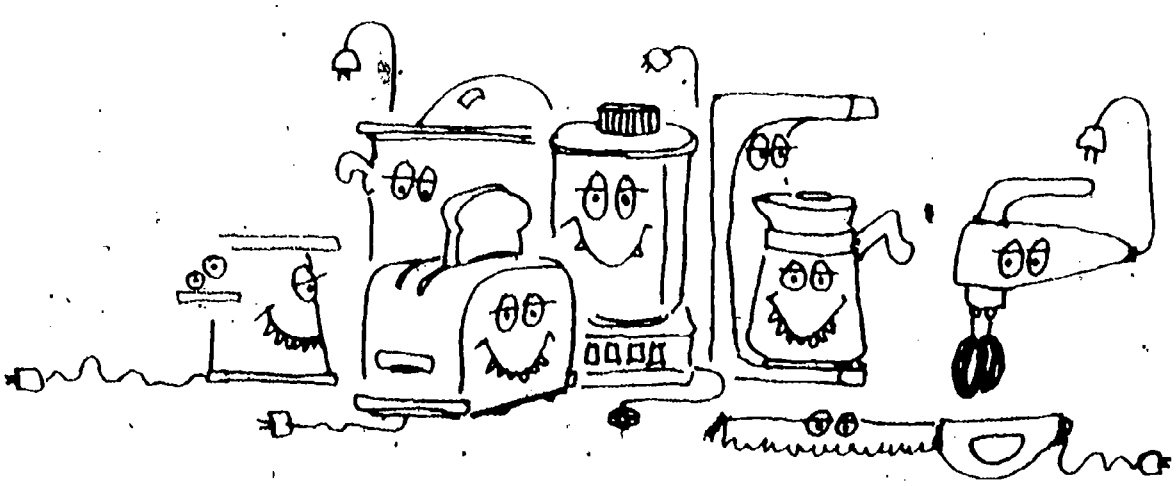
Related Activity

The teacher will ask students how they would react in a personal situation such as:

A recent violent storm has damaged local electrical power sources so that electricity in the area must be rationed in private homes to allow adequate supplies to local hospitals and other users.

The teacher might ask questions such as:

a. If you knew that the air conditioner and other appliances continued to be used in your best friend's home how would you react?
b. What would you do about it?
c. What should you do about it?



GOAL 4: ENERGY CONSERVATION IS NECESSARY TO MAINTAIN OUR QUALITY OF LIFE.

Activity 1 Family Actions That Save Energy

Objective: For the student to be able to explain successful methods of energy conservation used by individuals and families.

Resources:
1. Energy Conservation In the Home Activity X
2. Tips for Energy Savers

Procedure: Saving energy doesn't demand drastic changes in life-style. Small changes add up to big savings. In fact, your family probably saves energy in ways worth sharing with others.

I. 1. Ask each member of your family to describe his/her best energy saving habit.
2. As a family, list ways that your family could save even more energy. Choose one action that the family thinks it can live with. Then give it a try for one month.

II. With your class, discuss the following:
1. Energy saving actions already used by families.
2. Energy saving actions agreed upon by families. (Some families may not agree on an action - don't push it)

III. 1. After one month, ask your family to evaluate the success of their "Energy Saving Action". Is it working? Why or why not?

2. Hold a class discussion to determine what actions usually work and what actions usually fail.

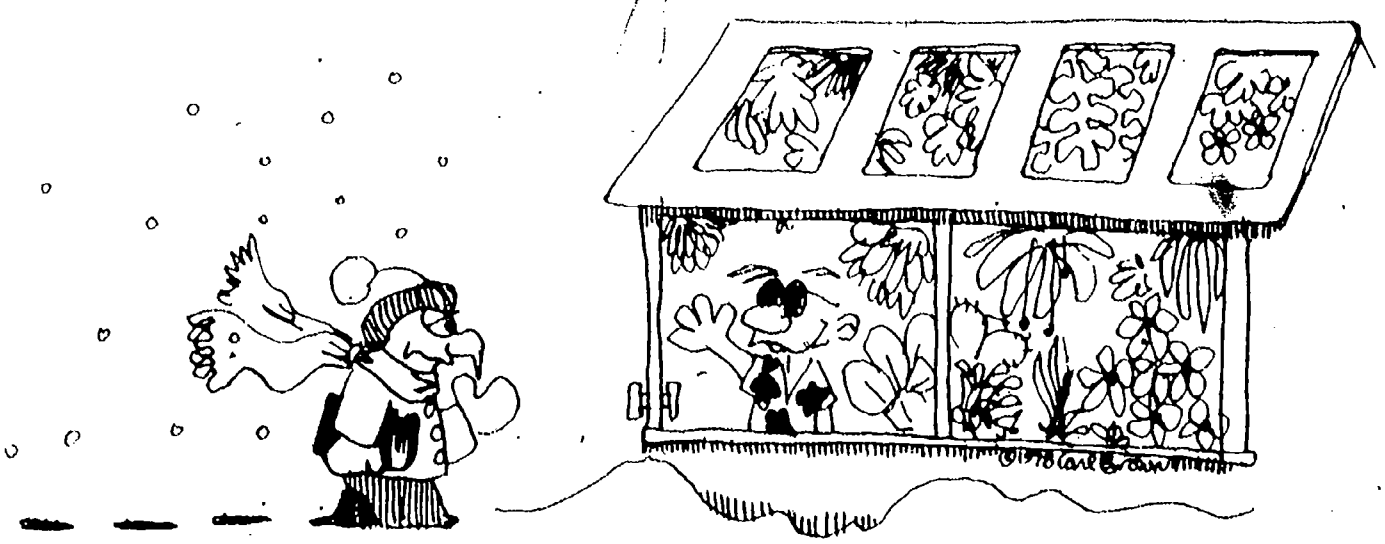
Activity 2 How Can I Save Heat In My Home?

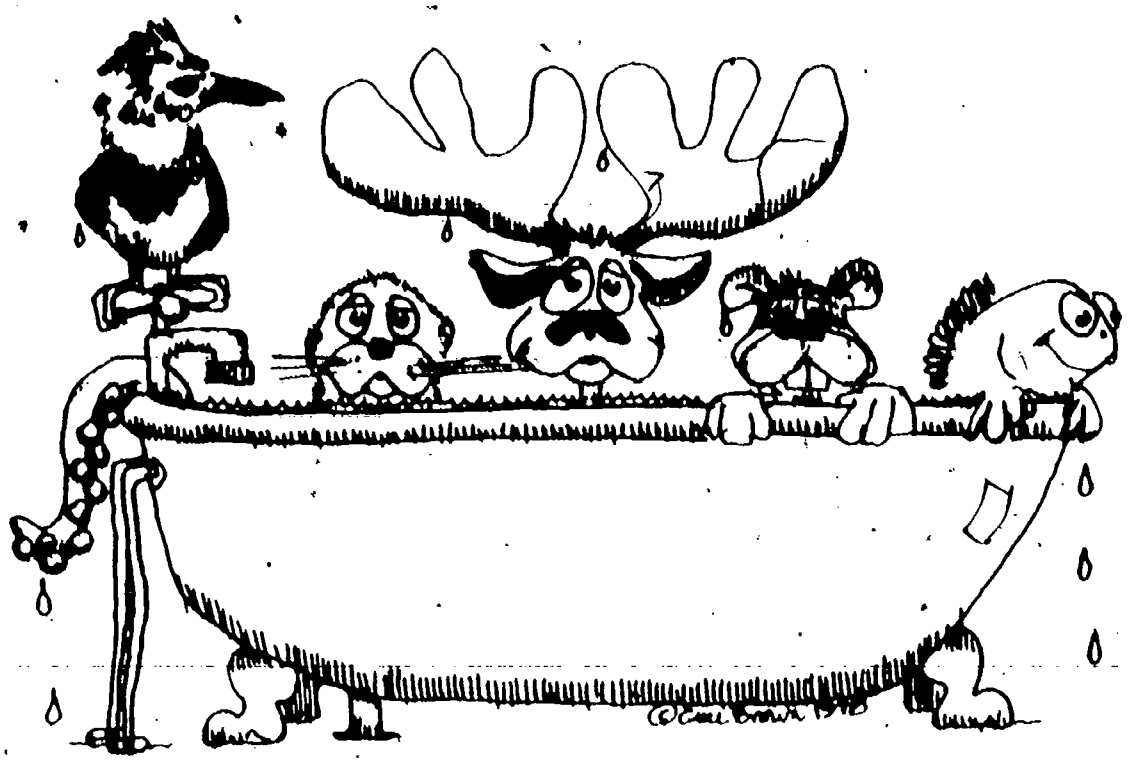
Objective: The student will be able to explain different ways to save energy in his/her home

Resources: Energy and Man's Environment Activity #49

Procedure:

1. Simulation: It is a very cold winter and there is a critical shortage of fuel. The government has reduced each family's fuel allocation by 25 percent.
2. Make a list of ways to deal with the problem.
3. What could each person's family do?
4. What could the father do? the mother? the children?
5. How can they still be comfortable if they reduce the temperature in their home?





Activity 3 How Can I Save Water?

Objective: For the student to be able to determine the amount of water that could be saved by showering rather than taking a bath.

Resource: Energy and Man's Environment Activity #51

Procedure:

1. Take a normal shower with tub drain closed, measure water level.
2. Next day take a normal bath; measure the water level.
3. Compile data brought by all students.
4. Graph each set of data using bar graph and/or line graph.
5. Average the amount used in each case using class data.
6. List ways of reusing water to additionally conserve.

Activity 4 The Over-Packaging Problem

Objective: For the student to be able to describe how resources are sometimes used unnecessarily.

Resources: Caldwell Environmental Education Program

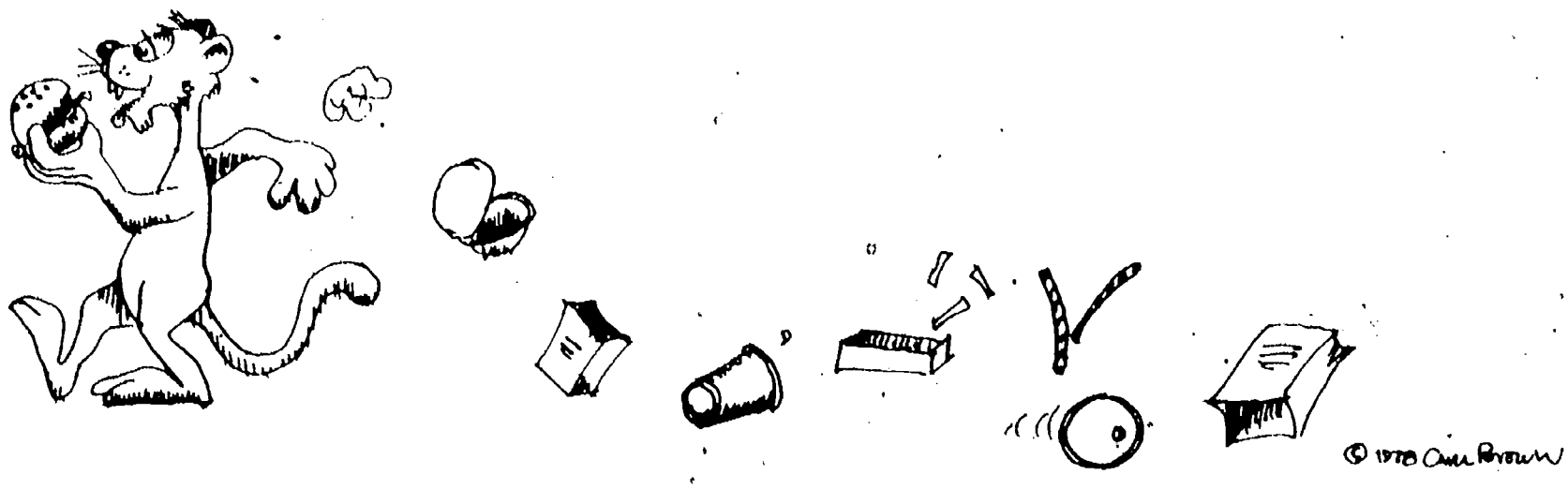
Procedure: "The Over-Packaging Problem"

Buy a hamburger from a fast food outlet which is packaged not only in paper but is served in a plastic container. Bring All the packaging materials to class and let the students discuss which of the items are essential packaging materials and which are not. The following questions can help guide the discussion:

1. What natural resources are used to produce each of the items?
   (Plastic is made from petroleum)
2. Are the natural resources used renewable or non-renewable?
3. What are the advantages of packaging hamburgers in plastic containers?
4. What are the disadvantages?
5. What happens to the packaging material after the hamburger has been eaten?

Related Activity:

Go to a store or examine products coming into your home. Compile a list of products that are over-packaged.



GLOSSARY

ACCELERATION. The time rate of change of velocity in either speed or direction.

ALTERNATING CURRENT (AC). An electric current whose direction of flow is changed at periodic intervals (many times per second).

ATOM. The smallest particle of an element which can enter into a chemical combination. All chemical compounds are formed of atoms, the difference between compounds being attributable to the nature, number, and arrangement of their constituent atoms.

ATOMIC ENERGY. The constitutive internal energy of the atom which was absorbed when it was formed; Energy derived from the mass converted into energy in nuclear transformation.

BLACKOUT. A total power failure unintentionally caused by storm damage, equipment failure, or overloaded utility equipment. An exceptional situation in which all power is deliberately cut off by electrical generating facilities.

BLANKET INSULATION. Cotton fiber, mineral wool, or wool fiber made into varying thicknesses in a length.

COAL. Solid, combustible, organic hydrocarbon formed by the decomposition of vegetable material without free access to air.

COAL GASIFICATION. The conversion of coal to a gas suitable for use as a fuel.

COMBUSTION. Burning; technically, a rapid oxidation accompanied by the release of energy in the form of heat and light. It is one of the three basic contributing factors causing air pollution. The others are attrition and vaporization.

COMFORT ZONE. The proper temperature, humidity, and air movement to create a feeling of comfort.

CONDUCTOR (ELECTRICAL). A material capable of carrying an electrical current.

CONSERVATION. The care or management of natural resources.

CONSERVATION OF MATTER AND ENERGY (LAW OF). The sum of the potential and kinetic energy of an ideal energy system remains constant.

CONSERVE. To manage or use wisely.

CONVECTION. The transfer of energy by moving masses of matter, such as the circulation of a liquid or gas.

CONVENTIONAL HYDROELECTRIC PLANT. A hydroelectric power plant that utilizes streamflow only once as the water passes downstream, as opposed to a pump-storage plant which re-circulates all or a portion of the streamflow in the production of power.

CRUDE OIL. Liquid fuel formed from the fossils of animals and plants; petroleum as it comes from the ground.

CURRENT (ELECTRIC). The rate of transfer of electricity.

CURTAILMENT. Cutting back the use of energy resources as opposed to conserving or wisely using energy resources.

DIRECT CURRENT (DC). An electric current that flows in only one direction through a circuit.

DIRECT ENERGY CONVERSION. The process of changing any other form of energy into electricity without machinery that has moving parts. For example, a battery changes chemical energy into electricity by direct energy conversion.

DOUBLE GLAZED WINDOW. Two panes of glass factory-sealed together with a small air space between them. Double glazing has about twice the R-value of single glazing.

EFFICIENCY. The ratio of the useful work performed to the amount of energy used in the process.

ELECTRICAL ENERGY. The energy associated with electric charges and their movements. Measured in watt hours and kilowatt hours. One watt-hour equals 860 calories.

ELECTROCHEMICAL CELL. A cell in which chemical energy is converted to electric energy by a spontaneous oxidation-reduction reaction.

ELECTRON. The electron is a small particle having a unit of negative electrical charge, a small mass, and a small diameter. Every atom consists of one nucleus and one or more electrons.

ELEMENTS. Elements are substances which cannot be decomposed by the ordinary types of chemical change, or made by chemical union.

ENERGY. The capability of doing work. Potential energy is energy due to position of one body with respect to another or relative parts of the same body. Kinetic energy is due to motion.

ENTROPY. Entropy is the capacity factor for isothermally unavailable energy. Every spontaneous process in nature is characterized by an increase in the total entropy of the bodies concerned in the process.

ENVIRONMENT. The sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.

FIRST LAW OF THERMODYNAMICS. (Also called the Law of Conservation of Energy). Energy can be neither created nor destroyed.

FISSION. A nuclear reaction from which the atoms produced are each approximately half the mass of the parent nucleus. In other words, the atom is split into two approximately equal masses. There is also the emission of extremely great quantities of energy since the sum of the masses of the two new atoms is less than the mass of the parent heavy atom. The energy released is expressed by Einstein's equation, $E = Mc^2$.

FLYWHEEL. A method of energy storage working on the principle of a spinning wheel. By its inertia, a spinning wheel stores mechanical energy.

FOAM INSULATION. (1) Styrofoam; (2) Rigid foam boards; or (3) Liquid foam insulation.

FOSSIL FUELS. Coal, oil, natural gas, and other fuels originating from geologic deposits of ancient plant and animal life depending on oxidation for release of energy.

FUEL. A substance used to produce heat energy, chemical energy by combustion, or nuclear energy by nuclear fission.

FUEL CELL. A device in which fuel and oxygen are combined to produce chemical energy that is converted directly into electricity.

FUSION (ATOMIC). A nuclear reaction involving the combination of smaller atomic nuclei or particles into larger ones with the release of energy from mass transformation. This is also called a thermonuclear reaction by reason of the extremely high temperature required to initiate it.

FUSION. A reaction in which light nuclei combine to form an atom with greater mass.

GAS. A state of matter in which the molecules are practically unrestricted by cohesive forces. A gas has neither definite shape nor volume.

GASOLINE. Mixture of hydrocarbons obtained from petroleum.

GENERATOR. A device that converts heat or mechanical energy into electrical energy.

GEOTHERMAL. As applied to power generation, the use of heat energy obtained through the medium of hot water or steam coming from beneath the earth's surface.

GEOTHERMAL ENERGY. The heat energy available in the earth's subsurface believed to have been produced by natural radioactivity. The thermal gradient of the earth's crust is such that the temperature in a deep well or mine increases by about $1^{o}F$ for each 100 ft. of depth.

GRAM. A unit of mass in the metric system; 10^{-3} standard kilogram.

GREENHOUSE EFFECT. A method of using solar radiation to warm underheated areas (window treatments are opened to allow the window to admit and trap the sun's heat).

GROSS NATIONAL PRODUCT (GNP). A measure of economic activity which is the total market value of all goods and services produced in a country. Depreciation and other allowances for capital consumption are not deducted.

HEAT. Energy possessed by a substance in the form of kinetic energy, usually measured in calories or, in space heating, by the British thermal unit. Heat is transmitted by conduction, convection, or radiation.

HEAT CAPACITY. That quantity of heat required to increase the temperature of a system or substance one degree of temperature. It is usually expressed in calories per degree Celsius.

HEAT ENERGY. Energy that causes an increase in the temperature of an object. It may change the object from solid to liquid or from liquid to gas.

HEAT PUMP. A device that absorbs heat from the outside air and pumps it into the house. It works in reverse as a standard air conditioner for cooling.

HORSEPOWER. A unit that measures the rate at which energy is produced or used. A man doing heavy manual labor produces energy at the rate of about .08 horsepower.

HYDROELECTRIC PLANT. An electric power plant in which the turbine-generators are driven by falling water.

HYDROELECTRICITY. Electricity production by water-powered turbine generator.

HYDROLOGY. The science dealing with the properties, distribution, and circulation of water and snow.

HYDROPOWER. Power by falling water.

INSULATION. A substance that insulates is one that can slow down the flow of heat or sound.

INTERNAL COMBUSTION ENGINE. Energy is supplied by a burning fuel which is directly transformed into mechanical energy by controlled combustion.

JOULE. A metric unit of work or energy; the energy produced by a force of one newton operating through a distance of one meter.

KILOCALORIE. Heat energy equal to 4.19×10^3 joules.

KILOVOLT (KV). 1,000 volts.

KILOWATT (KW). The unit of power equal to 1,000 watts, 3.413 BTUs, or 1,341 horsepower. Roughly, the power of one kw is capable of raising the temperature of a pound (pint) of water $1^{o}F$ in one second.

KILOWATT-HOUR (KWH). The amount of work or energy delivered during the steady consumption of one kilowatt of power for a period of one hour; equivalent to 3.412 BTUs.

LIGHT. Radiant energy which an observer can see.

LIQUIFIED NATURAL GAS (LNG). Natural gas that has been changed into a liquid by cooling to about -260°F (-160°C) at which point it occupies about 1/600 of its gaseous volume at normal atmospheric pressure; thus, the cost of shipping and storage is reduced.

MECHANICAL ENERGY. The kind of energy that is released to make objects move.

MEGAWATT (MW). A unit of power equal to 1,000 kilowatts or one million watts.

METHANE. Colorless, nonpoisonous, and flammable gaseous hydrocarbon; emitted by marshes and by dumps undergoing decomposition.

NATURAL GAS. Naturally-occurring mixtures of hydrocarbon gases and vapors occurring naturally in certain geologic formations; usually found associated with oil.

NONRENEWABLE RESOURCES. Depletable energy resources such as the fossil fuels - coal, gas and oil.

NUCLEAR ELECTRIC POWER PLANT. One in which heat for raising steam is provided by fission rather than combustion of fossil fuel.

NUCLEAR (ATOMIC) FUEL. Material containing fissionable uranium of such composition and enrichment that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction and produce heat in a controlled manner for process use.

NUCLEAR POWER. Electric power produced from a power plant by converting the energy obtained from nuclear reaction.

NUCLEAR POWER PLANT. Any device, machine, or assembly that converts nuclear energy into some form of useful power, such as mechanical or electrical power. In a nuclear electric power plant, heat produced by a reactor is generally used to make steam to drive a turbine that, in turn, drives an electric generator.

NUCLEAR REACTION. A reaction involving a change in an atomic nucleus, such a fission, fusion, neutron capture, or radioactive decay, as distinct from a chemical reaction, which is limited to changes in electron structure surrounding the nucleus.

OFF-PEAK. Energy supplied during periods of relatively low system demands.

OIL SHALE. Sedimentary rock containing solid organic matter (kerogen) that yields substantial amounts of oil when heated to high temperatures.

OIL SPILL. The accidental discharge of oil into oceans, bays, or inland waterways. Methods of oil spill control include chemical dispersion, combustion, mechanical containment, and absorption.

OPEC (ORGANIZATION OF PETROLEUM EXPORTING COUNTRIES). An organization of countries in the Middle East, North Africa, and South America which aims at developing common oil-marketing policies.

PEAKING. Power plant operation to meet the highest portion of the daily load.

PEAKING CAPABILITY. The maximum peak load that can be supplied by a generating unit, station, or system in a stated period of time. For a hydroproject, the peaking capability would be equal to the maximum plant capability only under favorable pool and flow conditions. Often the peaking capability may be less due to reservoir drawdown or tailwater encroachment.

POWER. The time rate at which work is done. If an amount of work (w) is done in time (t) the power or rate of doing work is $P = w/t$. Power will be obtained in watts if W is expressed in joules and t in seconds.

PUMPED HYDROELECTRIC STORAGE. The only means now available for the large-scale storage of electrical energy. Excess electricity produced during periods of low demand is used to pump water up to a reservoir. When demand is high, the water is released to operate a hydroelectric generator. Pumped energy storage only returns about 66 percent of the electrical energy put into it, but costs less than an equivalent generating capacity.

PUMPED STORAGE PLANT. A hydroelectric power plant which generates electric energy for peak load use by utilizing water pumped into a elevated storage reservoir during off-peak periods.

R-VALUE. Thermal resistance; computed by the conductivity divided into one. The measure of resistance to heat flow.

RECLAMATION. Act or process of reclaiming; for example, strip-mined land should be reclaimed -- replanted and leveled.

RENEWABLE RESOURCES. Nondepletable resources; for example, the sun.

RESERVES. The amount of a natural resource known to exist and expected to be recovered by present-day techniques.

RESOURCES. The estimated total quantity of a natural resource such as minerals in the ground; includes undiscovered mineral reserves.

SECOND LAW OF THERMODYNAMICS. One of the two "limit" laws which govern the conversion of energy. Referred to here as the "heat tax", it can be stated in several equivalent forms, all of which describe the inevitable passage of some energy from useful to a less useful form in any energy conversion.

SOLAR CELL. A photovoltaic cell which converts radiant energy from the sun into electrical energy.

SOLAR ENERGY. Radiation energy from the sun falling upon the earth's surface.

SOLID WASTE. Useless, unwanted, or discarded material with insufficient liquid content to be free flowing.

STATIC ELECTRICITY. Electricity at rest.

STEAM-ELECTRIC PLANT. A plant in which the prime movers (turbines) connected to the generators are driven by steam.

STOCKPILE. A storage pile or reserve supply of an essential raw material; for example, coal is stockpiled in the open air for storage purposes.

STRIP-MINING. A process in which rock and topsoil strata overlying ore or fuel deposits are scraped away by mechanical shovels. Also known as surface mining.

TECHNOLOGY. Applied science.

THERMAL EFFICIENCY. The ratio of the electric power produced by a power plant to the amount of heat produced by the fuel; a measure of the efficiency with which the plant converts thermal to electrical energy.

THERMAL ENERGY. The total potential and kinetic energy associated with the random motions of the particles of a material.

THERMAL PLANT. A generating plant which converts heat energy to electrical energy. Such plants may burn coal, gas, oil, or use nuclear energy to produce thermal energy.

THERMAL POLLUTION. Degradation of water quality by the introduction of a heated effluent. Primarily a result of the discharge of cooling waters from industrial processes, particularly from electrical power generation.

THERMODYNAMICS. The science and study of the relationship between heat and mechanical work.

TRANSMISSION. The act or process of transporting electric energy in bulk from a source or sources of supply to other utility systems.

TRANSMISSION LINES. Wires or cables through which high voltage electric power is moved from point to point.

TURBINE. A motor, the shaft of which is rotated by a stream of water, steam, air, or fluid from a nozzle and forced against the blades of a wheel.

VAPOR. The words vapor and gas are often used interchangeably. Vapor is more frequently used for a substance which, though present in the gaseous phase, generally exists as a solid or liquid at room temperature. Gas is more frequently used for a substance that generally exists in the gaseous phase at room temperature.

VAPORIZATION. The change of a substance from a liquid or solid state to the gaseous state. One of three contributing factors to air pollution; the other are attrition and combustion.

VOLT. The unit of electromotive force. It is the difference in potential required to make a current flow through a resistance.

VOLTAGE. The amount of force employed to move a quantity of electricity; measured in volts.

WATER VAPOR. Water in the form of a gas.

WATT (W). A unit of measure for electric power equal to the transfer of one joule of energy per second. The watt is the unit of power most often associated with electricity (1 horsepower = 746 watts) determined by multiplying required volts by required amperes (volts x amps = watts).

WEATHERSTRIPPING. Reduces the rate of air infiltration by making sure that all doors and windows fit their frames snugly.

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