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ABSTRACT

Included in this module are five activities dealing with energy conservation in the urban environment. The activities include: (1) conducting an energy inventory: (2) the physical nature of temperature, space, and insulation and their effects on energy use: (3) blackouts: (4) the sellers and consumers of energy: (5) energy conservation decision-making. Also included are an overview, teacher background information, an activity preview, and a pretest. (RE)

Curriculum Module II

Urban Environmental Education Project

Energy Conservation: What Are the Options?

developed by Albert P. Nous

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URBAN ENVIRONMENTAL EDUCATION PROJECT

Curriculum Module II

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Catherine Cornbleth, Curriculum Series Editor
University of Pittsburgh

Energy Conservation: What Are The Options

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Energy Conservation: What Are the Options?

OVERVIEW

> Sixty per cent of the American people do not believe that there are real energy problems in this country; one-third of these people believe that energy issues are contrived.
>
> Mistrust of government and big business, and their responses to energy questions, is strong.
>
> There is widespread popular belief that technology can and will resolve any energy problems.

These findings from recent public opinion surveys suggest some of the dimensions of the energy conservation issue.

What is the basis for the U. S. public's attitude of skepticism mixed with optimism regarding energy?

How real (or imminent) are serious energy shortages?

To what extent can government, private industry, and science-technology be depended upon to develop satisfactory answers to energy questions?

Many people are not only cynical but ignorant of ways to save energy. When people do practice energy conservation, they are primarily concerned with comfort, cost, and parity — "Don't expect me to conserve energy unless you and everyone else is going to do it too!"

Regardless of the sources of energy problems, the effects are real. Rising costs, industrial cutbacks and layoffs, blackouts, and long lines at gasoline stations are just a few of the symptoms.

In this module, personal energy use and conservation options at home are examined to provide a knowledge base for reasoned decision-making. The focus is on electricity because of its importance in our daily lives.

(Similar questions might be raised and explored with respect to other forms of energy.) Thus, the relevance of the topic is intended to provide motivation to become informed and examine values and consequences.

Five energy conservation options have been distinguished. These conservation options would require changes in (1) building design and construction, (2) use/efficiency incentives, (3) advertising, (4) electric rate structures, and/or (5) individual and business practices (resulting from rationing or restrictions on use). Examination of these options includes consideration of their consequences for individuals, groups, the nation, and our global system. Here, attention is directed to the first three options.

Of major concern is the survival and quality of life in the urban environment — standards and costs of living, personal and social well-being (including health and safety), and aesthetic enjoyment. What trade-offs are we willing to make? What can individuals and citizens' groups do? What should you and I do?

TEACHER BACKGROUND INFORMATION

With few exceptions, the energy we use is produced by the combustion of some kind of fuel. Most of our electric energy is generated in power plants that burn fossil fuels -- coal, oil and natural gas. (These are called "fossil fuels" since they were formed deep in the earth from the remains of plants and animals that were buried beneath sediments. The pressure and heat produced by the weight of overlying sediments changed the plant and animal remains into these fuels.)

The current worldwide "energy crisis" has been developing for many years. However, there has been little planning for future needs -- needs which seem certain to increase. Many of the reserves of oil and natural gas, which were once thought to be almost inexhaustible, have now been depleted. Consequently, it has been necessary to drill deeper into the earth, including offshore through the ocean bottom, at much greater costs in order to locate new resources. Of the proven reserves, the greatest quantities are located in the Middle East where political instability has made dependence on imports very risky. While more and more energy is being used throughout the world, available supplies are dwindling. By the early 1970's, energy had become a high priority international concern. Not only must we search for new sources of energy, but we must seriously consider means of conserving current energy resources.

Electric energy demand is growing at an annual rate of about seven percent, with a doubling time of 10 years. Total energy use is growing at about three and a half percent annually, with a doubling time of 20 years. Thus the demand for electricity is twice that for all energy sources.

Supplying electric energy is becoming increasingly difficult given diminishing fuel reserves, increased costs and environmentalists' opposition to power plant construction. A number of new and largely untested systems may help meet future demand. Generally, however, it is difficult to estimate the likely success of these options. Some of these, such as solar power and hydropower, are non-depletable. Eventually, we will be completely dependent on non-depletable resources. Meanwhile we continue to rely on depletable fuels, primarily the fossil fuels.

While the energy crisis is a web of interrelated issues, a major problem is that in many areas the current energy demands exceed supplies or are expected to exceed supplies in the very near future. In principle the solution to the problem is simple. We must either increase the supply or decrease the demand. In practice we are finding it very difficult to do either without disrupting our ways of living.

Most of the power industry's effort is directed toward increasing supplies in order to meet demand, partially because that is its mandate, and partially because, traditionally, that has been its (and our) response -- habits not easy to break. The industry's efforts have largely, though not entirely, followed traditional development lines, involving known energy resources and systems. It has been left largely to government to explore newer sources such as fusion and solar power.

If we cannot or do not increase the energy supply to meet demand, then we must reduce demand. This involves questioning our energy requirements and seeking areas in which use might be cut. In other words, we must conserve energy, either by limiting goods and services or increasing the efficiency of our energy use. We can do this voluntarily, or it could be forced on us in the case of a gasoline shortage or a power blackout, or it could be legislated at the state or national level.

There are degrees of conservation. One way of categorizing conservation and its effects is as follows:

1. Conservation that most people find generally desirable;
2. Conservation that results in minor inconveniences and, therefore, is somewhat less desirable to most people;
3. Conservation that has a major impact on life styles and, therefore, is undesirable to most people.

In the first category are conservation measures that can save the energy consumer money and energy, without significant inconvenience or loss of desired amenities. Major savings in energy come from insulating homes and weather-stripping doors to prevent unwanted air flow into a heated or cooled building. The original capital cost may appear significant, but it is usually paid off through reduced operating costs in a few years. Some major appliances, such as air conditioners, are built in different models with different energy efficiencies, but little or no difference in capital cost or performance. Careful, educated shopping can save the consumer operating costs and the country energy. Energy costs for operating large and small buildings can be significantly reduced by improved building design. Energy costs money, and most consumers will take advantage of any savings in energy use which do not change their life style in significant ways.

Beyond the relatively easy steps that can save energy and money without hurting, are ways of conserving energy that may be somewhat inconvenient or undesirable to many people. For example: Turning off lights not actually in use; Turning off the air conditioner when you leave the house for a number of hours; Using public transportation, a bicycle, or walking instead of driving; Not buying or using nonessential appliances; Using returnable bottles instead of cans for beverages; Hanging your clothes out to dry in the sun. All of these mean inconvenience for some people; they also mean energy and dollar savings.

If voluntary energy savings are not enough, and if demand grows faster than supply, we may someday face major government control of energy use. Gasoline rationing, limitations on car size, cutting off power to some industries, and severe building restrictions are all possible if we do not balance demand and supply.

At what point do the economic, environmental, and other costs of increased energy supplies outweigh the benefits (e.g., goods and services, freedom of choice)?

How does one determine the "quality of life"? What is the "good life"?

The Case for Conservation

Energy conservation today will allow the earth's limited resource base of fuels to be "stretched" further. It will enable our children and those in other lands to share in the earth's finite stock of fossil fuels. It will make an especially critical difference to those living in less industrialized nations where the marginal return per unit of fuel is far greater than in highly industrialized nations.

Energy conservation will allow us to continue to use some of the fossil fuels for other purposes such as drugs and lubricants. The energy cost of manufacturing such substances from carbon and hydrogen, once our present feed-stocks have been exhausted, will be astronomical.

We use technology to produce much of our energy in the United States. This technology contributes to polluting and degrading the environment. The consequences of environmental pollutants such as heavy metal particles, cancer producing chemicals, and radioactive materials are serious. Practicing energy conservation will allow us to minimize this pollution and even to avoid energy sources that pollute while we search for safer ways to produce energy for our daily needs.

Practicing energy conservation might also make us healthier. Much energy is needed to produce our food. Energy conservation could lead to leaner diets, more exercise, less pollution, and other indirect benefits to human health.

If we used less energy, it would be easier to secure and control our energy supplies, instead of depending on many sources spread all over the world. However, it is unlikely that the United States will ever be energy independent.

Additional reasons for energy conservation are economic. Simply put, conservation is cost-effective. Consider the following examples:

1. It has been estimated that a large-scale investment in energy conservation ($500 billion) would save twice as much energy as a comparable investment in new supplies would produce.
2. Generally, it is more energy efficient and less costly to heat a home with natural gas than with electricity. However, it is much more efficient to transport people by means of an electric mass transit system than by private gasoline-powered automobiles.

3. A barrel of oil saved is more valuable than a new barrel of oil produced, due to the "energy cost" of production. A dollar invested in wise energy conservation makes more net energy available than a dollar invested in developing new energy resources. For example, ceiling insulation in a typical home presently costs about $300 installed and will save about seven barrels of oil each year for the lifetime of the house. A conservative estimate of the energy to be saved by the insulation over the years is 60 barrels. Thus we are "producing" heating oil costs only about $3 per barrel, the insulation will not be economically attractive. But, today, heating oil costs $16 per barrel. Regulated natural gas costs $11 per barrel-equivalent, and electricity costs as much as $35 per barrel-equivalent. Ceiling insulation is, by comparison, cheap.
4. At the individual home-owner level, home insulation may well guarantee a higher rate-of-return than any other investment available to the average citizen. Common stocks, corporate bonds, and savings accounts pay interest rates of 5 to 10 percent -- often at some degree of risk. Home insulation may earn 20 to 40 percent in saved fuel costs at little or no risk. Moreover, investments in home insulation will raise property values.

Options for Electric Energy Conservation

Policies that have been advocated to slow the growth of electric power demand are of five basic types:

1. Building design and construction. Policies designed to change building code requirements; bans on the manufacture, sale or installation of certain types of equipment; restrictions on the wattage or minimum efficiency of electrical equipment and appliances; and restrictions on new building permits.

2. Voluntary use/efficiency incentives. Policies designed to encourage conservation, including consumer education measures that would teach basic energy conservation practices; programs for labeling electrical appliances with energy efficiency ratings or with average annual energy use costs; and provisions for financial incentives for development and use of energy-conserving appliances and devices.

3. Advertising. Policies designed to minimize the "audience effect" of promotional advertising aimed at increasing the use of electricity; using advertising to encourage conservation.

4. Variable electric rate structures. Policies designed to change the user cost of electricity through changes in utility rate schedules, including use taxes.

5. Taxation and/or rationing. Policies designed to increase the purchase costs of electrical equipment, including sales taxes based on the estimated average annual electricity use of the equipment; tax relief for either users who install more efficient equipment or manufacturers who make such equipment; and direct rationing of electricity.

ACTIVITY PREVIEW

This module contains five activities. Parts of two activities, involving building construction and time of electrical appliance use, are intended as "homework." Otherwise, each activity requires a minimum of 45 minutes of class time. Supplementary experiences also are suggested, which would increase the time needed.

Activity 1. Checkpoint

Energy use and conservation in the home are explored by recording home energy use for heating, cooking, lighting, air-conditioning, and appliances as well as building insulation and construction materials. (Anticipated time needed for this take-home activity is one-two days plus one class period for discussion of findings.)

Activity 2. Temperature, Space, and Insulation Material — How Do They Affect Energy Use?

This demonstration-observation activity illustrates heat loss/gain in an ice cube/box system. Students' observations are recorded on a worksheet that directs attention to common household practices to minimize heat loss, i.e., building design and insulation materials in relation to efficient energy use. (Preparation time is needed to set up the demonstration; also, a simplified version of this activity is provided.)

Activity 3. Blackout!

Using a chart to show electric appliance use x hour of operation, students examine and determine likely consequences on their lifestyles of restrictions on the availability of electricity.

Activity 4. Advertising and Energy Conservation

The students examine advertisements or promotional campaigns that encourage either greater or more efficient (less) use of electricity in terms of the degree to which people are affected by advertising.

Activity 5. Energy Conservation — What Should We Do?

This decision-making activity encourages individual and group choices relevant to energy conservation and the quality of life in the urban environment, using the information gained from the previous activities.

NOTE: A knowledge pretest for students, reprinted on the following pages, is provided in the Student Materials Packet.

Energy Conservation: What Are The Options?

MODULE PRETEST

1. It is generally more energy efficient and less costly to

   a. heat a home with electricity than with natural gas.
   b. transport people with private gasoline-powered automobiles than with electric mass transit.
   c. use fluorescent instead of incandescent lighting.
   d. pay higher prices to produce more electricity than to insulate your home.

2. The greatest loss or gain of heat in most homes is through

   a. doors and windows.
   b. heat ducts or pipes.
   c. hallways.
   d. the roof.

3. The number of Btu's of heat divided by the number of watts of electricity used is called

   a. a degree celsius.
   b. an energy efficiency ratio.
   c. a volt.
   d. a utility rate.

4. "Blackout" is a term used to describe the situation where

   a. electrical power to an entire area is interrupted or stopped.
   b. electrical power to an area is stopped for industry but not for homes.
   c. an electrical appliance wears down and operates less efficiently.
   d. electrical power to an area is cut down.

5. When energy is in short supply, the cost of producing goods and services

   a. is not affected.
   b. decreases.
   c. increases.
   d. increases and then decreases.

6. Conserving energy would most likely result in

   a. higher prices for electricity.
   b. less dependence on imported energy sources.
   c. more water pollution.
   d. all of the above.

7. People can save energy and money on home heating and cooling by

    a. closing off rooms that are not being used.
    b. insulating attics and ceilings.
    c. putting weatherstripping around doors and windows.
    d. all of the above.

8. If most people refuse to conserve energy voluntarily, then

    a. probably nothing serious will happen.
    b. we may face government restrictions on energy use.
    c. we will probably run out of energy in five years.
    d. energy will cost less because of the high demand.

9. All of the following are arguments <u>against</u> energy conservation, <u>except</u>

    a. conservation saves money in the long run.
    b. energy shortages are not as serious as some people believe.
    c. it is inconvenient to use less electricity.
    d. conservation is not enough; the problem requires stronger action.

10. All of the following are examples of energy conservation, <u>except</u>

    a. increasing home insulation.
    b. riding in carpools instead of driving alone.
    c. buying appliances with higher EERs.
    d. turning off all electric appliances for two hours per day.

ACTIVITY 1. Checkpoint

Objectives: By completing the "Checkpoint" survey, students gain awareness of energy efficiency in relation to their own homes. In addition, students might distinguish more and less energy efficient practices, identify specific energy conservation possibilities in their own homes, and note difficulties associated with energy conservation measures.

Organizing Ideas: Residential building design, construction, and use (including heating, cooling, and appliances) are major energy conservation factors in urban areas.

Resources:

Energy Conservation Research. Our Energy: Problems and Solutions. Malvern, PA: Energy Conservation Research, 1977.

This book provides a description of energy forms, laws of energy conservation, and an extensive list of conservation ideas for the household. This reference booklet is suitable for students in grades 7 and 8.

Scott, Cheryl. "Where to Start Saving Home Energy Dollars," Better Homes and Gardens, October 1978, 64-65.

This simply presented illustration introduces a variety of options for consideration and further investigation. Information regarding the energy use and cost of various home appliances is usually available from local utility companies. For example, Duquesne Light, P.O. Box 2495, Pittsburgh, PA 15230.

Student Materials:

Handout (provided in the Student Materials Packet)

Checkpoint (SM 1.1, 1.2, 1.3)

For Your Energy Information (SM 1.4)

Suggested Procedures:

1. The "Checkpoint" survey is designed to be completed by students at home. One-two days are likely sufficient time to observe household facilities and obtain needed information from family members, labels, and other sources.

   a. The survey handouts, SM 1.1-1.3, might be distributed and overviewed on a Friday (perhaps after completion of the pretest and introduction of the module) and completed by Monday in time for group sharing and discussion of findings.

   b. An optional information sheet, SM 1.4, provides additional background and definitions. It might be used before or after the survey is introduced. By personalizing energy use and abuse, this activity is intended to stimulate student awareness, involvement, and willingness to pursue the issues.

   c. Additional vocabulary that might be reviewed beforehand includes:

split level	incandescent	stucco
veneer	crawl space	humidifier

   (The Energy Efficiency Ratios of air conditioners usually can be found on their labels or in the owner's manual.)

2. Sharing of students' findings might involve tabulation of their responses to all or selected items on a large wall chart. A transparency might be made of the "Checkpoint" survey form for use as a tally sheet. Alternatively, students who live in similar kinds of buildings (items 1 and 2) might meet in small groups to share their findings.

3. Follow-up discussion of the survey results should focus on energy efficiency and conservation (savings). Ask students to consider questions such as:

   a. Which response (to each item or to selected items) represents the greatest energy efficiency or conservation practice? Or, how would you rank the energy efficiency or conservation potential of each response (to particular items)?

   b. In what ways is your home an energy waster?

   c. What could you do to conserve energy in your own home? (Identified problems might be listed on the chalkboard, and tallied or ranked.)

   d. What things couldn't you change to conserve energy at home? What makes these energy problems more difficult to solve?

   e. What have you (or members of your family) already done to conserve energy in your home?

   f. How would you rate your home for energy conservation? (Excellent, Very Good, Average, Below Average, Poor)

   g. If you rated your home less than Very Good, what do you intend to do to improve your rating?

Checkpoint

Complete this "Checkpoint" survey by checking the answer to each question that describes the building in which you live. In the right-hand column, add any notes or comments that you believe are important, such as additional information, suggested changes or improvements.

Building Construction	Notes
1. How old is the building in which you live? ___ less than five years ___ between five and ten years ___ between ten and twenty years ___ more than twenty years	
2. How many floors or stories are there in the building in which you live (not counting any basement)? ___ one story ___ split level ___ two stories ___ three or more stories	
3. Do you have an attic or crawl space in your home? ___ yes ___ no	
4. Is the attic floor insulated? ___ yes ___ no ___ does not apply	
5. What is the veneer on the building? ___ brick ___ wood ___ aluminum ___ vinyl ___ stucco ___ natural stone ___ other: ______________	
6. On cold or windy days, can you feel cold air near your windows or doors when they are closed? ___ yes ___ no	
7. Is there weatherstripping around your doors? ___ yes ___ no	

Heating and Air-Conditioning

Notes

8. What fuel or form of energy is used to heat your home?
   ___ gas
   ___ electricity
   ___ oil
   ___ coal
   ___ propane
   ___ solar
   ___ other: ____________________

9. When was your home heating system last cleaned and serviced?
   ___ during the current heating period (within the last year)
   ___ more than a year ago
   ___ never
   ___ no record available

10. If your home is air-conditioned, list the Energy Efficiency Ratio (EER) of each unit.
   Unit #1 EER = $\frac{\text{BTU/Hour}}{\text{Watts}}$ = __________

   Unit #2 EER = $\frac{\text{BTU/Hour}}{\text{Watts}}$ = __________

11. Where do you set your thermostat in the winter during the daytime?
   ___ 65'F or less
   ___ 65'F to 68'F
   ___ 69'F to 72'F
   ___ 73'F to 75'F
   ___ above 75'F

12. Where do you set your thermostat in the winter during the night-time?
   ___ 65'F or less
   ___ 65'F to 68'F
   ___ 69'F to 72'F
   ___ 73'F to 75'F
   ___ above 75'F

13. If your home is air-conditioned, where do you set your thermostat in the summer?
   ___ 68'F or less
   ___ 69'F to 72'F
   ___ 73'F to 76'F
   ___ 77'F to 80'F
   ___ above 80'F

Cooking, Hot Water, and Appliances

Notes

14. What fuel or form of energy is used for cooking in your home?
    ___ gas
    ___ electricity (including microwave)
    ___ other: ____________

15. What fuel or form of energy is used for heating water in your home?
    ___ gas
    ___ electricity
    ___ solar
    ___ none
    ___ other: ____________

16. How many of each of the following items are there in your home?

    a. single pane windows ___
    b. doors ___
    c. storm doors ___
    d. insulated windows ___
    e. incandescent bulbs ___
    f. fluorescent bulbs ___
    g. black/white TVs ___
    h. color TVs ___
    i. frost-free refrigerators ___
    j. regular refrigerators ___
    k. microwave ovens ___
    l. regular gas or electric ovens ___
    m. self-cleaning ovens ___
    n. water heaters ___
    o. humidifiers ___
    p. air cleaners ___
    q. ____________ ___
    r. ____________ ___
    s. ____________ ___

FOR YOUR ENERGY INFORMATION . . .

Someone once said that death and taxes are two things of which we can be sure. Today we can add high energy costs to that list. Your family is paying higher prices for electricity, gasoline, and other forms of energy, and it looks like prices will continue to go up and up. But, your family may be paying even higher electric and heating bills because you are using more energy than necessary. When energy was cheaper and more plentiful, people were probably less concerned about how energy efficient their homes or cars were. But, times have changed!

The design and construction of the building in which you live costs you money for energy. Heating and cooling costs you money. The use of appliances costs you money. Making a list of these things can help you see where you can save energy and money.

Use the "checkpoint" survey to examine the building where you live. Consider the ways your home conserves (saves) and wastes energy. What can you do to conserve energy in your home?

Here are some definitions for common energy related words:

British Thermal Unit (BTU) — the amount of heat necessary to raise the temperature of one pound of water one degree fahrenheit.

Energy — the ability to do work or to make things move.

Energy Efficiency Ratio (EER) — a number that measures the energy efficiency of similar appliances. The number is obtained by dividing the number of British Thermal Units (BTUs) by the number of watts used to run the appliance. The higher the EER numbers, the more efficient the appliance and the less it will cost to operate.

Insulation — material used to hold or minimize the loss of heat. The degree of effectiveness of such material is shown as an R-value; the higher the R-value, the greater the effectiveness.

Kilowatt -- a unit that measures the rate at which energy is produced or used. A rate of one kilowatt (kilo-is a prefix meaning 1,000; therefore, one kilowatt = 1,000 watts) maintained for one hour produces or uses one kilowatt hour of energy.

Power — the rate at which a certain amount of energy is used over a period of time.

ACTIVITY 2. Temperature, Space, and Insulation Material — How Do They Affect Energy Use?

Objectives: After observing two demonstrations and recording their observations, students infer the effects of space and insulation material on temperature and energy use for home heating and cooling.

Organizing Ideas: The amount of energy needed to heat or cool a given space depends on its size and on the type (and amount) of insulation used.

1. Space capacity
2. Insulation (R-value)

Resources:

Three graduated cylinders or measuring cups (for each demonstration)

A dozen or more ice cubes (for each demonstration)

Four thermometers in degrees Celsius (for each demonstration)

Three boxes or coffee cans (with lids) of similar construction but different size (for demonstration A)

Tape measure or yard/meter stick (for demonstration A)

Three small boxes or coffee cans (with lids) of similar construction and size and three larger boxes (without lids) of similar construction and size (for demonstration B)

Styrofoam, wool-type, and another form of insulation, e.g., crushed newspaper (for demonstration B)

Student Materials:

Handouts (provided in the Student Materials Packet)

Space and Temperature (SM 2.1, 2.2)

Insulation, Space, and Temperature (SM 2.3, 2.4)

For Your Conservation Information (SM 2.5)

NOTE: A simplified version of this activity using one thermometer, hot water, three different size containers of the same material (for demonstration A), and three containers of the same size but different materials, e.g., paper, glass, and styrofoam cups, is described in Part 5 of the Suggested Procedures.

Suggested Procedures:

1. An optional information sheet, SM 2.5, provides additional background and definitions. It might be used to introduce the demonstrations.
2. The demonstrations can be organized and conducted by the teacher or by a group of students. The ice and boxes should be set up prior to class time so that the ice has time to melt and in-class time can be used for recording observations and discussing implications.
   a. Set up each demonstration as illustrated in the handouts (SM 2.1 and SM 2.3). For each demonstration, set up the three "systems" in approximately the same area at the same time. Use the same amount of ice (number of cubes) in each system. (Punch or cut small holes in the boxes before inserting the thermometers. DO NOT USE THE THERMOMETER TO MAKE A HOLE IN THE BOX.) For demonstration A, measure the space capacity (length X width X height) of each box system.
   b. After a period of time (at least one hour), take the temperature readings inside and outside each box. Remove the remaining ice from each container, and measure the amount of water.
   c. The demonstration leader(s) should describe each demonstration and announce the results so that the student observers can record the findings on their charts (SM 2.1 and SM 2.3).
3. Following each demonstration, ask students to complete the appropriate handout (SM 2.2 for demonstration A and SM 2.4 for demonstration B), working individually or as a teacher-led group.

4. After completing the handouts, students might review their responses to questions raised in Activity 1 about home energy efficiency and conservation. Additional considerations might be noted regarding trade-offs. For example: initial construction or remodeling costs, aesthetic concerns and values (e.g., high ceilings, windows to provide access to the outside.)

5. A simplified version of this activity would use hot water in three different size beakers (or other similar types of containers) for demonstration A and hot water in three different types of containers of the same size for demonstration B. The temperature of the water would be measured initially and after one or more periods of time, e.g., 5 minutes, 10 minutes. (Shake down the thermometer after each measurement.). Charts such as the following might be drawn on the chalkboard to summarize the results.

Demonstration A

Container	Temperature: Time 1	Time 2
Small		
Medium		
Large		

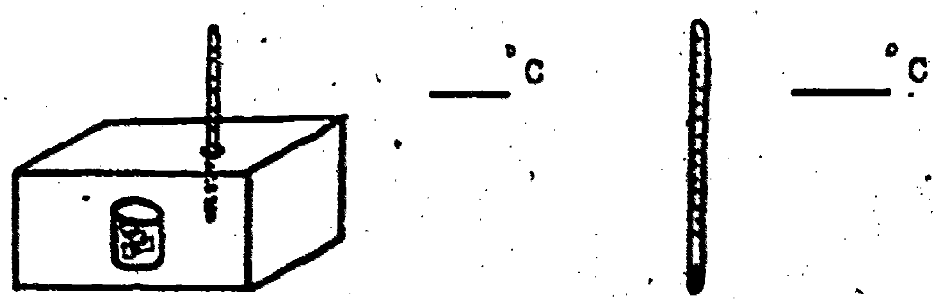
Demonstration B

Container	Temperature: Time 1	Time 2
Paper		
Glass		
Styrofoam		

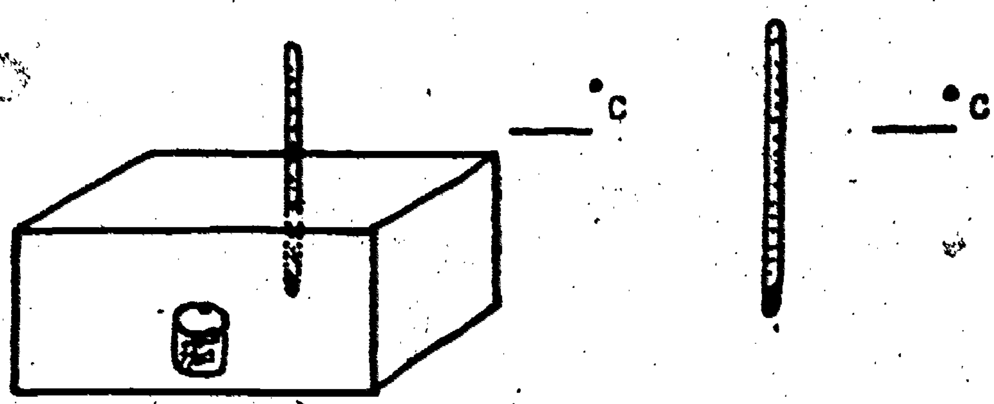
Modifications of the questions on SM 2.2 and SM 2.4 could be used for follow-up discussion.

Space and Temperature

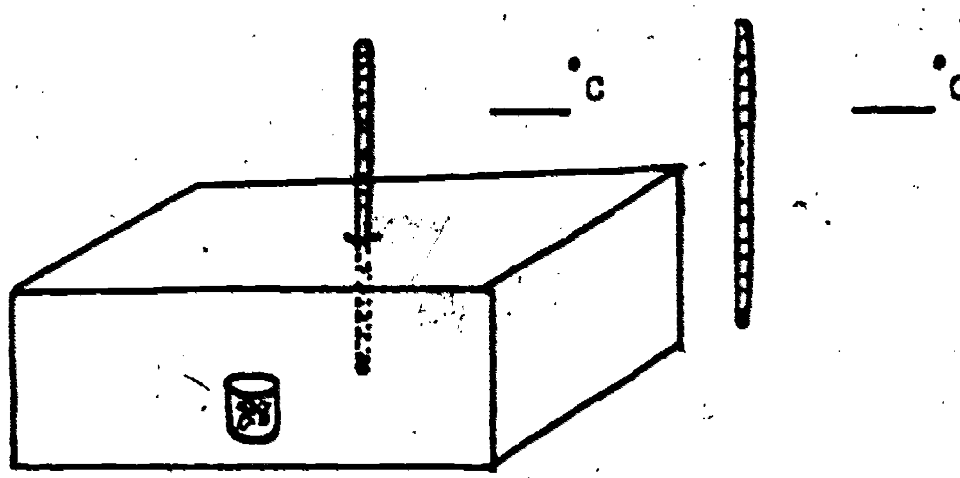
SYSTEM A
SPACE CAPACITY ________



SYSTEM B
SPACE CAPACITY ________



SYSTEM C
SPACE CAPACITY ________



System	A	B	C
Space capacity			
Inside temperature			
Outside temperature			
Liquid volume of melted ice after ____ hours			

1. How did the liquid volume of ice water vary from System A to System C?

2. How did the temperature inside each box vary from System A to System C?

3. How did the temperature outside each box vary from System A to System C?

4. How would you explain the differences in temperature inside and outside each box system?

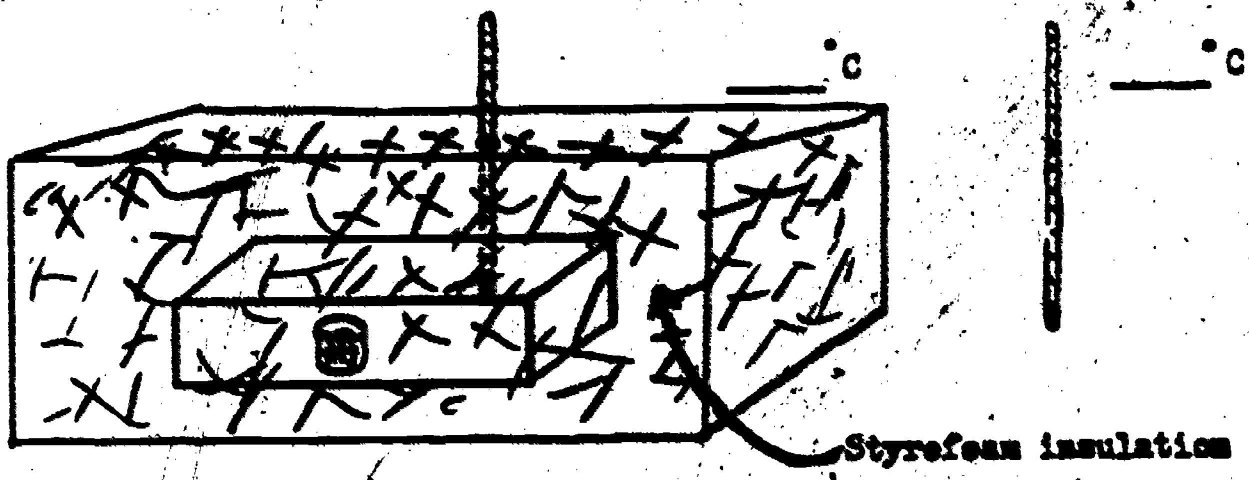
5. On the basis of your observations, which box system is most energy efficient?

   Why do you suppose that it is a more energy efficient space system than the other two?

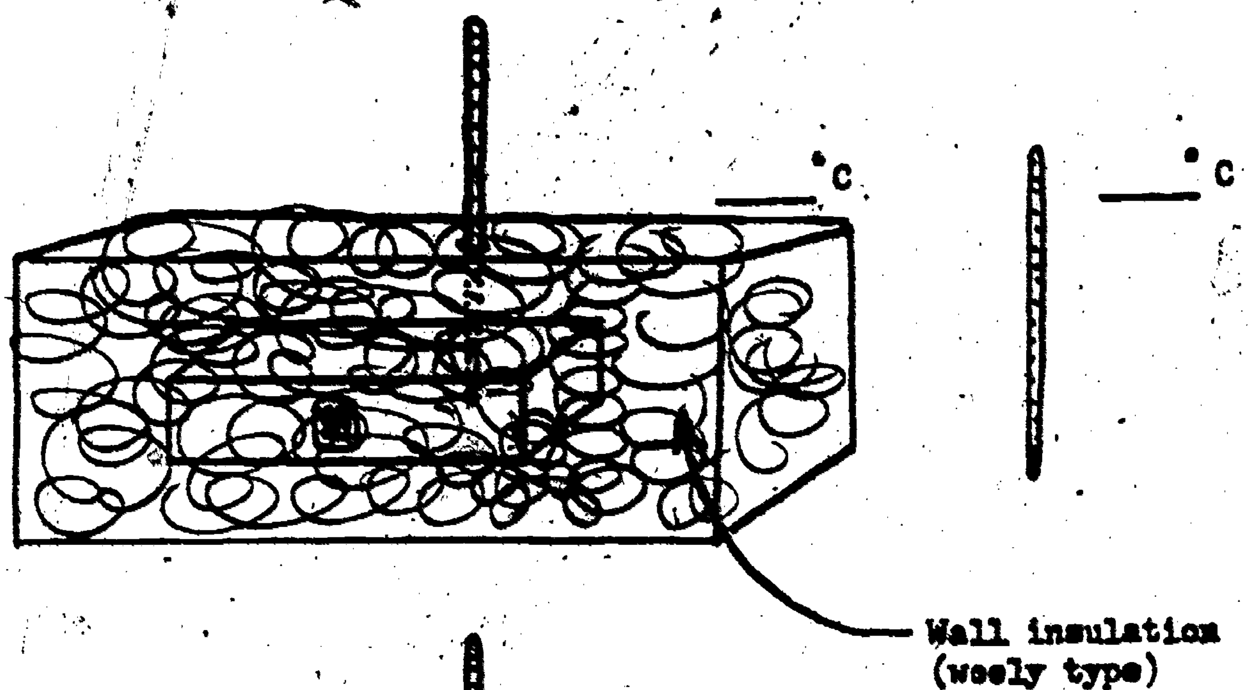
6. What do your observations suggest about efficient energy use (conservation) in home heating and cooling?

Insulation, Space, and Temperature

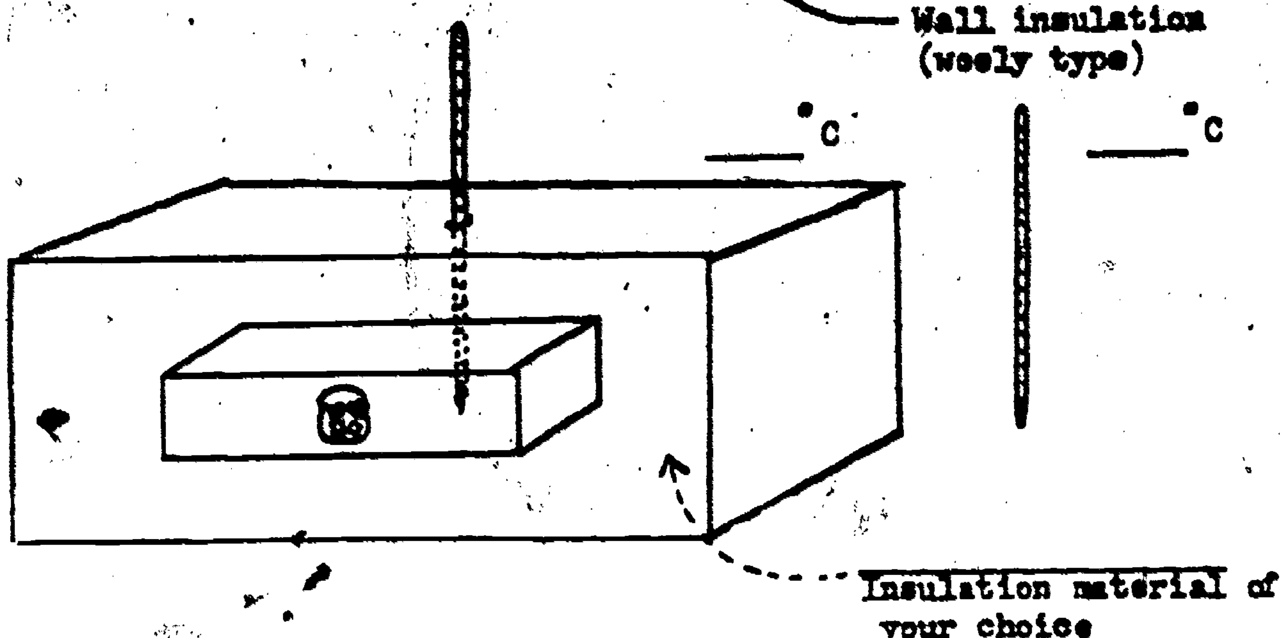
SYSTEM A



SYSTEM B



SYSTEM C



System	A	B	C
Insulation type	Styrofoam	Wall (wooly)	
Inside temperature			
Outside temperature			
Temperature difference			
Liquid volume of melt after ______ hours			

1. How did the liquid volume of ice water vary from one insulating system to the next?

2. How did the temperature inside each box vary from one insulating system to the next?

3. How did the temperature outside each box vary from one insulating system to the next?

4. Which insulating system best retained coolness?

5. What do your observations suggest about the effects of insulating material on efficient energy use (conservation) in home heating and cooling?

FOR YOUR CONSERVATION INFORMATION . . .

There are different ways of conserving energy. One includes those conservation measures that can save you money and energy at home. Big savings in energy come from insulating buildings and weatherstripping doors to prevent unwanted air from flowing into or out of a heated or cooled area. The original cost may seem high, but it is usually more than balanced by lower heating and electric bills.

The amount of energy needed to heat or cool a given space depends on the size of the space and the insulation. Insulation is material used to retain or minimize loss of heat. Insulation materials have tiny air spaces that trap air to keep it from escaping. Insulation does not have to be heavy to work well. The degree of effectiveness of such material is expressed as an R-value; the higher the R-value the greater the insulation effect.

Before people buy insulation materials, they usually find out the R-value of the insulation that is needed. The R-value is the insulation efficiency rating. The R stands for resistance to winter heat loss or summer heat gain. To minimize winter heat loss, colder regions need insulation with higher R-values.

In Pennsylvania, for example, 9½ - 10½ inches of glass fiber batts or blankets is needed to properly insulate ceilings; that represents an R-value of 30 (R-30). To properly insulate the floor, a house in Pennsylvania should have 6-6½ inches of glass fiber batts. That represents an R-value of 19 (R-19). However, since all materials of the same thickness do not have the same R-values, it is important to check the R-values on insulation materials.

Some definitions that are helpful in understanding home energy conservation are:

<u>Space capacity</u> -- the volume of an area, enclosed by a certain length, width, and depth (height).

<u>Heat</u> -- a measure of kinetic energy, measured in calories or BTUs.

<u>Temperature</u> -- a measure of the average kinetic energy (per molecule in a body), measured in degrees Celsius or Fahrenheit.

The demonstrations illustrate the effects of space capacity and insulation on energy use and conservation. Look for the differences that space capacity and insulation material make.

ACTIVITY 3. Blackout?

Objectives: Given the "Blackout?" chart of household electrical appliances and the hours of the day, students record the time of use for each item in their homes. After completing the chart, infer the effects of a limited power blackout on their lives and identify at least three changes in household practices that would result in electrical energy savings (and label them as either conservation or curtailment practices).

Organizing Ideas: Personal convenience as well as necessary household operation influence the amount of electrical energy used daily in the home.

1. Conservation
2. Curtailment

Resources:

Lengyel, Dorothy L., Wert, Jonathan, M., and Worthington, Barry K. Selected Energy Conservation Options for the Home. University Park, PA: Pennsylvania State University Cooperative Extension Service, 1978. This extensive listing of more than 125 energy conservation options is written in non-technical language and is available free on request from the Extension Service, Agricultural Administration Building, 16802.

Tips for Energy Savers. Bulk copies of this easy-to-read pamphlet are available free from the U. S. Department of Energy at either of the following addresses: "Tips" Distribution, Office of Administrative Services, Washington, DC 20545; Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

Student Materials:

Handout (provided in the Student Materials Packet)

Blackout? (SM 3.1, 3.2, 3.3)

Suggested Procedures:

1. Part A is designed to be completed by students working individually with handout SM 3.1, in class or at home.

   a. By way of introduction, you might share the following information with students and solicit questions.

      Many people are not willing to give up certain comforts in order to conserve energy. In their own homes, people often feel that they do not have to give anyone any reasons why they use energy. Well, we may see a time when energy is not available for people to "do as they please." How would you feel for example, if there was no electricity to operate the TV? What would you do?

      The energy situation in the United States does not seem to be getting better. Both energy demand and prices are going up. The future availability and costs of energy sources remain uncertain. If we do not conserve, our energy "bank" will soon be almost (or completely) empty. By conserving energy, we can make our energy supplies last longer, and we will have more time to develop new energy sources and technology. Some estimates are that we could cut our energy use by 30 percent without too much difficulty or inconvenience.

      In this activity, you will check on electric use in your own home — which appliances are used? When are they used? Consider how you might conserve energy, and some ways your life might change if there was less (or no) electricity available.

   b. Vocabulary that might be reviewed with students includes:

      Conservation — voluntary reduction of resource use (in this case, voluntarily using less electricity).

      Curtailment — complete stoppage of resource use, voluntary or imposed (in this case, nonuse of electricity during certain times or for certain purposes).

      Brownout -- reduction of electrical power supply from a utility station (affects some electric items).

Blackout — complete shut-off of electrical power supply from a utility station (affects all electric items).

2. After students have completed Part A, the questions raised in Parts B, C, and D, SM 3.2-3, might be used as the basis for group discussion. Alternatively, students might be asked to respond in writing prior to sharing their ideas.

3. This activity might be extended by asking students to determine the approximate dollar energy savings for each change in electric power use they suggest. Such information usually is available from local power companies, for example: Duquesne Light Company, Box 2495, Pittsburgh, PA 15230. Also, having students combine and total their estimated energy savings would increase the impact of this activity. However, note that only about 20 percent of the energy used in the United States is used at home. With this additional information, students might re-evaluate their energy conservation and curtailment recommendations. For example:

   a. To what extent do the energy and dollar savings seem worth the other "costs" involved? (e.g., convenience, safety)

   b. We are basing our estimates on present energy prices. What difference would rising energy prices make? What else might happen? (e.g., declining energy use could result in higher prices as utility companies attempt to offset income cost through conservation).

   c. Emphasize the complexity of energy problems. While there are some things that we can do, there are no simple solutions. Further, it is unlikely that we can accurately forsee all the consequences of our actions--or inaction. (What we don't expect can happen.)

4. Another, optional follow-up would involve students in designing, conducting, and evaluating an energy use survey of the school. A report might then be made to the student government or school administration.

Blackout?

A. Listed below are electricity-using items that might be found in a contemporary American household. Across the top of the chart, the hours of the day and evening are numbered. Make an "X" in the boxes to indicate the approximate hours of a typical weekday that you or members of your family would usually be using each item.

TIME

Midnight ... Noon

ITEM	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Dishwasher																								
Microwave Oven																								
Electric Range & Oven																								
Blender																								
Can Opener																								
Electric Clock																								
Automatic Coffeemaker																								
Toaster																								
Slow Cooker																								
Refrigerator																								
Vacuum Cleaner																								
Clothes Washer																								
Clothes Dryer																								
Space Heater																								
Water Heater																								
Color TV																								
B & W TV																								
Radio-Record Player																								
Power Saw																								
Electric Blanket																								
Hair Dryer																								
Electric Toothbrush																								
Room Air Conditioner																								
Electric Fan																								
Electric Furnace																								
Yard Light																								
Lamps & Lighting																								
Garage Door Opener																								
Other																								

B. Use your "Blackout?" chart to answer the following questions.

1. During what hours do you and your family use the largest number of electric items?

2. Which electric items are used all day (or all night) long?

3. In addition to the items you just listed, which ones are used more than six hours per day?

4. Which of the electric items seem necessary for your safety or comfort?

C. Imagine that it is the month of June and your local power company has scheduled an electric power blackout between 3:00 and 6:00 p.m., Tuesday through Thursday, in order to ccnserve limited energy supplies.

How would your daily life be affected? (List at least three ways in which your life would be different.)

D. To reduce the likelihood that we will be faced with power blackouts, what changes in electric power use might you, other members of your family, and members of your community make in order to conserve energy? (List at least three changes; then label each change that you have just listed as an example of conservation (CO) or curtailment (CU).

ACTIVITY 4. Who's Selling/Buying Energy Use?

Objectives: In this activity, students gain awareness of the possible effects of advertising on their own energy use and, given a sample ad, (1) identify the sponsor and intended audience, (2) interpret the message conveyed, and (3) infer the likelihood of increased or decreased electric energy use as a result of such advertising.

Resources:

Copies of advertisements and promotional campaign literature (from newspapers, magazines, and trade publications; also, from TV commercials).

Available sources on advertising and propaganda techniques might be used as references or supplements.

Student Materials:

Handouts (provided in the Student Materials Packet)

Who's Selling/Buying Energy Use? (SM 4.1)

Suggested Procedures:

1. Bring to class (or ask students to gather) advertisements for goods, services, or practices that involve energy use. (A sample is provided on the next page. However, more current ads in their original form likely will be more relevant and visually appealing. Student magazines usually contain such ads.)
2. By way of introduction to this activity, indicate to students that advertising (newspaper ads, TV commercials) is used both to encourage us to buy energy-using products and to conserve energy. How are we influenced by such advertising?

a. Some electric appliances are more energy efficient than others. More energy efficient products may cost slightly more, but the initial expense is made up, and then some, by reduced operating costs. Today, the energy efficiency ratio (EER, see SM 1.4) is indicated on most appliance labels. (Further information about the EER labeling program can be obtained from the U.S. Department of Energy, Appliance Program, Washington, DC 20461.)

b. Information about the energy use and operating costs of various electric appliances can be obtained from Tips for Energy Savers and local utility companies (see Activity 3).

3. Working individually or in small groups, ask students to analyze selected ads, using the questions on the handout, "Who's Selling/Buying Energy Use?" (SM 4.1), as a guide.

4. Follow-up might involve students in sharing their findings and considering how advertising might (positively or negatively) affect our energy use. If information about various advertising techniques is available, students also might identify the techniques used in the ads.

- Instant Delivery
- Large Assortment to choose from

SALE ENDS SATURDAY!

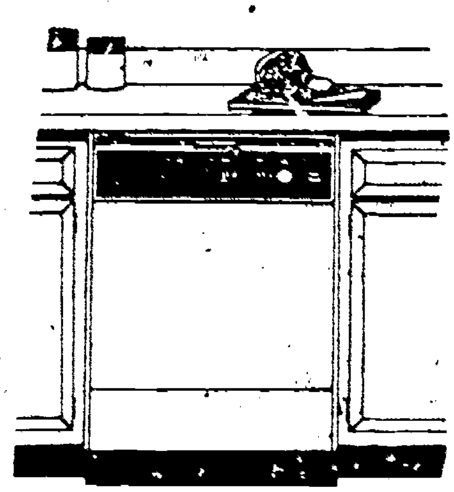
Soft food disposer saves time by eliminating a trip to the sink for plate scraping and pre-rinsing. Multi-level washing action saves time by letting you load dishes randomly while insuring efficient cleaning. Any way you look at it, this great [redacted] provides an easy way out of your kitchen. See it today.

Escape from your kitchen for only $199^00

Just push a button and let your

brand name goes here!

dishwasher do the rest



PITTSBURGH PRESS, Sunday, November 12, 1978

Who's Selling/Buying Energy Use?

Study an energy-related ad, and answer the following questions about the ad.

1. What is being advertised?

2. Who is the seller (or sponsor)?

3. Who is the intended buyer (or audience)?

4. What is the message? (What is the ad trying to encourage you to do?)

5. How much do you feel influenced or pressured to do as the ad suggests? Why do you feel that way?

6. What are some examples of decisions you have made to buy (or, not to buy) something because of its energy use or efficiency?

ACTIVITY 5. Energy Conservation: What Should We Do?

Objectives: After sharing and reviewing their findings about energy conservation options (from worksheets, demonstrations, and other reference materials), students engage in decision-making regarding an individual and/or a public policy energy conservation-urban environment goal. (To complete the decision-making map, students identify the issue and their goal, select what appear to be the three most promising (conservation) options, identify the likely consequences of each, and make a tentative decision based on the available evidence.)

Organizing Ideas:

1. Sound energy conservation decisions require consideration of alternative responses in terms of the available evidence and one's values.
   a. Each energy conservation option has advantages and disadvantages.
   b. There is no ideal means of energy conservation; when supply, technological, economic, environmental, and other factors are considered, there is no single best conservation measure.
2. In a democratic socio-political system, both individual and group choices and actions influence energy-environment policy decisions and outcomes.
   a. Individual responsibility
   b. General welfare

Resources:

NASA. NASA Tech House. Washington, DC: U. S. Government Printing Office, 1977.
This inexpensive, illustrated pamphlet describes applications of aerospace technology to home construction. Examples include energy and water conservation. Compared to an equivalent, contemporary home, the Tech House uses one-third as much electricity and half as much water.

Student Materials:

Handout (provided in the Student Materials Packet)

- Decision-Making Map

Transparency (provided in the Student Materials Packet)

Decision-Making Map (same as handout)

Suggested Procedures:

1. Since the overall purpose of this module is to encourage and assist students to make reasoned decisions about a crucial urban environment-quality of life issue, it is desirable to review the students' findings from previous activities, to explain the decision-making process and map, and to communicate the importance of informed citizens making rational choices. (The stakes are high!) The decision-making map transparency might be used alone or in conjunction with the handouts to explain the process. Also, individual responsibility and choices might be distinguished from public policy decisions in relation to the concept of general welfare.

2. Students might complete personal conservation decision-making maps individually or in small groups. Then, students might present and compare their conclusions and reasoning. To stimulate discussion and evaluation of students' decisions, questions such as the following might be raised.

   a. What is the problem? (How would you stake the major energy conservation issue(s)?)

   b. What do you want to happen? (How do you want things to turn out?)

   c. What can we do to achieve this goal? (Why would you do that?)

   d. What difficulties might we have if we did that? (Why do you suppose that not everyone agrees about what to do?)

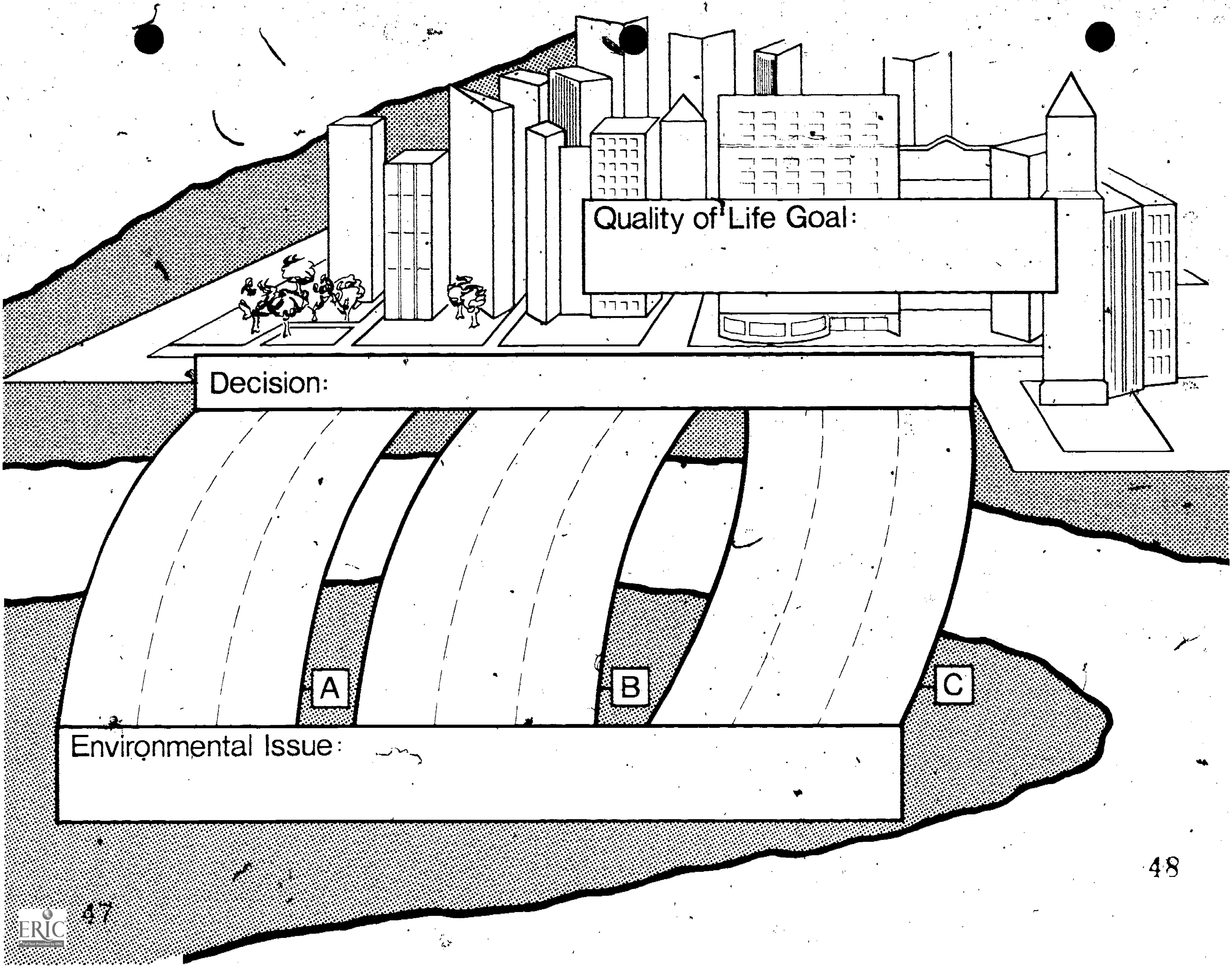
e. How would doing that change your way of life—personally, economically, or socially? (Who else would be affected? In what ways?)

f. What are the advantages of doing that? disadvantages?

g. What trade-offs are you willing to make? (Encourage consideration and weighing of costs versus benefits.)

h. What seems to be the best way to achieve this goal? (What might make you change your mind? Without avoiding difficult choices, encourage students to remain open-minded and willing to modify their positions given new information or changed circumstances.)

3. For a group/public policy decision format, students would complete the decision-making map in small groups or as a class in a "town-meeting" setting. Use options provided in the "Teacher Background Information" section of this module which might be useful. In addition, individual students might find out more about and report on one energy conservation option before any decision is reached. (Alternatively, students might focus on consumer education strategies to promote energy conservation.) The questions listed previously might be used to stimulate and guide student discussion and decision-making.


Quality of Life Goal:
Decision:
A
B
C
Environmental Issue:

Energy Conservation: What Are The Options?

MODULE EVALUATION

Please complete immediately after module use and return to C. Cornbleth, 4A01 Forbes Quadrangle, University of Pittsburgh, Pittsburgh, PA 15260.

Teacher ______________________ School ______________

Address ____

Grade/Subject Area ________________ Date ______________

A. Module Use Checklist

Please indicate whether you and/or your students used each section of this module by circling either YES or NO.

YES NO 1. Overview

YES NO 2. Teacher Background Information

YES NO 3. Activity Preview

YES NO 4. Pretest

(Activity 1. Checkpoint)

YES NO 5. Checkpoint Survey

6. For Your Energy Information

(Activity 2. Temperature, Space, and Insulation Material--How Do They Affect Energy Use.)

YES NO 7. Space and Temperature

YES NO 8. Insulation, Space, and Temperature

YES NO 9. For Your Conservation Information

(Activity 3. Blackout?)

YES NO 10. Appliance Use Grid (Part A)

YES NO 11. Personal Application (Part B, C & D)

YES NO 12. Activity 4. Who's Selling/Buying Energy Use?

YES NO 13. Activity 5. Energy Conservation--What Should We Do?

B. Initial Reactions

Please comment briefly on each of the following aspects of the module.

1. Importance of (knowledge, skills, and attitudinal) objectives:

2. Significance of content:

3. Appropriateness of activities (procedures, materials):

4. Useability, ease of teaching, practicality:

5. Student reactions:

6. Your overall reaction to the module (check one):

___ Very Positive; ___ Positive; ___ Neutral or Uncertain;

___ Negative; ___ Very Negative

Thank you.