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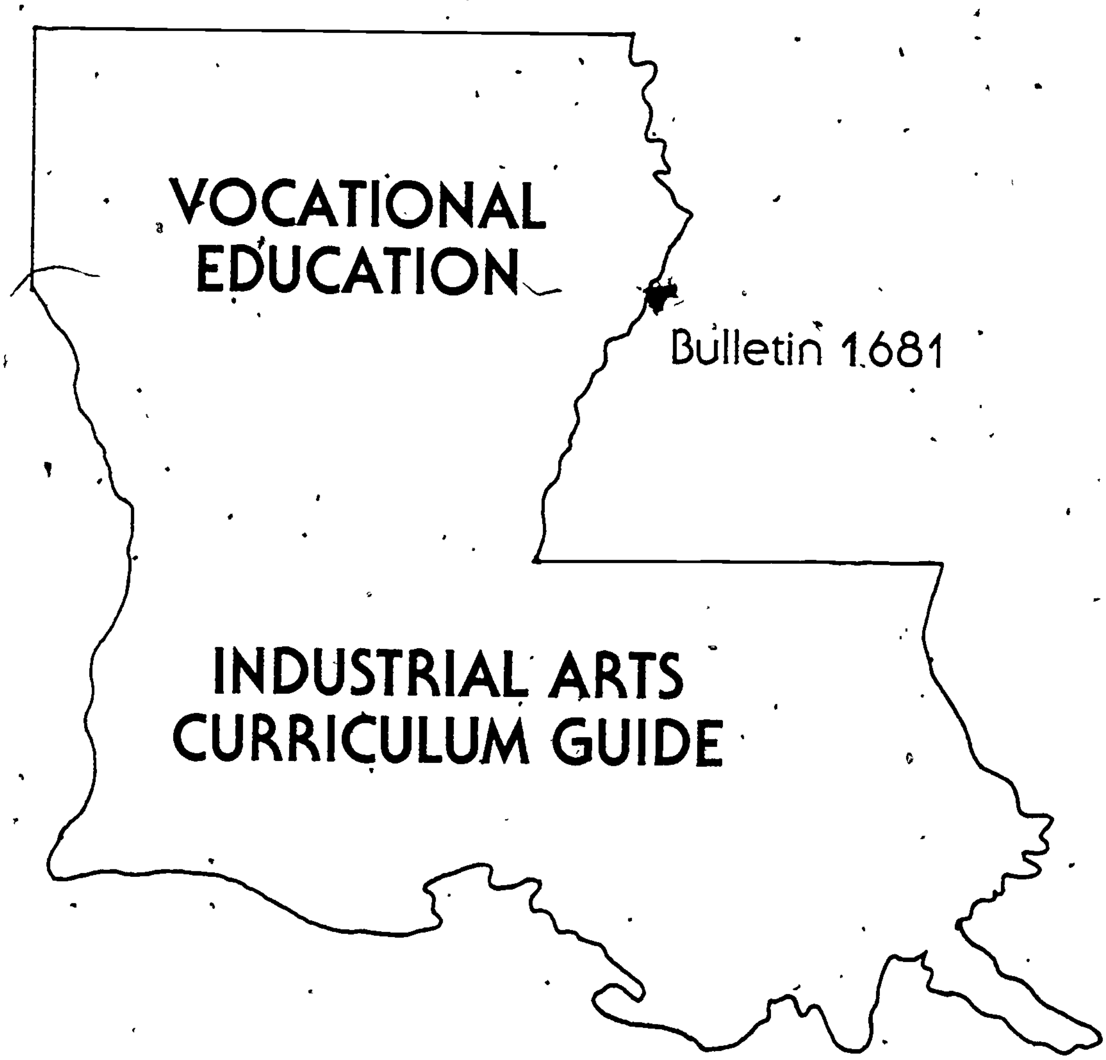
ABSTRACT

This curriculum guide provides materials for activities related to energy sources, forms, and uses that can be used in grades 7 through 12 and adapted to social studies, science, home economics, and industrial arts. The time requirement for implementation is 3 to 6 weeks. Three transparencies are first provided for use as study aids. A list of energy sources follows that the instructor may use to choose facets of energy to emphasize. Lesson 1 consists of materials designed to determine students' awareness of house areas where energy can be saved. Objectives; activities; resources, materials and equipment; an enrichment activity; an energy attitude survey; and a pretest are provided. Lesson 2 offers information on home energy use, including terms and definitions, and continues the pretest. Material on cutting energy use and three student activities are provided. Lesson 3 presents objectives, activities, transparencies, informative materials, and student activities on factors affecting energy use in home heating and cooling. A Student Schoolhouse Energy Survey follows that provides students with practical experience in detecting energy waste. Other materials include an activity on exponential growth and test items (with an answer key) that may be used as a pre- or post-test, a final examination, or several quizzes. (YLB)

ENERGY CONSERVATION

CURRICULUM GUIDE GRADES SEVEN THROUGH TWELVE



VOCATIONAL EDUCATION

Bulletin 1681

INDUSTRIAL ARTS CURRICULUM GUIDE

Issued By
Louisiana Department of Education

J. KELLY NIX
State Superintendent

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PREFACE

There is ample evidence available at present to indicate to the general public that there is a near-crisis in the energy supply of the United States. The President, the Congress, and various energy-oriented committees and commissions issued statements emphasizing the shortage of fossil fuels (our energy mainstay) and pointing out the devastating effect this shortage is having and will have upon our economy and life-styles.

The oil embargo by the Arab states in the early seventies, which resulted in automobiles lined up at gas stations and millions of people in the north and northeast being without heating oil for days, seems not to have convinced Americans that energy resources are not only limited but are in fact being rapidly exhausted.

There are far too many people who continue to use energy of all kinds as though the supply were inexhaustible. Very few people can be mobilized to contribute to the development of new energy sources, which requires time and money. But everyone can contribute to energy conservation. In order to make conservation a real factor in the energy crisis there are several things that must be done: (a) our perceptions of our energy resources must be made more realistic, (b) we must be more willing to modify our life-styles, (c) we must believe that we as individuals can make a difference, and (d) we must have the facts regarding energy reserves and the problems attending the development of new energy sources.

It is conservatively estimated that conservation measures alone in transportation, industry, home heating and cooling, could reduce our energy consumption by as much as 30 to 50 percent. This can be done without seriously depriving people of any of the comforts and necessities they now enjoy and would result in substantial savings for consumers as well.

Historically, it has always been difficult to get a society to adjust its consumer habits downward. It is always easier to let others take the sacrificial actions. Further than that, we tend to be a nation addicted to conspicuous consumption. More is better; bigger is better. This attitude must change if we are to solve the energy crisis. To effect an attitudinal change, we must influence the group that has the greatest stake in the future of the society: the children and youth. They are also the most impressionable and are more likely to accept facts and findings of energy experts at their face value.

INTRODUCTION

In the residential and commercial sections, natural gas provides nearly 41 percent of the energy; oil is close behind with almost 36 percent; electricity provides 21 percent, while coal provides only 1.7 percent. Further than that, 55 percent of the petroleum used in the United States is consumed by transportation; or to put it another way, one out of every nine barrels of petroleum produced in the world is used in American cars, trucks, and buses. (See Journal of Soc. Issues, Vol. 37, #2, 1981, p. 9.)

Q. What barriers stand in the way of an effective energy program?

A. The basic philosophy of major producers of energy is increased consumption so that profits may be increased. The major producers of energy are the oil companies who also own coal mines, coal gasification plants, and are the agencies given the responsibility for developing alternate energy sources. So the same forces that have been responsible for the attitude that "more is better" are still given the major role in solving the energy crisis problems. They are concerned with producing energy, not in conservation or reduction in consumption.

Their lobbyists are so influential in Washington that legislation that favors reduction in use of energy or development of renewable resources of energy has little chance of passing the Congress in any effective form.

Denis Hayes in his publication, Energy; The Case for Conservation, illustrates the problem:

> Our way of life is rife with opportunities to conserve energy. The United States matured in an era of abundant fuel and declining real energy prices. Energy was substituted for all other factors of production--including, whenever possible, human activity. We became a sedentary society, trading vast amounts of cheap fuel to avoid trifling exertions or monetary inconveniencies. For example, to avoid occasionally moving their feet ten inches and their hands six inches, most American car buyers pay extra for automatic transmissions that decrease gasoline mileage by ten percent or more. Often (as with our national habit of leaving on unnecessary lights) we squander energy for nothing. Our relentlessly rising fuel consumption has had an institutional rationale. A dollar invested in facilities to produce more energy makes energy available to the producer who then sells it for profit, although the same dollar invested in conserving energy makes far more energy available. Conserved energy (which would otherwise be wasted) is counted as sold; the company for whom a dollar

is burned is a dollar earned is generally unenthusiastic about returned merchandise.

If a utility does not continue to increase its sales to the public, stockholders will be unhappy and corporate officers will likely lose their jobs.

A true national debate about our real energy options has never taken place, and our institutions of commerce and government, fashioned to serve the cause of growth, have succeeded admirably. But, while they know full well how to grow, they don't know how "not to grow," as growth to them means using more energy. In their view, energy conservation would mean a poorer America.

In its "Energy to the year 1985" report, the Chase Manhattan Bank expresses this viewpoint forcefully.

> It has been recommended in some quarters that the United States should curb its use of energy as a means of alleviating the shortage of supply. However, an analysis of the uses of energy reveals little scope for reductions without harm to the nation's economy and its standards of living. The great bulk is utilized for essential purposes: as much as two-thirds is for business related uses and most of the remaining third serves essential private needs. Conceivably, the use of energy for such recreational purposes as vacations and viewing of television might be reduced, but not without widespread economic and political repercussions. There are some minor uses of energy that could be regarded as not essential but their elimination would not permit any significant savings.

It is inconceivable that any such statement about energy conservation could issue from any group that has the slightest interest in the future welfare of society or the economy. This statement and others like it made by industry and its financial backers confuse energy conservation with curtailment. Curtailment means giving up automobiles; conservation means trading in a seven-mile-per-gallon status symbol for a 40-mile-per-gallon commuter vehicle. Curtailment means a cold house; conservation requires a house with an efficient heating system. Energy conservation does not require curtailment of essential services; it merely requires the curtailment of energy waste.

The basic principles of energy conservation may very effectively be included in almost any of the typical school disciplines. They do not require separate scheduling in their own right. Establishing energy conservation in the curriculum requires certain essentials that must be provided to students. These would include the following concepts and principles: a comprehensive definition of energy, sources of energy--fossil fuel, biomass, solar energy, wind energy, nuclear energy, and geothermal energy. Students need to know the potential of various sources and which of these are renewable and which are nonrenewable.

Since petroleum products provide our most widely used fuels the imminent exhaustibility of these fuels cannot be stressed too much. Petroleum products are clean burning, easy to use, and having been plentiful in the past, are relied upon as major energy sources in our economy. Coal, our most plentiful energy resource, is difficult to mine, pollutes the air when it burns, requires long trains of rail cars to get it to the places where it can be used. Consequently, it is both a slow and expensive process for industry to convert oil- and gas-fired production to coal. But this is one alternative energy source that must be exploited if our economy is to remain viable and continue to grow. Yet conservation is our best hope for immediate relief in the present energy crunch. The U. S. Department of Energy publication, "Tips for Energy Savers", 1981, says: "If every household in the United States lowered its average heat in temperature six degrees over a 24-hour period, we would save more than 570,000 barrels of oil per day." This can be done without creating physical discomfort and it will save money for consumers. This same publication goes on to say, "If every gas-heated home were properly caulked and weatherstripped, we would save enough natural gas each year to heat about four million homes."

According to R. Stobaugh and D. Yerger in "Energy Future," 1979, quote:

> Conservation, not coal or nuclear is the major alternative to imported oil. It could perhaps supply up to 40 percent of America's current energy usage. Moreover, the evidence suggests that there is much greater flexibility between energy use and economic growth than is generally assumed and that a conservation energy strategy could actually spur growth.

Similarly, M. Ross and R. Williams in "Drilling for Oil and Gas in Our Building," 1979, quote:

> A goal to reduce fuel consumption for space heating is economically and institutionally feasible. This goal is far greater than the 4 percent saving potential estimated by the Department of Energy.

Further evidence of the need for energy conservation is given in the Journal of Social Issues, Vol. 29, No. 3., which states:

> Between 1950 and 1974, the global economy tripled in size. Global energy consumption also increased threefold. Indeed, increased

energy consumption is the inevitable companion of economic growth, although the amount by which consumption increases varies with the stage of economic development and with efforts to reduce energy waste.

While energy needs increase in absolute terms with economic growth, the use of certain kinds of energy tends to grow even faster. Today, (1979) five years after the unprecedented rise in oil prices all countries continue to become increasingly reliant on oil. Indeed over the quarter century in which the global economy tripled in size petroleum use in the industrialized countries increased 4.3 times.

Denis Hayes in the previsously cited publication, Energy: The Case for Conservation, is even more radical in his assertions about what conservation can do toward reducing the energy shortage.

More than one-half of the current U. S. Energy Budget is waste. For the next quarter century, the United States could meet all its new energy needs supply by improving the efficiency of existing uses. Energy derived from conservation would be safer, more reliable, and less polluting than energy from any other source. Energy conservation could reduce our vulnerability in foreign affairs and improve our balance of payments positions. Moreover, a strong energy conservation program would save consumers billions of dollars each year. . . . in 1975 American wasted more fossil fuel than was used by two-thirds of the world's population. We annually consume more than twice as much fuel as we need to maintain our standard of living. We could lead lives as rich, healthy and fulfilling with as much comfort and more employment using less than half of the energy now used.

The preceding citations would seem sufficient to justify our best efforts in the area of energy conservation as well as to set forth the possibilities of our achieving large scale success. This project is intended to serve as a guide for teachers in developing an energy conservation awareness in secondary students, as well as in other teachers. Teachers need to be aware of the seriousness of the energy crunch. They need to know the possible consequences to the economy and thus the lifestyle to which we have become accustomed.

We are heavily dependent upon fossil fuel, i.e., oil and natural gas, for the production and transportation of goods of every kind. The heating and cooling of our homes, schools, hospitals, and other commercial buildings depend almost solely upon fossil fuels as their energy sources.

Electricity, which is a secondary product, has depended in a large measure upon oil and natural gas for its generation. Although ERDA now prohibits any new electric generating plants from using oil or gas as their primary fuels, many old established generating plants are still relying upon petroleum products for fuels. According to National Wildlife Federation Journal, 1978:

> Although we Americans produce 35 percent of the gross world product, we make up only six percent of the world's population and consume 32 percent of the total world energy. As much as 30 to 50 percent of the energy we consume is wasted. Because energy was cheap we built inefficient cars, inefficient buildings, and inefficient factories. Because we used energy wastefully, the opportunities for saving energy now are great and the reasons are compelling. Conservation of energy can help keep the costs down and reduce pollution of the environment.

The big users of energy are automobiles, trucks, buses, planes, trains, and ships. Automobiles are the most wasteful users, mainly because Americans use automobiles for transporting one to two persons most of the time. Transportation uses 18.9 percent of our energy, commercial industries use 29 percent, home heating and cooling use 18.9 percent, and electrical generation, 26.8 percent.

The major areas in which concerned people can make a difference are in building weatherization and site improvement and selection. More expeditious use of transportation is a third area with much potential for energy conservation.

Building weatherization covers insulation of exterior walls, unheated attics and floors built on piers. The amount of insulation needed is determined by the climate of the area in which one lives. For information regarding the insulation recommendation for the various zones of the United States, see Providing for Energy Efficiency in Homes and Small Buildings, Part II, June 1980, U. S. Department of Energy, Washington, D. C. 20585.

The addition of storm windows and doors is a conservation measure that will pay large dividends in energy savings. Add to this weatherstripping of all exterior doors and windows and the caulking of all cracks around door and window jambs, and more energy savings will be realized.

Site selection may in some cases be used to reduce energy consumption in the home. Soil embankment on the north side can protect the house from the cold winter winds. If there are trees in the site they should be allowed to stand because they provide protection against both heat and cold. If there are no trees shrubbery should be utilized. Evergreen shrubbery should be planted on north and west sides of the house and deciduous trees should be planted on the south side. These trees provide shade from the summer sun and let the winter sun's rays pass through to warm the house in winter. The thermostat should be kept at 68° in winter and 78° in summer. This practice will save additional energy.

More expeditious use of transportation facilities could further add to conservation of energy. Cars should have motors tuned regularly, and should be driven no faster than 55 miles per hour. Tires should be properly inflated at all times. Car pooling should be practiced wherever possible. Public transportation should be more widely used.

Recycling waste is still another conservation measure. For example, reclaimed aluminum can be returned for use with five percent of the energy used in producing it from ore: to make steel from scrap requires only about 25 percent of the energy used in making steel from ore. Even using scrap paper requires only 60 to 70 percent of the energy used to make paper from wood.

The function of this guide is to make the citizenry energy-conservation conscious, knowledgeable regarding the ways and means available for saving energy, and aware of what devastating effect an energy crisis could have on our life-styles and upon the economy in general. A clarification of the meanings of terms such as energy, work, and power is necessary so that students may understand the writings of experts in the energy field. Some of the following provide valuable information.

Energy is defined as the power to do work. The energy we use other than food energy comes from several different sources. The leading source is fossil fuels. They are coal, natural gas, crude oil and tar sands. Fossil fuels get their name from their sources, which are the remains of plants and animals buried under layers of earth by its volcanic eruptions. These organic substances were buried without oxygen for millions of years during which time they were fossilized. Later man tapped these subterranean sources and brought out crude oil and natural gas.

Fossil fuels are finite and we are rapidly exhausting the earth's supply of this valuable energy resource. The United States, with six percent of the earth's population, uses 33 percent of the earth's fuel or energy. Our needs double at an exponential rate. Some experts say that we have no more than a 30-year supply. Energy is the capacity to do work, that is, the ability to make something move. The impending exhaustion of fossil fuels is an impelling reason for the practice of conservation to give the nation more time to find alternate sources.

Energy comes from biomass, which is a renewable source. Examples of biomass are wood products, agricultural waste, industrial waste, and sewage sludge. Energy comes from water also. Examples are hydroelectric power plants, waterfalls, and ocean waves. Hot springs and geysers furnish negligible amounts of our energy supply. Until these secondary sources or other sources are sufficiently developed to make this country capable of producing its own supply, the effort to conserve is one of its best hopes.

The three transparencies that follow can be used as study aids to help students acquire more information about energy sources, forms and uses. Transparency I may profitably be used as a take-home test or study activity. Transparency II provides an opportunity for students to do library research on energy sources and to discover the difference between renewable and non-renewable sources of energy. Transparency III. provides general information on the sources of energy America relies upon at present. Pages 11 and 12 provide the instructor with a choice of facets of energy to emphasize in accordance with the time available and the grade level of the students involved.

In the pilot study at Glen View Junior High School the teacher limited the exploration of energy sources to the concept of energy, the definition of energy, the history and formation of fossil fuels, the advantages and disadvantages of nuclear energy, and definitions of hydro-power and solar power. For senior high school students the avtivities may include a wider study of energy sources.

TRANSPARENCY I

*Identify the Form of Energy:

_______________ 1. Produced from the fission of atoms.

_______________ 2. Produced from the vibration of molecules.

_______________ 3. Produced by the movement of electrons through a path.

_______________ 4. Produced from the movement of inanimate objects.

_______________ 5. Produced from the combination of two or more substances with another or with each other.

_______________ 6. Produced from fusion of atoms.

_______________ 7. Produced by waves traveling through space.

_______________ 8. Produced by body tissues.

_______________ 9. Energy from the sun.

_______________ 10. Produced by waves traveling through matter.

*It is suggested that the contents of this transparency be used as a take-home study test for students to fill out and return to the teacher at the next class period.

TRANSPARENCY II

WHERE DOES ENERGY COME FROM:

Fossil Fuel - Non-renewable sources

Coal

Oil

Natural gas

Renewable Sources

Geothermal energy

Solar energy

Wind

Hydropower

Nuclear energy

Bioconversion

Breeder Reactors

TRANSPARENCY III

WHERE DOES AMERICA GET ITS ENERGY?

Oil	46%
Gas	32%
Coal	17%
Water Power	4%
Nuclear Power	1%

ENERGY SOURCES

The Nature of Energy and Power

1. Concept of energy
2. Definition of energy, work, and power
3. Relationship between different forms of energy

Fossil Fuels

1. History of use of fossil fuels
2. Formation of fossil fuels
3. The availability of fossil fuels in the United States and the world
4. Consumption of fossil fuels for transportation, commercial, industrial, and residential purposes
5. Production of power from fossil fuels
6. Advantages and disadvantages of fossil fuels
7. Fossil fuels as chemical raw materials
8. Environmental impact
9. Career opportunities

Radioactive Materials

1. Nature of the atom
2. Explanation of nuclear reactions (fission and fusion)
3. How a nuclear reaction can be used to produce power
4. Uranium mining
5. Availability of uranium in the United States
6. The advantages and disadvantages of nuclear energy
7. The role of nuclear fuels in the utility industry
8. Environmental impact
9. Career opportunities

Water

1. Water power, its history and origin
2. Availability
3. How it can be used to produce power
4. Applications for industrial use
5. Advantages and disadvantages of its use
6. The role of hydro-power stations for the generation of electricity
7. Environmental impact
8. Career opportunities

Solar

1. Explanation of Solar Power
2. Historical utilization
3. Its applications for heating and air conditioning
4. Its advantages and disadvantages as an alternate source of energy
5. The role of solar power in the future
6. Environmental impact
7. Career opportunities

Wind

1. Explanation of how the winds are produced
2. History of their use
3. Power generation from wind
4. Advantages and disadvantages
5. The role of wind oower for the nation's future energy needs
6. Environmental impact
7. Career opportunities

Geothermal

1. Description of geothermal energy source
2. Location of geothermal energy sources
3. Power production of geothermal sources
4. Advantantages and disadvantages
5. The role of geothermal power for the nation's future energy needs
6. Environmental impact
7. Career opportunities

ENERGY CONVERSION DEVICES

INTERNAL COMBUSTION ENGINES

DIRECTIONS FOR USE OF MATERIALS THAT FOLLOW

These materials as modified can be used with grades 7 through 12 and can be adapted to social studies, science, home economics, or industrial arts. Not every lesson has to be taught. The teacher may adjust the emphasis to fit into a period covering three to six weeks. In our pilot study at Glen View Junior High School, Ruston, Louisiana, the activities covered six weeks.

The attitude test that follows is intended to survey the feelings that students have about the energy crisis, because the individual's basic attitude will determine to a large extent how responsibly he will respond to calls for energy conservation. The background information comes from Energy and the Family by Gulf States Utilities Company and is used with their expressed permission.

LESSON 1

Lesson 1 consists of a series of items designed to determine, to some extent, each student's awareness of the areas in the house where energy can be saved. This lesson will also provide the student and teacher with some insights regarding what the student knows about such concepts as filters, weatherstripping, caulking, peak periods of energy use, etc.

The two transparencies that follow serve as teaching aids which should be useful to the teacher in pointing out the places and parts of a building where heat loss or heat gain is most common and why this is the case.

This activity provides a good opportunity for the teacher to demonstrate with numbers just how important even a small crack can be. For example, a one-fourth inch crack at the bottom of a 36-inch-wide door is equivalent to an opening nine inches square in a wall. Clearly anyone would be concerned with closing a nine-inch-square hole in the wall of a house even though it is no more wasteful of energy than a one-fourth inch crack at the bottom of the door.

LESSON 1: ATTITUDE SURVEY, PRETEST, BACKGROUND INFORMATION

Objective:

To become aware of the energy situation.

I. Objectives:

A. Justify the importance of energy in our everyday lives.

B. Summarize the effect of future cost increases of energy on the family budget at different stages of the life cycle.

C. Recognize reasons for the increase in energy use from 1955 to 1985 in the United States.

D. Choose measures to conserve energy and identify the most difficult measure.

E. Determine personal attitudes on energy.

II. Activities

A. Turn off all lights as you begin the introduction of the unit. Use a lighted candle for illumination. Ask students to think about "what their lives would be like without electricity."

B. Have students examine transparencies:

1. Residential projection (cost increase by kilowatt-hour for the home by years). Ask the following questions:

a. What will be the cost per kilowatt-hour in 1985? What was the cost in 1979? Explain to the students that costs per kilowatt-hour in 1985 will be about double that of 1979. So, if an average monthly bill in 1979 was $100, then an average monthly 1985 bill will be about $200.

b. Ask what age they will be in 1985.

2. Population growth - Explain that persons in the 20-35 age group influence economic activity much more than any other group. It is during this period that marriage and the establishment of a household and family usually occurs. Equipping new or expanding households requires purchasing a large range of products. During this period, the need for goods and services is greatest. The economic activity to satisfy needs must increase at a rapid rate since the majority of the population is this age. As a result, the need for energy will expand rapidly, too.

3. Have students examine graph on Per Capita Use of Energy. Compare the amount of energy used in 1955 and the amount projected for 1985. Point out that in 30 years the amount of energy needed will increase two and one-half times. Point out that the population has increased only 20 percent.

Ask the following questions: (1) Why is more energy being used? (2) What should be done about the amount of energy used? (3) How is this going to affect the family in the future?

4. Utility fuels for 1970-1990 - Explain that these are the fuels that will be used to produce electricity during 1970-1990. Ask the following questions:

   a. What fuel sources were being used the most in 1970? 1976? What fuel sources will be used the most in 1984? 1986?

   b. What is happening to the use of gas and petroleum? Explain that because of dwindling supplies and increased costs, less and less petroleum will be used. Explain that government regulations prohibit the building of any new power plants that use natural gas to produce electricity. Natural gas has important uses other than as a boiler fuel.

   c. When will utilities start using coal to produce electricity?

   d. When will nuclear energy be used? Explain that coal nuclear energy will increasingly take the place of oil and natural gas as fuels for generating electricity.

5. Have students play a completion game on "Energy Conservation Is . . ." Pass out white or colored paper in the shape of E's and C's. Have students write down 10 completion sentences on "Energy Conservation is . . ." on their letter. Discuss. Take these up to make into bulletin board entitled "Energy Conservation Is . . ." (These could also be placed on the wall.)

6. Hold a buzz session to discuss "Three Things I Would Do Willingly to Conserve Energy" and "The Toughest Energy Conservation Measure for Me Would Be . . ." Use colored paper plates to divide groups by colors (approximately three to five students into three to five groups with different colored paper plates for each group). NOTE: If colored paper plates are not available, use white paper plates marked by different colors of magic markers or crayons, or use sheets of colored construction paper. Have students appoint a group leader to write answers on paper plates. Discuss answers. Paper plates can be used to construct a mobile.

7. Hand out attitude survey and pretest. Have students complete survey and pretest in class. If students do not finish by the end of the class period, take up the papers and have students complete them at the beginning of the next class meeting.

8. Assign Background Information, Lesson 2, page 20.

III. Resources, Materials, and Equipment

A. One candle and holder

B. White paper cut out as E's and C's

C. Three to five different colors of paper plates or construction paper

D. Attitude survey and pretest

IV. Enrichment Activity

Interview a parent or a home owner and report the reaction to the following questions:

A. How do you feel about the cost of your heating bill?

B. Do you believe there is a shortage of fuel?

C. What would be your suggestion for solving the energy crunch?

Suggested Time Period: two class periods

NOTE: It is not necessary to use all activities under Lesson 1. Pick out activities suited to your time frame.

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 most Americans are "spoiled," self-indulgent and reluctant to take responsibility for the future? ___yes ___no ___don't know

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

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

8. Do you believe energy conservation always means doing without? ___yes ___no ___don't know

9. Would you be willing to reduce your standard of living to conserve energy? ___yes ___no ___don't know

10. Do you believe you as an individual can make an impact on energy conservation? ___yes ___no ___don't know

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

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

13. Do you think the <u>energy saved</u> is worth the inconvenience of conserving energy? ___yes ___no ___don't know

14. Do you feel technology will "bail us out" of the energy shortages? ___yes ___no ___don't know

15. Do you feel you have any input or participation in the energy use decisions made by your family? ___yes ___no ___don't know

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

Name: ______________________ School: ______________________

Course: ______________________ Date: ______________________

Period: ______________________

LESSON 1

PRETEST

This pretest is to see how much you already know about energy conservation. You will be graded on this as a regular test. However, participation is important. It is not necessary to answer the question if you do not know the answer.

I. TRUE/FALSE

Read the sentences carefully. Write True or False in the blank provided.

__________ 1. Fluorescent lights give four times the light for the same amount of energy as incandescent lights.

__________ 2. Air leakage is a great cause of heat loss from the home.

__________ 3. A home with many windows uses less energy to heat and cool than a home with few windows.

__________ 4. R-Value is the measure of an insulating material's resistance to heat flow.

__________ 5. Draperies are not as effective as a shading device as shade trees or awnings.

__________ 6. An economical way to heat the home is to use the electric oven.

__________ 7. Family habits affect the amount of energy used.

__________ 8. Water heaters use a small amount of energy, so it does not matter how much hot water is used.

__________ 9. Washing dishes by hand after each meal uses less hot water than a dishwasher.

__________ 10. Ventilating the attic area does not affect the energy efficiency of the home.

__________ 11. Utility bills are not important when considering the total cost of home ownership.

BACKGROUND INFORMATION

LESSON 2

I. Energy Conservation:

Keeping the amount of energy consumed to a minimum by using methods that will allow maximum use of available energy without needless wasting.

II. Terms and Definitions:

A. Watts - A unit of electrical power needed to do a unit of work within a given time.

B. KWH (kilowatt-hour) - the amount of energy equal to 1000 watts of electricity used for one hour. (Example: Ten 100-watt light bulbs burning for one hour.)

C. Life-cycle costs - total costs of home or appliance ownership for its useful life.

D. Peak period - time of day when the greatest demand for electricity occurs (2-6 p.m., Monday through Friday).

E. Off-peak period - 10 p.m. to 10 a.m. on weekdays and all weekends. (On weekends, industries do not need as much electricity and businesses are closed.)

F. Intermediate peak period - 10 a.m. to 2 p.m. and 6 p.m. to 10 p.m.

G. Blackout - temporary loss of power which can happen when an electric power plant has too much demand placed on it and becomes overloaded.

H. Incandescent lights - type of lighting most commonly used in homes. Electricity passes through a tiny, spiraled tungsten wire mounted inside a bulb, causing it to become white hot and produce light.

I. Fluorescent lights - most economical type of lighting. Lasts seven times longer than an incandescent light and gives off four times as much light. A 25-watt fluorescent light is equal to a 100-watt incandescent light. An electric current flowing through the tube containing gases causes the phosphor coating to glow and produce light. The gas serves as a conductor to activate the phosphor. Fluorescent lights do not give off as much heat as incandescent lights.

J. Thermostat - device used to regulate the heating or cooling system within a home.

K. Air conditioning filter - material usually made of fiberglass or foam rubber used to collect dust, dirt, grease, and other particles and to prevent them from entering mechanical heating and cooling equipment.

L. Electric meter - device that measures electricity in kilowatt-hours and has either dials or numbers for recording the amount used.

M. Natural gas meter - device that has dials like the electric meter, but measures gas consumption in hundreds of cubic feet.

(Pretest continued)

II. MULTIPLE CHOICE

Read sentences thoroughly. Underline the answer you think is correct.

1. A material used in walls and attics of homes to keep heat from escaping is:

   a. solar film   b. turbines   c. insulation

2. The temperature at which the air conditioner thermostat should be set during the summer is:

   a. 78 degrees   b. 72 degrees   c. 68 degrees

3. Filters of central heating and cooling units or air conditioners should be changed or cleaned:

   a. once a year   b. once a month   c. every six months

4. To save energy, the water heater temperature should be set at:

   a. 90-100 degrees   b. 120-140 degrees   c. 165-175 degrees

5. A strip of metal, rubber, or felt applied around door facings to prevent drafts is:

   a. insulation   b. caulking   c. weatherstripping

6. Microwave ovens take an average of ______ the time required to cook in conventional (or regular) ovens.

   a. one quarter   b. one tenth   c. three quarters

7. Lint filters of clothes dryers should be cleaned after every:

   a. 10 loads   b. one load   c. five loads

8. To avoid the possibility of a "blackout" or loss of power during the summer, as little electricity as possible should be used during the "peak" period (when the demand is the highest) which is from:

   a. 10 p.m. to 10 a.m.   b. 2 p.m. to 6 p.m.
   c. 6 p.m. to 10 p.m.

9. A material used as a filler to stop up cracks around window frames is:

   a. weatherstripping   b. filter   c. caulking

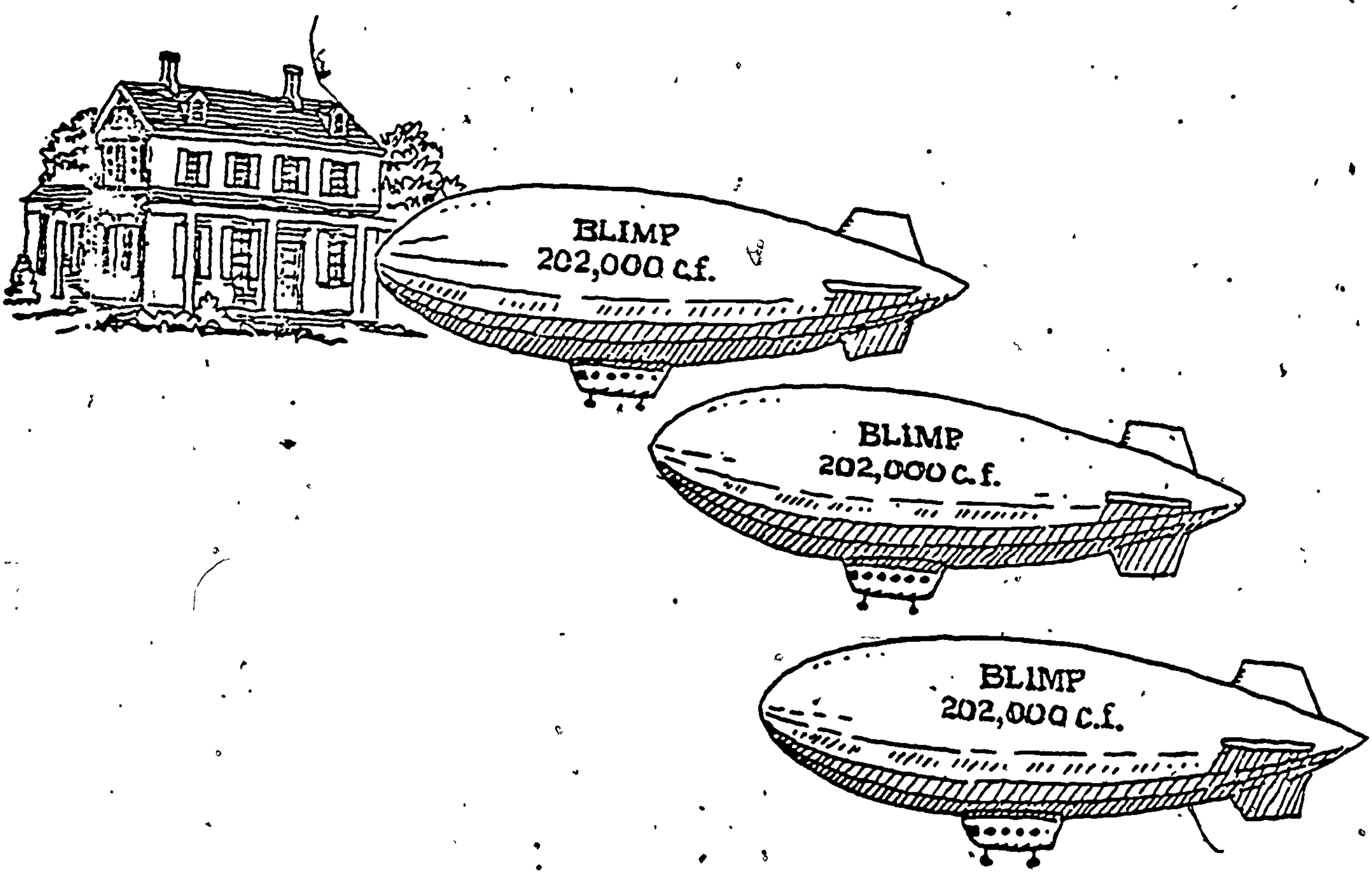
TRANSPARENCY IV

THE FACTORS AFFECTING THE AMOUNT OF ENERGY USED IN THE HOME HEATING AND COOLING SYSTEMS

1. Changes in outdoor temperature humidity
   - the lower the temperature, the greater the heat loss.
   - the more hot and humid the summer, the greater the amount of air conditioning required
2. Structural components of the
   - doors
   - windows
   - walls
   - ceiling and attic
   - floors
   - fire place
3. Family size, structure and habits
   - how often doors are opened
   - how much time is spent at home
   - how rooms are used
   - values and special needs of family members
4. Orientation of the home on its site
   - designing windows on the home so it will have as few as possible on the east and west sides
   - designing windows on the south side to use the sun for warmth in the winter
   - placing trees on the east and west to shade the house from summer sun
5. Lowering the thermostat in the winter and raising it in the summer
   - For every degree you raise the thermostat in the summer you save three percent (raised from 72 degrees to 78 degrees = 18 percent savings).
   - two percent is saved for every degree the thermostat is lowered in the winter (lowered from 70 degrees to 68 degrees saves 4 percent on energy).
6. Where heat loss or gain occurs
   - poorly insulated walls, floors, and ceiling
   - through doors and windows constructed of single paned glass which allows as much as 20 times more heat loss than a well insulated wall
   - crack or space opened to the outside
   - open fireplace chimney
   - a house on piers with floor spaces
   - through unshaded glass receiving direct sun

TRANSPARENCY V

It would take three Goodyear Blimps to equal the volume of air infiltration moving through an average home in one day.



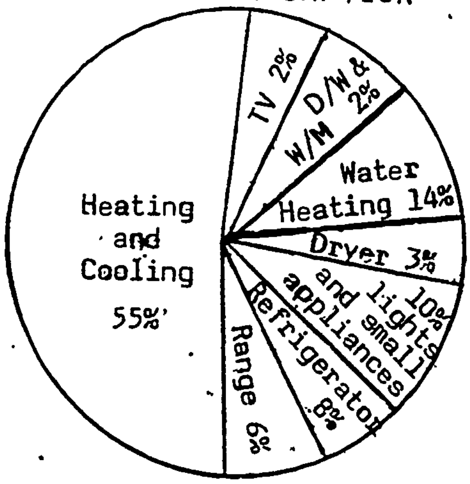
The blimps represent the amount of air that may pass through a house in one day.

*Transparency from Appendix of Energy and the Family by Gulf States Utilities, Highway 45, Conroe, Texas.

BETTER LIVING WITH LESS ENERGY

TRANSPARENCIES OR CHARTS	NARRATIVE
1. Better Living with less Energy	Today we'll take a look at low-cost and no-cost ideas that we can use to cut down on energy use.
2. Man with bill (frustrated)	In a few years most of us will be on our own and responsible for our own expenses. Some of us will go directly out of high school into jobs. Some of us will also get married and start families. Some of us will postpone total independence by going to college to prepare for a career. No matter what our goals are, we will be responsible for our expenses. With energy costs rising, we want to do as much as we can to cut down on energy needs such as heating and cooling the home.
3. Scales comparing housing costs 1977-1997	Remember that energy costs will use up more of our budgets, thus we will have less to spend for other things we want or need. We can keep energy costs to a minimum by building a new home to be energy efficient or by retrofitting an existing home. Compare the difference in the expenses of owning an energy-efficient home to a regular home. Notice the difference in utilities. With an energy-efficient home there is money left over to use for other wants or needs of the family. Notice the rising costs by 1997. The utility cost, $410, for an average home (not energy efficient) is predicted to be higher than the house payment (principal, interest, taxes, and insurance), $369. The utility cost for an energy-efficient home is considerably less, $266, than the house payment, $369. It definitely pays to have an energy-efficient home. While an energy-efficient home will cut down considerably on heating and cooling costs, our habits in using appliances and equipment also affect the utility bill.

TYPICAL ANNUAL HOME ENERGY CONSUMPTION



Most of us wonder what appliances use the most electricity. Another question is "Do lights use a lot of electricity?" Let's look at this chart to see what appliances and equipment use the most electricity.

55% Heating and Cooling
14% Water Heating
10% Lights and Small Appliances
8% Refrigerator
6% Range
3% Dryer
2% Television
1% Dishwasher
1% Washing Machine

5. Factors Affecting the Amount of Energy Consumed in the Home:
   (a) Changes in outdoor temperature
   (b) Construction of the home
   (c) Temperature Control (Thermostat setting)
   (d) Family size, structure, and habits

Some families spend more on electricity than others. The reasons families use different amounts of electricity are:

(a) Changes in outdoor temperature
(b) Construction of the home
    This means doors, windows, ceiling, attic, floor, fireplace.
(c) Lowering the thermostat in winter, raising it in summer.
(d) Family size, structure, and habits
    This means how many children, their ages, how many family members are at home during the day, how many electrical appliances are used, and how often.

6. Thermostat Setting

Since cooling and heating the house accounts for about 55 percent of the bill it pays to check the thermostat setting. Keep the thermostat at a lower temperature setting during the winter and higher during the summer. In the winter, the thermostat should be set around 68 degrees during the day and 60 degrees at night. Maintain a setting of 78 degrees or higher during the summer. Make sure family members do not constantly change the setting. For every degree you lower the thermostat in the winter, you save two percent per degree on the utility bill. Three percent per degree raised is saved in the summer. Use fans to help circulate conditioned air. A temperature setting of 78 degrees will feel like 68 to 70 degrees when a fan is used.

7. Window unit

Some homes use window air conditioners. If your home has one, keep the compressor or cooling knob on the lowest possible setting. If you are gone for more than eight hours, it is usually best to turn the air conditioner off. Another way to be comfortable is to close off any rooms not in use during the day. Also shade an air conditioner with an awning if exposed to direct sunlight.

8. Filter

Check the air conditioner filter once a month, whether it is a central unit or window unit. Most filters need to be changed once a month. Filters serve to keep your system free of lint, dust, and grease. A dirty filter causes a heating or cooling system to work harder, thereby using more energy and increasing the possibilities of an expensive breakdown. Never operate the equipment without a filter.

9. Outside unit

If you have a central heating and cooling system, keep the outside unit free of leaves, grass, or plants that might restrict air movement. Also, have annual checks and maintenance done by professional servicemen.

10. Water heater

After heating and cooling, the next largest part of the utility bill is water heating. Since water heating accounts for about 15 to 20 percent of your bill, it pays to save as much as possible. In dishwashing, house cleaning, laundry, and bathing, use as little hot water as possible. Lower the thermostat to between 120 to 140 degrees; 130 to 140 degrees may be needed if you have a dishwasher. By lowering the temperature you can save over 18 percent of the energy you would use at the higher setting.

11. Household cleaning

Use cold water as much as possible for cleaning. Mopping floors, cleaning windows, mirrors, and woodwork can be done with cold water. Don't let the water run while washing dishes by hand, shaving, brushing teeth, etc.

12. Draining water heater	Keep water heaters free from mineral residue. Drain a gallon from the tank about once a month if it is a new water heater. Old ones should not be drained because leaks may occur.
13. Flow restrictors and leaky faucets	Flow restrictors are very inexpensive devices that reduce the flow of water in showers and faucets without reducing the pressure. A flow restrictor can cut the water flow from 10 gallons to two to three gallons per minute. Remember this rule: Take short showers or partially filled tub baths to conserve. Repair all leaky faucets. One drop a second can waste as much as 60 gallons a week.
14. Water heater jacket	A water heater jacket is additional insulation added to the outside of the water heater. The purpose of the jacket is to keep the heat from escaping from the water tank. The water heater will not come on as often, and will use less energy.
15. Lady at light switch	Most of us have a bad habit of not turning lights off when we leave a room. Also, we forget to turn off appliances such as the radio and television. Although lighting is a very small part of the utility bill, we need to think about how all of our small wasteful habits add up. Every little bit of conservation can add up to a noticeable saving in dollars and energy. Use dimmer switches for incandescent bulbs when less light is needed. One rule to remember: do not turn off fluorescent lights unless you are going to be out of the room for more than 15 minutes.
16. Fluorescent tube	There are different kinds of light bulbs available. Some of these give off more light but use less electricity. Some bulbs also give off less heat than others. Remember these tips:

(a) Use low-wattage bulbs in areas where concentrated lighting is not needed for reading or safety, such as closets or storage areas.

(b) Three-way bulbs are good for portable lamps because you can control the amount of watts used. Some activities require less light, so there is no need to use more electricity than is needed.

(c) Fifty-watt reflector floodlights can be used instead of 100-watt incandescent bulbs and still give the same amount of light.

(d) Fluorescent lights give off four times as much light as incandescent of similar wattage. At one quarter of the energy cost, a 25-watt fluorescent can provide as much light as a 100-watt incandescent. Fluorescents also last seven times as long as incandescents. There are new fluorescents now available that can be installed in lamps and ceiling fixtures to take the place of incandescent bulbs.

17. Lady using oven to heat room

Never use the oven to keep warm. Ovens use a great amount of electricity. about 3500 watts. Using a gas stove would also waste large amounts of energy and would release dangerous gases into the living area.

18. Electric skillet

Use small appliances rather than the oven. They can do the same job without using as much energy.

Electric skillets have many uses . . . cooking casseroles (one-dish meals), baking potatoes, cakes, apples, panbroiling, and braising. Other recipes that can be prepared in the skillet include baked beans, spaghetti sauce, candies, skillet cookies, and vegetables. The electric skillet uses only 1500 watts compared to the oven which uses 3500 watts.

19. Microwave oven

A microwave oven is more energy efficient than a conventional oven. It saves a lot of time and energy. The microwave oven cooks in an average of one-fourth of the time of a regular oven. The microwave oven uses about 1500 watts, compared to the regular oven's 3500 watts. Also, microwave oven cooking is cool cooking, compared to the regular oven. The only heat produced is in the food being cooked. This is important during the summer. When a regular oven is in use, the kitchen heats up, which causes the air conditioner to run more.

20. Oven meal

Be conservative in using the regular oven. Prepare oven meals. Cook the entire meal at one time. . . main dish, vegetable, and dessert.

Preheating ovens for meats is unnecessary. Preheat only for baking. . . and for no more than six minutes.

If you need to clean the oven, switch on the self-cleaning feature of the oven when it is already hot. Clean it at night or early morning when electricity demand is lower.

21. Baking tips

If possible, bake and roast early in the morning, so you will not add more heat to the house during the hot part of the day.

(a) Do not be an oven peeper. Opening the door results in heat loss from the oven and longer cooking time. Also, during the summer there is no need to add unnecessary heat to the kitchen. Every time the oven door is opened, the oven temperature drops 25 to 50 degrees.
(b) When baking, make a double quantity. Put the extra portion in the freezer for further use.
(c) Bake in glass or ceramic dishes and reduce the oven setting by 25 degrees.

22. Pans on surface units

(a) When cooking on the surface units, use pans with tight-fitting lids and with flat bottoms.

(b) Use the right size surface unit for the pan. Place small pans on the smaller surface units and larger surface units.
(c) Cooking with large amounts of water uses more energy and lessens the nutritional value of foods.
(d) Never boil water in an open pan. Water will come to a boil faster and use less energy in a kettle or covered pot.

23. Surface unit dials

(a) Cook foods at the lowest possible heat and with the least amount of water.
(b) Keep surface unit reflectors shiny. They reflect more heat, cooking foods faster.
(c) Save energy by turning off the surface unit or the oven a few minutes before cooking is completed.

24. Appliance guide label

Major appliances deliver more value than ever. When it's time to buy an appliance, use appliance labeling. The labeling program is designed to help consumers shop for energy-saving household appliances and shows estimated annual operating costs.

25. Defrosting freezer section

(a) Defrost the freezer regularly. Never allow more than one-fourth inch of frost to accumulate as this will reduce the freezer's efficiency.

Although automatic defrost freezers use more energy, if a manual defrost freezer builds up too much frost, it will use just as much.
(b) Clean dirt, lint, and grease from the refrigerator condenser coil. Make this clean-up chore a regular part of spring cleaning.

26. Freezer section

Keep the freezer compartment full so it cannot take in warm air each time the door is opened. Freeze milk cartons filled with water to take up space. Some space should be left between food items in the refrigerator so the air can circulate.

If controls are too extreme, it means wasted energy. Under normal conditions, the freezer temperature should be zero to five degrees and the refrigerator section should be 38 to 40 degrees.

27. Man in refrigerator

Before opening the refrigerator door, decide what you are looking for. When warmer outside air enters the refrigerator, the refrigerator has to use more energy to cool down again.

28. Electric dishwasher

When buying a dishwasher, check into such energy-saving features as a power-saver switch and a short wash setting. Ask the dealer what energy-saving features different brands offer. Other tips to remember are:

(a) Washing dishes by hand uses more water than a dishwasher: nine to 14 gallons of hot water are used for hand washing one meal's dishes, while 11 to 16 gallons are used for a diswasher load (three meals).

(b) If pre-rinsing is needed, use cold water. Newer models usually do not require pre-rinsing.

(c) Use the power-saver switch or cut off the dishwasher during the drying cycle and let the dishes air dry. Open the door for air drying.

(d) Wash only full loads.

29. Washer

Washing and drying clothes is a major household chore. We are often careless energy wasters. What can we do to conserve?

(a) Wash and dry full loads or use the mini-load cycle for smaller loads. Do not overload, though overloading reduces cleansing action.

(b) Save hot water for white or heavily soiled loads. Use cold water for washing and rinsing as much as possible. Occasionally wash in warm water to retain whiteness and brightness. It costs an average of 30¢ a load to wash in hot water and less than a penny to wash in cold water.

30. Dryer	When drying clothes do not overdry. You waste energy and wrinkle clothes.
31. Dryer lint filter	Keep the filter of the clothes dryer clean. Remove lint after each load. Lint blocks the flow of air in the dryer and forces the dryer to use more energy.
32. Clothesline	Use a "solar dryer" to dry your clothes. In most cases, you save on energy, unless the clothes have to be ironed.

These are ideas to help you cut down on energy use. Can you think of any others?

ACTIVITY 2

LESSON 2

"ENERGY CHOICES"

Read each statement, then circle your one choice for each.

1. You just came home from playing football at school and you want to clean up. Would you:

   a. take a shower, or

   b. take a tub bath?

   Reason for choice: ______________________

   ____

2. It is evening, and you are in your room. Your mother asks you to come to the kitchen for a few minutes to help her. Would you:

   a. leave the lights on in your room, since you'll be back in a few minutes, or.

   b. turn off the lights in your room?

   Reason for choice: ______________________

   ____

3. You just came home from school and want a snack. Would you:

   a. open the refrigerator and poke around in it to see what's there, or

   b. decide what you want to eat, then quickly remove it from the refrigerator?

   Reason for choice: ______________________

   ____

4. You are cooking a casserole dinner for your family. Would you:

   a. preheat the oven, or

   b. start baking the casserole in a cool oven?

   Reason for choice: ______________________

   ____

5. Your family is away from home and you are responsible for the laundry. There are only a few soiled clothes to be washed. Would you:

   a. wash the few soiled items, or

   b. wait until a full load of soiled clothes needs to be washed, then wash the clothes?

   Reason for choice: ______________________

   ____

6. Your family is remodeling the bathroom, and can't decide on a light fixture, would you:

   a. recommend fluorescent lighting, or

   b. incandescent lighting?

   Reason for choice: ______________________________

   ____

7. You just came in from softball practice and in order to cool off quickly, you would:

   a. turn the thermostat on the air conditioner down, or

   b. use a portable fan and leave the thermostat setting as it is?

   Reason for choice: ______________________________

   ____

8. You want your bread toasted. Would you:

   a. use a small toaster, or

   b. use the broiler element in the conventional oven?

   Reason for choice: ______________________________

   ____

9. You are responsible for washing dishes used during the day. Would you:

   a. wash dishes by hand, or

   b. use the dishwasher?

   Reason for choice: ______________________________

   ____

10. You need to wash a load of normally soiled clothes. Would you:

   a. use warm water for washing and cold water for rinsing, or

   b. hot water for both washing and rinsing?

   Reason for choice: ______________________________

   ____

"ENERGY CHOICES"

ANSWER SHEET

1. This choice depends on the length of time you are in the shower. About 10 gallons of water per minute goes down the drain when showering. In general, take a short shower or take a bath in a partially filled tub.

2. Turn off incandescent lights when leaving your room. It is always more energy efficient to turn lights off.

3. Decide what you want to eat, then quickly remove it from the refrigerator. Energy is wasted when the refrigerator door is open too long.

4. Start baking a casserole in a cool oven. Only preheat the oven for items that rise during baking, such as cakes and cookies.

5. Wash only full loads of clothes. Water and energy are wasted doing small loads of clothes.

6. Fluorescent tubes produce up to four times as much light as incandescents using the same amount of electricity, yet they last up to seven times longer.

7. Use a portable fan and leave the air conditioner's thermostat setting as it is. Portable fans are energy efficient; use them to circulate conditioned air.

8. Use a small toaster. Using a portable appliance is one of the fastest and most economical ways to prepare many foods.

9. Use the diswasher because washing dishes by hand after each meal uses more hot water than a dishwasher. Nine to 14 gallons of hot water are used for one meal's hand washing, while 11 to 16 gallons are used for a dishwasher load containing a full day's dishes.

10. Use warm water for washing and cool water for rinsing. The best balance between energy conservation and cleaning is to wash in water above 80°F (27°C) for normal soil conditions. The closest setting on the washer is warm, which is approximately 95°F (35°C). Occasionally wash in hot water, consistent with garment labeling, if soil accumulates after several launderings. Wash in hot water for heavily soiled clothes.

ACTIVITY 3

LESSON 2

CALCULATING OPERATING COST OF APPLIANCES

A kilowatt-hour is 1000 watts used for one hour. A 1000-watt hair dryer used for one hour is one kilowatt-hour.

$$\frac{\text{Watts X Hours Used}}{1000} = \text{Kilowatt-hours}$$

HOW TO CALCULATE THE COST OF OPERATING APPLIANCES

1. Estimate the number of hours the appliance is used during the day.
2. Multiply the hours used by the wattage of the appliance.
3. Divide by 1000 to get the kilowatt-hours used.
4. Multiply kilowatt-hours by the rate per kilowatt-hour to find the approximate cost.

EXAMPLE:

Color television = 240 watts

$$\frac{\text{240 watts X 5 hours used}}{1000} = \frac{1200}{1000} = 1.2\ \text{KWH}$$

1.2 KWH X 5.0¢/KWH* - 6¢ for 5 hours a day

*Average current residential rate is 5¢/KWH.

ACTIVITY 3a

PROBLEMS

Calculate the cost to operate the following appliances:

	APPLIANCE	WATTS	HOURS USED	COST OF OPERATION
1.	Electric clock	2	24	________
2.	Clothes washer	512	2	________
3.	Clothes dryer	5500	2	________
4.	Hair dryer	1000	1/4	________
5.	Microwave oven	1500	1	________
6.	Conventional oven	3500	1	________
7.	Toaster oven	1000	1/2	________
8.	Electric skillet	1150	1	________
9.	Vacuum cleaner	630	1	________
10.	Ceiling fan	150	3	________

KEY TO ACTIVITY 3a

LESSON 2

1. Less than 1/2¢
2. 5¢
3. 55¢
4. 1¢
5. 7.5¢
6. 17.5¢
7. 2.5¢
8. 6¢
9. 3¢
10. 2¢

LESSON 3: FACTORS AFFECTING THE AMOUNT OF ENERGY USED TO HEAT AND COOL THE HOME

Objective:

The student should be able to explain the factors affecting the amount of energy used to heat and cool the home and determine ways to reduce the amount of energy used.

1. Explain the factors affecting the amount of energy used to heat and cool the home.
2. Identify the types of heating and cooling systems used in the Gulf Coast region.
3. Select energy efficient cooling equipment by the guidlines of Energy Efficiency Ratio.
4. Determine ways to reduce the amount of energy used to heat and cool the home.

Activities:

1. After students have completed reading background information, discuss the following:

   (a) What is the largest user of energy in the home?

   (b) What factors affect the amount of energy the heating and cooling system uses?

   (c) Where does heat loss occur in the home?

   (d) What types of heating and cooling systems are used in Texas and Louisiana? Are there any other types not in the background information used in other regions of the U. S.? Why?

   (e) What does EER mean? How do you select cooling equipment by EER ratings?

   (f) What does retrofit mean? What can be done to a home to minimize heat loss and gain?

(g) Why is it important for an attic to be adequately ventilated? What are the types of attic ventilation? Show transparencies on the purpose of attic ventilation and types of attic ventilation.

2. Identify Quiz, "What Is It?"

3. Assign background information, Lesson 3, and Crossword Puzzle as review for lessons 2, 3, and 4.

Materials and Equipment:

- Background Information, Lesson 3

- Identify Quiz, "What Is It?"

- Transparencies on attic ventilation and types of attic ventialtion

TRANSPARENCY VI

BUYING ENERGY EFFICIENT EQUIPMENT

The big difference in buying air conditioners is cost of operation.

The difference is expressed as EER. (Energy Efficiency Ratio) Seasonal Energy Efficiency Ratios) (SEER) may also be used.

The method of comparison is essentially the same.*

The higher the EER number, the less it costs to operate the unit. Higher EER units are generally more expensive than lower E.E.R. units. But in the long run, the total cost is less, because the utility bills are less.

Example: An air conditioner with an EER of five uses twice as much energy as a similar one with an EER of 10. With energy costs increasing the higher EER is by far the best buy.

CALCULATING E.E.R. OF AN AIR CONDITIONER

Units used - BTUs - British Thermal Units

To calculate the EER of an air conditioner, find the cooling capacity of an air conditioner.

This is listed in BTUs of heat removed per hour.

A one-ton unit is equal to 12,000 BTUs per hour.

A four-ton unit is equal to 48,000 BTUs per hour.

The amount of electricity the unit uses will be listed in watts.

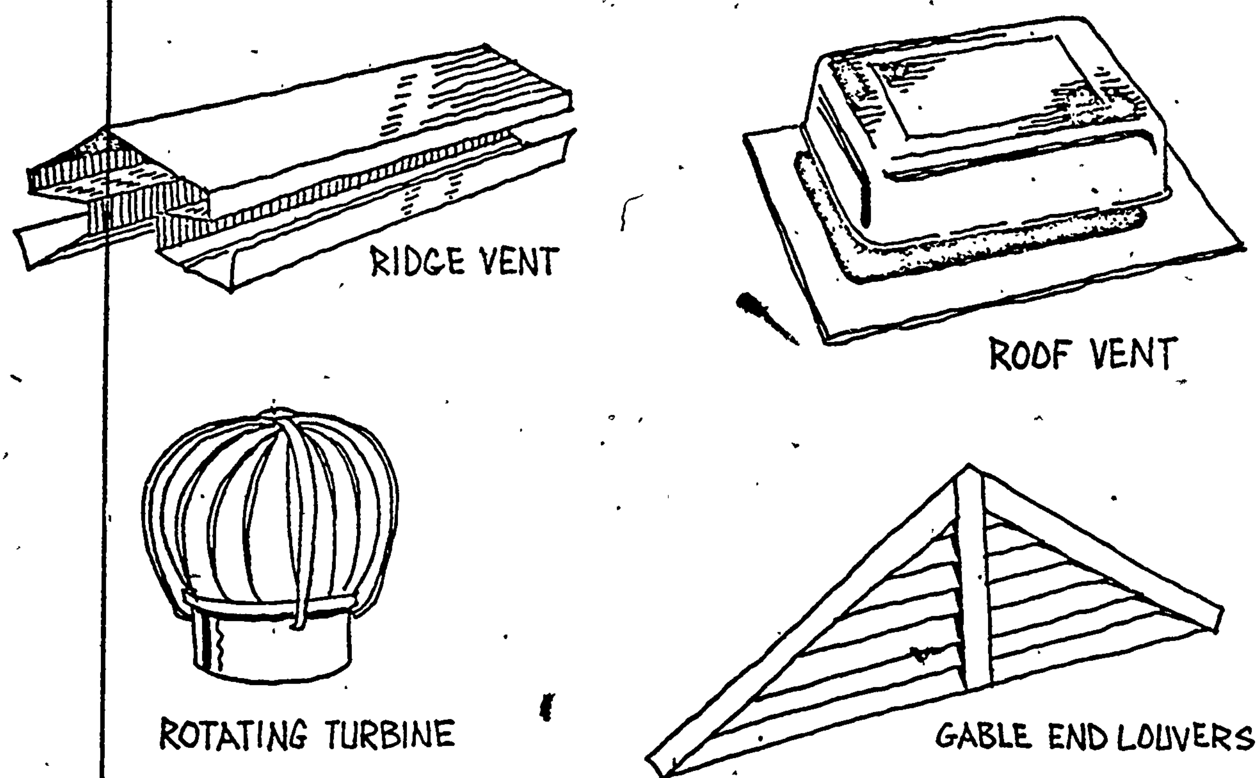
To figure the EER, divide the BTU per hour by the number of watts.

$$EER = \frac{BTU}{Watts} = \frac{12{,}000\ BTU}{1{,}400\ Watts}$$

$$EER = 8.6$$

TRANSPARENCY VII

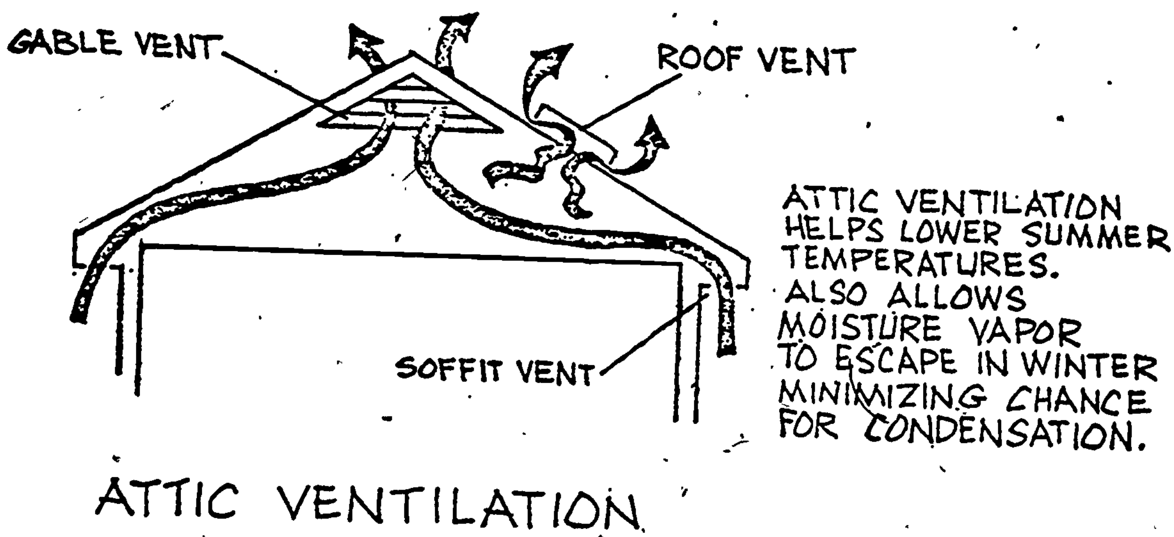
The teacher should either secure from a building supply dealer examples of roof vents or take students to dealer's showroom. Dealers will generally be happy to explain how each type works and what functions it serves.



The Different Types of Roof Vents*

*Source: Transparency Appendix from Energy and The Family by Gulf States Utilities, Highway 45, Conroe, Texas.

TRANSPARENCY VIII



*Source: Transparency Appendix from Energy and The Family by Gulf States Utilities, Highway 45, Conroe, Texas 77001.

BACKGROUND INFORMATION

LESSON 3

I. Terms and Definitions:

A. Insulation - material used in home construction to retard (slow down) the heat loss from home in the winter and heat gain in summer.

B. Home orientation - locating the house on a site in order to reduce heat gain on the east and west so the home will be less expensive to cool in the summer.

C. Deciduous trees - trees that lose their leaves in the winter. They allow the sun in during the winter but keep the sun out during the summer.

D. Evergreen trees - trees that keep foliage all winter. Coniferous trees are evergreens that make especially good windbreaks.

E. Thermal - related to heat.

F. Active solar system - involves pumps, motors, or other mechanical devices.

G. Passive solar system - collects the sun's energy more by design and orientation than with the use of hardware.

H. Ductwork - If your home has central cooling and/or heating, it will have ductwork. Ductwork is the air delivery system to the rooms. It is most commonly found in the attic or in the furred down (low) areas of the ceiling.

I. Attic ventilation - system used to remove heat and moisture from the attic. Example: wind turbines and eave vents. Without ventilation, heat buildup may become excessive. At night, heat may continue to radiate into the rooms or space below. Ventilation is also required to remove damaging moisture from the attic.

J. EER (Energy Efficiency Ratio) - rating used to help the consumer determine and compare the operating costs of air conditioning units. The higher the rating, the more energy-efficient the unit. (Example: EER of 9.0 would cost less to run than EER of 6.5).

$$EER = \frac{\text{BTU per hour (cooling capacity)}}{\text{watts (electrical comsumption)}}$$

K. Retrofit - addition of energy-saving features to an existing home

L. Payback period - the amount of time it takes for an energy-saving improvement to pay for itself through savings on the utility bill. If adding R-30 insulation to a home with R-0, insulation costs $500 and you save $250 a year on your utility bill, it would pay for itself in two years.

M. Weatherstripping - material placed around doors and windows that keeps air in or out of a home.

N. Caulking - flexible material used to fill up cracks where two immovable parts of the house meet. Caulking prevents air from entering and leaving the house.

O. Fireplace damper - door attached inside the flue of a fireplace which should be closed when the fireplace is not in use to prevent air from escaping from the house up the chimney.

II. Home Heating and Cooling Systems: The home's biggest energy consumer.

A. Factors affecting the amount of energy consumed by home heating and cooling systems

1. Changes in outdoor temperature and humidity
   - the lower the outdoor temperature, the greater the heat loss
   - the more hot and humid the summer, the greater the amount of air conditioning required

2. Structural components of the house
   - doors
   - windows
   - walls
   - ceilings and attic
   - floors
   - fireplaces

3. Family size, structure, and habits
   - how often doors are opened and closed to outside air
   - how much time is spent within the home and how rooms are used
   - family members' values and special needs

4. Orientation of the home on its site

- designing windows on a new home so the home will have as few windows as possible on the east and west sides to cut down air conditioning requirements.

- designing windows on a new home on the south to use the sun for warmth in the winter.

- placing trees on the east and west to shade the home from summer sun.

5. Lowering the thermostat in winter and raising it in summer. For every degree you raise the thermostat setting in the summer, you save three percent. Example: If you change the thermostat from 72 to 78 degrees, this would equal: six degrees X three percent = 18 percent saved on the cooling part of the bill. The recommended summer thermostat setting is 78 degrees. Two percent is saved for every degree the thermostat is lowered in winter. The recommended winter thermostat setting is 68 degrees during the day and 60 degrees at night.

6. Where heat loss or gain occurs:

   - through uninsulated or poorly insulated walls, ceilings, and floors.
   - through windows and doors. Single-paned glass allows as much as 20 times more heat loss than a well insulated wall.
   - Air infiltrates through any cracks or spaces open to the outside. A one-sixteenth inch crack around sides and top of door is equal to a 4 X 4 inch hole.
   - up fireplace chimney
   - uninsulated floor of a house on piers
   - through duct work that is poorly insulated or has leaks
   - Heat gain occurs through unshaded glass receiving direct sun. (It would take three Goodyear Blimps to equal the volume of air infiltration moving through an average home in a single day.)

III. <u>Types of Heating Systems in Texas and Louisiana</u>

A. Central Heating Systems - heated air is distributed through ducts to each room in the home.

1. Electric resistance - most common electric heating in this area
2. Electric heat pump - heats in winter with heat from the outside air; cools in summer
3. Gas heat

B. Gas or electric space heaters

C. Panel-ray electric panels

D. Baseboard (not very common in this area)

E. Wood-burning stove

F. Fireplaces - not very efficient unless they are special types of fireplaces that have an outside air intake vent to the firebox.

G. Solar heating systems - not very common in this area because of the cost of installation and effectiveness of the system.

IV. Cooling Systems

A. Central cooling - colled air is distributed through ducts to each room in the home.

1. Electric
2. Heat pump
3. Gas

B. Room air conditioners

C. Attic fans

D. Window or room fans

E. Ceiling fans

V. Buying Energy Efficient Equipment

The big difference in air conditioners is how much they cost to operate. The difference is expressed as EER, which stands for "Energy Efficiency Ratio." Seasonal Energy Efficiency Ratios (SEERs) may also be used. The method of comparison is essentially the same. The higher the EER number, the less it costs to operate the unit. Higher EER units are generally more expensive than lower EER units. But in the long run, the total cost is less, because the utility bills are lower. For example, an air conditioner with an EER of five uses twice as much energy as a similar unit with an EER of 10. With energy costs likely to double in the next seven to 10 years, the higher EER unit is by far the better buy.

To calculate the EER of an air conditioner, find the cooling capacity of air conditioner. This listed in BTUs (British Thermal Units) of heat removed per hour. A one-ton air conditioner is equal to 12,000 BTUs per hour. For example, a four-ton unit would be 48,000 BTUs. The amount of electricity the air conditioner uses will be listed in watts. To figure the EER, divide the BTU per hour rating by the number of watts. For example, a 12,000 BTU per hour unit using 1400 watts has an EER of 8.6. Another 12,000 BTU unit might require 18,000 watts, giving it an EER of 6.7.

$$\frac{12{,}000 \text{ BTU/hour}}{1{,}400 \text{ watts}} = 8.6 \text{ EER}$$

$$\frac{12{,}000 \text{ BTU/hour}}{1{,}800 \text{ watts}} = 6.7 \text{ EER}$$

VI. Heat Loss and Gain

Many homes use more energy because of the way they are built and the type of materials used. Many homes are energy hogs. Ways to reduce heat loss during the winter and heat gain during the summer are:

A. Add insulation to the attic and outside walls.

B. Add insulation to the floor of a house if it is on piers, or add skirting around the crawl space.

C. Weatherstrip around windows and doors.

D. Caulk cracks both inside and outside the home.

E. Install storm windows.

F. Cover fireplace opening with a glass screen if the damper is not tight fitting.

G. Plant coniferous trees or bushes on north to northeast sides of home to break cold winds.

H. Plant deciduous trees on east and west to shade in summer.

I. Install adequate attic ventilation.

J. Install adequate insulation around ductwork and check for air leaks around ductwork.

There is always heat in the air until the temperature reaches absolute zero.

ACTIVITY

LESSON 3

What Is It? How Does It Relate to Energy Conservation?"

Identify the following items and tell how each relates to energy conservation. Write down answers on a sheet of notebook paper numbered 1-9. (Take materials out of baggies so labels cannot be seen.)

1. weatherstripping (spring metal)
2. piece of insulation
3. foam gasket for wall outlet
4. caulking
5. flow restrictors for shower heads/faucets
6. weatherstripping (metal and rubber)
7. solar screen
8. solar film
9. meter dial

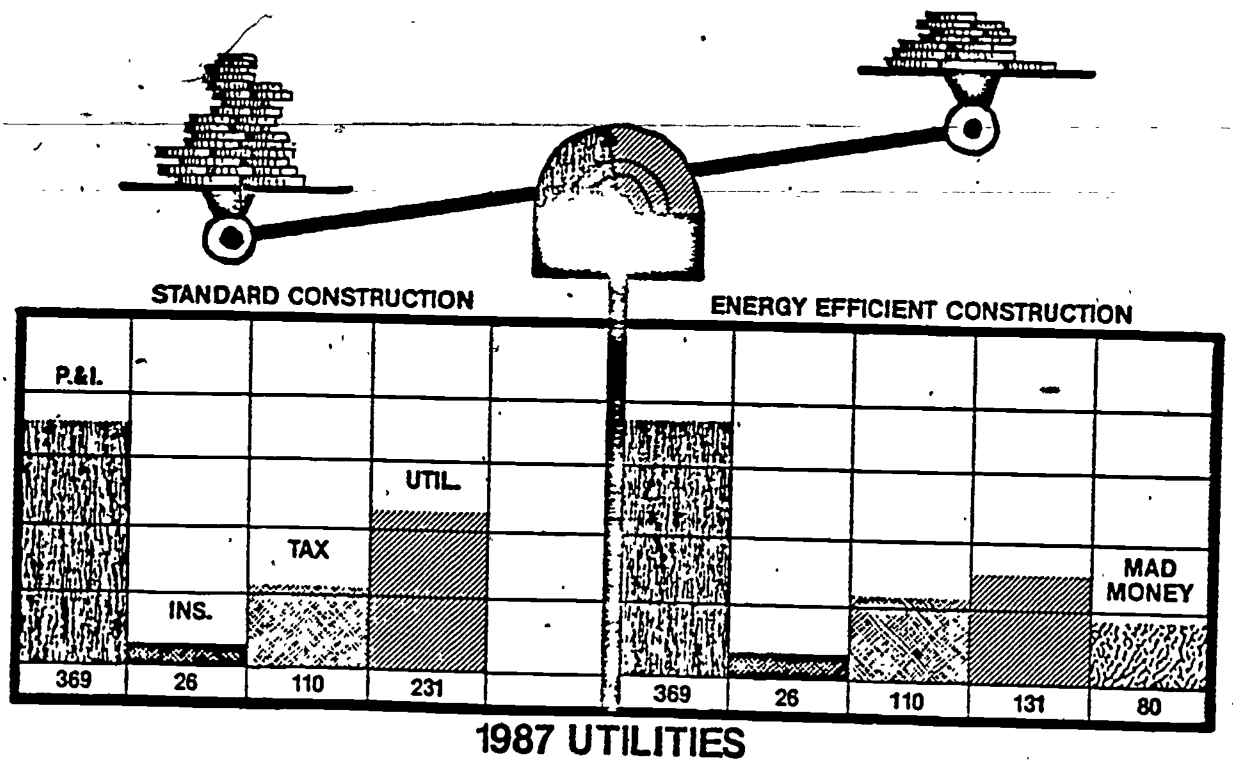
Adapted from: Energy Management Strategies for Colorado, Home Economics Teachers, Public Service Company of Colorado, November, 1979.

Energy Efficiency in Housing

An energy efficient house is important to the homeowner and to overall energy conservation. Higher energy costs are causing homeowners to consider energy consumption of a house a primary factor in determining whether or not to buy that home.

Graph A below illustrates the difference one may reasonably expect in monthly housing costs in 1987 of a home built by regular standards compared to a home built by energy efficient standards.

TOTAL HOUSING COST COMPARISON



Graph A

Source: Energy and the Family by Gulf States Utilities, Inter-State 45, Conroe, Texas

ENERGY SURVEY

The Student Schoolhouse Energy Survey that follows has as its objective providing students with an opportunity to put into practice those techniques they have learned about conserving energy by reducing waste, whether wasted through lack of insulation and weatherstripping or through the unwise use of heating and cooling systems. Can students really spot conditions and situations that result in unnecessary energy waste? Can they make valid recommendations that would result in energy savings?

Bear in mind that the same techniques used for detecting waste of energy in the school can be used in the home, and the same conservation measures recommended and adopted by the school will reduce energy loss or waste in the home.

Our hope is that each student who participates in the needs assessment programs in the school will put these same practices, as far as possible, to use in his own home.

Another objective of the survey is to assist the school administration through its engineering and maintenance personnel in discovering areas of effectively reducing this waste. Key persons to work with teachers and students in this survey are the maintenance people in charge of the buildings under survey.

COMMENTS PERTINENT TO STUDENT SCHOOLHOUSE ENERGY SURVEY

Before beginning the actual survey each participating student should have in hand a copy of the survey form. The teacher should make sure that students understand precisely what the survey covers and what steps to take in the process.

In addition to the survey form each student should carry a notebook for the purpose of recording and summarizing in cases where the student cannot see or record all data from one point of observation.

The survey is intended as a culmination of all that has gone on up to this time. It attempts to bring to bear all the skills and know-how acquired in student activities and study. The material found in the section Better Living With Less Energy contains much of the information needed for a successful completion of the survey form.

STUDENT SCHOOLHOUSE ENERGY SURVEY

Student's Name____________________ Grade Level_______ Room Number_______

School________________________________ Number of Students____________

Length of School Day________________ Hours for Cleaning____________

Monthly Heating/Cooling Costs____

I. A Look at the School From Outside

A. Draw an outline of the school in the space below.

B. What direction does the school entrance face? ____________

Which way does the wind usually blow? ________________

What protection does the building have? ______________

C. Does the school have many windows? Many___ Some___ Few___

What percent of the wall area is windows? ____________

How many windows face South? _____ North?_____ West?_____

Can the windows be opened?____ Are the windows tight fitting?_____

Should any windows be double paned?________ Where? ________

D. Could energy be saved by replacing selected windows with insulated walls or insulating material?______________Where?________

Are any ~~windows~~ cracked or broken?____________ How many?________

E. Do the outside doors fit tightly? ________________

Do doors need weatherstripping?____________________

Should there be double doors at any of the entrances? ________

F. Are the outside walls in good condition?________________

Of what material are the outside walls made? ____________

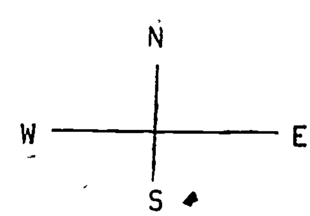
Is there insulation in the walls?______________Roof?__________

How does the color of the walls or roof affect energy use?________

____

G. Is the security lighting effective in preventing vandalism?________

How many hours are these outside lights turned on?______________



II. A Look Inside the School

A. Note the following for each area listed below:

Area	Color of walls	Lighting level in foot-candles	Incandescent	Types of lighting fluorescent	Other	Temperature
Halls	______	______	______	______	______	______
Offices	______	______	______	______	______	______
Gym	______	______	______	______	______	______
Cafeteria	______	______	______	______	______	______
Library	______	______	______	______	______	______
Other	______	______	______	______	______	______

How does the color of the wall affect lighting? ____________________

____

B. List any areas of the school where there are unnecessary lights:

____

List any rooms where the lights appear too bright: ____________

Does the school use energy-efficient fluorescent lamps? ____________

Mercury vapor? ____________ Other? ____________

If fluorescent lamps have been removed, are the energy using ballasts disconnected? ____________

C. Are there areas where lights have been left on when no one was present? ___ List: ____________

Are the light switches located for easy use? ____________

Is the natural light from windows used properly? ____________

D. How does keeping the following clean affect energy use?

Windows ____________________

Light fixtures ____________________

Skylights ____________________

III. Cafeteria/Kitchen

A. What energy sources are used in the kitchen

Natural gas_____

Electricity_____

Other_____

B. List kitchen items using energy (not human) and hours they are used:

Item	Hours Used

Is the kitchen well arranged to use energy efficiently?__________

Is heat-producing equipment located next to cooling equipment?___

IV. Exhaust Fans

List the hours exhaust fans operate in the following areas:

Rest rooms____________ Kitchen__________ Art____________

Industrial Arts______________ Other________________

How are most exhaust fans controlled? ______________

V. Hot Water for Washing

What is the temperature of the hot water as it comes from the tap in:

Rest rooms__________ ^oF (__________ ^oC)

Cafeteria/Kitchen _______ ^oF (__________ ^oC) $^oC = 5/9\ (F - 32)$

Dishwasher __________ ^oF (__________ ^oC) $^oF = 9/5\ (C + 32)$

Do any faucets drip?__________ Where?______________

Measure the gallons per minute from a faucet______________

How many BTUs are used per hour by the water heater?__________

If electricity is used to heat water, does the heater turn on only at night?__________

VI. Heating/Cooling System

Do the thermostats read/control the room temperature accurately?_____

Are the thermostats well placed? ____________________

What is the night thermostat setting?________ °F (__________ °C)

What are the day settings of thermostats?____ °F (__________ °C)

Is there good air movement from the heating/cooling equipment?______

Is untreated outside air used for cooling when possible?__________

Are the heating/cooling elements kept clean? ______________

Do the little used areas have lower thermostat settings for heating? ________

VII. Heating Control Room

If the school is heated by a boiler or furnace, what are the BTUs used per hour?____________________

Does the heating unit appear clean and well maintained?__________

When was the last time the flame/air settings had an efficiency check? ____________________ Is it posted?__________

Is the time clock on the right day and time?__________

What hours does the time clock allow the heating system to operate on day setting?__________ Night setting?__________

What fuel is used to heat the school?__________

VIII. Putting It All Together

After surveying the school and answering the above questions, it is time to look at what you have discovered.

1. Please list good energy management practices that have already been implemented in the school:

2. Please list places you observed energy being wasted. Also state a possible solution for each item observed:

THE ENERGY SURVEY REPORT

A. Administrative

1. Name of Student ______________________

   Class ______________________

   Teacher ______________________

2. Name of Building Surveyed ______________________

   Address ______________________

   Date Building was Surveyed ______________________

   Time of Day of Survey ______________________

   Ambient (outside) Temperature ________ °F ________ °C

B. Technical Ratings

<u>Instructions</u>: Please assign a rating to the following building systems you have observed during your energy survey by circling the appropriate numeral. Low numbers represent conditions of energy inefficiency; high numbers represent conditions of wise energy use.

After you have decided upon a rating, explain your decision. Please list specific reasons for your choice:

1. Building Structure

   Rating: Low 1 2 3 4 5 6 7 8 9 10 High

   Explain: ______________________

   ____

   ____

2. Lighting

   Rating: Low 1 2 3 4 5 6 7 8 9 10 High

   Explain: ______________________

   ____

   ____

3. Cafeteria/Kitchen

   Rating: Low 1 2 3 4 5 6 7 8 9 10 High

   Explain: ______________________

   ____

   ____

4. Exhaust Fans

Rating: Low 1 2 3 4 5 6 7 8 9 10 High

Explain: ______________________________

____

____

5. Hot Water for Washing

Rating: Low 1 2 3 4 5 6 7 8 9 10 High

Explain: ______________________________

____

____

6. Heating/Cooling System

Rating: Low 1 2 3 4 5 6 7 8 9 10 High

Explain: ______________________________

____

____

C. Overall Energy Efficiency Rating

Please average the ratings assigned above to determine the overall building score. Write average in space below.

(______________________)
Overall Rating

D. Recommendations

Please make five (5) recommendations that, if implemented, would make the building more energy efficient.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

The above ratings and recommendations represent my best judgment.

Name of Student: ____________________ Date: ____________

Student Schoolhouse Energy Survey Form adapted from Something Special for Teachers by Tenneco, Inc., Public Affairs Department, P. O. Box 2511, Houston, TX 77001, used with their permission.

EXPONENTIAL GROWTH

Concept: Exponential growth is geometric growth (on a pattern, for example, of 1 2 4 8 16, rather than arithmetical growth on a pattern of 1 2 3 4 5). Exponential growth is growth at a fixed percentage rate over a period of time (a savings account at compound interest is a standard illustration).

Objective: To explore how consumption of energy coupled with exponential growth leads to depletion of energy resources.

Materials: Checkerboard for each student
Five pounds of rice

Background: To understand the implications of exponential growth in population, in resource consumption, or in pollution levels, calculate the doubling time of a growing quantity. A handy rule of thumb is to divide the percentage rate of such growth into the number 70 to arrive at the doubling time. For example the population of the world, now roughly four billion persons, is growing at about 1.6 percent per year. The doubling time is 70 divided by 1.6, or 44 years. So long as that rate of growth holds constant, we can calculate the future population as follows:

4 billion people in 1975
*plus 44 years . . . . 8 billion people in 2019
*plus 44 years . . . . .16 billion people in 2063

To say this another way, a child born in 1975 who lives 88 years will experience first hand what it is like in a world of 16 billion persons or will witness first hand what it was that intervened to forestall the 16 billion.

The U. S. growth rate for electric consumption is illustrative. For much of the 20th century, it was seven percent a year, doubling each decade (70 ÷ 7 = 10). This meant that besides replacing obsolete facilities, utilities had to double their usable generating capacity each 10 years. Plotting this progression on a simple graph would give a visual idea of the impact of such growth if it were to continue for two more doubling times from 1970. In fact, many industry experts were predicting just such a growth rate, but since the embargo, consumption has moderated; the industry now projects slower rates of growth.

This moderation in growth rate also may be illustrative of a general slowdown both of population growth in the United States and of growth in energy use. It is wise to keep in mind, however, that even lesser growth rates are experimental--that is, they do lead to doublings, even though the doubling time is lengthened.

The following exercise illustrates the arithmetic of doubling exponential growth, and suggests there are limits to exponential growth of any quantity.

Procedure:

1. Give each student a checkerboard, some rice, and directions to place one grain of rice in the lower left hand square, two grains in the next square, four in the next, eight in the next, and continue this pattern. Have students estimate the amount of rice they will need.

   When students realize they have run out of room and are faced with an impossible task, discuss these questions in class.

   a. Were you able to fill all the squares? If not, why not?

   b. How is the doubling of rice grains in the squares like our current consumption of energy?

   c. What will happen if we continue to consume energy at our present rate of consumption?

2. Discuss the game of "Rice Checkers." There are 64 squares on the board. If the number of grains of rice is doubled 63 times, that will be two to the sixty-third power of grains of rice on the sixty-fourth square. Students would have to put more rice in the last square than there is rice in the whole world. No one was able to complete the game because he ran out of room. The current consumption of energy is increasing at a rapid rate too.

3. Show students how to calculate doubling time t_2, using the following expression:

$$t_2 = \frac{70}{\text{annual \% growth rate}}$$

4. Calculate t_2 for each of the following examples:

   a. Inflation (and electricity consumption) at 7% per year.

   b. Population at 1.64% per year.

   c. Energy consumption at 3% per year.

THE RICE CHECKERBOARD ACTIVITY

The function of The Rice Checkerboard that follows is to demonstrate exponential growth. Exponential growth is geometric rather than arithmetical. As an illustration arithmetic growth occurs in steps as 1, 2, 3, 4, 5, etc., whereas geometric growth takes place in increments as 1, 2, 4, 8, 16, etc.

Using a small one-pound package of rice with only two or three checkerboards students can easily recognize how exponential growth in the use of energy can easily lead to the complete exhaustion of non-renewable sources of energy or how exponential growth in population can soon overpopulate the earth.

RICE CHECKERBOARD

Comments on Test Items

The test questions that follow may be used as a pre-test and post-test, or as a final examination. Items may be selected from the test and used in two or three short quizzes. The use will depend upon the preferences of the teacher. The items cover materials set forth in the guide and require careful reading in order for students to answer the questions correctly.

Students should be able to answer correctly 80 percent of the questions when the activities are completed. If this level is not reached on the initial exposure, the materials should be reviewed.

TEST QUESTIONS

Directions: Select the number that represents the word or phrase that best completes the statement.

1. Heat loss is normally measured by the: (1) BTU, (2) Fahrenheit unit, (3) kilogram, (4) heating units.

2. A BTU is the amount of heat it takes to raise the temperature of one pound of water by: (1) 1° Fahrenheit, (2) 4° Fahrenheit, (3) 3° Fahrenheit, (4) 1 kilowatt hour.

3. Another way of "sizing" a BTU is to say it is about the amount of heat given off when: (1) a gallon of gas is burned completely, (2) wooden match is burned completely, (3) a quart of oil is burned completely, (4) an explosion occurs.

4. Using 1 kilowatt-hour of electricity releases: (1) 2,412, (2) 3,412 BTU, (3) 8,000 BTU, (4) 1,215 BTU.

5. Some types of insulation for houses are: (1) rockwool, (2) polyethylene, (3) batt insulation, (4) loose fill.

6. Vapor barriers are installed to reduce the: (1) flow of heat, (2) flow of moisture, (3) flow of radiation, (4) flow of conduction.

7. Vapor barriers should always be installed on the: (1) cold side, (2) warm side, (3) top side, (4) outside.

8. The insulation with vapors barriers attached are: (1) blanket, or batt insulation, (2) fiberglass or wool, (3) loose fill, (4) rigid insulation.

9. The insulating value of roof and ceiling sections can be determined by: (1) the size of the house, (adding the percent value of each of the materials making up the sections), the type of construction, (4) style of house, (5) all of the above.

10. Any building will constantly exchange air with its environment when; (1) outside air leaks in, (2) top air leaks in, (3) inside air leaks out, (4) bottom air leaks in.

11. This leakage or infiltration is caused by: (1) poor construction, (2) wind, (3) the building acting as a chimney, (4) the opening of outside doors, (5) all of the above.

12. When air in a building is warmer than the outside air, the entire building acts like a: (1) heater, (2) stove, (3) chimney, (4) wind storm.

13. To determine leakage around sills and cellar windows, examine the structure from the inside. Look for: (1) cracks, (2) daylight between the sill and the foundations, (3) poor construction, (4) drafts at the cellar windows.

14. Apply caulking compound only during: (1) cold weather, (2) hot weather, (3) warm weather, (4) high humidity.

15. The temperature for applying caulking compound should be above: (1) 30°F, (2) 20°F, (3) 40°F.

16. When applying caulking compound, the surfaces should be: (1) clean and wet, (2) clean and dry, (3) clean and flaking with paint, (4) clean with loose dirt.

17. Do not use caulking compound between surfaces that are to be (1) finished, (2) moved, (3) taped, (4) painted.

18. Use weatherstripping in areas where one surface has to be: (1) painted, (2) moved, (3) undercoated, (4) unpainted.

19. In applying the blanket type of insulation, be sure to apply vapor barrier on the (1) warm side of the insulation, (2) cold side of the insulation, (3) underside of the insulation, (4) moisture side of the insulation.

20. Do not use insulation with a vapor barrier when: (1) insulating a new home, (2) re-insulating over an already insulated area, (3) Using loose fill insulation, (4) using rockwool.

21. The attic should be insulated to: (1) R-7 standards, (2) R-11 standards, (3) R-16 standards, (4) R-30 standards.

22. Exterior walls should be insulated to: (1) R-0 standards, (2) R-11 standards, (3) R-16 standards, (4) R-30 standards.

23. Metal ductwork in the attic or under the house on piers should be: (1) removed, (2) re-surfaced, (3) insulated, (4) painted.

24. Heating and cooling costs are reduced by about: (1) $220 per year by caulking, (2) $185 per year by caulking, (3) $500 per year by caulking, (4) $195 per year by caulking.

25. Heating and cooling costs are reduced by about: (1) $195 per year by weatherstripping three-by-six foot windows, (2) $200 per year by weatherstripping three-by-six foot windows, (3) $175 per year by weatherstripping three-by-six foot windows, (4) $160 per year.

26. Tools for insulation: (1) hacksaw, (2) screwdriver, (3) crowbar, (4) tape measure, (5) all of the above.

27. You can save a few dollars insulating doors by: (1) using a contractor, (2) doing it yourself, (3) using a friend, (4) using common labor.

28. When insulating ducts, you should wrap all ducts with insulating: (1) batts, (2) blankets, (3) rockwool, (4) fiberglass.

29. When the outside temperature is in the 90s your attic temperature could easily reach: (1) 140 degrees, (2) 170 degrees, (3) 130 degrees, (4) 175 degrees.

30. A periodic checkup and maintenance of your heating and cooling equipment can reduce your: (1) heating, (2) energy consumption, (3) conduction, (4) energy conduction.

ESSAY QUESTIONS

1. What is the main purpose of the Seed public service program developed by Tenneco, Inc.?

The information for
The following essay question came from Home Weatherization Manual, U. S. Department of Energy, Washington, D. C. 20585.

2. Why should one use vapor barriers in insulation?

Key to Test Questions on pages 64, 65 and 66

No.	Ans.	No.	Ans.
1.	1	16.	2
2.	1	17.	2
3.	2	18.	2
4.	2	19.	1
5.	All	20.	2
6.	All of these	21.	4
7.	2	22.	2
8.	1	23.	3
9.	2	24.	1
10.	1.3	25.	3
11.	All of these	26.	All of these
12.	3	27.	2
13.	All of these	28.	2
14.	3	29.	3
15.	3	30.	2

Essay Question No. 1.

The main purpose of Seed publication is to alert school personnel to the great opportunity to conserve energy and thereby slow down the increasing cost of energy in schools.

Essay Question No. 2.

Vapor barriers are used to prevent vapor from the air from reaching the interior of the building where it can cause damage to the structure.

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