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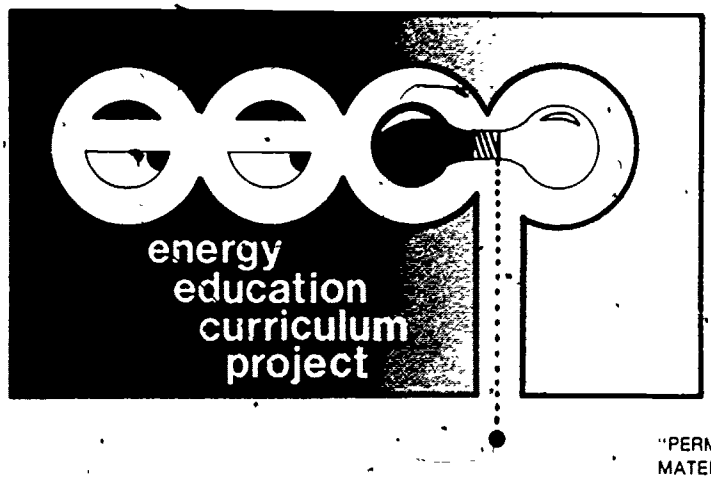
ABSTRACT

Energy education units (consisting of a general teacher's guide and nine units containing a wide variety of energy lessons, resources, learning aids, and bibliography) were developed for the Indiana Energy Education Program from existing energy education materials. The units were designed to serve as an entire curriculum, resource document, supplementary materials, or as a laboratory manual of "hands-on" activities which could be infused into existing grades 9-12 curricula. Unit II, focusing on energy consumption and conservation in the home, consists of an introduction (rationale, unit objective, and general background information), nine lessons, unit resources, bibliography, and teacher evaluation form. Each lesson includes lesson title, objectives, background information, activities, evaluation techniques, and resources. Titles of lessons are: (1) Energy Conservation in the Home; (2) Supplemental Information, Using Wood; (3) Supplemental Information, R-Values and Uses; (4) Home Heating & Cooling - Save Energy, Save Dollars; (5) Energy Questions and Checklists; (6) Weatherize Your Home; (7) An Easy-on Energy Home; (8) Making an Insulation Experiment Model; and (9) Energy Conservation Worksheets. (Author/JN)

LESSONS from An Energy Curriculum for the Senior High Grades

Unit II — Energy Consumption and Conservation in the Home



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HAROLD H. NEGLEY, STATE SUPERINTENDENT OF PUBLIC INSTRUCTION

LESSONS FROM AN ENERGY CURRICULUM FOR THE SENIOR HIGH GRADES

Unit II -- Energy Consumption and Conservation in the Home

Division of Energy Policy
Indiana Department of Commerce
Lt. Governor John M. Mutz, Director

Division of Curriculum
Indiana Department of Public Instruction
Harold H. Negley, Superintendent

January 1982

FOREWORD

Indiana educators have always responded to the demands placed upon them by society to resolve natural and human resource issues and problems. The task of teaching energy concepts and conservation practices to Indiana's youth is a response to energy problems facing our state and nation. It will be accomplished by many high school teachers and students getting involved in energy education.

We feel that students of all ages must be taught an energy conservation ethic. This ethic will enable each student to use Indiana's and America's energy resources more effeciently and with less waste. To help high school teachers accomplish this major goal, we are pleased to introduce a new Senior High School Energy Education Curriculum. This exciting and innovative program contains energy education activities, programs and resources for you and your students.

We encourage you and your students to get involved in the lessons presented here. We hope you will use these materials as a starting point and go far beyond by involving other classroom teachers, students, resource agencies and citizens in your community. A broad educational effort is needed to help prepare students to deal with this growing issue which affects us all.

Harold H. Negley
State Superintendent of
Public Instruction

John M. Mutz
Lieutenant Governor
State of Indiana

ACKNOWLEDGMENTS

The Energy Education Curriculum Project is coordinated by the Indiana Department of Public Instruction, Division of Curriculum, with the support and assistance of the Indiana Department of Commerce, Division of Energy Policy.

These materials, from the senior high grades Energy Education Curriculum Project (EECP), were adopted from existing national energy education programs. The materials were selected by the EECP staff with assistance and direction from a Review Panel and the Energy Education Steering Committee.

George Cannon, Patricia Shutt and Joe Wright, Energy Education Consultants; coordinated and supervised the preparation, evaluation and dissemination of these energy education materials. Carol Wood, Teacher Associate, assisted the EECP staff with the design and dissemination plans for the materials.

Members of the Senior High Energy Education Steering Committee are -- John A. Harrold, Director of the Division of Curriculum; Darrell Morken, Director of the Division of Traffic Safety; Gary Geswein, Vocational Agriculture Consultant; Jerry Colglazier, Science Consultant; Joyce Konzelman, Home Economics Consultant; Jane Lowrie, Social Studies Consultant; Victor Smith, Research and Evaluation Coordinator; Gregg Steele, Industrial Arts Consultant.

Clarence Broadus, Director, and Michael Hennegan, Residential/Education Coordinator, Division of Energy Policy, offered suggestions and comments which helped to improve the materials.

The materials included in this unit of the senior high segment of the Energy Education Curriculum Project (EECP), were adopted with permission from:

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

This material was prepared with the support of the U.S. Department of Energy (DOE) Grant No. DE-F645-76CS 60038. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of DOE.

UNIT II

TABLE OF CONTENTS

INTRODUCTION
(Rationale)

ENERGY EDUCATION - WHAT IT IS - Past, Present, Future

Energy education is the attempt to resolve the conflict between our present life style and the energy costs in both dollars and resources to produce and maintain that life style.

Energy education is reality education in that it deals with that which exists here and now.

But, energy education is also a study of futuristics. The future that all of us must be willing to live in and accept is the one that we are creating right now by our daily decisions. We must examine the beliefs that "growth is good" and "bigger is better" and determine the impact these beliefs will have on our future.

Energy educators interested in the challenge to teach students about local, state, national and global energy resources, problems and issues should consider the the following questions:

1. Can you help prepare your students to make wise and careful decisions about our remaining non-renewable energy resources?

2. Can you help prepare them to investigate and make wise decisions about research and development efforts for alternate and renewable resources, recycling programs, more efficient transportation systems, better personal consumption habits, and a personal commitment to efficient energy usage?

3. Can you explain to your classes where energy comes from, what the basic sources of energy are, how long our non-renewable energy resources will last, and the energy options among which our nation's people must choose if we are to survive?

As the three questions above suggest, energy education is a challenge which encompasses all facets of living. Energy education is an opportunity for students to have impact on a long-lived problem, an opportunity to apply traditional content and skills to an important problem situation, and an opportunity for students to participate in personal and social decisions.

WHY STUDY ENERGY?

"One of the best ways to deal with a crisis is to consider it as an opportunity. From this point of view, the energy crisis provides almost endless possiblities for children to learn about themselves. Energy after all is what makes all things go. We need to realize that the energy crisis isn't just the newest fad.

By studying the energy crisis, students can see where humanity has been, where it is now, and where it might be going. The energy crisis is another chapter in the story of mankind's continuing effort to reshape the world and the inevitable cost of doing that."[1]

To insure proper utilization of energy sources, our society must be educated about alternate lifestyles, energy resources, technology, consumer behavior and occupations.

The Indiana State Department of Public Instruction, in cooperation with the Division of Energy Policy, has organized the Energy Education Curriculum Project (EECP) to meet the challenge of educating young people (our future adults) about energy, the energy crisis and the role they can play to help conserve America's economy and resources.

One way the Energy Education Curriculum Project staff has dealt with the task of disseminating energy information and education is through the Indiana Energy Curriculum Units. The units have been organized to help provide educators in many areas with lessons, charts, materials and "hands-on" activities to be used in the classroom.

[1]Kuhn, David J., "Teaching the Energy Lesson," in The Science Teacher, September 1978.

The Curriculum - Background Information

The Energy Education Units contained in the Senior High School materials were adopted from existing national energy education materials. A team of teachers from Indiana reviewed and evaluated energy documents from across the nation. After thoroughly reviewing the materials, only those activities or lessons which proved to be most effective in educating students were chosen for Indiana's program.

The units are designed to be used as the individual teacher wishes. The energy units could be used as an entire curriculum or as a resource document, supplement or laboratory manual of "hands-on" activities which can be infused into already existing curricula.

The Indiana Energy Education materials for grades 9-12 consist of a Teacher Guide, nine units containing a wide variety of energy lessons, resources, learning aids and a bibliography.

Unit II

Unit II entitled "Energy Consumption and Conservation in the Home" is a continuation of the previous unit in relating energy education directly to the student by involving the student in activities which are relative to his/her homelife and dwelling.

Unit Objective

At the completion of this unit, the student will be able to assess his/her home for energy efficiency. Using skills learned from this unit, the student will know how to correct heat/energy losses due to waste. The student will discover that energy used unwisely or wastefully is very expensive.

UNIT II

Lessons
A-I

Note: The lessons that follow can be infused into an already existing curriculum. It is hoped that the teacher will incorporate these lessons in the most beneficial manner.

EECP
Unit II
Lesson 4

LESSON TITLE: "Energy Conservation in the Home"

LESSON OBJECTIVE

The student will know how to correct heat/energy losses due to waste, and be aware of the fact that energy used unwisely or wastefully is very expensive.

BACKGROUND INFORMATION - See Attached

ACTIVITIES - See Attached

RESOURCES

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

Check with local utilities.

BACKGROUND INFORMATION

I. Teacher Information

A. Reproduce and review student information/activity sheets. (These are found throughout the unit.)

1. Information about my house.
2. Energy checklist.
3. Average monthly cost for home electric use.
4. Average monthly cost for home gas use.
5. Average monthly cost for home fuel oil use.
6. Repair a leaky faucet.
7. Weatherize your home.
8. An easy-on-energy home.
9. Key terms related to energy conservation.
10. Heat loss.
11. Insulation materials - R-values and uses.
12. Shower vs. bath: which is more energy efficie
13. Supplemental heat sources.
14. Energy management checklist.

B. Review the list of materials for the insulation experiment model.

C. Plan to have students assist you in building the insulation experiment model.

D. Construct an insulation identification board to be used in class.

1. Obtain pieces of common insulation material (6" square from local dealer).

E. Obtain appropriate awards (ribbons, cash prizes) to be presented to the winners of the home energy conservation contest.

1. A local power company might be willing to pay for the awards.

F. Review the Activity V outline and add any material/ideas you have.

Background Information (continued)

Energy Terms Used in Lesson A

BTU - British Thermal Unit - The heat required to raise the temperature of one pound water one degree Fahrenheit.

Caulk - Waterproof material (usually latex or silicone) used to seal cracks and help prevent buildings from losing heat or allowing cold air infiltration.

Condensation - A gas changes to a liquid - water vapor (gas) changes to water (liquid) when the temperature drops.

Conduction - Heat passing from heated areas to unheated areas - from inside of a house through structural materials (walls, ceilings, and windows) to the outside.

Convection - Heat tends to migrate from warm to cool areas. Thus, heat escapes and cold air enters wherever two different materials or parts of a dwelling join.

Creosote - An oily, pungent liquid distilled from wood tar or coal tar. It is usually used as a wood preservative.

Cubic foot - The volume of a cube one foot in length, width, and depth.

Damper - A valve in a chimney flue to control the draft.

Dehumidifier - A machine that removes the humidity (moisture) from the air.

EER - Energy Efficient Ratio - The number of BTU's of heat that one watt of electrical energy will remove from the air in one hour. The EER will be a number ranging from 4.7 to 12.2.

Energy Conservation - The wise and conservative use of energy-producing resources so they last longer.

Flue - A shaft for the passage of hot air and smoke - the inside liner of a chimney.

Fluorescent Lamp - A glass tube coated on the inside with a fluorescent substance that gives off light when acted upon by a stream of electrons.

Heatolator - A fan system that blows heat into a room that is usually lost up the chimney.

Background Information - (continued)

Humidifier - A machine that puts moisture into the air.

Humidistat - A device to measure the humidity in the air.

Humidity - The amount of moisture in the air.

Incandescent Lamp - A light having a filament that glows when heated.

Insulation - A material that prevents leakage of electricity, heat, or sound.

Relative Humidity - The amount of moisture in the air expressed as a percentage of moisture that the air is capable of holding at that temperature.

R-value - The resistance of insulation to heat passing through it determines the R-value. A high R-value is a better quality insulation.

Thermostat - A device that senses temperature.

Underwriters Laboratory (UL) - An organization that tests machinery and appliances that use electricity. UL on a label on the appliance means that this organization has approved it as a safe piece of equipment.

Vapor Barrier - A substance that restricts the flow of moisture through walls and ceilings, such as a safe piece of equipment.

Ventilation - To provide an opening for the escape of foul or unwanted air and the entrance of fresh air.

ACTIVITIES

Activity 1

Have students review the information found in this lesson.

Activity 2

Have students bring in examples of some of the topics discussed in the reading material such as: caulking types, literature on heating and cooling, insulation types, types of lighting.

Activity 3

Compare and discuss the materials brought into the classroom.

Activity 4

Discuss where energy is used in the home:

A. Heating

1. Home
2. Water

B. Cooling

1. Air conditioning
2. Fans

C. Refrigeration

D. Cooking

F. Cleaning

G. Other uses

1. Small appliances
2. Swimming pools
3. Yard and garden

Activity 5

Discuss how to prepare the home for efficient energy use.

A. Heating

1. Home

a. Insulation

(1) R-value - Insulation's resistance to the passage of air

(2) Common types of insulation

(a) Flexible:

1. cellulose fiber with vapor barrier
2. glass fiber or mineral wood with vapor barrier

(b) Loose fill

1. glass fiber and mineral wood
2. cellulose
3. vermiculite, expanded

(c) Rigid board

1. polystyrene, expanded
2. urethane, expanded
3. glass fiber-board
4. polystyrene, molded beds

(d) Foamed-in-place

1. Expanded urethane, sprayed (with fireproof covering)

(3) Vapor barriers

(a) Always faced toward the living space.

(b) Prevent the passage of moisture through walls and ceilings.

(c) Aluminum foil is more effective than Kraft paper.

(d) Do not install a vapor barrier between layers of insulation.

(e) In finished attics or sidewalls where applying vapor barriers is impossible, the recommended procedure is to:

1. Apply two coats of enamel or aluminum paint.
2. Use vinyl, plastic, or foil wall covering.
3. Vent the top and bottom of each stud cavity with plug inserts on the exterior of the home. Face the louvers of the

plugs downward so precipitation will not enter the wall.

(4) Ventilation

(a) Vent attics to remove summer heat and winter moisture.

(b) Caulking

1. Much heat is lost through cracks around windows and doors.

2. This heat loss is caused by convection and conduction.

3. Sealing cracks with an inexpensive caulking compound or by using weather-stripping material can result in as much as a 15% savings on the fuel bill.

(c) Weather stripping

(d) Storm windows and doors

(e) Heat pump

(f) Supplemental heat -

1. Fireplaces

(a) conduct an annual check for cracks, loose bricks and mortar, and cracks in the fuel lining.

(b) be sure damper closes tightly to prevent loss of heat up the chimney.

(c) Accumulated soot and creosote should be cleaned from the flue each year.

(1) A commercial cleaning contractor can clean the flue with a vacuum system that is usually more efficient and cleaner than any do-it-yourself method.

(d) When installing a new fireplace be sure to look into heatolators (fan system) and glass doors for the front.

2. Wood stoves

(a) Be particularly careful when installing stoves and stove pipes in a home.

(1) Keep away from flammable surfaces.

(2) Be sure stove pipes are marked "all fuel"; they are either double or triple thickness with an insulating material between each layer.

3. Electric heaters

2. Water heating

a. Reduce thermostat setting on the water heater to 110° - 120° F (43° - 49° C).

b. Wash only full loads of laundry.

c. Use dishwasher only when full.

d. Take showers rather than baths.

B. Cooling

1. Air Conditioning

a. Purchase the proper size unit for the area to be cooled.

(1) EER rating

(2) Fans

(a) exhaust

(b) window

(c) ceiling

1. This method has been used to replace the need for air conditioning.

(3) Heat pump

C. Refrigeration

1. Keep refrigerators away from heat sources, i.e. stoves, radiators.
2. Maintain seals and gaskets around refrigerator.
3. Chest freezers are less wasteful than upright types.
4. Be sure the refrigerator/freezer is well insulated.
5. Try to keep freezers full.

D. Cooking

1. Keep seals around oven in good repair.
2. Use the proper size burner for the pan size.
3. Use the self-cleaning feature on the oven sparingly.

E. Lighting

1. Use energy saving bulbs.
2. Use fluorescent bulbs.
3. Keep bulbs and reflectors clean.
4. Discuss use of rheostats.

F. Cleaning

G. Other uses

1. small appliances
2. swimming pools
3. yard and garden

LESSON TITLE: "Supplemental Information, Using Wood"

LESSON OBJECTIVES:

1. The student will demonstrate how to install, maintain and use a wood stove safely in the home.
2. The student will become knowledgeable about wood stove costs, safety practices and proper wood selection.

BACKGROUND INFORMATION - See Attached

Additional Tips - See Attached (Background Information)

ACTIVITIES:

1. Spend one day on background information acquainting students with the material concerning maintenance and use of the wood stove in addition to costs involved and safety practices.
2. Conduct field trips to establishments (if available) that sell wood stoves to familiarize students with types and uses.
3. Collect wood types listed in the background information and conduct experiments on ease of starting, cooling qualities, sparks, fragrance and heat class.

RESOURCES:

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

Public utilities

Wood stove companies

SUPPLEMENTAL INFORMATION #1
USING WOOD

Background Information:

Fireplaces and wood stoves have been popular decorative home accessories. Now, with the advent of the energy crisis, people are seeking ways to reduce fuel bills. Fireplaces and stoves are regaining some of the importance they held decades ago when they were the main source of heat in a home.

Unless properly installed and used, fireplaces and stoves waste as much heat as they produce and may present serious fire hazards. As a rule, a wood stove is approximately four times more efficient than a fireplace.

FIREPLACE MAINTENANCE

If you regularly use a fireplace, an annual fall check-up is in order. Hot gases that escape through cracks in a fireplace can be a hazard to health and can cause a house fire.

Check the chimney for loose bricks and mortar and the flue lining (the passage in the chimney through which air and gases travel) for cracks. Make repairs before you use your fireplace.

Be sure that the damper at the top of the fireplace closes tightly; otherwise, large volumes of warm room air will escape when the fireplace is not in use.

In summer, the damper should remain closed to prevent "sooty smelling" back drafts and to prevent birds from gaining access to the home.

Accumulated soot and creosote should be cleaned from the flue each year. To do this, pull a weighted sack of straw up and down the flue. Seal the front of the fireplace before you begin the job to prevent soot from entering the living area. A commercial cleaning contractor can clean a chimney with a vacuum system which is much more efficient than any do-it-yourself method.

FREESTANDING FIREPLACES AND WOOD STOVES

Use extreme caution when you install a freestanding fireplace or wood stove. The recent increase of home fires in the United States is attributed mainly to faulty installation of stoves and to lack of care in kindling and maintaining wood fires.

Many types of stoves are available in a variety of materials. Your best and safest choice is a stove made of cast iron which is durable and spreads heat well. If you burn coal, such a stove should be lined with firebrick and have a grate specifically designed for coal. Some stoves and freestanding fireplaces are double lined (jacketed) and are sometimes labeled as zero clearance. They can be placed close to walls. A single-jacketed stove MUST have proper clearance from floor, walls, and ceilings.

If you purchase an old cast-iron stove, have it checked by someone knowledgeable in its operation.

Buy from a reputable dealer and arrange to see a similar stove in operation before you make a purchase. Follow the manufacturer's maintenance instructions.

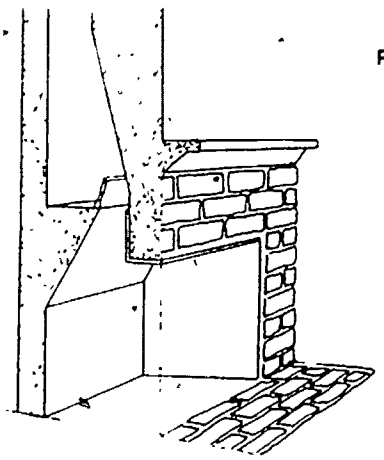
INSTALLATION OF WOOD STOVES

A wood stove must be set on a foundation of stove board, slate, brick, or other fireproof material.

If you use a prefabricated chimney, make sure it is insulated and carries a U.L (Underwriters' Laboratories) "All Fuel" label. DO NOT USE A CHIMNEY LABLED "VENT." A vent pipe is a single thickness of metal. Such a pipe gets very hot and can start a fire in any combustible materials near it in a wall or ceiling. "All Fuel" chimneys are either a double thickness of pipe with asbestos between the pipes or a triple-walled pipe with an air gap between the pipes.

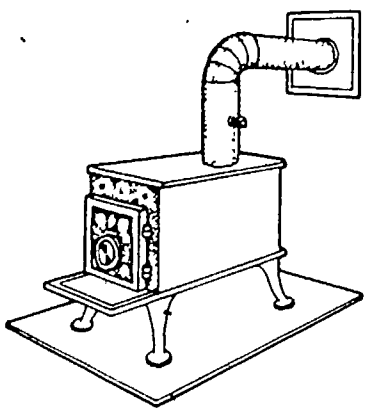
Any smoke pipe that must go through a wood frame ceiling or wall should have a properly sized U.L. "All Fuel" thimble. The opening in the wall or ceiling should be 1" (2.5 cm) larger than the thimble and should be lined with asbestos. A smoke pipe must be at least 18" (45 cm) from an unprotected wall.

It is safest to have a wood stove installed by a competent dealer.



Cross section of fireplace and chimney

Properly installed wood stove



SAFETY PRACTICES

Safety precautions must be taken whenever wood is burned to prevent damage from sparks, soot, and chimney fires and to prevent personal injuries.

One approach to igniting a fire would be to open the damper and place two logs on the grate or fire basket. Between them place wadded newspaper and small pieces of wood or branches. Place small, dry logs over this; a teepee shape works well. Ignite near the base of the teepee. Once the logs have ignited, move them close together and close the fireplace screen or stove door. Before adding new logs, rake the coals to the front of a fireplace grate where they will reflect heat into the room. Always be sure that an inch (2.5 cm) or more of space exists under the grate and/or irons and above the ashes for air circulation and to protect the metal from excessive oxidation. Add pieces of firewood sparingly. Maintain a quiet, cozy fire; avoid a roaring blaze.

Don't close the damper entirely until the fire is completely out. This may take several hours after the fire burns down. The next day, rake through the ashes before you remove them.

Burn wood stoves hot for 20 minutes each day to prevent creosote buildup.

Consider using a combination screen-tempered glass unit with your fireplace; the screen is used while the fire is burning; the glass doors are closed when the fire is reduced to embers.

Insist that all members of a household follow these safety rules:

1. Keep flammable materials away from the fire.
2. Never leave small children unattended in a room where a fireplace or stove is in use.
3. Allow only adults to tend the fire.
4. Keep fireplace screens and stove doors closed while fire is burning.
5. Clean the fireplace regularly. Maintain an inch (2.5 cm) of ashes to improve the refractory effect of burning fuel.

WOOD SELECTION

Fireplace and stove wood should be dried as much as possible before burning. Dry wood burns efficiently and is not as likely to produce soot and creosote problems. To make the most efficient use of wood, cut it to size and store it under cover at least 6 months before using it. Wood that is air-dried for 12 months will be about 20 percent moisture and will produce five times more BTU's than green wood.

Consult the following table for the burning characteristics of wood.

Characteristics of Northeastern U.S. woods for fireplace use

Species	Ease of starting	Coaling qualities	Sparks	Fragrance	Heating class (I best)
Apple	Poor	Excellent	Few	Excellent	II
Ash	Fair	Good	Few	Slight	II
Beech	Poor	Good	Few	Slight	I
Birch (white)	Good	Good	Moderate	Slight	II
Cherry	Poor	Excellent	Few	Excellent	II
Cedar	Excellent	Poor	Many	Good	III
Elm	Fair	Good	Very few	Fair	II
Hemlock	Good	Low	Many	Good	III
Hickory	Fair	Excellent	Moderate	Slight	I
Locust (black)	Poor	Excellent	Very few	Slight	I
Maple (sugar)	Poor	Excellent	Few	Good	I
Oak (red)	Poor	Excellent	Few	Fair	I
Pine (white)	Excellent	Poor	Moderate	Good	III

ELECTRIC HEATERS

Auxiliary electric heaters are useful for temporary, localized heat. To save energy and dollars, use them only when necessary. If you need auxiliary heat in your bathroom(s), a wall or ceiling radiant fixture connected to a timer is the ideal arrangement.

Portable heaters should be used with caution in bathrooms or other areas where water might come in contact with them.

By very careful to watch young children around any portable heater. Also, be sure that no combustible items such as clothes or toys are left on, in front of, over or near any portable heater.

ADDITIONAL TIPS

If you have any doubts about the safety of your fireplace or stove, ask your local fire department to inspect it before you use it.

Don't burn charcoal indoors; it can consume most of the available oxygen in a room. This also applies to liquid propane (LP) camping heaters and to kerosene space heaters. The sale of portable, unvented kerosene heaters for household use is prohibited by law.

For reasons of fire safety, a sunlamp should never be used for supplemental heat.

If you plan to build a fireplace, consider installing a heat-circulating firebox. Air can be circulated from it throughout a room or to several rooms. Electric fireplace grates draw cool air from a room into tubes where it is heated and returned to the room. Consider one if you use a fireplace as a regular and major source of heat. An ash dump built into the hearth and chimney is a great convenience. Ashes can be emptied through a clean-out door in the basement.

Save your wood ashes. They are full of potash (potassium) and make an excellent fertilizer for a vegetable garden in the early spring. Keep the ashes dry until ready for use.

LESSON TITLE: "Insulation Materials - R-Values and Uses"

LESSON OBJECTIVE

The student will associate the R-value with insulation type and be aware of available insulation materials, their uses and costs.

BACKGROUND INFORMATION

Insulation

Any material that reduces the passage of heat through the walls, ceilings, floor, or roof of a building is insulation. Thermal insulation is any one of a variety of materials designed and installed in a structure for the sole purpose of reducing heat conduction. It does not heat or cool. Because thermal insulation forms a protective blanket around the living area of a home, it is needed around all areas heated in winter and cooled in summer. Fuel supplies are limited and expensive; so properly selected and correctly installed thermal insulation is one of the best energy-saving investments a homeowner can make. It is a one-time investment and pays dividends in the form of reduced fuel bills.

Insulation R-values

A good thermal insulating material is dry, fire resistant, economical, easy to install, and, most importantly, contains many small pockets to trap air and resist heat conduction. The resistance of insulation to heat passing through it determines its effectiveness or its resistance value (R-value).

The higher the R-value, the more effective the insulating material. For example, 1" (2.5 cm) of dense glass fiber insulating material has an R-value equal to about 40" (100 cm) of concrete. Therefore, when purchasing insulating material, always buy according to the R-value, not by thickness. Industry standards require that R-values be printed clearly on insulation wrappers or containers.

Insulation materials

There are four basic types of thermal insulation: flexible, loose fill, rigid, and foamed-in-place.

Flexible materials include glass-fiber and mineral-wood batts and blankets from 1"-9" (2.5 cm-23 cm) thick. Batts are usually 4" long; blankets come in long rolls and are cut to length by the installer. Batts and blankets are commonly available in 15" (38 cm) and 23" (58 cm) widths to fit standard wood framing. They are sold with or without a Kraft paper or foil vapor barrier. Both are flame and moisture resistant and are easy to install. Batts and blankets are used for insulating unfinished attic floors and rafters, the underside of floors, crawl spaces, and open walls.

Urea-foam insulation is a new technique, and to date, its long-term effectiveness is not known. Urea formaldehyde shrinks 1-3 percent and is considered non-combustible. If urea formaldehyde is foamed into a structure when the outside temperature is below 55oF (13oC), without the proper equipment and precautions, it may not cure properly. Fumes from the materials can be temporarily unpleasant.

Sprayed-on urethane is considered combustible and must be covered with a fire-rated finish.

The homeowner planning to install insulation should be familiar with the effects of humidity in a home and should take steps to alleviate it. Moisture breaks down insulation, and wet insulation is worse than no insulation at all. Vapor barriers and ventilation restrict and reduce excess moisture; they go hand-in-hand with properly installed insulation.

Table 2. Insulation materials, R-values, and uses

Material	R-value* per inch	R-value* (per cm)	Where used
Flexible			
Cellulose fiber with vapor barrier	3.20-4.00†	(1.3-1.6)	Unfinished attic floors, open sidewalls, heating ducts, crawl spaces, under-side of floors, rafters
Glass fiber or mineral wool	3.00-3.40†	(1.2-1.3)	
Loose fill			
Glass fiber and mineral wool	2.80-3.40	(1.1-1.3)	Finished and unfinished attic floors, finished frame walls
Cellulose	3.50-3.70	(1.4-1.5)	
Vermiculite, expanded	2.13	(0.84)	
Rigid board			
Polystyrene, extruded	5.26	(2.1)	Basement walls, new construction, floor slab perimeter
Expanded urethane, preformed	5.80-6.25	(2.3-2.5)	
Glass fiberboard	4.00	(1.6)	
Polystyrene, molded beads	3.57	(1.4)	
Foamed-in-place			
Expanded urethane, sprayed	6.25	(2.5)	Finished frame walls, finished and unfinished attics
Urea formaldehyde	5.00§	(2.0)	Finished frame walls

*Determined from ASHRAE Handbook, 1972.
†Varies according to density and fiber diameter.
§ From manufacturers' specifications

Additional Insulation Information.

Potential for Energy Savings
* Indicates little or no investment required

	Potential Savings
. R-19 is minimum recommended for attic floors	15-25%
. Insulation with rating of R-11 is minimum recommended for exterior walls and floors over unheated areas ...	10-20%
. Heat loss through windows and doors can be reduced by more than 50% with the addition of storm windows and doors resulting in a 10% overall reduction	10-20%
* Infiltration of outside air entering the house around window and door casings and wherever different materials or parts of a building join adds significantly to the heating and cooling load-from 30 to 50% ... Caulking and weatherstripping can minimize this additional load and energy waste with a minimum investment	15-40%
* Remember that warm air rises, so any opening to the attic can cause a significant heat loss. A typical home may easily have 30 square inches of leakage to the attic through doors, around chimneys and light fixtures, which will waste $30 to $40 of energy annually	5-10%

Estimated Return on Insulated Investment

Investment Area	Percent Return	Payback Time
ceiling and wall insulation	15-50%	2 to 6 years
storm windows and doors	12-20%	5 to 8 years
caulking and weatherstripping	100-500%	3 to 12 months

STUDENT ACTIVITIES

1. Have students visit a house under construction and view the installation of the insulation.

2. They should also take note of the types of insulation being used and the location.

3. Students should collect different types of insulation materials and bring them into class. After examining the materials thoroughly the student should then test the results.

RESOURCES:

Energy Management Strategies for Colorado Home Economics Teachers, developed by the Colorado State Board of Community Colleges and Occupational Education, by the Public Service Company of Colorado and by Energy and Man's Environment of Portland, Oregon.

Public Service Company of Colorado
an investor-owned utility

EME

COLORADO STATE BOARD
NIL SINE NUMINE
COMMUNITY COLLEGES
and
OCCUPATIONAL EDUCATION

LESSON TITLE: "Home Heating and Cooling -- Save Energy, Save Dollars"

LESSON OBJECTIVE:

The student will be able to determine how heating waste in our homes can be eliminated and the energy conserved.

BACKGROUND INFORMATION

Most people can be comfortable in a dwelling without the heat if the outside temperature is above 65°F (18°C). When the temperature drops below 65°F (18°C), heat is added in the home to satisfy comfort. The time during which heat is required, popularly known as the "heating season," lasts as long as 10 months per year in some parts of the northern regions of the United States.

The usual energy sources used for heating are natural gas, propane, oil, electricity, and, to a lesser extent, coal, wood, and kerosene. Alternative sources utilizing the sun, wind, and water are being developed, but it will take time and money to perfect them and make them practicable.

Alternative energy sources are not the subject of this activity. Rather, it is directed toward the majority of homeowners and renters who use gas, oil, or electricity for heat and who, in the face of limited natural and financial resources and spiraling costs, want to save energy and dollars.

Not long ago energy was considered cheap and abundant. Much was wasted, for the sake of convenience. Now it is known that existing energy supplies are limited, and every person who pays a heating bill knows fuel is no longer cheap. But the waste goes on. This lesson of "Save Energy, Save Dollars" points out how heating waste can be eliminated and the energy conserved.

Comfort need not be sacrificed, but convenience must be evaluated realistically. For example, it is convenient to have an automatic heating system. If you do not turn back your thermostat before retiring at night, it would be inconvenient to train yourself to do so. But leaving a thermostat at the same setting, day and night, is wasteful. Covering single-pane windows with heavy plastic during the heating season takes time and costs about $60 for a home of 1,400 square feet (130 square meters). That's inconvenient. Not covering windows may increase your fuel bill up to 30 percent. That's sheer waste!

New habits must be learned and corrective steps taken to reduce energy use. Your fuel bill is a recurring expense; the energy-saving measures described in the following sections are, for the most part, one-time expenses, and the money spent will be returned to you in energy and dollars saved. The time to take these steps is now.

HEAT LOSS

Heat tends to migrate from warm to cool areas. Thus, heat escapes and cold air enters wherever two different materials or parts of a dwelling join. This is heat loss by convection. In addition, heat passes from heated to unheated areas of a structure or from heated areas through structural materials to the outdoors. This is heat loss by conduction.

Securing your home against heat losses caused by convection and conduction could reduce your fuel bill as much as 40 percent. A tall order? Not if you are willing to examine your home carefully and make thorough repairs and adjustments.

Remedies for Heat Loss Caused by Convection

Older homes often have many cracks around doors and windows. Masonry exteriors - stone, stucco, and brick - often develop cracks which should be sealed. But old or new, frame or masonry, insulated or not, all homes suffer some heat loss through convection. Remedies for this situation - caulking, weather stripping, and sealing - are among the least expensive of energy savers and, in most cases, are do-it-yourself jobs.

ACTIVITIES

Activity 1

Have students look for energy loss areas on the outside of the home by checking:

a. around window and door frames, sills, and joints. Also check the putty around window panes and repair if cracked or worn away.

b. between porches and the main body of the dwelling.

c. around water faucets, electrical outlets, and gas or oil lines.

d. where the chimney or masonry meets the siding.

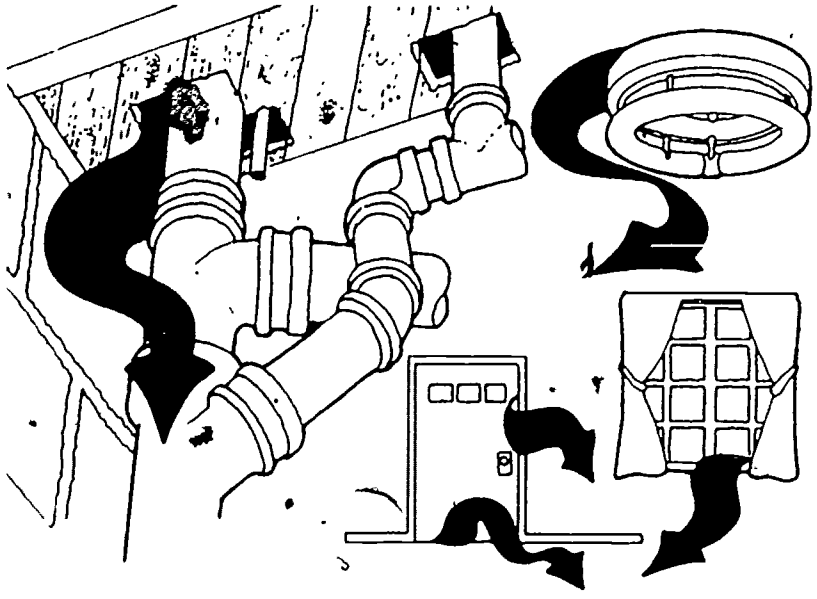
e. between foundation and the sill plate.

f. around ceiling fixtures.

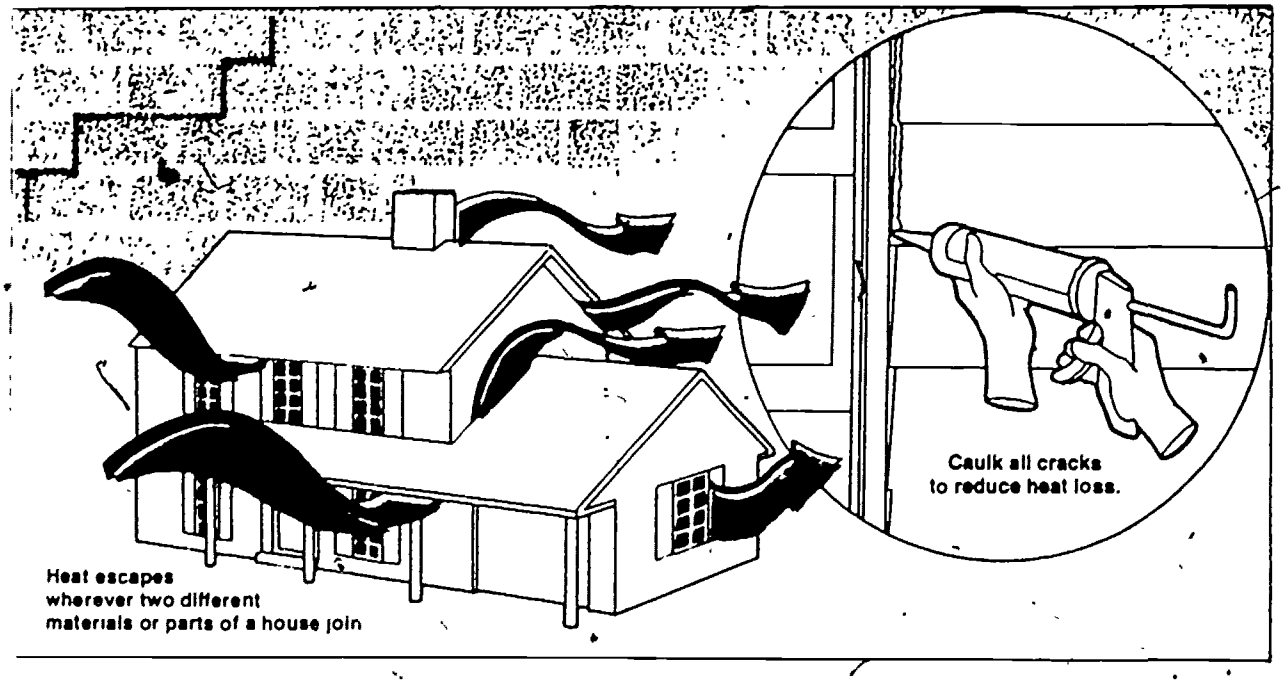
g. around water pipes and drains.

h. around the furnace flue, plumbing vents, pipes, and air ducts in the attic.

i. between heated and unheated areas, such as attached garages and crawl spaces.



Common areas where heat loss occurs inside home



RESOURCES:

Energy Management Strategies for Colorado Home Economics Teachers, developed by the Colorado State Board of Community Colleges and Occupational Education, the Public Service Company of Colorado and by Energy and Man's Environment of Portland, Oregon.

LESSON TITLE: "Energy Questions and Checklists"

LESSON OBJECTIVE:

The students will be able to explain home construction, lighting in homes and businesses and residential energy use.

BACKGROUND INFORMATION - See Attached (Question Sheet #1)

ACTIVITIES - (See attached and below)

A. Upon completion of question sheet 2, have the students discuss their responses.

B. After completing activity A, the Energy Checklist should be distributed to students for completion. The students will have to take the checklist home to acquire accurate responses.

When all of the checklists are completed and returned to the classroom, a MASTER CHECKLIST may be compiled for the classroom by tallying responses on a chart. Discuss different types of responses and determine strongest points in each category.

Example: What percentage of students use natural gas as the central heating unit in their homes?

RESOURCES:

Energy Management Strategies for Colorado Home Economics Teachers, developed by the Colorado State Board of Community Colleges and Occupational Education, by the Public Service Company of Colorado and by Energy and Man's Environment of Portland, Oregon.

BACKGROUND INFORMATION

(Question Sheet #1)

Instructions: Answer these questions about your house before completing the energy checklist.

1. What is the house made of? (wood, stone, etc.)

2. What shape or design is your house? (T, L, box)

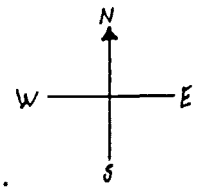
3. Is your house one or more stories? If more than one story, describe it.

4. What direction does the front of your house face? (north, south, east, west)

5. Is it a single or double family house?

6. What trees and shrubs are planted around your house? Where are they located?

7. Make a simple drawing of your home and the plants around it.



ACTIVITIES:

(Question Sheet #2)

Check for lighting in the home and business:

Have you done or will you do the following things to conserve electricity:

	Yes	No
1. Do you turn off lights as you leave the rooms in the house?	___	___
2. Do you have one large watt bulb for a lamp instead of several in one room?	___	___
3. Do you keep bulbs, lamps, and lighting fixtures clean (dirt absorbs light)?	___	___
4. Have you reduced the amount of ornamental lights for holidays?	___	___
5. Have you or will you install dimmer switches when replacing old switches?	___	___
6. Only use outdoor lighting when essential?	___	___
7. Use light colored rugs, walls, draperies, and upholstery in your rooms?	___	___
8. Leave all lights turned out while the sun is shining in the house?	___	___
9. Use candles in the evening whenever possible?	___	___
10. Use only one large watt bulb when watching television?	___	___
11. Turn a night light on only when needed?	___	___

ENERGY CHECKLIST

Mark the following items you have in your home with an X.

1. Central heating unit

   a. natural gas _____
   b. oil/kerosene _____
   c. electric _____
   d. wood _____
   e. coal _____
   f. other _____

Question: What does it cost you to heat your home?

per month _____ per year _____

2. Supplementary units

   a. wood burning stove(s) _____
   b. built-in fireplace(s) _____
   c. space heater(s) _____
   d. other(s) _____

Question: How much does it cost to operate the unit for a year? _____

3. Source of hot water

   a. electric _____
   b. domestic (part of the furnace boiler) _____
   c. gas _____
   d. solar _____
   e. other _____

Question: How much does it cost for hot water?

per month _____ per year _____

4. Home cooling

   a. central air conditioning unit _____
   b. room air conditioning unit(s) _____
   c. window fan(s) _____
   d. ceiling fan(s) _____
   e. attic fan(s) _____
   f. other(s) _____

5. Refrigeration

   a. Refrigerator-freezer

      1. single door - manual defrost
      2. two door - semi frost
      3. two door - self defrost
      4. side-by-side - self defrost

   b. Freezer

      1. chest type
      2. upright
      3. other

6. Laundry service

   a. washer
   b. dryer
      1. electric
      2. gas
   c. iron

7. Cooking

   a. gas
      1. pilot light
      2. no pilot light
   b. electric
   c. wood/coal
   d. microwave
   e. other

8. Lighting

   a. incandescent
   b. fluorescent
   c. kerosene
   d. candles
   e. natural light (window, sky light)
   f. other

9. Other kitchen appliances

   a. dishwasher
   b. coffee maker
   c. toaster
   d. can opener
   e.
   f.
   g.
   h.

10. Other home appliances

a. dehumidifier _____
b. television _____
c. stereo _____
d. radio _____
e. hair dryer(s) _____
f. electric blanket(s) _____
g.
h.

LESSON TITLE: "Weatherize Your Home"

LESSON OBJECTIVE:

Students will determine methods to reduce heating and cooling costs by demonstrating weatherstripping of doors, windows and sealing exterior openings.

BACKGROUND INFORMATION - See Attached

ACTIVITIES

The following material provides step-by-step instructions on how to weatherstrip windows and doors and also how to seal and caulk areas of the home. By performing these activities, the student will be able to diminish home heating and cooling costs in his/her home of the future. (See attached - To Weatherstrip a Window)

RESOURCES

Home Care and Maintenance Series L-245D, Ohio State University

Cooperative Extension Service, Ohio State University

Cooperative Extension Service, Pennsylvania State University

Cooperative Extension Service, Purdue University

Background Information

Cooperative Extension Service - Ohio State University

Even though your house is well insulated, it is possible to reduce heating and cooling costs by weatherstripping doors and windows and sealing exterior openings. Besides keeping out wind and moisture, applying weatherstripping and sealing materials will reduce the entry of dust and noise.

What You Need for the Job

.Hammer
.Scissors
.Screwdriver
.Caulk gun
.Steel measuring tape
.Weatherstripping
.Sealing material

Weatherstripping Doors and Windows

Weatherstripping may be purchased by the piece, in strips, rolls or in handy kits complete with suitable fasteners for a single door or window. It is made of a variety of materials. Some are surface mounted and visible, while others are concealed when the door or window is closed.

Pliable gaskets (Figure 1) - See at End of Lesson F

Flexible gaskets of vinyl, rubber and felt are attached with brads or staples to the door and window stops. Some will have an adhesive backing to hold them in place. When the door or window is closed, the edge presses lightly against the gasket. Pilable gaskets are visible. Painting gaskets may cause them to harden.

Rigid Strip Gaskets (Figure 2)

Rigid strip gaskets usually are made of tubular vinyl attached to a metal strip or of a felt-type material glued to a wood strip. Attach both types with nails or screws to door and window stops. Rigid strip gaskets are visible. Paint may be applied to the wood or metal strip but not to the gasket.

Spring Metal Strips (Figure 3)

Attach strips of bronze, aluminum or copper with brads to door and window frames. Use this type of weatherstripping on either double-hung or casement windows. Spring-metal weatherstripping provides good draft control, but it may make doors hard to open and close. Installation is not difficult, but care must be taken not to kink or bend the metal strips.

Threshold Weatherstrip (Figure 4)

Eliminate drafts and blowing moisture at the bottom of outside doors by using door-bottom weatherstripping. It is usually packaged in easy-to-install kits along with fasteners and complete instructions.

Among the most common types of threshold weatherstripping are metal and felt or vinyl strips attached to the bottom of the door. The felt or vinyl compresses against the threshold. The strips are inexpensive and easy to install.

A badly worn threshold may be the problem. Consider replacing a worn theshold with a metal unit. Some have a raised vinyl inset that will compress against the bottom of the door to form a seal (Figure 5). Metal threshold units are available for doors of varying widths.

Tips On Weatherstripping Doors And Windows

Regardless of the type you select, use recommended fasteners according to the manufacturer's directions. Make sure the strip or seal is straight. Curves, bends or kinks in the weatherstripping lessen efficiency.

ACTIVITIES

Activity 1

Provide students with knowledge and skills to weatherstrip a window by having them:

a. Close and lock the window. Make sure the contact edge of the weatherstripping presses snugly against the sash or casing before attaching.
b. Weatherstrip the upper sash on the outside of the window.
c. Attach weatherstrips to the frame so they press against the sash.
d. The lower sash is weatherstripped from the inside.
e. Attach the top piece to the lower sash so it covers the crack where upper and lower sash rails meet.
f. Attach the bottom piece to the face of the sash with the contact edge down against the inside window sill.
g. Attach side pieces to frame so they press against sash.

Activity 2

Provide students with knowledge and skills to weatherstrip a door by having them:

a. Close and lock the door.
b. Attach side and top pieces of weatherstripping to the door stops on the outside. Press contact edges snugly against the door's face.

These procedures do not apply to metal weatherstripping or cord caulk.

Activity 3

Provide students with the knowledge and skills to enable them to seal cracks and seams in their homes.

a. Sealing exterior cracks and seams is an important part of home maintenance. It reduces entry of air, dirt and moisture into the house and contributes to lowering of heating and cooling costs.

b. Among the most important exterior areas of a house requiring attention are:

.Around chimney flashing
.Joint between chimney and siding
.Joint between eaves and gable molding
.Joint between window sill and siding
.Joint between window frame and siding
.Joint between window drip cap and siding
.Joint between window frame and masonry
.Around door frames
.Joints between masonry or concrete and main parts of house
.Inside corners formed by siding

c. Sealing Materials

Many different sealing and caulking materials are available for use inside and outside the home. Each is designed for specific uses. Be careful to select the right sealing material for the job. Follow the manufacturer's recommendations on where the product can be used, surface preparation and application.

Activity 4

Discuss with students how it is possible to reduce heating and cooling costs by weatherstripping doors and windows and sealing exterior openings. Besides keeping out wind and moisture, applying weatherstripping and sealing materials will reduce the entry of dust and noise.

a. WHAT YOU NEED FOR THE JOB

.Hammer
.Scissors
.Screwdriver
.Caulk gun
.Steel measuring tape
.Weatherstripping
.Sealing material

b. WEATHERSTRIPPING DOORS AND WINDOWS

Weatherstripping may be purchased by the piece, in strips, rolls or in handy kits complete with suitable fasteners for a single door or window. It is made of a variety of materials.

Some are surface mounted and visible, while others are concealed when the door or window is closed.

Pliable Gaskets (Figure 1)

Flexible gaskets of vinyl, rubber and felt are attached with brads or staples to the door and window stops. Some will have an adhesive backing to hold them in place. When the door or window is closed, the edge presses lightly against the gasket. Pliable gaskets are visible. Painting gaskets may cause them to harden.

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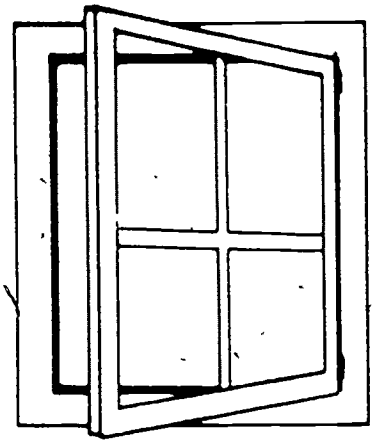


Figure 1

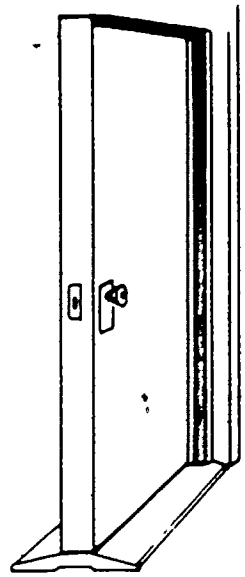


Figure 2

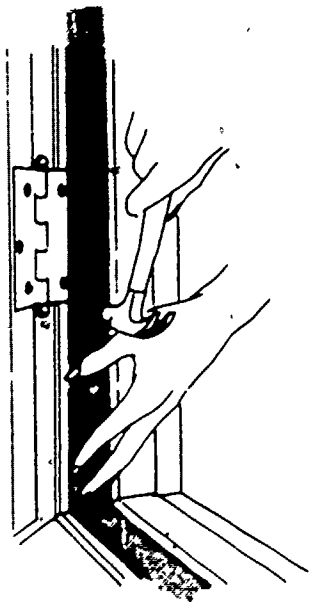


Figure 3

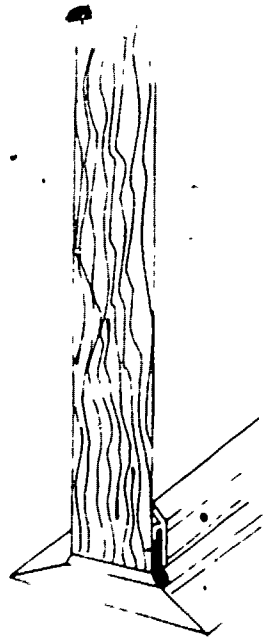


Figure 4

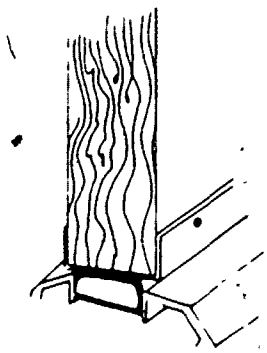


Figure 5

LESSON TITLE: "An Easy-on-Energy Home"

LESSON OBJECTIVE

Students will compare their own home with an "Easy-on-Energy Home"

BACKGROUND INFORMATION:

Many steps may be taken by home owners to greatly reduce energy costs in heating and cooling of the home. Some of these steps may be taken in building construction both on the exterior and interior or simple alterations in thermostat settings. The following activity will provide an opportunity for the students to become aware of energy saving techniques and also to compare their own home with the "Easy-on-Energy Home Model."

ACTIVITIES

Check each statement which pertains to your home and compare your home with the Easy-on-Energy Home. (See Attached)

RESOURCES:

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

Local home builders association or construction company

AN EASY-ON-ENERGY HOME

Activities

Check each statement which pertains to your home, and compare your home with our Easy-on-Energy Home.

1. Properly insulated. It takes twice as much electricity (or any other fuel) to heat an uninsulated home as to heat an insulated home. The recommended values for insulation are:

R-30	Ceilings
R-15	Exposed side walls
R-4	Basement walls below grade
R-19	Floor over any unheated area including garage ceilings and crawl spaces.

_____

2. Double glass or storm windows throughout the house. Total glass area (including sliding glass doors) should not exceed 12 percent of the living area.

_____

3. Insulated doors or storm doors with weather stripping on doors leading outside.

_____

4. Water pipes insulated. Keeps your hot water tank from working overtime.

_____

5. Doors and windows weather-stripped and caulked.

_____

6. Thermostat set at 70o daytime/65o night. For every degree you raise it above the normal setting, you'll raise your heating costs by about 5 percent.

_____

7. Attic fan used, especially if the roof can't be insulated. The fan will draw out heat during the day and pull cool air in at night. Minimum attic space ventilation ratio: one square foot of free area inlet and one square foot of free area outlet for each 600 square feet of ceiling area.

_____

8. Furnace filter kept clean. Filters should be changed several times a year. Clean filters save unnecessary maintenance and service calls and keep the air cleaner.

_____

9. On sunny days blinds and drapes are open to let the sun help heat the home, and on cooler days they are closed to insulate against cool air.

_____

10. If the home has a fireplace, it is installed with a tight fitting damper and kept closed when not in use. Open dampers, when the fireplace is not in use, are great heat robbers. Use the fireplace to take the chill out on a cool day, but don't use a fire in cold weather because more heat goes up the chimney then the fire gives off.

_____

11. Overhangs or awnings shading southern and western exposures. You can reduce much of the sun's heat penetrating into the room by as much as 50 or even 75 percent.

_____

12. Doors leading to outside kept closed. This prevents unnecessary air exchange from inside to the outside.

_____

13. Furnishings away from outside walls and heating units. Keeping furnishings away from the outside wall prevents the tendency to turn up the thermostat. Blocking heating units can waste energy, damage furniture and is a fire hazard.

_____

14. Exhaust fans vented to the outside are installed in moisture producing areas such as the laundry, bathroom and kitchen to control the humidity level within the leaving area. It is suggested that a humidistat be installed to automatically operate the kitchen exhaust fan.

_____

15. An accurate heat loss calculation made for the dwelling in order to size the heating and cooling equipment. The size of the installed heating system -- whether baseboard, radiant ceiling, furnace or heat pump -- should be based on this calculation.

_____

16. Heating and cooling provided by an electric heat pump which extracts more energy from the outside air than it consumes.

_____

SCORE YOURSELF

No. 1 - 3	5 points
No. 4 - 6	4 points
No. 7 - 9	3 points
No.10 -12	2 points
No.13 -15	1 point
No.16 -BONUS	10 points

_____

55	PERFECT SCORE! - YOU HAVE AN EASY-ON-ENERGY HOME!
40-54	KEEP WORKING AT IT!
25-39	DO YOU HAVE MONEY TO BURN?
24 OR LESS	- YOUR'RE FUELISH!

LESSON TITLE: "Making an Insulation Experiment Model"

LESSON OBJECTIVE:

Students will be able to construct an insulation experiment model and demonstrate its use.

BACKGROUND INFORMATION:

In order for students to fully understand insulation types and their uses in the home, an experiment model should be constructed. By constructing the model students will be able to conduct experiments testing the R-values and the quality of the insulation. Students will be able to see for themselves if particular varieties of insulation meet governmental standards and regulations, and how effectively they reduce energy costs.

ACTIVITIES:

See Attached.

RESOURCES:

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

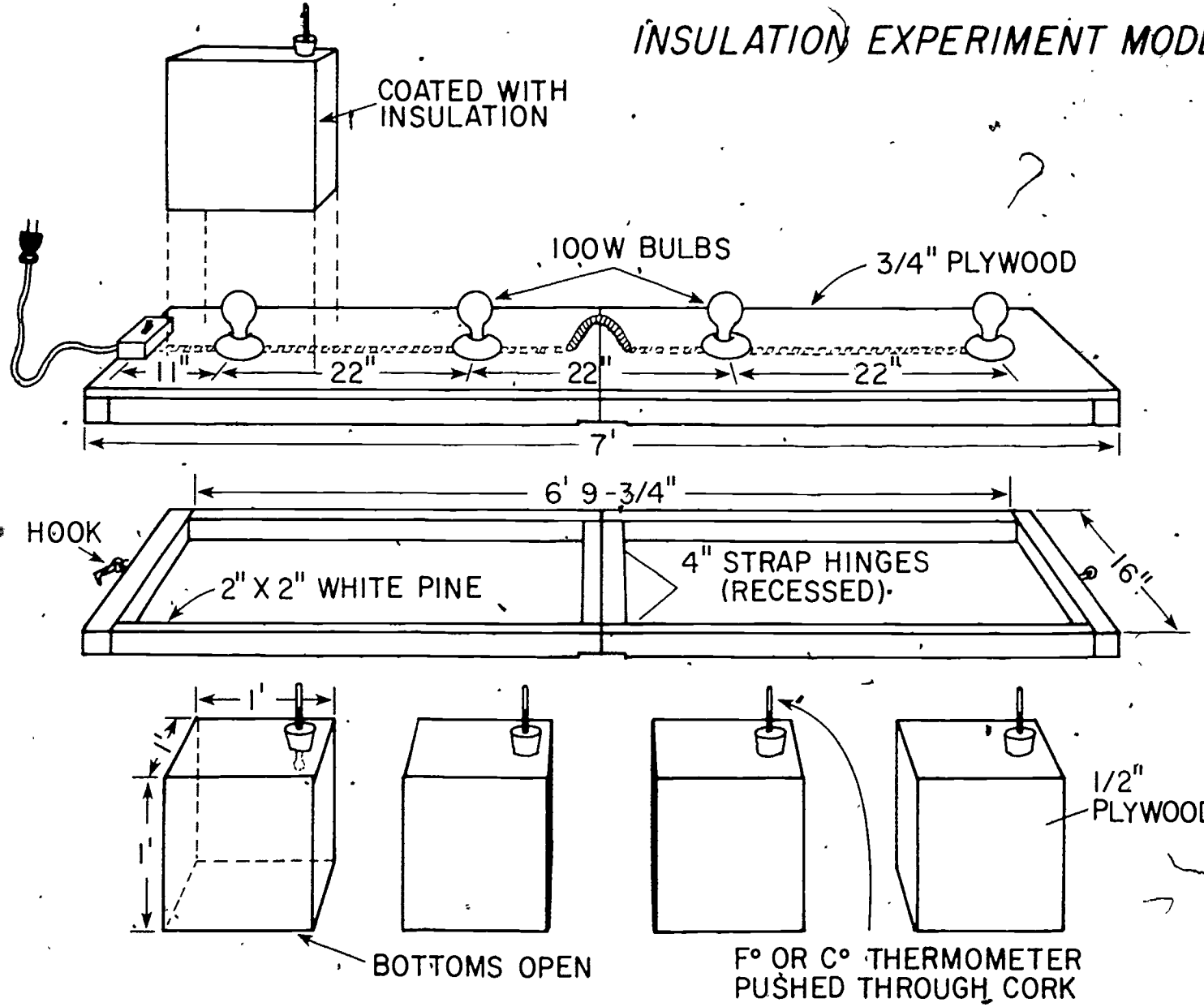
Activities

Making an Insulation Experiment Model

List of Materials for Insulation Experiment Model

1. Base - 3/4" x 16" x 7' — 1 piece of plywood
2. Stand - 6' x 9-3/4" (3/4" x 2" x 2") — 2 pieces of white pine
   - 16" (3/4" x 2" x 2") — 2 pieces of white pine
3. Switch - 1
4. #14 flexible cable - 10 ft.
5. Thermometers - 4, with corks
6. Electrical boxes - 4
7. Receptacles - 4 (porcelain)
8. Male plug - 1
9. Light bulbs - 4 (100 w)
10. Cubes - 1' x 1' x 1' - plywood
11. Insulation materials:
    a. Flexible type
       1. glass wool
    b. Rigid board
       1. polystyrene extruded
       2. expanded urethane
       3. polystyrene (molded beads)
    c. Control cube
       1. not insulated, cracks at joints
    d. Cube with cracks caulked and no insulation applied
12. Caulk - 1 tube
13. Hinges - 2
14. Hook - 1
15. Eye - 1

INSULATION EXPERIMENT MODEL



EACH 1' CUBE IS COATED WITH DIFFERENT INSULATING MATERIALS

LESSON TITLE: "Energy Conservation Worksheets"

LESSON OBJECTIVE:

Students will be able to describe energy efficient homes by viewing drawings of various construction techniques in home building.

BACKGROUND INFORMATION:

The following lesson consists of drawings depicting various house types with exterior and interior areas shown relating to energy conservation. Following the drawings, there are questions asking for choices of the most energy efficient models.

The teacher will be able to check retention of information learned in previous lessons by the student reponses to each question.

ACTIVITIES:

See Energy Conservation Worksheet - Part I and Energy Conservation Quiz - Part II on attached pages.

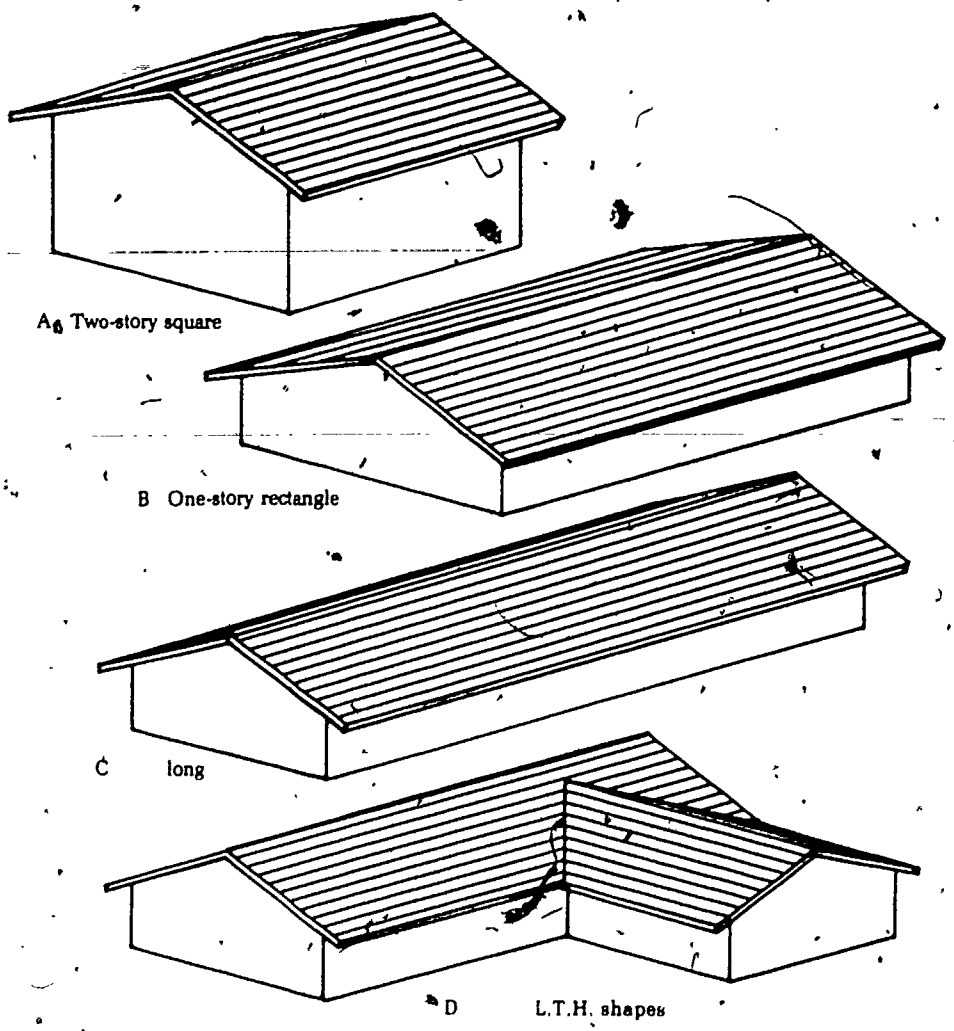
RESOURCES:

Energy Conservation: In the Home and On the Farm developed by Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania and the Pennsylvania Farm Electrification Council, 1980.

ENERGY CONSERVATION WORKSHEET - PART I

HOUSE SHAPE

Wall to Floor Ratio



A Two-story square

B One-story rectangle

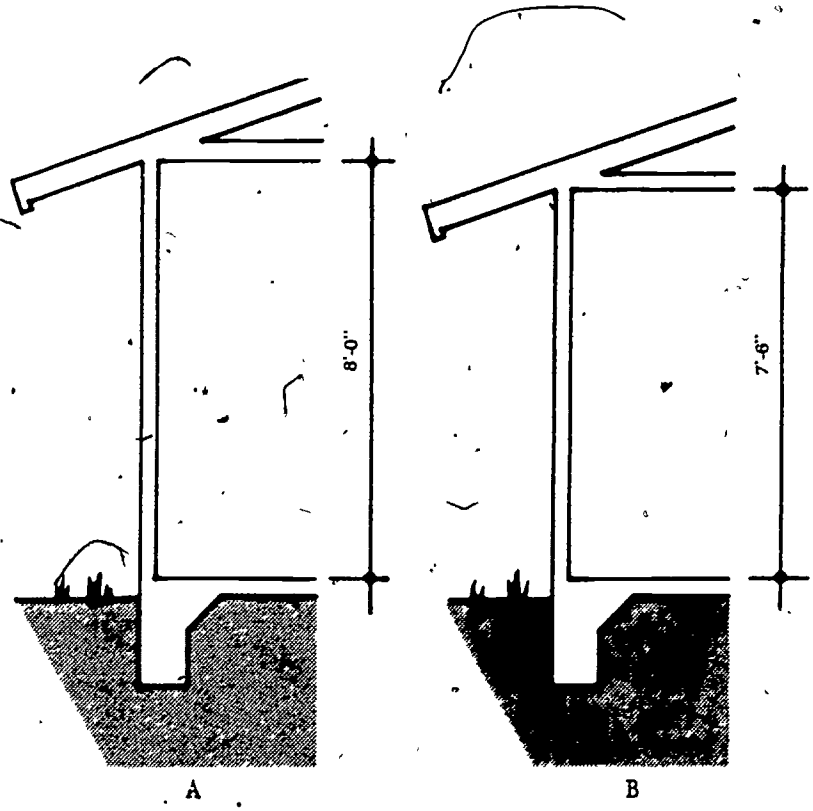
C long

D L.T.H. shapes

1. Using shape as the basis for your decision, which house has the least amount of heat loss. a,b,c,d?

NOTE: The following activity consists of drawings depicting various house types with exterior and interior areas shown relating to energy conservation. Following the drawings, there are questions asking for choices of the most energy efficient model.

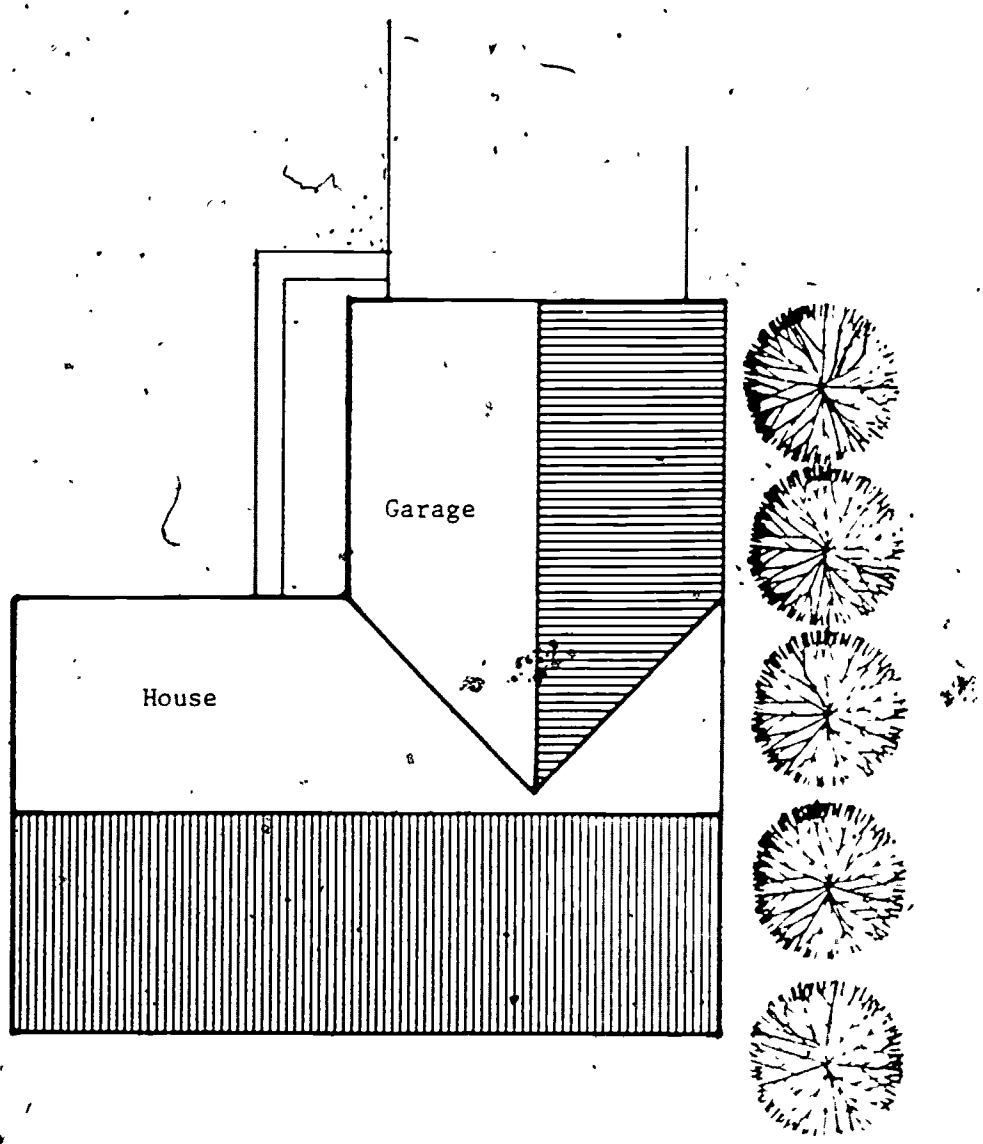
CEILING HEIGHT



2. Using wall height as the basis for your decision, which wall will lose heat. a, b?

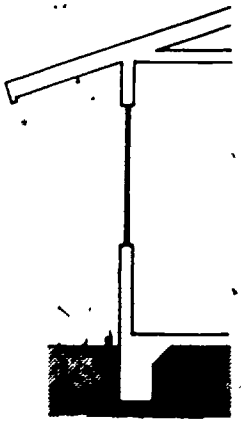
PLAN THE ORIENTATION

COLD CLIMATE INSULATION

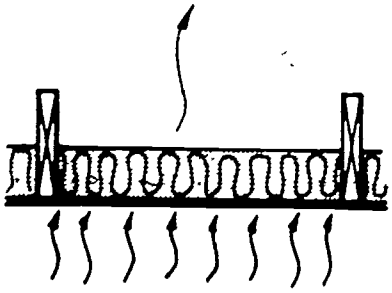


3. Should this Indiana house and garage unit have a. (south and east), or b. (north and west) exposure to allow sun to help warm the house?

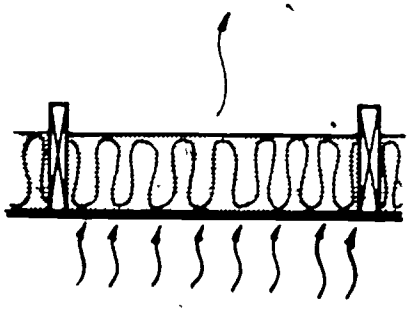
DESIGNING OVERHANGS



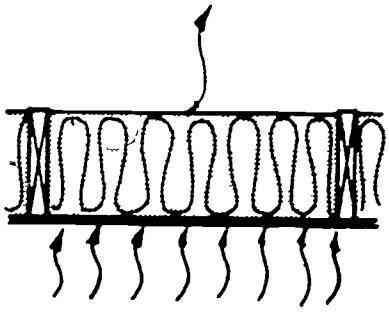
4. Which overhang reduces <u>heat gain</u> through windows in summer. a or b?



R-11 Insulation



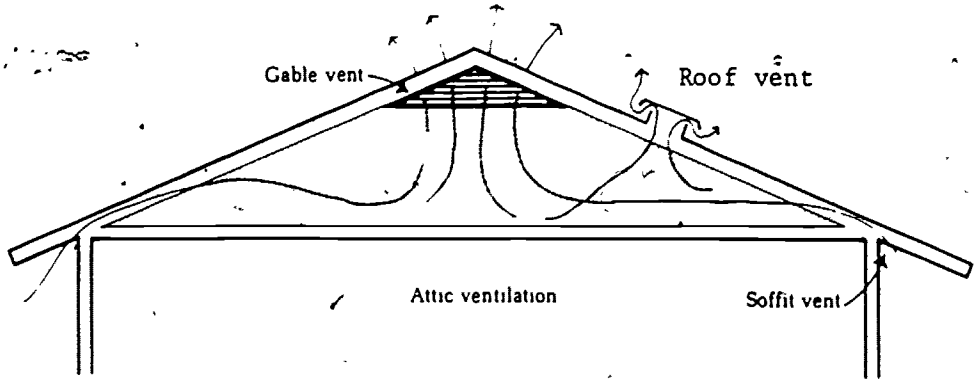
R-19 Insulation



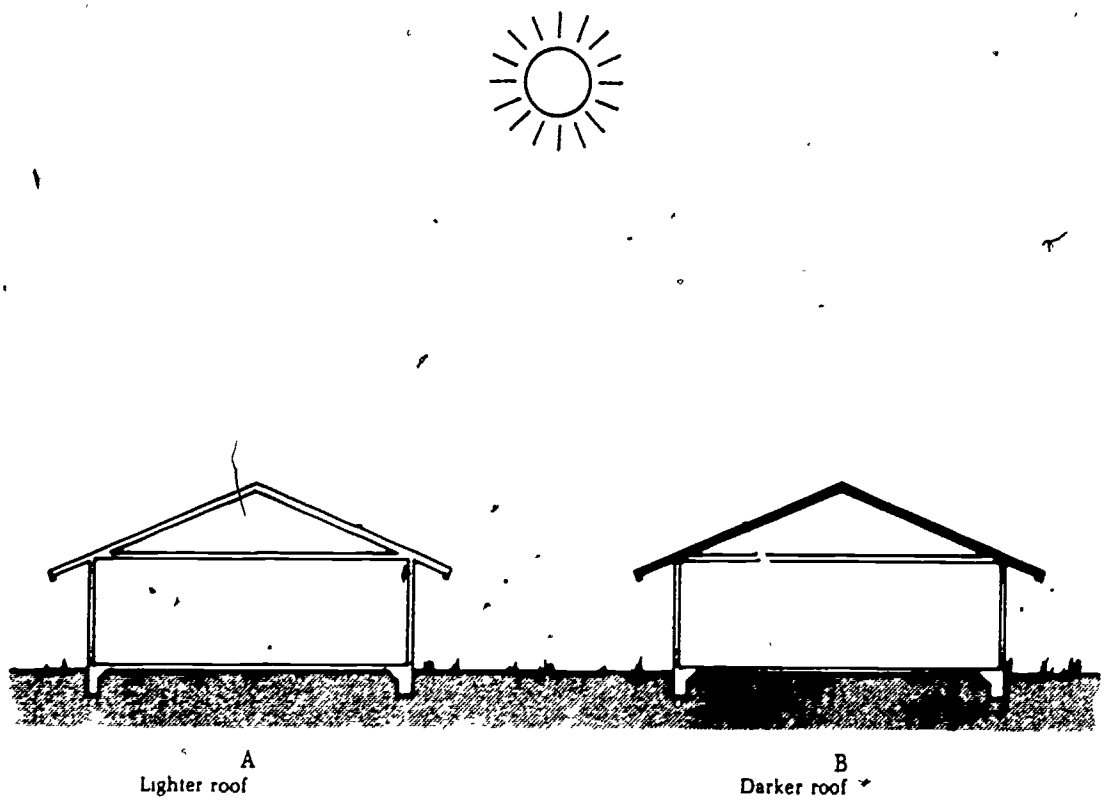
R-22 Insulation

5. Which R factor is more effective at retarding heat flow. a,b, or c?

ATTIC VENTILATION

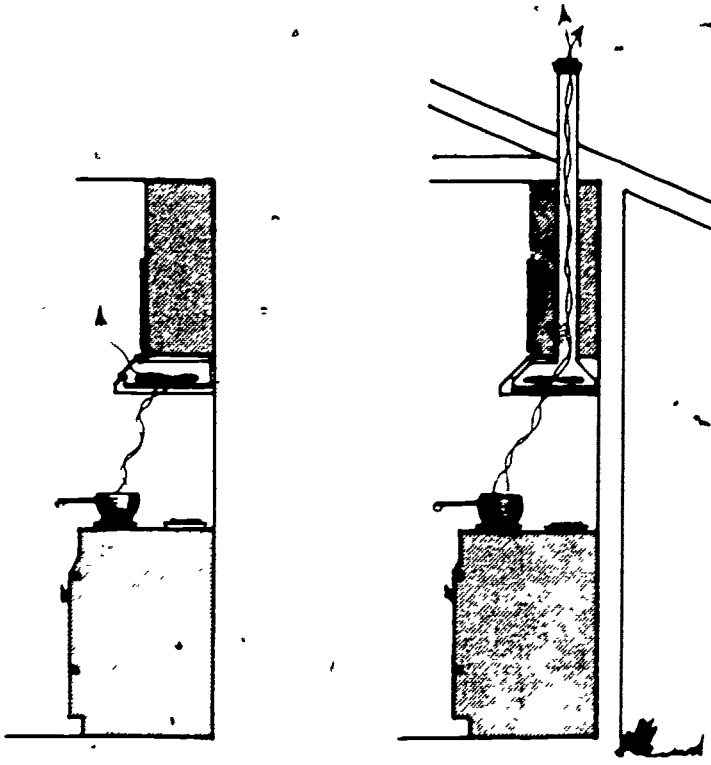


6. Ventilation of attic and roof spaces helps to a. decrease b. increase, c. maintain air temperatures in these spaces during the summer months.



7. 1. Which roof reflects heat. a or b?
   2. Which roof absorbs heat. a or b?

RANGE HOODS

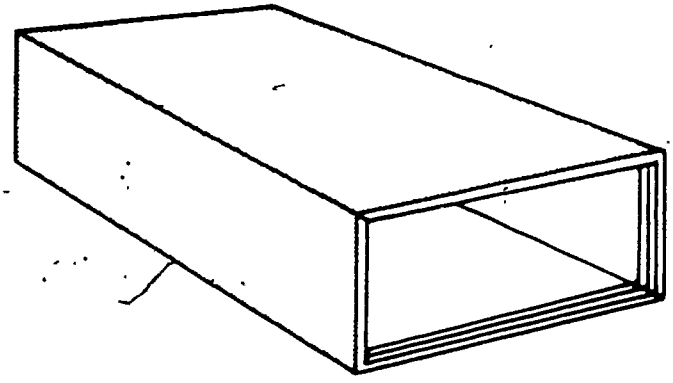


A
Recirculating range hood

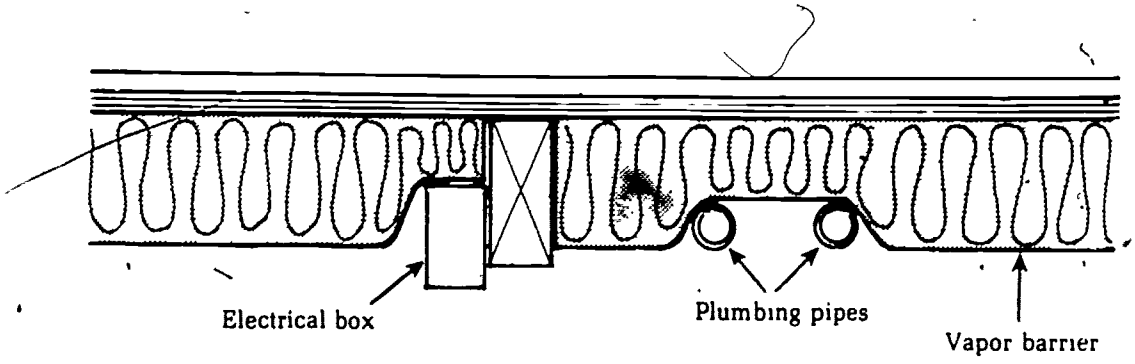
B
Exhaust range hood

8. Which range hood would you recommend for cold climates. a or b?

DUCT INSULATION



9. Heat ducts a. should, b. should not be insulated



10. The water pipes and the electrical box on this outside wall a. <u>are</u>, b. <u>are not</u> properly insulated?

- ENERGY CONSERVATION QUIZ - PART II

1. The proper insulation R-value for a ceiling is _____.

   a. r-4, b. 4-6, c. R-10, d. R-30

2. Total glass or storm windows in a house should not exceed 12% of the living area and large sliding doors should face the _____side of the house.

   a. northern b. southern c. eastern d. western

3. You can save heat loss at doors and windows by applying which of the following? _____

   a. extra paint b. weather stripping c. flexible plastic d. all of the above

4. An attic fan will _____.

   a. draw out heat in the day
   b. draw in cool air during the evening.
   c. require one square foot of free area inlet and one square foot of free area outlet for every 600 square feet of ceiling area.
   d. all of the above.

5. A furnace filter should be cleaned at least _____.

   a. once a year.
   b. several times a year.
   c. never, it is self-cleaning
   d. monthly

6. Blinds and drapes can be used to save energy consumption by _____.

   a. keeping them open to let the sun in during the winter days.
   b. keeping them closed to keep out the cold on cloudy winter days.
   c. keeping them closed on hot summer days.
   d. all of the above.

7. Home fireplaces can be a source of heat loss when _____.

   a. dampers are left open when not in use.
   b. using the fireplace during the summer.
   c. using well dried hardwoods.
   d. none of the above.

8. Placing furnishings away from outside walls and heating units _____.

   a. prevents the tendency to turn up the thermostat.
   b. blocks heating units preventing an even heat distribution.
   c. can damage furniture and is a fire hazard.
   d. all of the above.

9. The size of heating and cooling units installed in your home should be based on _____.

   a. what you think is adequate for comfort.
   b. an accurate heat loss calculation made for dwelling.
   c. the space available in the basement and the size of the roof.
   d. none of the above.

10. Heating and cooling provided by an electric heat pump can _____.

   a. extract more energy from the outside than it consumes.
   b. be very costly to use under most conditions.
   c. cause a problem with other heating units in the house.
   d. create the need to change filter pads twice a week.

ANSWER KEY FOR ENERGY CONSERVATION WORKSHEETS

Part I

1. a
2. b
3. a
4. a
5. c
6. a
7. 1. a, 2. b
8. a
9. a
10. a

Part II

1. d
2. b
3. b
4. d
5. b
6. d
7. a
8. d
9. b
10. a

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Here Is Your Indiana Government, 18th Edition, August 1977. Published by: Indiana State Chamber of Commerce, One North Capitol, Indianapolis, Indiana 46204.

PLEASE TELL US WHAT YOU THINK ABOUT THE SENIOR HIGH SCHOOL ENERGY MATERIALS

Your position: (check)
___ teacher
___ dept. head
___ administrator
___ other

Your grade level: _____

Subject(s) taught: _____

If possible, please answer these questions after you have taught unit lesson(s) in your class and examined teacher's guide. If this is not possible, please answer based on your personal inspection of the unit materials.

1. What project materials are you evaluating? (Check all that apply)

___ Unit I
___ Unit II
___ Unit III
___ Unit IV
___ Unit V
___ Unit VI
___ Unit VII
___ Unit VIII
___ Unit IX
___ Teacher's Guide

2. What is the basis for this evaluation? (Check all that apply)

(1) teaching 4 or more lessons
(2) teaching 1 to 3 lessons
(3) personal inspection
(4) discussion with others who know materials

3. Have you shared these units with other educators? (Check one)

(1) No
(2) Yes, with 1-4 others
(3) Yes, with 5-10 others
(4) Yes, with more than 10

Circle the number from 1 (Definitely No) to 7 (Definitely Yes) which best reflects your answer

	DEFINITELY NO			NEUTRAL			DEFINITELY YES
4. Are these materials easy to understand and use?	1	2	3	4	5	6	7
5. Do these materials fit with the curriculum of your district?	1	2	3	4	5	6	7
6. Are you likely to make use of these materials in the future?	1	2	3	4	5	6	7
7. Are these materials appropriate for the level of your students?	1	2	3	4	5	6	7
8. Are these materials interesting to your students?	1	2	3	4	5	6	7
9. Is the reading level appropriate?	1	2	3	4	5	6	7
10. Do you think these materials will reduce energy consumption?	1	2	3	4	5	6	7

What did you like best

What did you like least

Suggestions/comments (use the back as needed):

RETURN TO: Energy Education Curriculum Project, Division of Curriculum, Department of Public Instruction, Room 229, State House, Indianapolis, IN 46204.