TO CONSERVE OR NOT TO CONSERVE

OBJECTIVES

The student will do the following.

1. Present his/her own ideas of how energy is wasted at home and at work.
2. Analyze information on ways to conserve energy.
3. Develop and present a program on how to save energy in a specific area.

SUBJECTS:

General Science, Physical Science

TIME:

5+ class periods

MATERIALS:

Each student sheet (included) identifies specific materials and requirements for the completion of the activity.

BACKGROUND INFORMATION

The most cost-effective and sensible approach to today's energy problems is practicing energy conservation. Each of us must realize that we cannot continue using energy at our present rate of consumption; we must look for ways to decrease our energy use. We can achieve this by being good consumers and changing habits that waste energy Areas where each of us can have an impact on conserving energy are heating and cooling our homes; use of hot water in the kitchen, laundry, and barn, lighting and use of appliances in our homes and work places; and wise and proper use of transportation systems.

PROCEDURE

I. Introduce the concept of energy conservation to tile class.

II. Ask the students to help you generate a list of reasons it is important for people to conserve energy. Leave this list in a visible place where students can refer to it (You might use a flipchart)

III. Give the Test Your Energy 10" test (included) to the students as a pre-test Have them grade their own tests.

IV. Divide the class into four or five groups depending upon whether you wish to have your students address commercial and industrial energy conservation. Assign each group one of the student activity sheet sets. The groups are to complete the activities, then develop presentations based on their findings. Encourage them to do further research and make visual aids, and tell them that their job is to convince their classmates to conserve energy. Allow time for all the in-class procedures: one period for the students to plan (as a group) how they will complete their group assignments, one period for each group to plan its class presentation, one period to set the stage and to take the pre-test; at least one period to hear the presentations, and one period to take the post-test and close the lesson.

Give them guidelines on the length of their presentations (for example, 15 minutes per group).

You may want to remind them to be cautious when completing activities which require use of electrical appliances, fire, or other potential hazards Remind them of the importance of communicating with (and in some cases, getting permission from) parents in completing the activity sheets Give them a reasonable deadline for completing the home assignments.

For your convenience, the five group titles and individual student activity topics are listed here

Group 1: Energy Savings in Heating and Cooling

1. The Effect of Closing Doors
2. The Effect of Fireplace Damper Position
3. The Effect of the Fireplace on Home Heating
4. Comparing Different Home Heating Systems
5. Comparing Window and Wall Heat Loss
6. Window Insulation Survey

Group 2: Hot Water Energy Savings

1. Hot Water Loss From Leaking Faucets
2. Washing Dishes in Warm Vs Hot Water
3. Boiling With or Without Covering Pan
4. Taking Baths Vs. Showers
5. Heat Loss From Long Hot Water Pipes
6. Washing Clothes in Cold vs. Hot Water

Group 3: Lighting and Appliance Energy Savings

1. How Many Watts for Seeing?
2. Comparing Energy Use of Appliance Brands
3. How Lighting Diminishes With Distance
4. Light Source Effectiveness
5. Schoolroom Lighting Survey
6. Home Light and Appliance Survey

Group 4: Automobile Savings

1. Comparing Gas Mileage
2. Fuel Per Passenger Mile
3. Tire Brand/Type Survey
4. Tire Air Pressure Effects
5. Car Weight Effects
6. Planning Your Trips

Group 5 Commercial and Industrial Energy Conservation

1. Find Out About Your Local Utility
2. Demand Charges and How to Reduce Them
3. Your School's Bills and Energy Management
4. Industry/Home Bill Comparison and Billing Units
5. Code Requirements and Their Energy Costs
6. Industrial Plant Energy Balance

NOTE:The activities and topics for Group 5 are more advanced than those for the other four groups are, and you may choose to omit this group. If you plan to use it, you should smooth

the way for the students by telling the school system's physical plant director, the school principal, local utility officials, and a selected local company's plant manager about the group and its objectives. You may be unfamiliar with the concept of demand charge (a charge to industrial customers for peak power requirements experienced even for an instant during an established period of time). The demand charge is added to the more usual kilowatthour consumption charge

V. Once all the presentations have been made, give the class the 'Test Your Energy 10" test as a post-test. Discuss tile answers to the test.

VI. Continue with the follow-up below.

FOLLOW-U P

I. Discuss the energy conservation tips your class has discovered Which ones do the students think they will really incorporate into their daily lives?

II. Discuss with the students how they can spread the knowledge they have attained about energy conservation to family and friends.

III. Ask the students what they think will happen to the earth and the human condition if we do not conserve energy in our daily lives.

RESOURCES

Alabama Energy Extension Service. *The Car Fitness Book*. N.p.: ADECA, 1984.

Alabama Power Company. *Energy Bulletin*. (Periodical.)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc *ASHRAE Handbook. 1985 Fundamentals*. New York: Author, 1985.

Dorf, R. C. *The Energy Factbook*. New York. McGraw-Hill, 1981.

Fowler, J. M. *Energy and the Environment*. 2nd ed. New York McGraw-Hill, 1984.

Honeywell Corporation. *Energy Conservation With Comfort* N.p.: Author, 1979.

Mass S., ed. *Factbook of Electric Food Service Equipment* 34th ed N.p.: n p., 1977.

Shurcliff, W.A. *Thermal Shutters and Shades*. Andover, MA: Brick House, 1980.

TEST YOUR ENERGY 1.0.

Answer each question below (True or False) and rate yourself on your knowledge of energy use and abuse in the home and on the road

50 to 45 correct answers	High Energy I.Q.
44 to 40 correct answers	Above-average Energy I.Q.

39 to 35 correct answers	Average; you need to learn more about energy conservation.
Fewer than 35 correct answers	Take the test again and study the answers, you're probably throwing money away needlessly.

Circle the letter of the correct answer.

T F 1. The United States uses more energy per person than any other nation in the world

T F 2. Tile United States produces 2/3 of the oil we consume.

T F 3. R-value means the resistance a material has to the flow of heat

T F 4. On cold winter days a roaring fire in the fireplace saves energy.

T F 5. In the afternoon you should keep the draperies closed on all west-facing windows to block out the hot sun

T F 6. Thermal-lined draperies and outdoor awnings can significantly reduce the energy required for air conditioning.

T F 7. A home that is dry during the winter must be kept warmer to be comfortable than one with a higher humidity level.

T F 8. Landscaping is important to home energy conservation.

T F 9. You can warm up your house faster by turning the thermostat higher than the desired temperature

T F 10. Weatherstripping doors and caulking windows can save up to 10 percent of home energy costs.

T F 11. There is no reason to ventilate the attic in the summer if it is well insulated.

T F 12. The furnace/air conditioner will run for longer periods of time when the air filter is dirty.

T F 13. The lower the temperature setting on your water heater, the less energy you will use.

T F 14. A frosty refrigerator uses less energy because frost acts as an insulator

T F 15. Food cooks faster in a covered pan.

T F 16. You don't have to preheat an oven for broiling or roasting

T F 17. On especially cold days **it** is a good idea to get a little extra heat into the

kitchen by turning on the oven and opening the oven door.

T F 18. It is usually less expensive to take a bath than a shower.

T F 19. It does not matter where the water heater is located in your home as long as it is in proper working order.

T F 20. The home heating and cooling system is the major residential user of energy

T F 21. Refrigerators operate best at **380** to **420** Fahrenheit

T F 22. The home freezer operates most efficiently when it is 1/2 to 2/3 full.

T F 23. Refrigerators are designed to accept frequent and lengthy door openings without increased operating costs.

T F 24. Small appliances such as toasters, electric skillets, and popcorn poppers generally use less energy for specific jobs than a range

T F 25. If the flame on your gas range is blue, it is not operating properly.

T F 26. Fluorescent and incandescent lights of the same wattage produce the same amount of light.

T F 27. Clean surfaces on reflector pans increase the energy efficiency of a range.

T F 28. Put frozen foods directly into the oven. There is no reason to defrost them beforehand

T F 29. By using cold and warm—rather than hot—water in your washing machine, you will save energy and money.

T F 30. You will save energy by doing several small loads of wash rather than one large one.

T F 31. Dry as many clothes as possible in each load.

T F 32. Permanent press garments save energy.

T F 33. A clean dryer filter saves energy by allowing the dryer to operate at a higher temperature.

T F 34. You can save up to 1/3 of your dishwasher operating costs by allowing the dishes to air dry rather than go through the dry cycle.

T F 35. Trash compactors and waste disposers use a great deal of energy and are not economically feasible

T F 36. Always remember to use warm water when running the garbage disposal.

T F 37. An iron consumes little energy.

T F 38. About 1/3 of all private automobile mileage is for commuting to and from work.

T F 39 Driving faster uses less energy because operating time is reduced.

T F 40. Always top off your gas tank when filling up your car.

T F 41. On cold days, it saves gas to warm up your car for S to 10 minutes before driving.

T F 42. It takes less gas to restart an engine than to idle it for more than one minute.

T F 43. The less air in the tires, the less gasoline you will burn.

T F 44. There is no difference between steel-belted radials and other tires when it comes to gas mileage.

T F 45. The heavier the car, the more gas it uses.

T F 46. Keeping your car tuned up will increase gas mileage.

T F 47. An air-starved engine wastes gasoline.

T F 48. The old 55-mph national speed limit was imposed during the oil embargo to help conserve fuel; higher speeds use significantly more fuel.

T F 49. The most efficient way mobile home owners can reduce heating/cooling costs is to install underpinning.

T F 50. Insulating your electric water heater will reduce your utility bill.

ANSWERS

1. TRUE The U S uses more energy per person than any other nation in the world. Although we comprise only about 6 percent of the world's population, we use 36 percent of all energy consumed in the world, and that figure continues to rise.

2. FALSE. The U S does not produce 2/3 of the oil we consume. We must import about half of the oil we use

3. TRUE. R-value does mean the resistance a material has to the flow of heat. The higher the R-value, the better the insulating capability of the material

4. FALSE A fireplace can cost you energy, as fireplaces are often sources of heat loss. When the heating system is on, a considerable amount of heated air goes up the chimney.

5. TRUE and FALSE The energy savings gained by keeping the draperies closed on the west-facing windows depends on the time of year. This is true in the summer, but false in the winter In summer, keep the draperies closed to block out the hot sun. In winter, keep them open and let the sun into the room for extra heat.

6. TRUE. Thermal-lined draperies and outdoor awnings block the hot sun and keep your home cooler.

7. TRUE A home will seem more comfortable if the humidity level is higher. A humidifying device not only increases comfort but helps save energy as well.

8. TRUE. Landscaping can affect home energy consumption. A lawn reduces reflective heat in summer. Trees that shed their leaves can provide shade in summer and allow warming sunlight to reach the house in winter.

9. FALSE. Your house will not warm up faster by setting the thermostat higher than the desired temperature. Set it at the proper temperature, and it will heat (or cool) your home just as quickly without wasting energy.

10. TRUE. Weatherstripping and caulking can save up to 10 percent of home energy costs.

11. FALSE Insulation can trap hot air in the attic. Ventilating the trapped air will make the house stay cooler, and you'll use less energy.

12. TRUE. A dirty air filter will cause your furnace/air conditioner to run for longer periods of time. Check the air filter about once a month because a dirty filter restricts the flow of air.

13. TRUE. The lower the temperature on your water heater, the less energy you will use. You can regulate the temperature of your water heater with the thermostat. The higher the setting, the higher your energy bill. Check the setting on your water heater.

14. FALSE A frosty refrigerator uses more energy than a defrosted refrigerator. Frost

makes the refrigerator work harder to remove warm air. Never let frost accumulate to more than 1/4 of an inch.

15. TRUE. Food cooks faster in a covered pan. The kitchen will stay cooler as well. Turn the heat off a few minutes before the food is completely cooked. Retained heat will complete the cooking

16. TRUE. You do not have to preheat an oven for broiling or roasting In addition, any food that cooks for more than one hour does not require a preheated oven

17. FALSE. Using your oven is a very costly way to heat your kitchen

18. FALSE. It takes twice as much hot water for a deep bath than for the average shower This can increase your energy bill because heating water accounts for as much as 20 percent of home energy expenses.

19. FALSE. Place the water heater as close as possible to areas where hot water is needed The longer the pipes, the greater the heat loss If hot water pipes are exposed, it is a good idea to insulate them Insulated pipes keep the water warmer.

20. TRUE. Heating and cooling systems are the major residential users of energy, home heating and cooling can represent as much as 70 percent of your home energy bill

21. TRUE. Refrigerators operate best at 38~ to 420 Fahrenheit, while freezers operate best at 00 Fahrenheit. Lower settings are unnecessary and waste energy.

22. FALSE The home freezer is most efficient when filled to capacity.

23. FALSE It costs money and energy every time a refrigerator door is opened

24. TRUE. Small appliances often use less energy than a range They are designed to do specific jobs, making cooking easier and usually quicker

25. FALSE. If the flame on your gas range is blue, it is operating correctly lf the flame has traces of yellow, the burners have become clogged and should be cleaned

26. FALSE. Fluorescent and incandescent bulbs of the same wattage do not produce the same amount of light. Fluorescent lights produce 3-1/2 times more light than incandescent bulbs of the same wattage

27. TRUE. Clean, reflective surfaces increase efficiency. Also, if your oven is self-cleaning, wait until after you have used the oven and less energy will be required for the cleaning process.

28. FALSE. Putting frozen food directly into the oven means the food will require more cooking time Plan ahead and thaw frozen food in your refrigerator before cooking it

29. TRUE. Much of the energy used in doing your family wash goes to heat the water Using cold water as often as possible should decrease your energy bill

30. FALSE. A large-capacity washer saves energy by handling in one load what a small washer must do in two loads

31. FALSE. Do not dry as many clothes as possible in each load You should sort the clothes by thickness before you place them in the dryer. It takes a longer cycle for slow-drying items.

32. TRUE. Be sure to take permanent press garments out of the dryer as soon as the cycle is complete. You probably will not have to spend energy ironing them.

33. FALSE A clean filter saves energy and money by allowing a high rate of flow of clean hot air and reducing drying time.

34. TRUE Turning off the dishwasher after the rinse cycle is complete or using the overnight dry setting can save you 1/3 of dishwasher operating costs

35. FALSE Trash compactors and waste disposers consume relatively small amounts of energy.

36. FALSE. Use cold water when running the garbage disposal. It is designed to work with cold water, and since hot water is a prime user (20 percent) of residential energy, this will save energy and money

37. FALSE A hand iron consumes as much energy as ten 100-watt light bulbs Permanent press items save ironing time Iron large batches of clothing at one time to avoid wasting energy reheating the iron.

38. TRUE. Join a carpool

39. FALSE The faster you drive, the more gasoline you burn

40. FALSE. When filling your car, remove the nozzle as soon as it cuts off and avoid possible spillage

41. FALSE. The best way to warm up a car is to drive slowly until the engine reaches proper operating temperature

42. TRUE Safety and theft considerations aside, it takes less fuel to restart than to let a car idle for a minute or more

43. FALSE Check air pressure in your tires regularly Under-inflated tires increase gas consumption

44. FALSE. Properly inflated steel-belted radials give better mileage and last longer.

45. TRUE The lighter the car, the less gas it uses Always remove unnecessary weight from the car.

46. TRUE. A car that is properly tuned will get better mileage The more smoothly your

engine runs, the less energy it will require to operate

47. TRUE. An air-starved engine will waste gasoline Keep the air filter clean and your mileage should increase

48. TRUE. The 55-mph national speed limit was imposed to conserve gasoline

49. TRUE. Underpinning, or a "skirt," is the most accessible and practical method of reducing heat flow for mobile homes.

50. TRUE. An investment of about $15 to insulate your electric water heater probably will pay you back in about 12 months

GROUP 1

Energy Savings In Heating And Cooling

Experience has shown that the most cost-effective and sensible approach to today's energy situation is energy conservation. Each of us must realize that we cannot continue consuming energy at the present rate. We must look for ways to decrease our use of energy.

Heating and cooling our homes accounts for most of our residential energy costs. The purpose of these activities is to discover some important ways to decrease the consumption of energy in our homes.

Your group is to complete the following six activities and then develop a presentation to be given to the rest of the class.

First, you will want to meet as a group to discuss your assignment and to decide who will be responsible for which activities. For example, if there are six people in the group you may decide to each choose one of the six activities Once each person has completed his/her assignment, you will want to meet again as a group to discuss your findings and prepare your group's presentation for the class

Activity 1: The Effect Of Closing Doors

The purpose of this activity is to determine whether or not energy can be conserved by closing doors to unoccupied rooms. You will need a thermometer and the chart below for recording data Record data for several rooms, such as bedrooms, bathrooms, and so forth. Measure the temperature at a spot in the middle of each room.

Room Temperature Chart

Room	Temperature With Door Open	Temperature With Door Closed

Choose

A. A time when you can leave your home's heating system set at a constant temperature for several hours.

B. A time when weather and/or sun conditions are fairly constant so they will not invalidate your data. For example, after dark is a good time. If you start with doors closed, wait at least 2 hours before recording the temperature with doors open. What can you conclude about closing doors to unoccupied rooms and energy conservation? If you have air intake vents, do you think opening or closing them would make a difference?

_____

_____

_____

Activity 2 The Effect Of Fireplace Damper Position

The purpose of this activity is to determine whether or not energy is conserved by keeping a fireplace damper closed. You will need access to a fireplace damper, a watch, and the chart below for recording data. Start by opening the damper in your fireplace. Then record the times when the heating system starts and stops. Do this for at least one hour. Close the damper and wait one hour. This gives the house temperature time to stabilize. Record the information again. Does the heating system run more with the damper closed or open? Remember not to

(1) change the thermostat while the experiment is in progress, or (2) choose a time to conduct the experiment when sunshine or weather changes will invalidate your data

Damper Chart

DAMPER OPEN		DAMPER CLOSED	
Starting Time	**Stopping Time**	**Starting Time**	**Stopping Time**
TOTAL ON TIME (min) =		TOTAL ON TIME (min) =	

Activity 3 The Effect Of The Fireplace On Home Heating

The purpose of this activity is to determine whether or not energy can be conserved by building a fire in the fireplace while the heating system is operating. You will need access to an open fireplace, a watch, and the chart below for recording data. Leave the thermostat for the home's heating system set on a constant temperature during the experiment. With no fire in the fireplace, record the time on your watch each time the heating system turns on and off. Then, using all safety precautions, build a fire in the fireplace. CAUTION: **Have a parent or someone who is experienced assist you.** Record the data. Does the heating system run more with or without the fire?

Fireplace Chart

DAMPER OPEN		DAMPER CLOSED	
Time Heating System Starts	Time System Stops	Time Heating System Starts	Time System Stops
No. of Times Heating System Started:_____ Total Minutes System Ran:_____		No of Times Heating System Started:_____ Total Minutes System Ran:_____	

Activity 4: Comparing Different Home Heating Systems

The purpose of this activity is to determine how much energy is used by home heating systems. You will need the chart below and transportation to stores or outlets carrying heating systems such as furnaces and heat pumps. Go on a "shopping spree" to several different stores or outlets that carry heating systems. Record the data on the chart below, or organize a chart that will better fit the data you accumulate. (Note: If transportation is not available, try to collect the information by telephone.)

Heating System Chart

Brand	Initial cost	Capacity (btu/hr)	Estimated annual fuel consumption

How does the efficiency of one system compare to another? What are some noteworthy advantages or disadvantages of each for consumers?

Activity 5: Comparing Window And Wall Heat Loss

The purpose of this activity is to determine how glass compares to wall materials in conserving energy. You will need a thermometer. the chart below for recording data, and access to windows on the north, south, east, and west sides of a home Start by measuring the temperature of the inside glass (put the thermometer directly on the glass) of 4 windows, one each on the north, south, east, and west sides of the house. Then measure the temperature of a spot on the north, south, east, and west walls which is at least 3 feet away in all directions from a door or window. Measure the temperature at each of the corresponding spots on the OUTSIDE walls and windows. Record all data

Window vs. Wall Chart

Inside Window	Temp (^{o}F)	Outside Window	Temp (^{o}F)
North		North	
South		South	
East		East	
West		West	

Inside Wall	Temp (^{o}F)	Outside Wall	Temp (^{o}F)
North		North	
South		South	
East		East	
West		West	

Which material (wall or window) has the greatest variation in temperature from inside to outside? Does compass direction have any effect? If you were designing an energy-efficient home, how would you apply this data?

Activity 6: Window Insulation Survey

The purpose of this activity is to determine the energy-conserving properties of different window coverings. Pretend you own your home and are just moving in. You are in the process of choosing coverings for all your windows Of course you want them to look good, but you are also concerned with whether or not they will affect energy consumption. You will need the chart below to record data and transportation to stores or outlets that sell window coverings. (You may need to design another chart that better fits the data you accumulate.) Go on a "shopping spree" to several different stores. Tell the shop attendants about your assignment and ask if they have information on heat loss for fabrics or other window coverings that they sell. (Note: If transportation is not available, try to collect the information by telephone)

Window Covering Chart

Kind	Cost	Heat loss(btu/hr)	Other Info

HOT WATER ENERGY SAVINGS

Experience has shown that the most cost-effective and sensible approach to today's energy situation is energy conservation. Each of us must realize that we cannot continue consuming energy at the present rate. We must look for ways to decrease our use of energy. Perhaps more than any other area of energy conservation, our daily routine habits (e g., the length of time we spend in the shower) affect energy consumption in the amount of hot water we use.

In these activities, you will explore ways to decrease hot water consumption by changing habits and being informed consumers. Your group is to complete the following six activities and then develop a presentation to be given to the rest of the class. Your presentation should

be based on the data you collect during completion of the activities. First, you will meet as a group to discuss your assignment and to decide who will be responsible for which activities. For example, if there are six people in the group you may decide to each choose one of the six activities. Once each person has completed the assignment, you will meet again as a group to discuss your findings and prepare your presentation for the class.

Activity 1: Hot Water Loss From Leaking Faucets

The purpose of this activity is to determine how much water is wasted by leaking faucets. You will need a faucet over a sink, a measuring cup, a watch with a second hand, and the chart below. First, turn the faucet on just enough to get one drop every second. Place the measuring cup under the faucet. Record the time. Then record the time when the cup is full. Repeat the procedure for 2 drops per second and 3 drops per second. Calculate how much water would be wasted in a day, a month, and a year for each drop situation.

Water Loss Chart

Drops! Second	Start time	End time	Total time	Water wasted daily (cups)	Water wasted daily* (gal)	Water wasted monthly (gal)	Water wasted yearly (gal)
1							
2							
3							

*Conversion Factor: 1 gallon = 16 cups

Activity 2: Washing Dishes In Warm Vs Hot Water

The purpose of this activity is to determine whether warm water cleans dishes as well as hot water. The assumption behind this experiment is that, **if** we cleaned more household items with warm water rather than hot water, we could save energy. You will need several soiled dishes or pots, dishwashing detergent, and hot and cold water. Choose dishes soiled with different kinds of food. For example, choose two dishes with bacon grease, two dishes with sugary juices, two dishes with melted cheese, or pairs of dishes with other foods. Clean one dish of each pair in hot water and one in warm water. Keep everything the same except for the temperature of the water, that is, use the same amount of detergent and scrub for the same amount of time. Dishes must be washed one at a time to avoid unequal soaking time. Record which dish of each pair was cleaned satisfactorily and which dish was not. What are your conclusions about cleaning with warm water? Is warm water acceptable for some, all, or no situations? What if you were cleaning bathtubs, tile, or basins instead of dishes?

Dish Cleaning Chart

Mark an X in the appropriate columns

Dishes Soiled With:	Hot Water		Warm Water		Comments
	Clean	Not Clean	Clean	Not Clean	

Activity 3 Boiling With Or Without Covering Pan

The purpose of this activity is to determine how much heating time can be saved boiling water with a lid on the pan. The assumption is that if we can find ways to reduce the time a stove stays on during cooking, we can conserve energy. You will need a stove, a pot with a see-through lid, a measuring cup, a watch with a second hand, and the chart below. Since you will be boiling water and need to watch the kettle, you may want to ask a friend or family member to stand by while you observe the boiling. First, put one cup of water in the pot Turn the stove on high and record the time on your watch. Then record the time when the water starts boiling rapidly. Let the pot and stove cool to room temperature. Repeat this procedure with the lid on the pot. Is boiling time more, less, or the same with and without a lid? What can you conclude about people who are in the habit of cooking with lids?

Water Boiling Chart

Pot	Time Stove Turned On	Time Rapid Boiling Begins	Total Time (Min)
With Lid			
Without Lid			

Activity 4: Taking Baths vs. Showers

The purpose of this activity is to compare the amount of water used taking a bath with that used taking a shower. You will need adhesive tape, an empty 2-liter plastic container, a tub/shower, and the chart below. Start by calibrating the tub. To do this, pour exactly 20 liters of water into the tub. Mark the water level with a piece of good quality adhesive tape. Pour in 20 more liters and mark the 40-liter water level with tape. Repeat until the tub is nearly full. Once the tub is calibrated, drain the water in the tub to a comfortable depth. Record the depth of the water. On the next day, take a shower with the tub plugged Take a adequate amount of

time to clean your body thoroughly. Record the depth of the water. If possible, repeat the shower procedure for several days, or get other family members to collect data for you. What can you conclude about the amount of water you and your family use in bathing/showering?

Bath/Shower Chart

Date	Bath (liters)	Shower (liters)

Activity 5: Heat Loss From Long Hot Water Pipes

The purpose of this activity is to show that heat is lost when water travels from the home's water heater through pipes to a faucet or other outlet. The assumption behind this activity is that more energy is lost when the pipe length between the water heater and the faucets is longer. You will need a home with several faucets, a metal stem thermometer, a watch, and the chart below. First, locate your home's water heater. Draw a sketch of your house plan and locate the heater and all faucets on the plan. Go to the faucets one at a time, turning on the hot water and waiting for it to become its hottest (note the time you turn on the faucet and the time the water reached its hottest temperature). When the water is the hottest it can be, measure the temperature of the water and record your data on the chart.

Hot Water Pipe Chart

Water heater temperature is set on _____ ^{o}F

Faucet locations	Warmest water temperature	Time to reach warmest temperature (min)

Activity 6: Washing Clothes in Cold vs. Hot Water

The purpose of this activity is to compare clothes cleaned in hot and cold water. The assumption is that if more clothes can be cleaned in cold water, then energy used to heat washing water can be conserved. You will need several clean white rags, a permanent marker or laundry pen, access to a washer, and the chart below. First, stain two rags each with dirt, grease, fruit juice, tomato sauce, or other common laundry stains. Do not put more than one kind of stain on one rag. Mark with a permanent marker what kind of stain you put on each rag. Divide the rags into two loads (one rag of each stain in each load), then wash one load in cold water and one load in hot water. Use the same amount and kind of detergent for both loads. Compare which stains are cleaned in each load. What can you conclude about how well particular stains come out in hot or cold water? Is hot water necessary for cleaning all, some, or none of the stains?

Stain Removal Chart

Record each type of stain. Mark an X to indicate whether it was cleaned or not cleaned.

	Hot Water		Cold Water	
Stain	Cleaned	Not Cleaned	Cleaned	Not Cleaned

Group 3

LIGHTING AND APPLIANCE ENERGY SAVINGS

Experience has shown the most cost-effective and sensible approach to today's energy situation is energy conservation. Each of us must realize that we cannot continue consuming energy at the present rate. We must look for ways to decrease our use of energy.

It is easy to use more light than you need. More than 10 percent of the electricity we use in our homes goes into lighting.

The purpose of these activities is to discover ways to decrease the consumption of energy when lighting and using appliances in our homes.

Your group is to complete the following six activities and then develop a presentation to be given to the rest of the class. Your presentation should be based on the data you collect during the completion of these activities. First, you will meet as a group to discuss your assignment and to decide who will be responsible for which activities. For example, if there are six people in your group, you may decide to each choose one of the six activities. Once each person has completed his/her assignment, you will meet again as a group to discuss your findings and prepare your presentation for the class.

Activity 1: How Many Watts For Seeing?

The purpose of this activity is to discover how much lighting wattage is necessary for activities such as sewing, reading, and other daily routines. The assumption behind this experiment is that if we used light bulbs with appropriate wattage, we could save the energy wasted on unnecessary lighting. You will need a lamp next to a comfortable chair in a dark room, several bulbs with different wattages (for example, 25 watts, 40 watts, 60 watts, 75 watts, 100 watts); a book to read, something to write with, or a sewing project; a watch; and the chart below for recording data.

Start by putting the largest wattage bulb in the lamp. CAUTION: Unplug the lamp each time you change the bulb, and allow the bulb to cool before you touch It. Sit in the chair and spend 5 minutes working on your project. Record on the chart how well you were able to work on it. For example, did you experience glare? Did it seem difficult to work? Was it too dark? If you are sewing or writing, you may choose to mark the work done under different wattages so that you can compare the work quality later. Then, change the bulb (in descending order of wattage) and work 5 minutes under each bulb (allow your eyes to adjust to the change in lighting before beginning each step). Record your data each time.

NOTE: The room should be dark other than the light from your lamp. Do not change the lamp position. Which wattage was best for your project? What was the minimum wattage necessary to do satisfactory work[7] Can you draw conclusions about how much light you waste or do not waste in your daily routine[7] What other factors affected the quality of your work?

Project Lighting Chart

Wattage	Comments	Rate your work quality (1 = worst, 5 = best)
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5

Activity 2: Comparing Energy Use Of Appliance Brands

The purpose of this activity is to determine which appliances on the market consume more energy than others. You will need the chart below and transportation to stores or outlets carrying kitchen appliances Choose four or more appliances (e.g., toaster, microwave, mixer, blender) for your investigation. Go on a "shopping spree' to several different stores. Tell the shop attendants about your assignment and ask if they have information on the energy efficiency of appliances they sell. Record the data you find. You may decide to design a better chart for organizing your data.

Appliance Chart

Appliance	Brand	Cost	Watts*	Volts	Amps*

*W = V x A; determine watts by multiplying volts times amps.

What appliance(s) would you choose to purchase? Why? What other factors besides energy efficiency affected your decision?

Student Sheet Activity 3: How Lighting Diminishes With Distance

The purpose of this activity is to determine to what degree the distance a light is away from a work site affects our ability to do satisfactory work. Although sharp differences in lighting intensity should be avoided, the use of "task lighting" (i.e., light focused on the work at hand rather than uniformly bright room lighting) can reduce energy consumption. You will need a stable standing lamp with a 60-watt bulb, a 20-foot extension cord, a comfortable chair, a watch, a yardstick, a project to do (such as a book to read, something to write, or a sewing project), and the chart below for recording data.

Start by turning all other lights in the area off. Put the lamp next to your chair. Sit and work on your project for 5 minutes. Record on the chart how well you were able to work on your project. For example, if it seemed difficult to work, was it too dark? (If you are sewing or writing, you may choose to mark the work done during each 5 minutes of work so that you can compare the work quality later.) Then move the lamp 5 feet away from you (allow your eyes to adjust to the change in lighting before beginning each step). Repeat the experiment. Do this for 10, 15, and 20 feet away. Work for 5 minutes and record your data each time. At which distance could you see your work the best? What was the maximum distance at which you could do satisfactory work? What other factors affected the quality of your work?

Distance Lighting Chart

Lamp distance (feet)	Comments	Rate your work quality (1 = worst, 5 = best)
0		1 2 3 4 5
5		1 2 3 4 5
10		1 2 3 4 5
15		1 2 3 4 5
20		1 2 3 4 5

How can one conserve energy in terms of lighting?

Can quality work be done with only a few lights on?

Activity 4: Light Source Effectiveness

The purpose is to research the efficiency of different kinds of light. You will need the chart below and transportation to several different lighting outlets. Go on a "shopping spree." Tell the shop attendants about your assignment and ask if they have information on the efficiency of different kinds of lights sold at their stores. You will be looking specifically for lumens per watt. Record the data you find. Find data for the kinds of light listed below as well as other kinds you may discover (Note If transportation is not available, try to collect the information by telephone)

Kinds Of Lighting Chart

Kind of Light	**Lumens/Watt**	**Comments**
Incandescent		
Fluorescent		
Mercury Vapor		
Sodium Vapor		

What kind of lighting would you choose to install if you were building your own home, installing streetlights, building an office building, or filming a movie?

Which kind of lighting s most energy-efficient, and why?

Activity 5: Schoolroom Lighting Survey

The purpose of this activity is to determine if your school is effectively conserving energy in lighting. You will need the chart below Contact your school custodian and ask to set up an appointment with him/her to help you do an inventory of the lighting in your school. Then choose a classroom or two, a parking lot, the office, and the cafeteria or auditorium in which to collect data. It is not necessary to inventory EVERY room in your school. Then go with the custodian to each room or area you have chosen and inventory the lighting using the chart below. Be sure to determine the room size of each room used for data. Also, try to determine if energy-efficient bulbs are used and whether some of the lights in a room can be turned off while others are left on.

School Lighting Chart

Room	Number of Bulbs	Kind of Bulbs	Watts	Number of light switches

In each room ask the following questions: How is lighting controlled? For example, can you turn only half the lights on at one time, or can the lights nearest the window be turned off? What recommendations can you make to increase lighting efficiency at your school?

Activity 6: Home Light And Appliance Survey

The purpose of this activity is to determine if your home lighting and appliances are

conserving energy. Inventory the wattages of all easily accessible lights and appliances. Most appliances have the wattage noted on a sticker or etching. Do not try to move large appliances. If no wattage is given on an appliance, see if its voltage and amperage are given. In most cases, you can compute the wattage by multiplying the number of volts (e.g., 120) by the number of amps Record all the data. CAUTION: Do not work around electricity with wet shoes or hands You do not need to include all the lighting and appliances in order to determine whether energy is conserved in your home.

Home Appliance And Lighting Chart

Appliance	Wattage	Estimated hours used/year

Did you find lights that were turned on but not being used? Could a light bulb of smaller wattage be used in any location? Did you find any unattended appliances turned on (e.g., radios, televisions, and fans)? Are dishwashers, clothes washers, and dryers used only when there are full loads to wash or dry? Do you think your family could save energy and money by improving their conservation of energy?

GROUP 4

Automobile Savings

Experience has shown that the most cost-effective and sensible approach to today's energy situation is energy conservation. Each of us must realize that we cannot continue consuming energy at the present rate. We must look for ways to decrease our use of energy

There are more than 100 million registered automobiles in the United States. A typical car, with an average fuel economy of about 15 miles per gallon, travels about 10,000 miles each year and uses over 650 gallons of gasoline. This means that private automobiles consume

some 70 billion gallons of gasoline each year. The importance of gasoline conservation by individual drivers cannot be overemphasized.

The purpose of these activities is to discover some important ways to decrease energy consumption in transportation.

Your group is to complete the following six activities and then develop a presentation to be given to the rest of the class. Your presentation should be based on the data you collect during the completion of these activities. First, you will meet as a group to discuss your assignment and decide who will be responsible for which activities. For example, if there are six people in your group, you may decide to each choose one of the six activities. Once each person has completed his/her assignment, you will meet again as a group to discuss your findings and prepare your presentation for the class.

Activity 1: Comparing Gas Mileage

The purpose of this activity is to compare the fuel efficiencies of automobiles on the market today. You will need transportation to car sale lots and the chart below. Choose 3 types of cars, for example, examine large luxury cars, medium size family station wagons, and small sports cars. Some other types might be mini-vans, full-size trucks, or small-size trucks. Visit several car sale lots and collect information on several makes and models within your 3 categories. Record all data. Create a better chart for organizing your data if necessary (Note: If transportation is not available, try to collect the information by telephone.).

Automobile Chart

Lot	Make	Model	Gas mileage	Cost	Fuel cost per year

Which car is most energy-efficient? What other factors would you consider in buying a car? Which car would you like to buy if you could, and why?

Activity 2: Fuel Per Passenger Mile

The purpose of this activity is to become aware of alternative types of transportation and how much fuel is consumed by each. You will need a telephone and the chart below. Calculate the gas (or energy) used per person if he/she goes the same distance by bus, car, motorcycle, airplane, bicycle, and other forms of transportation. To do this, call your local public service bus office or school bus garage and ask how big the average bus tank is, how many people can ride on a full bus, and the average gas mileage of a bus. Call the maintenance division at an airport to get similar information for an airplane. Call shops or use your own information sources to get data on cars, motorcycles, and other vehicles. Record all the data in the chart.

Transportation Chart

Form of Transportation	Gas/mile/person	Other

Which form of transportation is most energy-efficient? What other factors must you consider in choosing transportation? Which form of transportation do you choose most often, and why?

Activity 3. Tire Brand/Type Survey

The purpose of this activity is to discover information about the cost-efficiency of tires. You will need transportation to several tire outlets and the chart below. Choose a car make and model. It can be your own car, the family car, or a car you wish you had. Visit several tire outlets Talk to the shop attendants and tell them about your assignment Collect information on which tire would be the most energy-efficient for your car and why. Record all the data. Create a better chart for organizing your data **if** necessary (Note: If transportation is not available, try to collect the information by telephone.).

Tire Chart

Car Make and Model:_____

Tire Make	Shop	Tire Mileage	Cost	Cost Per Mile

Which tire would you choose to buy for your car, and why? Which tire gives you more per cost? Would different models of cars be more energy-efficient with different tires?

_____

_____

_____

_____

_____

Activity 4: Tire Air Pressure Effects

The purpose of this activity is to determine **if** tire air pressure affects the gas mileage of a car You will need a car, its owner's manual, and the chart below. First, check the tire pressure (or have someone check for you). Record the pressure and the mileage on the odometer. Fill the tank and record the number of gallons put in the tank. When the car has been driven 50 miles, refill the tank Calculate the gas mileage Then check the owner's manual for the maximum load pressure for the tires. Have the tires filled to that pressure and repeat the process above. Record the data.

Tire Pressure Chart

Tire pressure	Gas mileage

At which pressure did the car get the best gas mileage?_____

Activity 5: Car Weight Effects

The purpose of this activity is to determine if the weight of a car significantly affects gas mileage (mpg). You will need a car, something that weighs 300 pounds, and the chart below. First, record the mileage on the odometer and fill the tank. When the car has consumed 1/4 tank, record the mileage on the odometer again. Then, put 300 pounds in the back of the car. When the car has again consumed 1/4 tank of gas, record the mileage again Calculate the gas mileage with and without the 300-pound weight addition.

Car Weight Chart

Without Weight	With Weight
Mileage at start_____	Mileage at start
Mileage at end_____	Mileage at end
mpg_____	mpg

In which situation did the car travel further? Which situation was most energy-efficient? What does this say about large and small cars on the market today?

_____

_____

_____

_____

Activity 6: Planning Your Trips

The purpose of this activity is to determine if planning a route helps save energy. You will

need a map of your community, 4 friends or relatives who drive, and 4 copies of the chart below. Choose 5 points of destination on a map. The points could be stores or street corners or homes. Then ask your 4 friends separately to visit the 5 destinations. Ask them to record how many miles they drive between spots. Ask two of them to plan their routes, using maps. Don't ask the other two to do anything special. Collect the charts after they have completed the route

Mileage Chart

Name: _____

Mileage at start	=	_____
Mileage At First Stop	=	_____
Second Stop	=	_____
Third stop	=	_____
Fourth stop	=	_____
Fifth stop	=	_____
Total Mileage	=	_____

Which person traveled the fewest miles in completing the course? Why? Was it one of the drivers who planned their routes?

_____

_____

_____

_____

_____

_____

GROUP 5 (OPTIONAL)

Commercial and Industrial Energy Conservation

Experience has shown that the most cost-effective and sensible approach to today's energy situation is energy conservation. Each of us must realize we cannot continue consuming energy at the present rate. We must look for ways to decrease our use of energy. Commercial ventures and industrial plants, faced with rising energy costs and mindful of the corporate balance sheet, must find ways to use energy more effectively. The purpose of these activities is to discover how commerce and industry are billed for energy use, how large these bills can be, and how they can be reduced.

Your group is to complete the following six activities and then develop a presentation to be

given to the rest of your class. Your presentation should be based on the data you collected during completion of these activities. First, you will meet as a group to discuss your assignment and to decide who will be responsible for which activities. For example, **if** there are six people in your group, you may decide to each choose one of the six activities (NOTE The people who are to do Activities 1 and 2 should go together to meet with a utility company representative.). Once each person has completed his/her assignment, you will meet again as a group to discuss your findings and to prepare your presentation.

Activity 1: Find Out About Your Local Utility

You will need to work closely with the person(s) doing Activity 2. The purpose of this activity is to discover what energy resources are used to supply power to your local homes, school, and businesses. For example, in the early 1980s approximately 57 percent of the nation's electricity was produced using coal as a primary energy resource; 4 percent using petroleum; 12 percent using natural gas; 16 percent using nuclear energy; 11 percent using hydroelectric resources; and less than 1 percent using geothermal energy, waste, wood, and other resources.

You need to find out what kinds and percentages of energy resources were used to produce the power your local utility distributed. To do this, **it** is suggested that you telephone the manager's office at your local utility company, briefly describe this assignment, and request an opportunity to meet with a utility company representative who can provide information to you. Copies of the annual reports of your local utility and of their supplier(s) may be helpful.

Try to determine the answers to the following questions.

A. Has the prime energy resource for power generation changed in the past 10 years? If so, from what to what has it changed? What are the reasons for the change?

B. Can the utility company give you forecasts of future power sales which will allow you to draw a graph? How do they propose to supply increased power requirements? What prediction do they make about future rate increases?

C. Write a two-page summary giving your reactions to the interview and your degree of confidence that the utility company can supply future power needs.

D. If you were buying a house, would **it** be an all-electric home?

Activity 2: Demand Charges And How To Reduce Them

You will need to work closely with the person(s) doing Activity 1. The purpose of this activity is to discover how the billing of commercial and industrial customers differs from residential billing and whether 'demand charges" and "time of day rates" are used by your utility company. You need to become familiar with the "demand charge" concept so that you can explain it to your class. To do this, it is suggested that you (or a classmate) call the manager's office at your local utility company, briefly describe your assignment, and request an opportunity to meet with a utility company representative who can provide information to you.

Residences are usually charged only for the amount of power consumed, i.e. how many kilowatthours are used during the billing period. Commercial and industrial accounts are usually charged not only for how much power they use but also for the maximum amount of power they draw at any one instant during a pre-set twelve month period (i.e., the maximum number of kilowatts they need at any one time). This is a demand charge; it reflects the commercial or industrial customer's share of the utility's investment in power-generating capacity. For example, an aluminum products manufacturer would have a higher demand charge than an office supply company.

Try to determine the answers to the following questions:

A. Does your local utility make a demand charge for commercial and industrial customers? What is a demand charge? How is it calculated?

B. Energy management can lower energy costs for commerce and industry. One way is to use fewer kilowatthours. Another way is to lower the demand and, therefore, the demand charge. Large motors, for example, use more current when they are started. If large motors are turned on in stages, a sharp spike in required power can be avoided and, in time, demand charges can be reduced. Ask the utility company representative whether energy management surveys are offered to their local commercial and industrial customers. Ask what recommendations are most often made in order to reduce demand charges.

C. Ask the representative whether or not time of day rates have been considered by the utility company. These would give customers lower utility rates for power used during off-peak times of day.

D. Write a two-page summary of your findings and your reactions to the utility company visit. Does the company office building reflect good energy conservation practices?

Activity 3: Your School's Bills And Energy Management

Commercial and industrial customers are often charged not only for the energy they use, but also for the maximum amount of power they draw (demand). The purpose of this activity is to discover how your school is billed for electricity and what kinds of energy conservation measures are routinely taken. Find out if your school gets a utility bill and whether it is billed not only for the total kilowatthours of electricity consumed but also for the maximum kilowatts required at any one time during a pre-set time period. Set up an interview with the school system energy management specialist or the physical plant director and discuss what measures have been taken to reduce energy use and demand requirements.

During the interview, find out the answers to these questions:

A. Do the schools have higher utility bills in winter or in spring? What fuel is used most for school heating?

B. Is certain equipment operated intermittently to reduce maximum power requirements? For example, if there is air conditioning, are all the units turned on at one time?

C. How is water heated for washing and showers? Is the water heater on a time clock, and is it usually off on weekends? Would it be possible to heat water only at night when most other equipment (e g., lighting) is off?

D. How is the school heated? If a boiler is used, find out what fuel is used (oil, coal, or natural gas) and how the boiler is maintained.

E. Think about the school's energy bills. Can you suggest ways in which they could be lowered?

Activity 4: Industry/Home Bill Comparison And Billing Units

The purpose of this activity is to get estimates of the costs of electricity to commercial and industrial companies and information about the energy units used for billing

A. Assume you operate a 50.000-square-foot clothing factory and that 60 percent of the space is used for manufacturing and office activities. In that portion of the plant, ceiling light fixtures are evenly spaced as follows: Four tube fluorescent fixtures light every 150 to 175 square feet at an energy use rate of approximately 5 watts per square foot. Calculate the number of kilowatthours used to light manufacturing/office space each month if the plant is running only one shift each day and there are 20 working days in a month.

B. Suppose you wanted to figure out how much the amount of light calculated above would cost the company. You would need to find out what the company pays for electric power. You may find that a company pays a somewhat lower rate per kilowatthour than your parents do. but that they pay a "demand charge." This is a charge for how much power is needed at any one instant and that reflects the amount of capital investment the utility must make to supply the company. It differs from the energy use charge (cents per kilowatthour) which both the company and your parents pay. Often, however, large commercial and industrial users of electricity are charged a lower rate when they use more electricity. As an example, assume that the company pays 3 9 cents per kilowatthour and, in addition, a demand charge of $600 per month. Ignoring any other charges and taxes, calculate the monthly cost of lighting the manufacturing/office space in task A by adding the demand charge to the energy use charge.

C. Natural gas utilities usually sell the gas by the hundred cubic feet or by the therm. A therm is equal to 100,000 Btu and is approximately equivalent in heating value (Btu) to that in a hundred cubic feet (usually abbreviated as CCF) of gas. The reason for this is that one cubic foot of natural gas has a heating value of approximately 1000 Btu. Call the billing department of your local gas utility and ask them what the heating value of their gas is. Also find out whether they charge by the therm or the CCF and how much each therm or CCF costs. Using the heating value given, compute the difference (in Btu) between a CCF and a therm.

D. Find out whether any of the schools in your school system heat with coal or oil, and find out what units are used in billing for those fuels Include this information in your remarks to the class about your findings.

Activity 5. Code Requirements and Their Energy Costs

The purpose of this activity is to discover how public buildings often have special health and safety code requirements which add to energy use Lighting standards have identified what lighting level is adequate for certain tasks. For example, normal office work such as reading or writing requires approximately 50 footcandles on the desk, whereas hallways need only 10 to 15 footcandles. Ventilation standards usually require at least 5 cubic feet of air flow per minute *per person* to circulate and filter the air in public areas Industrial operations often produce dust or fumes that must be exhausted directly to the outside. For example, school classrooms require about 10 to 15 cubic feet per minute (abbreviated CFM) of ventilation; public restrooms, 20 to 25, and kitchens, 35 CFM.

A. Study the lighting in your classroom. What is the total wattage of the lights used? How many square feet of space do you have in your classroom? Estimate how high the ceilings are. Are the walls painted in a light color? Are there windows in your classroom? Calculate the watts of power used for lighting per square foot of floor space in the room and report this to your class. Take a class survey about whether or not there is sufficient light to read and write. If the answer is no, someone from your school system or the local utility company needs to check the room with a light meter.

B. Are the windows in your room ever opened[7] If so, at what time of day is this usually done? How many doors are there which lead either to the outside or to the hall? Are they usually open or closed? Are there windows or louvers above the doors that can be or are usually open? Does the heating and cooling system vent air into the room? Take a class survey about adequate room ventilation. If air circulation seems inadequate, an air flow meter can be used to check the room's ventilation.

C. Assume that you operate a movie theater which has 20,000 square feet of floor space. The ceiling is 15 feet high. Calculate the number of minutes required to change the air, if 20 cubic feet per minute per person of ventilation is required and the seating capacity is 300 persons (For comparison, homes often experience one air change per hour.).

D. Take a field trip to the supermarket at which your family shops and estimate the total wattage of lighting. Count the number of freezer compartments, and check out the number of times the front doors open and close during a 5-minute period. Before you start, talk to the manager and ask him to give you an estimate of the monthly electric power bill.

Activity 6: Industrial Plant Energy Balance

The purpose of this activity is to investigate the energy flow into and out of a manufacturing plant.

A. Call the plant manager's office at a nearby manufacturing plant. Explain to the manager's secretary about this assignment and ask for the opportunity to visit and interview a plant representative who can help you discover what energy sources enter the plant and what products and waste energy, if any, come out. An example of energy waste might be dumping water used to cook food while it is still relatively hot. Another kind of waste would be metal

shavings that are not recycled.

B. Draw a diagram showing the energy inflow (e.g., electricity, oil, coal, wood, natural gas). Mark on your diagram the approximate use rate of each energy source. Add to your diagram the energy outflows (e.g., warm water, smoke or hot air, waste materials, and the finished product).

C. Find out how the plant is heated. (They may be using waste heat for that purpose.) Find out how they heat water and approximately how much they use.

D. Ask if they have an on-going energy management program and, if so, whether they have identified savings from the program.

E. Write a two-page report summarizing your findings and use it, with your diagram, in making your presentation to the class.