THE ELECTRIC HOOKUP

Objectives:
The student will do the following:

1. Determine the wattage of various household appliances.

2. Calculate the number of kilowatt-hours used by appliances.

3. Identify the need to limit the use of appliances to conserve energy.

4. Identify costs per kilowatt-hour (kWh) of appliances.

Subjects:
General Science
Physical Science

Time:
3 class periods (over 2 weeks)

Materials:
student sheets (included)

Background Information

A list of all the energy-using appliances and equipment in an average American home would show why it is estimated that a well-equipped home consumes as much as 35,000,000 British thermal units (BTU) of energy each year to operate. Considering that much of this energy is wasted, a great opportunity for energy conservation exists.

The first step toward conservation is to gain a better understanding of the energy consumption of each appliance or piece of equipment. An appliance's wattage is an indicator of how much electricity is used while operating the appliance. An appliance requiring 1,000 watts would use one kilowatt-hour of electricity during one hour of operation. For example, the average mixer uses 127 watts. This 127 watts divided by 1000 watts/kilowatt-hour of operation equals 0.127 kilowatt-hour. If the mixer is used for 6 minutes, 0.0127 kilowatt-hour of electricity has been used.

Procedure

1. Introduce the activity by sharing with the class the information in the background section above.

2. Distribute the student sheet "Wattage Ratings," included. Have the students bring in wattage ratings from various appliances around their homes. Ask each student to choose appliances that use different amounts of energy and that produce different kinds of energy from the electricity they use (e.g., heat, sound, or motion). Caution the students not to move large appliances by themselves to obtain wattage ratings. Have them seek permission and aid from parents to locate wattage rating information. (Check the owner's manuals before moving appliances.) Use appliances in the school as examples. Students may be assigned different equipment to ensure a wide range and thorough investigation of household appliances. Student sheet answers (in terms of kilowatt-hours of energy required) may be expanded to annual use by determining daily or weekly use and multiplying. If you prefer, use the student sheet "APPLIANCE ENERGY USE," included.

3. Distribute the student sheet "HOW TO READ YOUR METER," included.

   A. Tell the students to record daily meter readings at home for two weeks, and then to bring in an old utility bill along with the data they will have accumulated.

   B. Review the information recorded on their utility bills. Then, have each student calculate the charge per kilowatt-hour by dividing the energy charge by the number of kilowatt-hours used in his/her home for that month's bill. (Be sure to use only the energy charge; do not include other fees the utility may assess.) Typical residential rates in the Valley region average less than $0.06 per kWh.

   C. Have each student relate the amount spent on one month's electric bill to something that is pertinent to his/her own life. For example, students may relate the electric bill to car payments, the cost of music tapes, stereo equipment, schoolbooks, or athletic shoes. Solicit several examples from the class.

4. After completing the activities on the student sheets, distribute the student sheet "MAKING CHOICES" included. Are the students willing to change their habits and attitudes, and possibly their lifestyles, to conserve energy?

5. Continue with the follow-up below.

FOLLOW-UP

1. Discuss the negative feelings the students may have about conserving electrical energy. What are the negative aspects of conservation? (By now, the benefits should be obvious-saving money and resources.) Conservation often takes self-discipline, development of routine habits, imposing rules upon oneself, lifestyle changes, and changes in purchasing patterns. Oftentimes these things are not fun or easy for people to accept. What ways can the students think of to motivate themselves and others to conserve?

2. Discuss some practical ways in which students can improve energy conservation in their own homes. Ask, "In what area is your family conserving energy best?" (for example, turning off lights). Ask, "In what area is your family not conserving energy well?" (for example, leaving the TV on while no one is watching). Are any of the students' families involved in serious energy conservation efforts such as the use of solar water heaters, automatic timers on heating/cooling systems, high-efficiency appliances and/or lighting, or other innovative conservation methods? Can the students recommend effective conservation practices to their classmates?

Student Sheet

WATTAGE RATINGS

Check four different appliances for their wattage ratings. Using the conversion to kilowatt-hours(kWh) calculate the electricity usage for each appliance.

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

Appliance: _____

_____watts/1000 watts/kWh per hour of operation = _____ kWh

ELECTRICAL APPLIANCE ENERGY TABLE

Appliance Wattage Rating	Kilowatt-hours of Electricity Used per Hour	Ounces of Oil Burned per Hour	Ounces of Coal Burned per Hour
10	0.01	0.01	0.13
25	0.025	0.025	0.33
40	0.04	0.4	0.5
60	0.06	0.6	0.8
100	0.1	1	1.33
150	0.15	1.5	2
200	0.2	2	2.66
300	0.3	3	4
500	0.5	5	6.66
750	0.75	7.5	10
1000	1	10	13.33
1500	1.5	15	20
2000	2	20	26.66
5000	5	50	66.66
10000	10	100	133.33

Student Sheet
APPLIANCE ENERGY USE

Think about burning ten 100-watt light bulbs for one hour. That's the amount of electricity equivalent to one kilowatt-hour. Just as you pay for gallons of gas, quarts of milk, and loaves of bread, you pay for kilowatt-hours of electricity.

The chart below shows the average number of kilowatt-hours of electricity that various appliances use.* If you are interested in how much it costs to operate one of these appliances for a month or a year contact your local utilities company.

	Average kWh Used	
Kitchen Appliances	Anually	Average kWh Used Monthly
Range w/self-cleaning oven	1224	102
Range w/oven	1152	96
Microwave oven	300	25
Frying pan	190	16
Coffee maker	110	9
Toaster	40	3
Mixer	10	1
Food disposer	30	3
Dishwasher	1560**	130
	2160	180
Refrigerator/freezer 16-25 cu ft side-by-side model, automatic defrost		
Refrigerator/freezer 14 cu ft automatic defrost	1800	150
Refrigerator/freezer 14 cu ft manual defrost	1200	100
Refrigerator/freezer 17 cu ft, 2-door, high efficiency, automatic defrost	1200	100
Freezer, 15 cu ft automatic defrost	1200	150
Freezer, 15 cu ft manual defrost	1800	100
Laundry Appliances		
Clothes dryer	1000	83
Clothes washer	624**	52
Hand iron	150	13
Other Appliances		
Quick recovery water heater	5400***	450
Vacuum cleaner	50	4
Clock	18	2
Toothbrush	0.5	0.04

Student Sheet
APPLIANCE ENERGY USE
(continued)

	Average kWh Used	
Entertainment Appliances	Annually	Average kWh Used Monthly
Color TV	660	55
Tube Type	440	37
Solid State	440	37
B&W TV		
Tube Type	350	29
Solid State	120	10
Radio/phonograph	110	9
Comfort Appliances		
Electric furnace	13200*****	(Seasonal)
Heat pump	66000****	(Seasonal)
Air conditioner, Central, per ton	1500*****	(Seasonal)
Air conditioner, Room, one ton	1500	(Seasonal)
Dehumidifier	400	33
Electric Blanket	150	(Seasonal)
Attic fan	300	(Seasonal)
Ceiling fan	130	(Seasonal)

* These figures are averages and will vary depending on the user's habits and lifestyle
** Includes kWh for heating water used by appliance.
*** This value accounts for all hot water usage, including dish washing and clothes washing.
**** Heat only.
***** Based on 1,500 sq. ft house insulated to meet TVA standards for energy efficiency. If your house does not meet these standards it may use considerable more electricity during the heating and cooling seasons.

Student Sheet

HOW TO READ YOUR METER

In order to read an electric meter you must read from left to right. You must also determine which way the hands are turning on each dial.

Example:

The 1 is to the left side of the dial. This would indicate the hand is turning counter-clockwise.

Here the 1 is the right side of the dial, indicating the hands turns clockwise.

Write down the number each hand has passed. This may not be the number nearest the hand. For instance, if the hand has passed the 4 and is almost to the 5, you still read it as 4. Write down the numbers in the same order as you read the dials from left to right.

In the example given, the reading is 46372. If the last reading was 45109, subtract 45109 from 46372. This will give you the number of kWh used.

That is all there is to reading a meter, with one exception. If a hand points straight at a number and you do not know if it has passed the number or not, then look at the dial to the right. Has its hand passed zero?

To analyze your family's electricity use, read your meter daily for about two weeks, at approximately the same time each day. Record the readings on the following table.

DAILY USE OF ELECTRICITY IN MY HOME

DATE	TIME	READING	kWh USED DAILY	COST (kWh X____ *)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				

* Current kWh cost; e.g. $0.056 per kWh in 1990.

Student Sheet

MAKING CHOICES

Pretend that the government has announced that, because of an energy crisis, electricity will be rationed. According to a new regulation, homeowners will be permitted to own and use no more than 12 electrical items other than lighting and heating/air conditioning systems. Listed below are a variety of items, which use electricity and are often found in American homes. Choose the 12 items you feel would be most essential to you and rank them from 1 to 12 (1 being the most important, 12 the least). Be prepared to defend your choices.

_____ Television
_____ Automatic coffeepot
_____ Dishwasher
_____ Blender
_____ Electric mixer
_____ Electric shaver
_____ Electric clock
_____ Curlers/curling iron
_____ Electric typewriter
_____ Microwave oven
_____ Telephone answering machine
_____ Electric blanket
_____ Garbage disposal
_____ Refrigerator
_____ Washer/dryer
_____ Food processor
_____ Electric knife
_____ Toaster
_____ Electric can opener
_____ Makeup mirror
_____ Waffle iron
_____ Vacuum cleaner
_____ Fan
_____ Sewing machine
_____ Water heater
_____ Stereo
_____ Electric stove
_____ Toaster oven
_____ Freezer
_____ Computer
_____ VCR
_____ Iron
_____ Griddle
_____ Crock pot
_____ Power tools
_____ Hair dryer