The Electric Hookup

Activity Overview

Grade Level: 6-8
Activity: M-4

General Description

Students will further their understanding of meter reading and energy usage by extending their investigation to appliance wattages. Students will also determine the kilowatt-hour and related costs for appliances. They will then discuss the need to limit the use of appliances to conserve energy. The teacher should provide the class with a background of home appliance energy usage (provided in this activity.)

Learning Outcome

The student will determine the wattage of various household appliances, calculate the number of kilowatt-hours used by appliances, identify the need to limit the use of appliances to conserve energy, and identify costs per kilowatt-hour (kWh) of appliances.

Subjects

Math, science, home economics

Process Skills

Observation, measurement, grouping facts, conducting research, working in teams

Duration

Three class periods over two weeks

Key Vocabulary

Kilowatt-hour, British thermal unit, wattage rating

Curriculum Standards

Texas (TEKS):
112.22.b.6.8, 112.24.b.8.10
Louisiana (LSCS):
PS-M-C1, PS-M-C6
Arkansas (ASCF):
3.1.24
National (AAAS Project 2016):
The Designed World – 8th

Materials

- Student sheets (included)
    1. Wattage Ratings
    2. Appliance Energy Use

Method

1. Introduce the activity by sharing with the class the information in the background section below.
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 in Activity M-3.

   a. Tell the students to record daily meter readings at home for several 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.)
   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 Discussion below.

Background

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.

Discussion

1. Discuss the feelings the students may have about conserving electrical energy. What are the 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. Often times 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 different appliances for their wattage ratings and estimate the amount of time the appliance is used (hour or fraction of an hour). Using the conversion to kilowatt-hours (kWh) calculate the electricity usage for each appliance.

Appliance	Watts		Length of time used		kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh
_____ :	_____ /1000 watts	x	_____hr_____	=	_____kWh

Using the table below, see how much energy the appliances you checked consume in equivalents of oil or coal.

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	Annually	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
Refrigerator/freezer 16-25 cu ft side-by-side model, automatic defrost	2160	180
Refrigerator/freezer 14 cu ft automatic defrost	1800	150
Refrigerator/freezer 17 cu ft, 2-door, high efficiency, automatic defrost	1200	100
Freezer, 15 cu ft automatic defrost	1800	150
Freezer, 15 cu ft manual defrost	1200	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
Entertainment Appliances		
Color TV	660	55
Tube Type	440	37
Solid State	440	37
Tube Type	350	29

	Average KWH Used	
Kitchen Appliances	Annually	Monthly
Solid State	120	10
Radio/phonograph	110	9
Comfort Appliances		
Electric furnace	13200*****	(Seasonal)
Heat pump	6600****	(Seasonal)
Air conditioner, Central, per ton	15000*****	(Seasonal)
Air conditioner, Room, one ton	15000	(Seasonal)
Dehumidifier	400	33
Electric Blanket	150	(Seasonal)
Attic fan	300	(Seasonal)
Ceiling fan	130*	(Seasonal)

Notes

* 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 considerably more electricity during the heating and cooling seasons.

Student Sheet – Meter Readings

Have students keep a journal of their monthly electric and/or gas meter readings. Ask them to note any fluctuations in monthly energy usage throughout the seasons and provide explanations (i.e. summer required more air conditioning, early fall had no A/C or heating, new appliance added, etc.)

DATE	READING	KWh USED	COST (kwh x $/kWh)	COMMENTS

Source: "Conserve & Renew" (1996) California Energy Commission