Name: _____ Date: _____

Student Exploration: Household Energy Usage

Vocabulary: current, energy consumption, fluorescent lamp, halogen lamp, incandescent lamp, lumen, usage, voltage, wattage

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. Think about all the electrical appliances in your house. Which ones do you think use the most energy per second? _____

   _____

2. Now think about how much each of these appliances is used. Which appliances do you think use the most energy each month? _____

   _____

Gizmo Warm-up

The *Household Energy Usage* Gizmo™ allows you to compare the energy used by different appliances in the home. On the BEDROOM tab, click the laptop computer.

1. **Voltage** (*V*) is a measure of how much electrical energy is in a circuit. Most household circuits operate at 120 volts (120 V).

   Is this true of the computer? _____

2. **Current** (*I*) is a measure of the amount of electrical charge that passes through the circuit each second. Current is measured in amperes (A).

   How much current does the computer use? _____

3. **Wattage** (*W*) is the energy that is used by a device each second. It is equal to current multiplied by voltage ($W = I \times V$). Wattage is measured in watts (W) or kilowatts (kW).

   A. What is the wattage of the computer? _____

   B. Click on the other objects. Which has the highest wattage? _____

Activity A: **Comparing light bulbs**	Get the Gizmo ready: • Click **Reset all appliances**. • Check that the BEDROOM tab is chosen.	

Introduction: Three types of light bulbs can be found in a typical household:

- Traditional light bulbs are **incandescent lamps**. In this bulb, an electric current passes through a thin tungsten filament. The filament heats up and glows, emitting light.
- In a **halogen lamp**, the filament is encased in a glass capsule containing pressurized gas. This allows the filament to be heated to higher temperatures and emit brighter light.
- In a **fluorescent lamp**, an electrical current passes through a gas inside a phosphor-coated tube. The gas emits ultraviolet radiation, which causes the phosphor to glow.

Question: Which kind of light bulb uses the least amount of energy?

1. Form hypothesis: Which of the three types of lamps do you think is the most efficient?

   _____

2. Gather data: On the BEDROOM tab, click on the **Incandescent light** to the left of the bed, and the **Halogen lamp** at the foot of the bed. Record the wattage of each. Then select the KITCHEN tab and record the wattage of the overhead **Fluorescent lamp**.

   Incandescent lamp: _____ Halogen lamp: _____ Fluorescent lamp: _____

3. Summarize: Which lamp uses the most energy? _____ Least? _____

4. Analyze: To gauge the efficiency of a light bulb, it is also important to consider how much light it produces. Light intensity is measured in **lumens** (lm). A lumen is equal to the light produced by a single candle. The lumens produced by each type of light are listed below.

   To compare the efficiency of each bulb, calculate how many lumens each bulb produces per watt. To do this, divide the number of lumens by the wattage for each lamp. Include all units.

Lamp	Lumens (lm)	Wattage (W)	Lumens per watt (lm/W)
Incandescent	800 lm		
Halogen	6,000 lm		
Fluorescent	2,000 lm		

   A. Which lamp produces light most efficiently? _____

   B. Which lamp is the least efficient? _____

(Activity A continued on next page)

Activity A (continued from previous page)

5. Investigate: Use the Gizmo to estimate the cost of an incandescent lamp:

   A. Select the BEDROOM tab on the left and the USAGE tab on the right. The **usage** of an electrical appliance is the average number of hours it is turned on each day. Select the **Incandescent light**, and set the **Appliance usage** to 4 hours 0 minutes.

   B. **Energy consumption** is the total amount of energy used in a given time period. It is found by multiplying the *usage* by the *wattage*. Energy consumption is measured in kilowatt-hours (kWh).

      What is the daily energy consumption of the incandescent lamp? _____

   C. Choose the COST tab and check that **1 day** is selected. Set the **Cost of electricity** to 10.0 ¢/kWh. The daily cost is equal to the daily consumption (in kilowatt-hours) multiplied by the cost per kilowatt hour (¢/kWh).

      What is the daily cost of an incandescent lamp? _____

   D. Select **1 month (30 days)**. What is the monthly cost of this lamp? _____

   E. Select **1 year (365 days)**. What is the yearly cost of this lamp? _____

6. Calculate: Click **Reset all appliances**, and select the **Halogen lamp** in the bedroom. Find the daily energy consumption, daily cost, monthly cost, and yearly cost of a halogen lamp. Keep the **Appliance usage** set to 4 hours and the **Cost of electricity** set to 10.0 ¢/kWh.

   Daily energy consumption: _____ Daily cost of halogen lamp: _____

   Monthly cost of halogen lamp: _____ Yearly cost of halogen lamp: _____

7. Calculate: Click **Reset all appliances**. Use the same procedure to find the daily energy consumption, daily cost, monthly cost, and yearly cost of the fluorescent lamp in the kitchen. Use the same usage and cost of electricity values.

   Daily energy consumption: _____ Daily cost of fluorescent lamp: _____

   Monthly cost of fluorescent lamp: _____ Yearly cost of fluorescent lamp: _____

8. Apply: Suppose a family replaces ten 60-watt incandescent bulbs with ten 30-watt fluorescent lamps. If each light was used for 4 hours per day and the cost of electricity was 10.0 ¢/kWh, how much money would they save in a year? Explain your answer.

   _____

   _____

Activity B: **Your energy bill**	Get the Gizmo ready: • Click **Reset all appliances**.

Appliance	Consum
Small fan	0
Electric blanket	1
Halogen lamp	3
Incandescent light	0
Printer	0

Question: How much energy does your household consume?

1. Observe: In the Gizmo, go through the house, clicking on the different electrical appliances.

   Which appliances have the highest wattages? _____

   _____

2. Form hypothesis: Which household appliances do you think use the most energy in a day?

   _____

3. Gather data: Choose the USAGE tab. Select each appliance that is used in your house, and estimate its daily usage. (For appliances you use less frequently, such as the clothes dryer, think about how much it is used in a week, and then divide by seven.) Water heaters are on about five hours per day, and refrigerators are on about eight hours per day.

   Record wattages, your daily usage estimates, and daily energy consumptions for your household in the tables below. Include units.

Room	Appliance	Wattage (kW)	Daily usage (h)	Daily consumption (kWh)
Bedroom	Incandescent light			
	Printer			
	Computer			
	Hair dryer			
	Electric blanket			
	Small fan			
	Halogen lamp			
Living room	Television set			
	Paddle fan			
	Air conditioner			
	Large lamp			
	Stereo system			
	Reading light			

(Activity B continued on next page)

Activity B (continued from previous page)

Room	Appliance	Wattage (kW)	Daily usage (h)	Daily consumption (kWh)
Kitchen	Refrigerator			
	Electric stove			
	Microwave oven			
	Fluorescent light			
	Dishwasher			
	Coffee maker			
	Toaster			
	Kettle			
Laundry room	Dryer			
	Washer			
	Iron			
	Water heater			

4. Analyze: Select the CONSUMPTION tab. The table lists the energy consumed by each appliance in a day. The **Total daily energy consumption** is reported below the table.

   A. What is the total daily energy consumption for your house? _____

   B. Which appliances are the biggest "energy hogs" in your house? _____

   _____

5. Apply: Now click the COST tab. If you know the current price of energy per kilowatt-hour, use that. Otherwise use 10.0 ¢/kWh. Set the **Cost of electricity** now.

   What **Cost of electricity** value did you decide to use? _____

6. Calculate: Select **1 day**, **1 month (30 days)**, and then **1 year (365 days)**. Record your household energy cost for each time interval below.

   1 day: _____ 1 month: _____ 1 year: _____

7. Think and discuss: What strategies can you use to reduce your electricity bill? How much money could you save? Write your answers on the back of this sheet or on a separate sheet of paper. If possible, discuss your ideas with your classmates and teacher.