Activity: Light vs. Heat Bulbs

Purpose

Lighting accounts for 20-25% of all the electricity used in the United States. On average a household uses5-10% of its energy for lighting. A commercial industry on the other hand consumes 20-30% of their energy in lighting only. 50% or more of the energy used is *wasted by obsolete equipment, inadequate maintenance, or inefficient use.* Energy savings for lighting will require either reduction in use or more *efficient* usage. The purpose of this activity is to:

- Compare the two most common types of electric lighting: incandescent bulbs and compact fluorescent bulbs (CFL)
- Introduce the latest technology in lighting and light bulbs
- Determine which is more energy efficient and cost effective

Equipment

1. Incandescent bulb (60 Watt) with light socket/plug
2. Compact Fluorescent Light Bulb (CFL, 13 Watt) with light socket/plug
3. LED bulb with light socket/plug
4. Infrared (IR) thermometer
5. light meter
6. ruler

Procedure

1. Break into groups of 3-4 students.
2. Examine your light bulbs. Record the watts consumed by each bulb in the appropriate space on the Data Table (Watts, W).
3. Record room temperature by pointing the IR thermometer at the bulbs before they are turned on. Hold the IR thermometer ~10 cm away from the bulb and point it directly at the center of the bulb surface. This should be the starting temperature for both light bulbs (T_s). Record in Data Table.
4. Turn on both light bulbs.
5. After 10 minutes, measure the temperature from 10 cm away from each bulb. Record these final temperatures (T_f) in the Data Table. Calculate the net change in temperature, ΔT ($\Delta T = T_f - T_s$), for both the incandescent and the compact fluorescent light bulbs. Record in Data Table.
6. Repeat steps 3-5 for demonstration LED bulb if available.

7. Before turning the light bulbs off, your teacher will obtain a measure for the light emitted from each light bulb using a light meter. Record this value (lux) in the Data Table.

	Incandescent Bulb	**Compact Fluorescent Light Bulb (CFL)**	**Light Emitting Diode (LED)**
Watts consumed			
Starting temperature, T_s (°C)			
Final temperature, T_f (°C)			
Change in Temperature $\Delta T = T_f - T_{s,}$ (°C)			
Light emitted (Lux)			

Part I. Conclusions

1. Draw three bar charts, one each for light emitted, power rating, change in temperature (one each graph, one bar for each bulb)
2. How does the light emitted by the bulbs compare?

3. If there was a difference, can you give a possible reason why?

4. Which light bulb consumes more power (watts)?

5. Which produces more heat (represented by a change in temperature)?

6. The main purpose of a light bulb is to provide light, not heat. Knowing this, explain the benefits of using compact fluorescent light bulbs instead of incandescent bulbs.

Part II. Life Cycle Cost Analysis

To answer the following questions please refer to the information provided below about 60-Watt incandescent bulbs and 13-Watt CFL (these two bulbs produce the same amount of light).

Categories (units)	Incandescent	CFL
Watts consumed (W)	60	13
Rated Lamp Life (hours)	1000	8,000
Electricity cost per kWh ($/kWh)	0.10	0.10
Cost per bulb ($)	0.25	3.00 (average)

1. Calculate the amount of electrical energy consumed by each bulb type over a 8,000 hour period in kilowatt-hours (kWh) ($W \times \frac{kW}{1000W} = kW$):

   a. Incandescent bulb:
   _____ W = _____ kW

   _____ kW X _____ hours = _____ kWh

   b. CFL:
   _____ W = _____ kW

   _____ kW X _____ hours = _____ kWh

2. Calculate the electricity cost per 8,000 hours for each bulb type.

   a. Incandescent bulb:
   _____ kWh X _____$/kWh = $_____

   b. CFL:
   _____ kWh X _____ $/kWh= $_____

3. Calculate the number of bulbs used in the 8,000 hour period.

   a. Incandescent bulb:
   _____ hours / _____Rated Lamp Life (hours per bulb)

   =_____ bulbs

   b. CFL:
   _____ hours / _____Rated Lamp Life (hours per bulb)

   =_____bulbs

4. Calculate the **total** purchase cost of the bulb (or bulbs) used during the 10,000 hours.

   a. Incandescent bulb:
   _____# of bulbs used over 8,000 hours X $ _____per bulb

   = $_____

   b. CFL:
   _____# of bulbs used over 8,000 hours X $ _____per bulb

   = $_____

5. Now calculate the **Total Life-Cycle Cost** for each bulb type over an 8,000 hour usage period. **This is calculated by adding the answer from question 2, the electricity cost, to the answer from question 4, the bulb cost, for each bulb.**

   a. Incandescent bulb:
   $_____ + $ _____ = $_____

   b. CFL:
   $_____ + $ _____ = $_____

6. Create a table summarizing the results of your calculations.

7. Based on your calculations of the Total Life-Cycle Cost for each bulb type, over a 8,000 hour usage period, which bulb would save you money?

8. How much money would you save by your choice for each light bulb?

9. How many light bulbs in your house do you think you can change to CFLs? How much money could your family save over 8,000 hours of light bulb use?