

DETERMINING THE ENERGY COST OF EXIT LIGHTS

*Taken from the Green Schools Tool Kit Manual to be used in conjunction with the tool kit

Objective:

Students calculate the energy and cost savings from changing incandescent light bulbs to LED bulbs in exit signs.

Grade Level: 10 – 12

Equipment:

- Infrared thermometer*
- Set of Light Emitting Diode (LED) exit sign light bulbs*
- Step ladder
- Safety gloves*

* From Green Schools Tool Kit

ADVANCE PREPARTION

Check to see which type of exit signs your school has. This investigation is designed for the older style exit signs that are lit by incandescent light bulbs. If your school's exit signs have already been upgraded to the newer fluorescent or LED bulbs, look for a nearby office building, store, or shop with the older signs. Explain the savings that could result from the investigation, and the owner may gladly let you test the exit signs.

Find out from your utility or from the custodian what local electricity rate is per kilowatt hour (kWh). A good estimation is \$0.15/kWh.

Find out from your custodian an estimated annual cost for replacing the exit light bulbs, including labor and material costs. Also find out the wattage and number of bulbs used in the exit light you will investigate.

Safety Warning

The exit light's incandescent bulbs will be very hot and can burn. Use safety gloves to remove them.

LEADING THE INVESTIGATION

1. Discuss the importance of exit lights in terms of safety. Point out that the school would be subject to a fine if the Fire Marshall or Safety Inspector was to find an exit light not working. Have students calculate how many hours per year each exit light burns since it must be on 24 hours a day, 365 days a year (8760 hours).
2. Have students take a look at an exit light. Those with incandescent bulbs often have:

- Red plastic that has been warped or burned white by the hot bulbs.
 - Broken filaments either from use (they may last as long as 6,000 hours or 7 months) or abuse (students sometimes slap at the lights, which breaks the bulb filament).
3. Follow the procedure described on the student page to compare the energy use of incandescent bulbs and LED bulbs in an exit sign.

FOLLOW-UP

- Using the calculations they made in the investigation, students compute how long it will take for the LED bulbs to pay for themselves.
- Students calculate the environmental impact of changing out the two light bulbs in one exit sign using the national average emissions per kilowatt hour (kWh):

1.23 pounds carbon dioxide (CO₂) per kWh
0.016 pounds sulfur dioxide (SO₂) per kWh
0.007 pounds nitrous oxide (NO_x) per kWh
0.043 milligrams mercury (Hg) per kWh

Your state office of energy or environmental services may be able to provide you with specific numbers for your state.

- Help students make a presentation to the school board to change out the exit light bulbs in all district schools.

Determining the Energy Cost of Exit Lights

Question

How much energy could be saved each year by changing incandescent bulbs in an exit sign to LED bulbs?

Your prediction:

Equipment

- Infrared thermometer
- Set of Light Emitting Diode (LED) exit sign light bulbs
- Step ladder
- Safety gloves

Procedure

1. Calculate the annual operating cost for the exit light with incandescent bulbs. To do this you will need to know the wattage of the light bulbs in the fixture and your local electricity rate.

Annual operating cost =
 $\frac{8760 \text{ hours per year} \times \text{bulb wattage} \times \# \text{ of bulbs}}{1000} \times \$ \frac{\text{electricity rate}}{\text{kWh}} = \$ \text{_____ per year}$

Add to this the annual replacement cost for the bulbs: _____

This is the total annual cost of the exit light with incandescent bulbs: _____.

2. Calculate what the annual operating cost would be if the exit light had LED light bulbs, which are rated at 1 watt each. (The number of bulbs and electricity rate will be the same as above.)

Annual operating cost =
 $\frac{8760 \text{ hours per year} \times \text{bulb wattage} \times \# \text{ of bulbs}}{1000} \times \$ \frac{\text{electricity rate}}{\text{kWh}} = \$ \text{_____ per year}$

Add to this the annual replacement cost for the bulbs: _____

(LED bulbs are rated to last 25 years, so the annual replacement cost is essentially \$0)

This is the total annual cost of the exit light with LED bulbs: _____.

3. Using the stepladder to reach the light fixture, open the cover of the EXIT light.
4. Use the infrared thermometer to read the temperature of a bulb: _____

5. Replace the incandescent light bulbs with the LED bulbs. Wait a few minutes and then take a temperature reading of the LED light bulbs: _____
6. Replace the incandescent bulbs.

Analyzing the Data

1. What is the difference in temperature between the LED bulbs and the incandescent ones?
2. Since heat is energy that the bulb consumes but doesn't use for light, what does this difference tell you about the two bulbs?
3. How much money could be saved each year by replacing the incandescent bulbs in the exit sign with LED ones?