

Which Light Bulb is Really Cheaper?

WHICH LIGHT BULB IS REALLY CHEAPER ?

Adapted from "How Many Light Bulbs Does it Take to Change a People," a Collaborative Project between the New England Electric System and the Conservation Law Foundation

Overview/Objective: Students will calculate and compare the long-term costs of incandescent bulbs versus energy-efficient fluorescent bulbs.

Time: 1 hour

Subject: Math

Suggested Grade Level: 5 – 9

Materials: Student worksheet (included)

BACKGROUND

Effective conservation efforts have two fronts: behavioral changes and changes in equipment. Behavioral changes include turning the lights off and keeping the thermostat several degrees lower. Equipment changes include replacing inefficient incandescent lights with more energy efficient fluorescent lights – then making those fluorescent lights even more efficient through such equipment as reflectors and high-efficiency ballasts. A 15-watt fluorescent bulb puts out roughly the same light as a 60-watt incandescent. With a reflector aimed at a specific point, a single 15-watt fluorescent bulb puts out more light than two 60-watt bulbs!

Incandescent bulbs - the ones you are accustomed to using in your lamps and light fixtures – work on the principle of *electrical resistance*. Current flows across a *filament* – a small strand of tungsten wire. That filament resists the flow of electrons more than the conductors (copper wire) that carry the electricity to it. As the electrons slow down, they heat up and begin to glow. In other words, incandescent bulbs give off both light and heat. Because their function is only to emit light, the electricity they use in making and giving off heat is wasted. Thus, they are *inefficient*.

Fluorescent bulbs, on the other hand, have no filament and do not work on the principle of electrical resistance. They use the flow of electrons (electricity) to excite gas atoms, which in turn *fluoresce*, or give off light. The inside of a fluorescent bulb, therefore, contains a gas rather than a filament. In addition, fluorescent fixtures contain an electrical device called ballast which stores and intensifies the current to provide something like a kick start to the gas inside the tube. That charging and intensifying of current is why fluorescent bulbs need a few seconds to go on once you throw the switch. Once they are lit, fluorescent bulbs emit a great deal of light and practically no heat. Thus, they are much more efficient than incandescent bulbs.

PROCEDURE

The effects of an energy conservation effort can be quite dramatic when presented numerically in terms of fuel savings, electricity savings, dollar savings, or environmental impact. The calculations in this activity require only simple arithmetic. This activity illustrates the value of conservation and provides good math practice.

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PART I: THE COST OF AN INCANDESCENT BULB

An incandescent light bulb (the kind most people use at home) costs about 75 cents and lasts about 750 hours. A 100-watt bulb burning for 10 hours each day uses 1000 watt-hours of electricity. (1000 watts equals one kilowatt – “kilo” means a thousand.) A kilowatt-hour of electricity costs about 15 cents. Your light bulb therefore costs about \$54.75 per year to operate (365 kWh/year X 15 cents). In addition, it must be changed every 75 days, so you must buy five bulbs each year.

1. If one incandescent light bulb costs 75 cents, how much would you have to pay for bulbs each year?

$$75 \text{ cents} \times 5 = \underline{\$3.75} \text{ (replacement cost)}$$

PART II: THE COST OF A FLUORESCENT BULB

A high-efficiency fluorescent bulb costs about \$2-\$5 and lasts about 10,000 hours. A 25-watt fluorescent bulb puts out roughly the same amount of light as a 100-watt incandescent light.

2. If your light burns ten hours each day, how many watt-hours of electricity would it use per day?

$$25 \text{ (watts)} \times 10 \text{ (hours)} = \underline{250} \text{ watt-hours (A)}$$

3. How many days would it take to consume one-kilowatt hour?

$$1000 \div (A) = \underline{4} \text{ days (B)}$$

4. How many kilowatt-hours do you use each year?

$$365 \div (B) = \underline{91.25} \text{ kilowatt hours per year (C)}$$

5. At 15 cents per kilowatt-hour for electricity, how much would you have to spend each year to keep your light bulb lit?

$$(C) \times 15 \text{ cents} = \underline{\$13.69} \text{ per year (D)}$$

6. This bulb lasts for roughly 10,000 hours and you use it 10 hours each day. How long will it last?

$$10,000 \text{ hours} \div 10 \text{ hours per day} = \underline{1000} \text{ days}$$

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PART III: COMPARING THE COST OF THE INCANDESCENT AND FLUORESCENT BULBS

Year I:

At the end of the *first* year, the incandescent light bulb will have cost \$54.75 to operate, and new bulbs will have cost \$3.75.

7. What has the total cost of the incandescent bulb been?
 $\$54.75 + \$3.75 = \underline{\$58.50}$

The fluorescent bulb cost \$13.69 to operate, and one new bulb cost \$2.50.

8. What has the total cost of the fluorescent bulb been for the year?
 $\$13.69 + \$2.50 = \underline{\$16.19}$

9. What are your savings if you use a fluorescent bulb?
 $\$58.50 - \$16.19 = \$42.31$ per year per bulb

10. Which light bulb is cheaper? The one that costs 75 cents of the one that costs \$2.50?

EXTENSIONS

1. Use this lesson as a spring board for surveying lighting usage in your school building.
2. Contact your local utility to see if they have inexpensive CFLs. Consider using the CFLs for a school fundraiser.

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PART I: THE COST OF AN INCANDESCENT BULB

An incandescent light bulb (the kind most people use at home) costs about 75 cents and lasts about 750 hours. A 100-watt bulb burning for 10 hours each day uses 1000 watt-hours of electricity. (1000 watts equals one kilowatt – “kilo” means a thousand.) A kilowatt-hour of electricity costs about 17 cents. Your light bulb therefore costs about \$62.05 per year to operate (365 days X 17 cents). In addition, it must be changed every 75 days, so you must buy five bulbs each year.

1. If one incandescent light bulb costs 75 cents, how much would you have to pay for bulbs each year?

PART II: THE COST OF A FLUORESCENT BULB

A high efficiency fluorescent bulb costs about \$2-\$5 and lasts about 10,000 hours. A 25-watt fluorescent bulb puts out roughly the same amount of light as a 100-watt incandescent light.

2. If your light burns ten hours each day, how many watt-hours of electricity would it use per day?
3. How many days would it take to consume one-kilowatt hour?
4. How many kilowatt-hours do you use each year?
5. At 17 cents per kilowatt-hour for electricity, how much would you have to spend each year to keep your light bulb lit?
6. This bulb lasts for roughly 10,000 hours and you use it 10 hours each day. How long will it last?

PART III: COMPARING THE COST OF THE INCANDESCENT AND FLUORESCENT BULBS

Year I:

At the end of the *first* year, the incandescent light bulb will have cost \$62.05 to operate, and new bulbs will have cost \$3.75.

7. What has the total cost of the incandescent bulb been?

8. What has the total cost of the fluorescent bulb been for the year?

Which light bulb is cheaper? The one that costs 75 cents or the one that costs \$5?