



# SOLAR ENERGY FOR THE CLASSROOM



Provided by Pierce Cedar Creek Institute  
www.cedarcreekinstitute.org

## Activity Overview

Grade Level: 6-8

### General Description

Students will compare the economical and ecological costs of using incandescent and compact fluorescent light bulbs (CFLs) in their homes.

### Learning Outcome

Students will learn that using CFLs can save money and reduce the environmental impact of providing artificial light in their homes.

### Science Content Standards

Content Area: Constructing New Scientific Knowledge (C) I.1.1

Standard: All students will generate scientific questions about the world based on observation.

Content Area: Reflecting on Scientific Knowledge (R) II.1.4

Standard: All students will describe the advantages and risks of new technologies.

Content Area: Reflecting on Scientific Knowledge (R) II.1.5

Standard: All students will develop an awareness of and sensitivity to the natural world.

Content Area: Ecosystems (LEC) III.5.6

Standard: All students will describe ways in which humans alter the environment.

Content Area: Changes in Matter (PCM) IV.2.4

Standard: All students will describe common energy transformations in every day situations.

Content Area: Geosphere (EG) V.1.5

Standard: All students will explain how technology changes the surface of the earth.

## CFL Demonstration

### Materials

- Incandescent light bulbs\*
- Compact Fluorescent Light bulbs (CFLs)\*
- Overhead of light bulb packages

\* Both incandescent and CFLs should be of similar light output (lumens)

### Before you begin:

- Find out how much your local utility charges per kWh. This information can be found on your personal utility bill. You may want to determine what you are actually paying once you factor in the various service charges.
- Purchase CFLs (compact fluorescent light bulbs) and incandescent bulbs locally. Remember to look for bulbs with similar light output (lumens) for accurate comparisons.

### Introduction

How many of you have light bulbs in your home? How many do you think there are in your home? Have you ever gone to the store to purchase light bulbs? If you have, you'll remember that there are MANY different bulbs to choose from. How do you know which bulbs to buy? Do you think buying certain types of bulbs could save you money? Today we're going to learn how to save money and lower the environmental impact by being wise shoppers when purchasing light bulbs.



# SOLAR ENERGY FOR THE CLASSROOM

---

## Package Information

Have you ever looked at the information on a light bulb package when purchasing light bulbs? There are three numbers that give us very valuable information. But first, let's discuss these questions:

- Why do we need light bulbs? (to provide us with light)
- How do you know when you need new light bulbs? (They burn out)
- Have you ever tried to change a light bulb immediately after it burns out? Were you successful? (No, it was too hot to touch!)

You've learned how energy changes from one form to another. Let's think a minute and answer these questions:

- What form of energy enables the light bulb to give us light? (electricity).
- The electricity changes to what form of energy? (light).
- Is that all? (No-heat)
- Do we purchase light bulbs because we need heat? (No)

So, this electricity is used to produce light, which we want, but also heat that we don't necessarily want (particularly in the summer).

- Do you have to pay for the electricity that allows this bulb to function? (yes)
- So with this information, what else can you tell me about the electricity and the cost? (that we're paying for the unwanted heat as well as the light).
- Do you think it is necessary for the bulb to produce heat in order to produce light?

Now, back to the light bulb package: (display incandescent package only). I'd like you to look at the three numbers here in the corner.

- The first number tells us how much light this bulb will produce—the light output or lumens. Lumens are how we measure light output. The higher the lumen number, the more light the bulb produces.
- The next number tells us how much energy this bulb uses and it is measured in watts. The lower the watt number, the less energy it uses.
- The third number tells us how long this bulb is expected to last—the life of the bulb—measured in hours.

So, using the information on this package:

- What is the light output for this bulb? (870 lumens)
- How much energy does this bulb require? (60 watts)
- How long is this bulb expected to last? (1000 hours)



# SOLAR ENERGY FOR THE CLASSROOM

---

## Package Information (cont'd)

Now, let's see how much it costs to get the light we want from this incandescent light bulb. We'll need to do a little math, so let's get started. (We already know that this bulb produces 870 lumens of light – we'll use this information later). First we need to know the following:

- The cost of the bulb (\$0.50)
- How long the bulb is expected to last (1000 hours)
- How much energy is required for this bulb to produce light (60 watts)
- How much my electricity provider charges per kilowatt-hour (\$0.08)

How much will I be charged on my utility bill for the energy required to produce light from this bulb? Let's do the math. On our utility bills, we are charged for the number of kilowatt-hours (kWh) of electricity we use each month. If this bulb uses 60 watts of electricity for 1000 hours—how many kWh's does that equal? We must convert the watts to kilowatts. Kilo means thousand.

**1 kW = 1000 watts**

**Wattage divided by 1000 = kW**

**KW X life of bulb = total electricity consumed**

**Total electricity consumed X cost per kWh = cost of electricity over the life of that bulb.**

60 kWh used X \$0.08 per kWh = \$4.80 (cost of electricity)

60 watts divided by 1000 = 0.06 kW

0.06 kW X 1000 hours = 60 kWh

60 kWh X \$0.08 = \$4.80 (total cost of electricity over the life of the bulb)

Life Cycle Cost:	\$0.50 (cost of bulb)
	<u>\$4.80 (cost of electricity)</u>
	\$5.30 (life cycle cost)

Now, let's look at another type of light bulb (hold up compact fluorescent bulb). This bulb is called a compact fluorescent or CFL for short. Looking at the numbers on the CFL package (show overhead of package):

- What is the light output? (925 lumens)
- How much energy does this bulb use? (15 watts)
- What is the expected life of this bulb? (10,000 hours)
- What is the cost of the bulb? (\$9.00)

Let's answer these questions:

- Does this bulb give more or less light than the incandescent we used in the previous example? (more)
- Does this bulb use more or less energy to produce light? (less)
- Which bulb has a longer life expectancy? (CFL)



# SOLAR ENERGY FOR THE CLASSROOM

---

## Package Information (cont'd)

Using this information, how much will it cost to produce light from the CFL?

$$15 \text{ W divided by } 1000 = 0.015 \text{ kW}$$

$$0.015 \text{ kW} \times 10,000 = 150 \text{ kWh}$$

$$150 \text{ kWh} \times \$0.08 = \$12.00$$

Life Cycle Cost:	\$9.00 (cost of bulb)
	<u>\$12.00 (cost of electricity)</u>
	\$21.00 (life cycle cost)

Now, let's compare the two bulbs:

The cost of electricity for one incandescent bulb that is expected to last for 1,000 hours is \$5.30; the cost of electricity for this CFL bulb that is expected to last 10,000 hours is \$21.00.

- How many incandescent bulbs (that last approximately 1,000 hours) will it take to equal the 10,000 hours of the CFL? (10)

Total cost of electricity for these bulbs:

$$10 \text{ incandescent bulbs} \times \$5.30 \text{ per bulb} = \$53.00$$

$$1 \text{ CFL} = \$21.00$$

Now multiply this number by the number of incandescent bulbs in your home. What is the potential savings if you converted these to CFLs?

## Replacing Incandescent Bulbs with CFL's

When replacing incandescent bulbs with a CFL, to get the best "match", you should compare the lumen output for each bulb. Try to find a CFL with a lumen output as close to the lumen output of the incandescent you are replacing.



# SOLAR ENERGY FOR THE CLASSROOM

---

## Environmental Impacts

Do you know where the electricity is produced that you use in your home and/or school?  
Do you know how the electricity is generated? (Discuss how/where electricity is produced in your area).

We know that every kWh of electricity produces 1.6 pounds of carbon dioxide.

Incandescent bulb:

$$60 \text{ kWh} \times 10 \text{ bulbs} = 600 \text{ kWh}$$

$$600 \text{ kWh} \times 1.6 \text{ lbs} = 960 \text{ lbs of carbon dioxide}$$

CFL:

$$150 \text{ kWh} \times 1.6 \text{ lbs} = 240 \text{ lbs of carbon dioxide}$$

- How much less carbon dioxide is produced by using the CFL?
- What impact on the landfill would each bulb have? (Using 10 incandescent bulbs would produce more packaging and more discarded bulbs going to the landfill).
- Less mechanical energy (yours!) is used to change 1 CFL as compared to 10 incandescent bulbs. Can you think of other impacts?