



# COMPARING LIGHT BULBS

## Grade 6, Science and Technology

Source: Adapted from TDSB's *Heat in the Environment*

### DESCRIPTION

In this learning activity, students will explore their daily energy use and ways to reduce their energy consumption. They will do a hands-on experiment to compare the amount of heat that incandescent and fluorescent light bulbs use.

### CURRICULUM LINKS – SCIENCE AND TECHNOLOGY, GRADE 6

*Understanding Matter & Energy– Electricity & Electrical Devices*

Overall Expectation: 1

Specific Expectations: 1.1, 1.2, 2.1, 2.6

### PLANNING NOTES

#### Materials

- 2 lamps
- 2-3 incandescent light bulbs
- 2-3 fluorescent light bulbs
- Large piece of white paper/white towel
- Ruler
- *Energy Match-Up!* ( Appendix 1 )
- *Introduction to Energy-Efficient Lighting* (Appendix 2)
- *Comparing Light Bulbs Observation Chart* (Appendix 3)

#### Prior Learning

The use of energy improves our lives, but has many different kinds of impacts on the environment. In recent years, more attention has been paid to generating electricity in more environmentally friendly ways. Conserving energy at home and at school reduces negative impacts on the environment.

#### Learning Skills & Work Habits

Collaboration, organization, initiative

#### Recommended Class Time

- 1 period

### TEACHING/LEARNING STRATEGIES

#### Minds On

Print out *Energy Match-Up!* (Appendix 1) or save paper by projecting it. Have students guess how much wattage each item uses. Students can draw a line from the item to the average wattage (joules/sec). Have students compare their results with a partner before taking it up.

#### Discussion

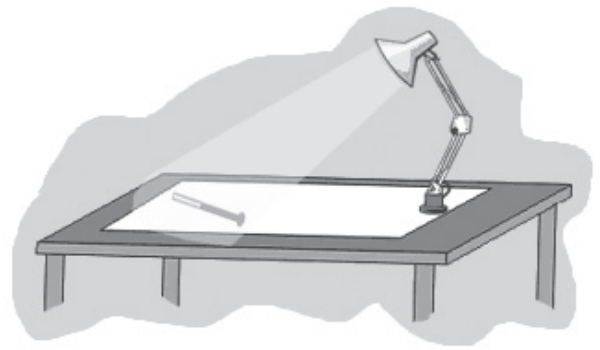
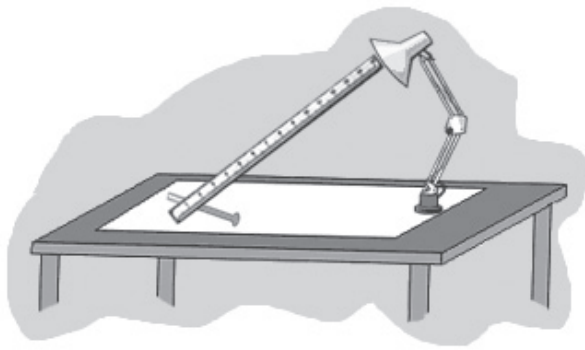
What was surprising? What appliances do we use on a regular basis? Which item uses the most energy on a typical day at your home or at school? (Hint: the appliances we use continuously need energy for the whole day; suggested answer: refrigerator, dryer.) What would help save energy? (Answer: behaviour/practice changes such as hanging clothes to dry or efficiency changes such as improvements in technology – Energy Star appliances.)

#### Activity

1. To start the lesson, have students read the *Introduction to Energy-Efficient Lighting* (Appendix 2).
2. After reading, ask students at what time of day they think the most electricity is used? Explain to the students that electricity in the home is used frequently in the morning and the evenings.
3. Show the two light bulbs: incandescent and fluorescent. Let students see and hold the bulbs, noting the differences between them. Pose a question to the class: Which of the two light bulbs produces more heat? To find out, the class is going to conduct an experiment.

#### Experiment

Preparation: Have students prepare an observational chart or use *Comparing Light Bulbs Observation Chart* (Appendix 3). To start the experiment, have students either sit or stand around a table or desk. This may be difficult with a large class, so you may want to set up two tables.



### Steps for the Experiment

1. Place the white towel/paper on the desk and put the lamp on the end of the desk. The paper has to be white so the light can be observed. Light colours also don't attract as much heat.
2. Place the thermometer on the paper and measure the distance from the bulb to the thermometer (30 centimetres is recommended).
3. Put in the lowest wattage light bulb (make sure the lamp is unplugged). *\*\*Emphasize to students that before you plug in or unplug something, the item must be turned off to avoid electric shock.*
4. After you put in the light bulb, but before you turn on the lamp, measure the start temperature. Have the students record this in their observational chart.
5. Turn on the lamp.
6. Leave the lamp shining on the thermometer for at least 5 minutes. Now wait and watch. While waiting for the 5 minutes to pass, explain to students what is occurring to the thermometer. (Bulb thermometers rely on the simple principle that a liquid changes its volume relative to its temperature. Liquids take up less space when they are cold and more space when they are warm. You can also talk about different types of thermometers such as bulb thermometers and electronic thermometers and how they are used to measure body temperature, air conditioning systems, refrigerators, heaters, thermostats, etc.)

7. At the end of 5 minutes, mark down the final temperature resulting from the heat from the light bulb. The lamp must remain in the same spot throughout to ensure accurate and consistent results.

Note: You may want to repeat the experiment with light bulbs of several different wattages. However, to get accurate results, you should let the lamp cool between testing the light bulbs (wait about 30 minutes). Keep the distance between the thermometer and the light bulb the same at all times, and make sure the thermometer is in the same spot for each experiment. It is recommended that you test two-three of incandescent and fluorescent light bulbs.

### What You'll Discover!

Incandescent lights give off heat as well as light energy. The higher the wattage of the light bulb, the higher the temperature. In a home or office, lots of incandescent lights means that the air conditioner would have to use more energy during the summer to cool the extra heat given off by lights.

### Culminating Discussion

After conducting all of the experiments, have students do a think-pair-share of what occurred during each experiment. Then, have a class discussion about what occurred. Clarify that the experiment proved that compact fluorescent lighting is more energy efficient because it does not produce as much heat as incandescent lighting. Record the students' observations. The reason that fluorescent lighting does not give off as much heat energy is because the light is dispersed by mercury vapours that create luminescence. Incandescent light bulbs create light by heating a filament (thin wire) of copper that emits light and heat.

## EXTENSION

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**Comparing Cost:** Energy prices are going up, so the best choice is a light bulb that consume less energy. How will you know which bulb is really the cheapest? Which type of bulb is the most expensive to purchase? Which bulb lasts the longest? Which uses the least amount of energy/power?

Fluorescent lights last about 9,000 hours. What is the total cost of lighting a room for about 9,000 hours with a compact fluorescent (CFL) vs. an incandescent light bulb? Brainstorm what information students need to gather (cost of light bulb + cost of electricity) to answer the question.

**Total cost = Price of bulb (\$ bulb) + cost of energy used (\$ energy)**

**Price of bulb (\$ bulb)** = # of bulbs needed to light a room for 9,000 hrs x price of bulb

- Cost of compact fluorescent bulb = \$8.00
- Compact fluorescent lasts 9,000 hrs

**Price of CFL bulb** = 1 bulb x \$8.00 = \$8.00

- Cost of incandescent bulb = \$1.00
- Incandescent bulb lasts 750 hrs
- 750 hrs x 12 bulbs = 9,000hrs

**Price of incandescent bulb** = 12 bulbs x \$1.00 = \$12.00

**Cost of energy (\$ energy)** = power used x the number of hours x price of electricity

(5 cents or \$0.05/kWh) 2012 electricity rates

- Power used for incandescent for regular lighting in a room is 75 W (watts). To convert into a kW (kilowatt), divide by 1,000 = 0.075 kW.
- Power used by a CFL for regular lighting in a room is 15 W or 0.015 kW

Type of bulb	Energy used	Price of energy	Energy cost	Total cost = \$ bulb + \$ energy
Incandescent	0.075 kW x 9,000h	\$0.05/kWh	\$33.75	\$12.00 + \$33.75 = \$45.75
Fluorescent (CFL)	0.015 kW x 9,000h	\$0.05/kWh	\$6.75	\$8.00 + \$6.75 = \$14.75

## APPENDICES

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Appendix 1 – *Energy Match-Up!*

Appendix 2 – *Introduction to Energy-Efficient Lighting*

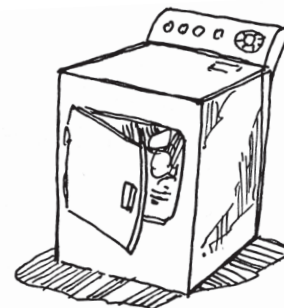
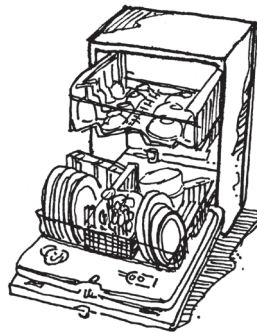
Appendix 3 – *Comparing Light Bulbs Observation Chart*



**APPENDIX 1**  
**COMPARING LIGHT BULBS**  
**ENERGY MATCH-UP!**

GUESS HOW MUCH ENERGY EACH ITEM USES!	
Appliance	Average Wattage (J/s)
Hairdryer	22
Toaster	30
Refrigerator	50
Computer (desktop)	80
CD player	115
Microwave	200
Clothes washer	500
Clothes dryer (electric)	500
Stereo	750
Air Conditioner (window)	1000
Television	1000
Dishwasher	1050
Computer (laptop)	1150
Furnace	2000
Fan	5000

ANSWERS	
Appliance	Average Wattage (J/s)
Hairdryer	1000
Toaster	1150
Refrigerator	500
Computer (desktop)	200
CD player	22
Microwave	1000
Clothes washer	500
Clothes dryer (electric)	5000
Stereo	30
Air Conditioner (window)	1050
Television	80
Dishwasher	2000
Computer (laptop)	50
Furnace	750
Fan	115





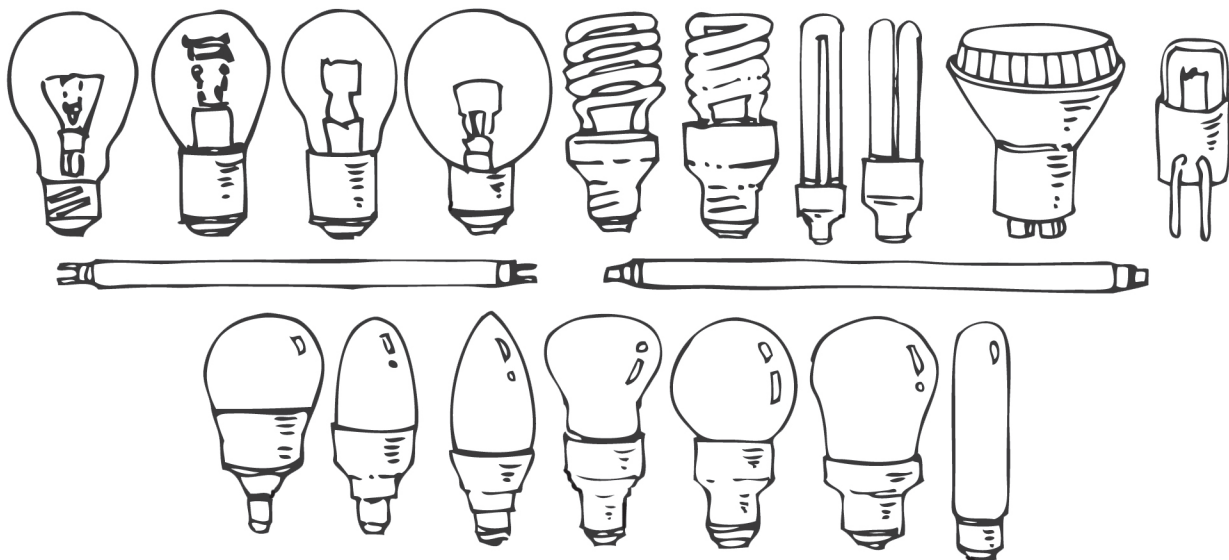
**APPENDIX 2**  
**COMPARING LIGHT BULBS**  
**INTRODUCTION TO ENERGY-EFFICIENT LIGHTING**

Energy-efficient, compact fluorescent lighting (CFL) has been on the market for several years. Today's lower costs, easy availability, and variety of configurations make CFL more appealing to homeowners. Energy- and cost-saving claims by CFL manufacturers are typically based on the difference in power consumption between CFL and incandescent bulbs with similar lighting performance. Lighting can make up anywhere from 5% to 45% of the total energy consumed at home or at school. By reducing demand, especially during peak times, consumers can have a significant positive effect on the environment.

**DID YOU KNOW?**

*A quick lighting fact! The average residential lighting energy use is 3.4 kWh per day or roughly 1,350 kWh/year — about 15% of total electricity use! That is a lot! Lighting accounts for 5% to 8% of annual utility bills. Average peak demand is about 0.65 kW per house during winter months and about 0.5 kW during summer months.*

*"Benchmarking Home Energy Savings from Energy-Efficient Lighting"  
([www.cmhc-schl.gc.ca/odpub/pdf/65830.pdf?lang=en](http://www.cmhc-schl.gc.ca/odpub/pdf/65830.pdf?lang=en))*





**APPENDIX 3**  
**COMPARING LIGHT BULBS**  
**COMPARING LIGHT BULBS OBSERVATION CHART**

Names: \_\_\_\_\_

Light Type	Hypothesis	Starting Temperature	Light Wattage	Time (Min)	Temperature
Incandescent				1	
				2	
				3	
				4	
				5	
Compact Fluorescent				1	
				2	
				3	
				4	
				5	