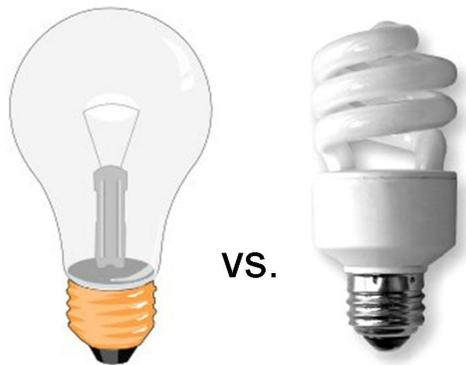


Activity: Light vs. Heat Bulbs

Winner - 2009 Premier Curriculum Award for K-12 Engineering



Summary

Students measure the light output and temperature (as a measure of heat output) for three types of light bulbs to identify why some light bulbs are more efficient (more light with less energy) than others.

Engineering Connection

Substituting energy efficient light bulbs is one way to save energy. Lighting needs are still provided, but with less energy consumption. Engineers are currently developing many new types of light bulbs. CFLs are becoming common place, but we can expect new and different ones soon.

Contents

1. Learning Objectives
2. Materials
3. Introduction/Motivation
4. Procedure
5. Attachments
6. Safety Issues
7. Assessment

Grade Level: 8 (6-8)

Time Required: 40 minutes

Group Size: 3

Activity Dependency :Household Energy Conservation and Efficiency

Expendable Cost Per Group : Not defined

Keywords: compact fluorescent light bulb, efficiency, energy audit, LED, lifecycle cost, light bulb, power, energy, energy audit, leaking energy, power

Related Curriculum :

subject areas Data Analysis and Probability
 Physical Science
 Physics

curricular units Energy Systems and Solutions

lessons Household Energy Conservation and Efficiency

Educational Standards

- National Council of Teachers of Mathematics Math
- work flexibly with fractions, decimals, and percents to solve problems (Grades 6 - 8) [2000]
- select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators, or computers, and paper and pencil, depending on the situation, and apply the selected methods (Grades 6 - 8) [2000]
- use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers, fractions, and decimals (Grades 6 - 8) [2000]
- understand relationships among units and convert from one unit to another within the same system (Grades 6 - 8) [2000]
- understand both metric and customary systems of measurement (Grades 6 - 8) [2000]
- understand and use ratios and proportions to represent quantitative relationships (Grades 6 - 8) [2000]
- recognize and apply mathematics in contexts outside of mathematics (Grades -1 - 12) [2000]
- use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken (Grades 6 - 8) [2000]
- select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision (Grades 6 - 8) [2000]
- model and solve contextual problems using various representations, such as graphs, tables, and equations (Grades 6 - 8) [2000]
- National Science Education Standards Science
- Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental. (Grades 5 - 8) [1995]
- Develop descriptions, explanations, predictions, and models using evidence. Students should base their explanation on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from description--providing causes for effects and establishing relationships based on evidence and logical argument. This standard requires a subject matter knowledge base so the students can effectively conduct investigations, because developing explanations establishes connections between the content of science and the contexts within which students develop new knowledge. (Grades 5 - 8) [1995]
- Mathematics is important in all aspects of scientific inquiry. (Grades 5 - 8) [1995]
- Think critically and logically to make the relationships between evidence and explanations. Thinking critically about evidence includes deciding what evidence should be used and accounting for anomalous data. Specifically, students should be able to review data from a simple experiment, summarize the data, and form a logical argument about the cause-and-effect relationships in the experiment. Students should begin to state some explanations in terms of the relationship between two or more variables. (Grades 5 - 8) [1995]
- Use mathematics in all aspects of scientific inquiry. Mathematics is essential to asking and answering questions about the natural world. Mathematics can be used to ask questions; to gather, organize, and present data; and to structure convincing explanations. (Grades 5 - 8) [1995]
- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development. (Grades 5 - 8) [1995]
- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways. (Grades 5 - 8) [1995]
- Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced. (Grades 5 - 8) [1995]

- Communicate scientific procedures and explanations. With practice, students should become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations. (Grades 5 - 8) [1995]

Learning Objectives ([Return to Contents](#))

The student will be able to

- calculate energy use and analyze how changing their behaviors and appliances will affect the energy their use.
- to conduct an experiment and make comparisons based on experimental evidence

Materials List

Per group:

- Incandescent bulb (60 Watt) with light socket/plug
- Compact Fluorescent Light Bulb (CFL, 13 Watt) with light socket/plug
- LED bulb with light socket/plug
- Infrared (IR) thermometer (available at Radio Shack or similar stores)
- Ruler
- Watt meter (optional) to confirm power

Per class:

- light meter

Introduction/Motivation ([Return to Contents](#))

Lighting accounts for 20-25% of all the electricity used in the United States. On average a household uses 5-10% 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.

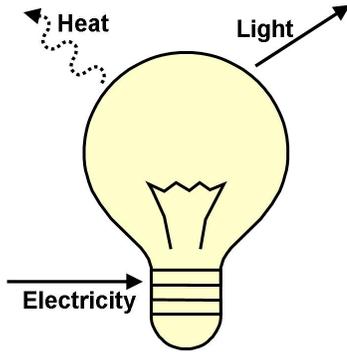
Recall the differences - conservation = turning off light bulbs, efficiency = using bulbs to produce light with less electricity). Today's activity will focus on efficiency.

Note that new technologies (developed by scientists and engineers!!!) can bring about substantial savings in energy use but still provide us with the benefits of electrical lighting. (hold up various bulbs) Do these look familiar? (students should be familiar with incandescent and (hopefully CFLs, but they have probably not seen an LED bulb). LEDs are currently quite expensive, but we should see more of them in stores within a few years.

Procedure

1. Break the students into groups if 3-4
 2. Hand out the activity sheets and go over the procedure (5 min)
- You will provide the lux reading for each bulb

- For Part II it is better to work as a class or in very small groups (1-2 students). This can be started as they wait for the light bulbs to heat up.
 - As demo or extra station, introduce LED bulbs (light emitting diode)
3. Complete the data collection. Note, it is important that several readings of temperature be taken for each bulb from sides and top. There can be significant variations in the temperature around the bulb. You can have the students chose a representative temperature, the maximum, or take several readings and calculate an average.
 4. Discuss reasons for increased efficiency - light - the desired energy "product but varying amounts of heat generated also"



Energy Conversion in a light bulb convert electromagnetic energy (electricity) into heat and light, which is also electromagnetic form of energy

5. Go over conservation and efficiency ideas (perhaps on the board) and spend a minute or two talking about the final project. Tell the class that they will need to define their ideas.

Attachments ([Return to Contents](#))

- [Student worksheet \(doc\)](#)
- [Student worksheet \(pdf\)](#)
- [Homework - Home Light Bulb Use \(doc\)](#)
- [Homework - Home Light Bulb Use \(pdf\)](#)

Safety Issues

- The bulbs can get quite hot, especially the incandescent bulb. Warn students to not touch the bulbs
- Warn the students to not look at the bulbs for too long. They can strain their eyes.

Assessment ([Return to Contents](#))

Collect and review student worksheet to assess data collection, calculations and answers to discussion questions.

Other Related Information ([Return to Contents](#))

This lesson was originally published by the Clarkson University K-12 Project Based Learning Partnership Program and may be accessed at <http://www.clarkson.edu/highschool/k12/project/energysystems.html>.

Contributors

Jan DeWaters, Susan Powers, and a number of Clarkson and St. Lawrence University students in the K-12 Project Based Learning Partnership Program.

Copyright

© 2008 by Clarkson University, Potsdam NY 13699.

This unit was developed under National Science Foundation grants No. DUE-0428127 and DGE-0338216. However, these contents do not necessarily represent the policies of the Department of Education or National Science Foundation, and you should not assume endorsement by the federal government.

Supporting Program ([Return to Contents](#))

Office of Educational Partnerships, Clarkson University, Potsdam, NY

Last Modified: August 12, 2009