



Solar Ovens

Solar Ovens Lesson 4: Energy Efficiency - Lighting

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DESCRIPTION: In this lesson, students will learn how to read light bulb packaging (lighting facts) and do a whole class experiment comparing a 60-watt incandescent to an equivalent CFL and an LED bulb.

GRADE LEVEL(S): 4 and 5

SUBJECT AREA(S): Science, energy, efficiency, electricity, power, lumens, Watts, equivalent, LED (light emitting diode) light, CFL (compact fluorescent light), incandescent light, power

ACTIVITY LENGTH: 00 hours, 45 minutes

LEARNING GOAL(S): Students will understand what energy efficiency means, and learn how to choose energy efficient light bulbs. Students will determine which lightbulbs are the most efficient. Students will understand how energy efficiency relates to energy generation and climate change.

NEXT GENERATION SCIENCE STANDARDS:

- 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- 5-PS3-1 (element) Energy can be transferred in various ways and between objects.
- 5-PS3-1 Use models to describe that energy in animal's food (used for repair, growth, motion, and to maintain body warmth) was once energy from the sun.
- 5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. (Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.)

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Student Background:

Students should have some sense of the fact that the electricity that powers their homes is energy that has been transformed from one form to another.

Educator Background:

Due to government regulations, it may be very difficult, if not impossible, to find incandescent bulbs that are actually rated for 60 Watts. They may say 60 Watts, but they will actually use less energy (e.g. 43 Watts) because of recent improvements in the technology to comply with new federal regulations. Try to find bulbs with similar lumens in order to make reasonable comparisons.

For a light bulb, heat generated is actually wasted energy since the goal of a light bulb is to provide light, not heat. The energy transforms into heat, in addition to creating light. Given an LED, CFL and incandescent of similar lumens, the incandescent will produce the most heat, and thus take more energy to produce the same amount of light.

Find out the cost per Kilowatt of energy for your school's location

Materials List:

- Energy Student Workbook pages 14-15
- A clamp lamp, lamp base or other device to plug the lights into. (3 would be ideal)
- An extension cord long enough so that the Kilowatt meter can be projected on the document camera
- An incandescent, a compact fluorescent and LED bulb with similar lumens. 60watt equivalent is suggested. (See note under teacher background about finding bulbs.)
- Free Workbooks from Portland General Electric: http://www.e-smartonline.net/portland/teachers/68110_materials/index.html (Energy Efficiency World)
- Access to the Internet (https://www.energystar.gov/index.cfm?c=kids.kids_index)
- Kill-A-Watt Meter (3 would be ideal)
- Infrared Temperature Gun
- "Nutrition facts"-style labels from packaging on purchased light bulbs, called "Lighting Facts"
- Energy Trust of Oregon Energy Saver Kit Directions (one per student)
- Access to the Energy Trust of Oregon Website: www.energytrust.org

Vocabulary

Energy Efficiency: Using less energy to do the same amount of desired work as something else.

LED: Light emitting diode. Type of light bulb.

Incandescent: A bulb that uses a filament. Type of light bulb.

Compact Fluorescent Light (CFL): A type of light bulb.

Watt: A way to measure how much energy something uses.

Energy: The ability to do work.

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Power: The rate at which is transformed from one form into another. For instance, a 60-Watt incandescent light bulb will transform 60-Watts of electrical power into light and heat when it is on. The amount of electrical energy consumed depends on how long it is operated. A 60-Watt light bulb operating for one hour will consume 60-Watt hours of energy or 0.06 kWh.

Lumens: The amount of visible light something produces.

Lesson Details:

- **Question of the Day/Exit Slip:** What does it mean for something to be energy efficient and why does it matter?
- **STEP 1:** Work with the students to do a vocabulary web for **energy efficiency**. (Use the blank pages in the back of their Energy Student Workbooks.)
- **STEP 2:** Show the students the 3 different light bulbs and tell them their names. Explain to the students that the CFLs and LEDs are becoming more popular because they are more energy efficient. They use less energy to get the same amount of light.
- **STEP 3:** Have the students turn to pages 14-15 in their student workbooks. Work with them as they begin to fill out the pages. Have them draw each bulb and record the lumens.
- **STEP 4:** Project the light bulb specifications or “nutrition facts” and guide the students in how to read light bulb “nutrition facts.”
- **STEP 5:** Connect the Kilowatt Meter to the clamp lamp so that the Kilowatt meter can be projected. Connect each bulb and record the Kilowatts. Take turns connecting each bulb to the clamp lamp, and after 1 minute, using a no-touch thermometer, test the temperature. Have the students fill out page 14 in their Energy Student Workbooks. If you have 3 lamps and 3 energy meters, all 3 bulbs can be done at once. Guide the students to understanding that the heat the bulbs produce is wasted energy. The hotter a bulb gets, the more energy it is wasting on heat that it could instead be transforming into light. Incandescent bulbs therefore use more energy, and more money, to get the same amount of light.
- **SAFETY NOTE:** Arrange students so that they are a good distance away from the bulb and give them several reminders not to stare directly at the bulbs when on.
- **STEP 6:** On page 15 in their student workbooks, work with the students to diagram an incandescent bulb vs. an LED bulb. Emphasize that more energy is transformed into heat, instead of light, with an incandescent bulb. (See example in teacher’s guide.) This could be a good time as well to remind students of differences in electromagnetic radiation, noting that different wavelengths perform different amounts of work but that the entire spectrum is still energy.
- **STEP 7:** When there is time, have the students read the magazine Energy Efficient World from PGE.
- **STEP 8:** If your school is in the Portland-Metro area, show your students how to get a free Energy Savers Kit from Energy Trust of Oregon. The kit includes LED light bulbs and water aerators. Give each student a copy of the directions to take home.

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