



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Benjamin C. Steele	Project Number 23273
Project Title Lights Out? Analyzing Break-Even Times for Home Lighting	
Abstract Objectives/Goals A widespread belief is that household lights, especially fluorescent bulbs, use such large amounts of extra power when first turned on that they should be left on when leaving a room for a short time. It is a fact that some bulb types use extra energy starting up, but are the startup costs so high that lights should just be left on when not needed? If so, how long? To find out the break-even times, I tested incandescent, halogen, compact fluorescent, and tube fluorescent bulbs. Methods/Materials I constructed a measuring apparatus for the experiment. The first half of the circuit powered test bulbs at household AC voltage, in series with a one-Ohm resistor to allow measurement of a voltage proportional to the current through the bulbs. The second half of the circuit carried the signal to a laptop computer through an isolation transformer. The transformer and a potentiometer reduced the sample voltage down to a lower level, which was safe for the computer audio input. I then recorded the waveforms of the current on the computer using inexpensive audio software, and computed the power used at each 23-microsecond sample interval. Results All the tested lights used extra startup power for surprisingly short periods of time. The incandescent bulb had a break-even time of 0.04 seconds and the halogen bulb had a break-even time of 0.12 seconds. Both of the fluorescent types were temperature-dependent and so their break-even times varied, but were short. For example, the compact fluorescent had a cold break-even time of about one-fifth of a second. Conclusions/Discussion All bulbs tested had break-even times of fractions of a second. Contrary to popular belief, home lighting should be turned off whenever unused to save energy.	
Summary Statement I found that, to save energy, home lighting should be turned off whenever unused.	
Help Received My dad helped photograph the setup for my display board and provided the laptop computer.	